Electric Eel

Electrophorus electricus

Gen. Habitat	Water
Habitat	Rivers
Temperature	0-35 C
Humidity	Undefined
Pressure	High
Salinity	1000-3000 ppm
pH	6.0-8.0

Summary:
The electric eel is a species of fish found in the basins of the Amazon and Orinoco Rivers of South America. It can produce an electric discharge on the order of 600-650 volts, which it uses for both hunting and self-defense. It is an apex predator in its South American range. Despite its name it is not an eel at all but rather a knifefish.

Description:
A typical electric eel has an elongated square body, a flattened head, and an overall dark grayish green color shifting to yellowish on the bottom. They have almost no scales. The mouth is square, placed right at the end of the snout. The anal fin continues down the length of the body to the tip of their tail. It can grow up to 2.5 m (about 8.2 feet) in length and 20 kg (about 44 pounds) in weight, making them the largest Gymnotiform. 1 m specimens are more common.

They have a vascularized respiratory organ in their oral cavity. These fish are obligate air-breathers; rising to the surface every 10 minutes or so, the animal will gulp air before returning to the bottom. Nearly 80% of the oxygen used by the fish is taken in this way. Despite its name, the electric eel is not related to eels but is more closely related to catfish.

Scientists have been able to determine through experimental information that *E. electricus* has a well-developed sense of hearing. They have a Weberian apparatus that connects the ear to the swim bladder, which greatly enhances their hearing capability.

The electric eel has three abdominal pairs of organs that produce electricity. They are the main organ, the hunter's organ, and the sachs' organ. These organs take up 4/5 of its body. Only the front 1/5 contains the vital organs. These organs are made of electrocytes lined up in series. The electrocytes are lined up so the current flows through them and produces an electrical charge. When the eel locates its prey, the brain sends a signal through the nervous system to the electric cells. This opens the ion channel, allowing positively-charged sodium to flow through, reversing the charges momentarily. By doing that it creates electricity. The electric eel generates its characteristic electrical pulse in a manner similar to a battery, in which stacked plates produce an electrical charge. In the electric eel, some 5,000 to 6,000 stacked electroplaques are capable of producing a shock at up to 500 volts and 1 ampere of current (500 watts). The organs give the electric eel the ability to generate two types of electric organ discharges (EODs), low voltage and high voltage. The shock could be harmful for an adult human.

The Sachs organ is associated with electrolocation. Inside the organ are many muscle-like cells, called electrocytes. Each cell can only produce 0.15V, though working together the organ transmits a signal of about 10V in amplitude at around 25 Hz. These signals are what is thought to be used for communication as well as orientation; useful not only for finding prey, but also in finding and choosing a mate.

High-voltage EODs are emitted by the main organ and the Hunter's organ that can be emitted at rates of several hundred Hz. These high voltage EODs may reach up to 650 volts. The electric eel is unique among the gymnotiforms in having large electric organs capable of producing lethal discharges that allows them to stun prey. There are reports of animals producing larger voltages, but the typical output is sufficient to stun or deter virtually any other animal. Juveniles produce smaller voltages (about 100 volts). Electric eels are capable of varying the intensity of the electrical discharge, using lower discharges for "hunting" and higher intensities for stunning prey, or defending themselves. When agitated, it is capable of producing these intermittent electrical shocks over a period of at least an hour without signs of tiring. The species is of some interest to researchers, who make use of its acetylcholinesterase and ATP.

The electric eel also possesses high-frequency sensitive tuberous receptors patchily distributed over the body that seem useful for hunting other gymnotiforms.

More Details:

In order to discharge an electric current, there must be numerous excitable cells set in series with one another. For example, if there are somewhere around 4500 of these excitable cells sitting in series, and each cell produces 140 millivolts, a total of around 630 volts of discharge could be expected.

The electric organs are comprised of individual cells, called electrocytes. Electrocytes are designed such that only one side of the cell carries the electric potential, and all of the cells are aligned similarly. Thus the charge is carried in one direction only through the body, with the head acting as the positive end of the 'battery' and the tail as the negative end. When the eel is resting, no electricity is generated from the organ, but when it begins to move it emits electrical impulses.

Electrocytes, like all eukaryotic cells, maintain a potential gradient across the membrane. This is done by active transport of Na^+ and K^+ ions through membrane pumps, protein structures which span the phospholipids bilayers forming the cell membrane. Transport of these ions is coupled to the synthesis of ATP, the standard currency of energy in all biological organisms.

Orb weaver spider

Genererus: araneus

Gen. Habitat	Land
Habitat	tropical and sub-tropical dry broadleaf forest
Temperature	0-35 C
Humidity	31-70%
Salinity	Undefined
Pressure	Undefined
pH	6.0-8.0

Description:

Generally, orb-weaving spiders are three-clawed builders of flat webs with sticky spiral capture silk. The building of a web is an engineering feat, begun when the spider floats a line on the wind to another surface. The spider secures the line and then drops another line from the center, making a "Y". The rest of the scaffolding follows with many radii of non-sticky silk being constructed before a final spiral of sticky capture silk. The third claw is used to walk on the non-sticky part of the web. Characteristically, the prey insect that blunders into the sticky lines is stunned by a quick bite and then wrapped in silk. If the prey is a venomous insect, such as a wasp, wrapping may precede biting.

Some "orb-weavers" do not build webs at all. Members of the genera Mastophora in the Americas, Cladomelea in Africa and Ordgarius in Australia produce sticky globules, which contain a pheromone analog. The globule is hung from a silken thread dangled by the spider from its front legs. The pheromone analog attracts male moths of only a few species. These get stuck on the globule and are reeled in to be eaten. Interestingly, both types of bolas spiders are highly camouflaged and difficult to locate.

The spiny orb-weaving spiders in the genera Gasteracantha and Micrathena look like plant seeds or thorns hanging in their orb-webs. Some species of Gasteracantha have very long horn-like spines protruding from their abdomens.

One feature of the webs of some orb-weavers is the stabilimentum, a crisscross band of silk through the center of the web. It is found in a number of genera, but Argiope, which includes the common garden spider of Europe as well as the yellow and banded garden spiders of North America, is a prime example. The band has been hypothesized to be a lure for prey, a marker to warn birds away from the web and a camouflage for the spider when it sits in the center of the web.

Most arachnid webs are vertical and the spiders usually hang with their head downward. A few webs, such as those of orb-weaver in the genus Metepiera have the orb hidden within a tangled space of web. Some Metepiera are semi-social and live in communal webs. In Mexico such communal webs have been cut out of trees or bushes and used for living flypaper.

More Details:

The orb weaver spider employs four different adhesive strategies in building and using its prey capture webs: cement, hooks, glue, and friction. Each of the following four circumstances requires a different mechanism or strategy: the way the spider selectively attaches itself to the threads of its web, the way the threads adhere to prey, how the threads adhere to one another, and how they adhere to the substratum. Generally speaking, orb weaver spiders use cement to build the web, hooks to temporarily attach themselves to the web, and either glue or friction to ensnare prey.

Cement is a liquid adhesive that hardens when exposed to air. Spider silk is a type of cement. At the time of its release from the silk-producing glands, spider silk is in liquid form and can form attachments to the substratum or existing web threads. There are seven known silk-producing glands, each corresponding to a unique type of silk. The secretions of the pyriform gland are especially important to the study of adhesion, as they are used to attach radial threads within the web, and draglines to the substratum.

Attachment silk, like other types of spider silk, is composed of the protein fibroin, with alanine and glycine as the predominant amino acids. Capture silk is produced by the flagelliform gland, and can be either dry (cribellate) or sticky (ecribellate). Cribellate thread ensnares prey through friction, or the resistance between two surfaces. Cribellate thread is composed of many fine, looped fibrils that increase its surface area and therefore its adhesion to prey. The precise mechanism thought to be at work is van der Waals forces, a type of intermolecular attraction. Ecribellate thread ensnares prey with the help of a viscous, glue-like substance deposited along its surface by the aggregate gland. Ecribellate glue contains nitrate, phosphate, and pyrrolidone.

Given the stickiness of spider glue and cement, orb weaver spiders use an entirely different strategy to temporarily attach themselves to their webs. Spiders steer clear of the web spirals, since these are composed of sticky capture thread. They walk only on the spokes, using two curved claws at the tip of each leg to attach themselves. Each claw has a comb-like serrated edge that aids in gripping web threads.

Many species of diurnal orb-web spiders use metallic coloring to reflect solar radiation. These organisms spend a great deal of time exposed to radiation while monitoring their webs, so are particularly susceptible to overheating. Metallic or other reflective coloration is an adaptive response to this challenge.

Panamanian liana

Gen. Habitat	Land
Habitat	tropical and sub-tropical broadleaf forest
Temperature	0-35 C
Humidity	31-70%
Pressure	Undefined
Salinity	Undefined
pH	6.0-8.0

Summary:
A vine of Panama's lowland forests that sheds water from upper leaflet surfaces through thigmonastic and nyctinastic leaf movements, or movement in response to touch and light, respectively.

Description:

A liana is a woody climber that starts at ground level, and uses trees to climb up to the canopy where it spreads from tree to tree to get as much light as possible. Lianas are especially characteristic of tropical moist deciduous forests and rainforests. These climbers often form bridges between the forest canopy, connect the entire forest and provide arboreal animals with paths across the forest. There are also temperate lianas, however, for example the members of the genus Clematis. Well-known lianas include Arnold, Monkey Ladder and Water Vine.

Lianas are useful navigation tools for arboreal species such as lemurs. For example, in the eastern rainforests of Madagascar, many prosimians achieve higher mobility from the web of lianas draped amongst the vertical tree species. Some lianas are strong enough to support the weight of a human.

The Panamanian liana, Machaerium arboreum, is a lowland forest vine that sheds water from upper leaflet surfaces using thigmonastic and nyctinastic leaf movements. Rapid draining of water by tropical plants is a useful and necessary adaptation since standing water on leaves encourages colonization by epiphytes (plants growing on other plants) and microorganisms, and reduces photosynthetic activities by encouraging the formation of light-blocking surface films.

The leaflets of the Panamanian liana employ several mechanisms to shed water: acuminate tips, thigmonasty, and nyctinasty (Dean, 1978). Acuminate tips, or drip-tips, are a morphological adaptation that promotes rapid water drain from the leaf surface. Thigmonasty is movement in response to tactile stimuli. Within seconds of the first gentle raindrop hitting a leaflet, the leaves fold or roll up, thereby preventing the collection of water on leaf surfaces. And finally, nyctinasty is a diurnal movement pattern. During the day leaflets are generally horizontal to take the greatest advantage of solar radiation, while at night they droop to approximately 50 degrees below the horizontal. The steep nighttime angle ensures that night rains will drain rapidly from the leaf surfaces.

Pilot Whale

Genera: Globicephala

Gen. Habitat	Water
Habitat	Temperate shelf and seas
Temperature	0-35 C
Humidity	Undefined
Pressure	High
Salinity	3000-10000 ppm
pH	6.0-8.0

Description:

Pilot whales are actually two species: Globicephala melas (Traill, 1809, long-finned) and Globicephala macrorhynchus (Gray, 1846, short-finned), and are large dolphin species second only to orca (killer whales) in size. Adult males measure up to 6.1 m in length and weigh up to 2,722 kg. Adult females measure up to 4.9 m in length and weigh up to 1,361 kg. They have a round head with a small beak and dolphin-typical up-curved mouthline. The rounded head of males protrudes over the lower jaw. Pilot whales are dark gray to black in color with a lighter colored patch on the ventral surface, and Globicephala macrorhynchus (short-finned) pilot whales may also have a faint patch behind the dorsal fin. The dorsal fin is curved with a long base, and the flippers are also curved—short in Globicephala macrorhynchus and significantly longer in Globicephala melas (long-finned).

Pilot whales are often found in captivity as they survive there and are easily trained. They have been trained by the US Navy to locate military equipment from deep ocean depths for retrieval. The pilot whale is a gregarious species often found in groups of 20-90, in which there are often small families of females and their calves. Although males are found in these groups as well, they are not necessarily fathers of the calves.

Pilot whales are often associated with mass strandings of several hundred animals. The cause of the mass strandings is unknown, although several theories exist such as sonar problems or parasitic infections that interfere with the central nervous system causing neurological disorders.

In general, pilot whales, Globicephala melas (long-finned) and Globicephala macrorhynchus (short-finned), are found in the northern and southern hemispheres in tropical and temperate waters throughout the world. Short-finned pilot whales tend to live in warmer waters, while long-finned pilot whales are more commonly found in more temperate waters, therefore the 2 sub-species tend to remain mostly segregated.

Pilot whales, Globicephala, feed on squid and other cephalopods and small fish. These dolphins have only 40-48 teeth compared to 120 in other dolphin species. Adults may consume up to 14 kg of food per day.

Pilot whales have been observed hunting in groups to help concentrate their prey in the center of a pod by using their vocal communications.

Female pilot whales reach sexual maturity at about 6 years of age or when they grow to about 4 m in length. Males reach sexual maturity at 12 years of age or 4.6 m in length. Females give birth about every 3-5 years, and gestation lasts 12-15 months. Newborn calves measure 1.8 m in length at birth and weigh about 102 kg. Females nurse their calves for about 22 months. Male pilot whales compete for females by fighting and often display aggressive behavior with females, resulting in scarred flesh and occasional infections. Females remain fertile to 35 years old and can lactate as late as 51.

More Details:

Pilot whales, like virtually all marine and freshwater fauna, must keep their skin free of microorganisms. Biofilms and biofouling microbes not only present health risks for their host, but also create drag. To combat colonization by undesirable microorganisms, many marine and freshwater fauna have evolved two different strategies: nanoridges combined with biogels, and enzymes.

Nanoridges and biogels
As is the case with many organisms, the pilot whale's outer layer of skin is composed of dead or degraded cells. The challenge is to maintain the antimicrobial functions of the cells despite their degraded state. The strategy is two-fold: nanoridges provide a physical barrier to microbial adhesion, while biogels provide a chemical barrier.

The skin surface of the pilot whale consists of a gel-like coating, zymogel, made of alternating hydrophilic and hydrophobic layers, embedded within a matrix of nanoridges. Nanoridges are formed by the outermost layer of hardened skin cells, and each depression, or pore, between ridges is approximately 0.1-1.2 um^2 across. By contrast, most marine biofouling organisms are approximately <0.2um in diameter. The theory is that because of size differentiation, biofoulers can successfully attach only at ridge-tips or pore-margins; thus, size exclusion effectively restricts the location and amount of skin area that can be colonized by microorganisms. Pore invasion by biofoulers is further curtailed by enzymes, which will digest (via keratinolysis) any microorganisms that manage to overcome the problem of anchorage and adhesion (Baum, 2002).

The second component, 'zymogel,' is a biogel coating of alternating hydrophilic and hydrophobic sectors. The biogel is embedded within a matrix of nanoridges "originating from the desmosomal junction system of the plasmalemma of the epidermal cells" (Baum et al., 2000; Baum et al., unpublished results; see also Geraci et al., 1986).

Enzymes
The tough outer layer of pilot whale skin contains numerous enzymes such as peptidases, esterases, phosphatases, phospholipases, and glycosidases (Baum, 2001). These enzymes appear to have two anti-microbial functions in the external skin cells: 1) hydrolyzing biofilm precursors, and 2) slowing the degradation of surface cells so that they retain their hydrolytic capabilities (Baum, 2001).

The first function, that of hydrolyzing biofilm precursors, uses hydrolytic enzymes. The hydrolytic enzymes esterases and peptidases are most active at the skin surface in a medium with a pH of about 8--or the pH of buffered seawater. Glycosidases are most active in a medium with a pH of about 6.
"We thus conclude, that the dolphin skin has developed a mode of defense against microorganisms including their acidic excretion products and polysaccharides by taking advantage of the environment for a high activity of hydrolytic enzymes created by the biofoulers in the pilot whale skin" (Baum, 2001).

The second function, that of slowing cell degradation in order to maintain metabolic and hydrolytic functions, involves the use of acid phosphatase along with peptidases. There is a direct correlation between the "presence of acid phosphatase in the stratum corneum conjunctum of terrestrial mammals" and the reduced rate and strength at which intercellular connections and cellular membranes are degraded (Baum, 2001).

What makes the pilot whale so interesting is that it employs both a structural and chemical strategy to prevent biofouling. Its enzymatic, or chemical, defense in particular is interesting because it works by using the invading microorganism's own secretions against it.

Reticulated Giraffe

Giraffa camelopardalis reticulata

Gen. Habitat	Land
Habitat	temperate grasslands and savannas
Temperature	0-35 C
Humidity	0-30%
Pressure	Undefined
Salinity	Undefined
pH	6.0-8.0

Summary:

The Somali Giraffe or Reticulated Giraffe, Giraffa camelopardalis reticulata, is a subspecies of giraffe native to Somalia, but is also widely found in Northern Kenya, and Southern Ethiopia. Reticulated giraffes can interbreed with other giraffe subspecies in captivity or if populations are low in the wild.

The reticulated giraffe is the most well-known of the nine giraffe subspecies, and is by far the giraffe most commonly seen in zoos. It's coat consists of large, polygonal liver-colored spots outlined by a network of bright white lines. The blocks may sometimes appear deep red and may also cover the legs. The giraffes and native north-eastern Kenya, Ethiopia and Somalia. The extraordinary height of giraffes allows them to feed from the branches of trees that other hoofed animals can't reach.

The giraffe (Giraffa camelopardalis) is an African even-toed ungulate mammal, the tallest of all land-living animal species. Males can be 4.8 to 5.5 metres (16 to 18 feet) tall and weigh up to 1,300 kilograms (3,000 pounds). The record-sized bull was 5.87 m (19.2 ft) tall and weighed approximately 2,000 kg (4,400 lb).[2] Females are generally slightly shorter, and weigh less than the males do. The giraffe is related to deer and cattle, but is placed in a separate family, the Giraffidae, consisting only of the giraffe and its closest relative, the okapi. Its range extends from Chad to South Africa.

Giraffes can inhabit savannas, grasslands, or open woodlands. They prefer areas enriched with acacia growth. They drink large quantities of water and, as a result, they can spend long periods of time in dry, arid areas. When searching for more food they will venture into areas with denser foliage.

Both sexes have horns, although the horns of a female are smaller. The prominent horns are formed from ossified cartilage and are called ossicones. The appearance of horns is a reliable method of identifying the sex of giraffes, with the females displaying tufts of hair on the top of the horns, where as males' horns tend to be bald on top — an effect of necking in combat. Males sometimes develop calcium deposits which form bumps on their skull as they age, which can give the appearance of up to three further horns.

Giraffes have long necks, which they use to browse the leaves of trees. They possess seven vertebrae in the neck (the usual number for a mammal) that are elongated. The vertebrae are separated by highly flexible joints. The base of the neck has spines which project upward and form a hump over the shoulders. They have anchor muscles that hold the neck upright.

Giraffes also have slightly elongated forelegs, about 10% longer than their hind legs. The pace of the giraffe is an amble, though when pursued it can run extremely fast. It can not sustain a lengthy chase. Its leg length compels an unusual gait with the left legs moving together followed by right (similar to pacing) at low speed, and the back legs crossing outside the front at high speed. When hunting adult giraffes, lions try to knock the lanky animal off its feet and pull it down. Giraffes are difficult and dangerous prey though, and when attacked the giraffe defends itself by kicking with great force. A single well-placed kick from an adult giraffe can shatter a lion's skull or break its spine. Lions are the only predators which pose a serious threat to an adult giraffe.

Modifications to the giraffe's structure have evolved, particularly to the circulatory system. A giraffe's heart, which can weigh up to 10 kg (22 lb) and measure about 60 cm (2 ft) long, has to generate around double the normal blood pressure for an average large mammal in order to maintain blood flow to the brain against gravity. In the upper neck, a complex pressure-regulation system called the rete mirabile prevents excess blood flow to the brain when the giraffe lowers its head to drink. Conversely, the blood vessels in the lower legs are under great pressure (because of the weight of fluid pressing down on them). In other animals such pressure would force the blood out through the capillary walls; giraffes, however, have a very tight sheath of thick skin over their lower limbs which maintains high extravascular pressure in exactly the same way as a pilot's g-suit.

The giraffe has one of the shortest sleep requirements of any mammal, which is between 10 minutes and two hours in a 24-hour period, averaging 1.9 hours per day.

Giraffes are thought to be mute; however, although generally quiet, they have been heard to make various sounds. Courting males will emit loud coughs. Females will call their young by whistling or bellowing. Calves will bleat, moo, or make mewing sounds. In addition, giraffes will grunt, snort, hiss, or make strange flute-like sounds. Recent research has shown evidence that the animal communicates at an infrasound level.

More Details:

The skin of the reticulated giraffe produces scented chemicals that moderate antimicrobial activity and repel insects.

Scented chemicals are highly odoriferous compounds of various types: alkaloids, such as asindole and 3-myethyindole (skatole); phenols, such as p-cresol; alkanes, such as octane; aldehyde, such as benzaldehyde, heptanal, octanal, nonanal; carboxylic acids, such as tetradecanoic, hexadecanoic acid; and a steroid, 3,5-androstadien-17-one.

P-cresol repels ticks, while indole and skatole repel insects, particularly mosquitoes. Other scented chemicals have antibacterial properties that inhibit Staphylococcus aureus and Propionibacterium acnes. Still others exhibit anti-fungal activities that inhibit Trichophyton mentagrophytes (the fungi responsible for athlete's foot in humans), T. rubrum, and Microsporum canis (Wood, 2002).

What makes these volatile chemical compounds interesting is that they are made with local materials using simple ingredients found within the organism, created at room temperature, and produced on an as-needed basis

The reticulated giraffe might inspire innovation in paint manufacturers (protective coatings and finishes), the construction industry (prolong material life through insect resistance), and wood preservation (anti-rot, anti-mold, anti-insect).

Shield Bug

Gen. Habitat	Land and Underground
Habitat	Various
Temperature	0-35 C
Humidity	Undefined
Pressure	Undefined
Salinity	Undefined
pH	Undefined

Description:

One of the easiest group of bugs to find and identify are the Shield Bugs. Generally they are flattish oval or shield shaped bugs (hence their common names) ranging from 5 - 35 mm in length. There are about 6 500 species in the world. In the Cydnidae, Acanthosomatidae and Pentatomidae the adults have five antennal segments and the nymphs only four. Shield bugs are mainly phytophagous (feeding on plant sap), though a few are carnivorous and may even be useful in controlling pests. They are often called Stink-Bugs because they can produce a horrible smell. In the adults the noxiously smelling fluid is produced by a pair of glands in the thorax and released via a pair of pits on the metathorax, in the nymphs there are 3 pairs of scent glands in the abdomen and the liquid is released through special openings in between the 3/4, the 4/5 and the 5/6 abdominal segments. The scent does work though and is known to repel certain vertebrate predators, in some species it will strongly stain your fingers like iodine. The stink comes from aldehydes such as CH3-(CH2)2-CH=CH-CHO, and is chemically similar to pheromones.

Some Shield Bugs are pests, i.e. Murgantia histrionica, the Harlequin bug which is a pest of cabbages, Antestiopsis spp. Which are a pest on coffee and Nezara viridula which is cosmopolitan (found all over the world) and a pest of a wide range of common crops such as tomatoes, beans and cotton. The phytophagous Shield Bugs all have symbiotic bacteria in their guts in order to help them digest the food they eat, the eggs are smeared with an inoculation of these symbionts when laid, which ensures that the young, which eat their eggshell on hatching, have enough of them to digest their next meal. In opposition to this most members of the subfamily Amyoteinae are predacious and useful controllers of other pests as they feed primarily on caterpillars (Lepidoptera) and larvae of Leaf Beetles (Chrysomelidae). We have 4 members of that subfamily in Britain, Zicrona caerulea, Picromerus bidens, Troilus luridus and Rhacognathus punctatus

More details:

Shield bugs come in many varieties and are found in many parts of the world. They range in color from drab browns and greens to brilliant blues and other striking hues--hues made possible by structural color. Also known as stinkbugs, shield bugs use color to either camouflage themselves or to warn potential predators of their bad smell and taste.

Shield bugs have microstructures on the elytron cuticle that create a brilliant blue color. This color results from the scattering of light by small, transparent, cone-shaped cuticular microtubercles. The microtubercles have a light wavelength small enough to produce the Tyndall or Mie scattering effect. The scattering is more effective for short wavelengths of incident light than long wavelengths. Colors ranging from yellow to green are due to the reflectance of the multilayer system and dark pigment backing-layer that acts as an absorber of the transmitted light. Reddish-brown colors result from areas with a lower number of multilayers that lack the dark pigment layer (Miyamoto, 2002).

Tent Caterpillar

Malacosoma americanum

Gen. Habitat	Land
Habitat	Temperate broadleaf and mixed forest
Temperature	0-35 C
Humidity	31-70%
Pressure	Undefined
Salinity	Undefined
pH	6.0-8.0

Description:

The Eastern tent caterpillar is a univoltine, social species that forms communal nest in the branches of trees. It is sometimes confused with the gypsy moth, or the fall webworm and may be erroneously referred to as a bagworm which is the common name applied to unrelated caterpillars in the family Psychidae. The moths oviposit almost exclusively on trees in the plant family Rosaceae, particularly cherries (Prunus) and apple (Malus). The caterpillars are hairy with areas of blue, white, black and orange. The blue and white colors are structural colors created by the selective filtering of light by microtubules that arise on the cuticle.

In terms of complexity of interactions, the Tent Caterpillar stands near the pinnacle of caterpillar sociality. The adult moth lays her eggs in a single batch in late spring or early summer. The egg masses contain on average 200-300 eggs. Embryogenesis proceeds rapidly and within three weeks fully formed caterpillars can be found within the eggs. But the small caterpillars lie quiescent until the following spring, chewing their way through the shells of their eggs just as the buds of the host tree begins to expand.

The newly hatched caterpillars initiate the construction of a silk tent soon after emerging. They typically aggregate at the tent site for the whole of their larval life, expanding the tent each day to accommodate their increasing size. Under field conditions, the caterpillars feed three times each day, just before dawn, at mid-afternoon, and in the evening after sunset. During each bout of feeding the caterpillars emerge from the tent, add silk to the structure, move to distant feeding sites en masse, feed, then return immediately to the tent where they rest until the next activity period. The exception to this pattern occurs in the last instar when the caterpillars feed only at night. The caterpillars lay down pheromone trails to guide their movements between the tent and feeding sites. The insect has six larval instars. When fully grown, the caterpillars disperse and construct cocoons in protected places. The adults (imago) emerge about two weeks later. They are rather strictly nocturnal, they startr flying after nightfall, and possibly stop some hours before dawn already (Fullard & Napoleone 2001). Mating and oviposition typically occur on the same day as the moths emerge from their cocoons; the females die soon thereafter.

The tent of the eastern tent caterpillar is among the largest built by any tent caterpillar. The tents are constructed in the crotch of the host tree and are typically oriented so that the broadest face of the structure faces the southeast, taking advantage of the morning sun. The caterpillars typically add silk to the structure at the onset of each of their daily activity periods. Silk is added directly to the surface of the tent as the caterpillars walk back and forth over the structure. The silk is laid down under slight tension and it eventually contracts, causing the newly spun layer of silk to separate from the previously spun layer. The tent thus consists of discrete layers separated by gaps within which the caterpillars rest. The tent has openings that allow the caterpillars to enter and exit the structure. Openings are formed where branches jut from the structure but are most common at the apex of the tent.

Light has a great effect on the caterpillars while they are spinning and they always spin the majority of their silk on the most illuminated face of the tent. Indeed, if under experimental conditions the dominant light source is directed at the tent from below, the caterpillars will build their tent upside down. Caterpillars continue to expand their tent until they enter the last phase of their larval life. The sixth-instar caterpillar conserves its silk for cocoon construction and adds nothing to the tent. The tents are multifunctional. They facilitate basking, offer some protection from enemies, provide for secure purchase, and act as a staging site from which the caterpillars launch en masse forays to distant feeding sites. The elevated humidity inside the tent may facilitate molting.

Eastern tent caterpillars are among the earliest of caterpillars to appear in the spring. Because the early spring weather is often cold, the caterpillars rely on the heat of the sun to elevate their body temperatures to levels that allow them to digest their food. Studies show that below 15 °C (59 °F) the caterpillars are unable to process the food in their guts. Early instars of the tent caterpillar are black and their bodies readily absorb the rays of the sun. When basking, the caterpillars typically pack together tightly, reducing heat loss due to convective currents. The long setae that occur on the caterpillars also serve to stem convective heat loss. The caterpillars may aggregate on the surface of the tent or within the structure. The tents act as miniature glass houses, trapping the heat of the morning sun and allowing the caterpillars to warm more quickly than they would if they remained outside the tent. Studies have shown that basking, aggregated caterpillars can achieve temperature excesses (Tbody–Tambient) of as much as 44 °C. Indeed, the caterpillars can easily overheat and they must take evasive action when they become too hot.

Because of its layered structure, the tent is thermally heterogeneous and the caterpillars can adjust their temperature by moving from layer to layer. The caterpillars may also aggregate on the outside of the shaded side of the tent and hang from the tips of their abdomens to enhance convective heat loss and cooling.

As shown for some other caterpillars, eastern tent caterpillars are capable of generating a small amount of metabolic heat while they digest their meals. When recently fed caterpillars pack tightly together, the temperature of the caterpillars in the interior of the mass may be several degrees Celsius above ambient temperature even in the absence of a radiant heat source. It is unclear whether this small heat gain has a significant effect on the rate of caterpillar growth.

Tent caterpillars, like many other species of social caterpillars, vigorously thrash the anterior part of their bodies when they detect predators and parasitoids. Such bouts of thrashing, which may be initiated by a single caterpillar, radiate rapidly though the colony and may result in group displays involving dozens of caterpillars. Such displays create a moving target for tachinid flies, wasps and other small parasitoids that lay their eggs on or in the body of the caterpillar. They also clearly deter stink bugs and other timid predators. Groups of caterpillars resting on the surface of the tent constitute aposematic displays. Few birds other than the cuckoo find the hairy caterpillars palatable. The leaves of the cherry tree are cyanogenic and the caterpillars regurgitate cyanide ladened juices when disturbed.

Tent caterpillars secrete silk from a spinneret wherever they go and frequently used pathways soon bear conspicuous silk trails. As the caterpillars move about the tree, they largely confine their movements to these trails. Curiously, it is not the silk that they follow but a trail pheromone secreted from the posterior tip of their abdomen. Caterpillars deposit exploratory trails by dragging the tip of their abdomen as they move over the tree in search of food. Caterpillars that find food and feed overmark the exploratory trails they follow back to the tent, creating recruitment trails. Recruitment trails are much more attractive to the caterpillars than exploratory trails and they serve to lead hungry caterpillars directly to the newest food finds. It is possible for a single successful forager to recruit the entire colony to its food find.

The exact identity of the trail pheromone of the eastern tent caterpillar has not yet been determined but the chemical 5β-cholestane-3-one has been shown to be fully competitive with the authentic trail pheromone. Caterpillars readily follow trails of this chemical, even abandoning their own trails in favor of artificial trails prepared with the compound.

The eastern tent caterpillar is of some importance as a plant pest since it may defoliate ornamental trees. Defoliated trees, however, rarely suffer significant damage and typically refoliate within several weeks. More seriously, the caterpillar has been implicated in Mare Reproductive Loss Syndrome (MRLS), but the exact mechanism by which the caterpillar triggers abortion in horses has yet to be determined.

More details:

Almost immediately upon hatching, sibling caterpillars work together to spin a silk tent that serves as shelter, sauna, and staging ground for feeding trips.

The tent has several important features. First, it is 'smart,' expanding as its residents require more space. Second, it is essentially waterproof, protecting its residents both from rain and from low-power pesticide sprays. Third, it gathers radiant energy from the sun, while reducing convective heat loss by blocking the wind. And finally, its layout is such that its residents can regulate their body temperatures by changing position inside the tent.

The waterproof nature of the caterpillar's tent is likely due to the properties of caterpillar silk coupled with the design of the tent. Although the exact chemical composition of Eastern tent caterpillar silk is not known, it is thought to resemble the silk of related species. The silk of its cousin, Bombyx mori, consists of 73 percent fibroin and 22 percent sericin; wax and inorganic compounds comprise the remaining five percent. The tautness of the Eastern tent caterpillar's silk strands also contributes to waterproofing, helping the tent to withstand driving rain. The caterpillar stretches each strand beyond its equilibrium length before fastening it; then, when wet by rain or condensation, the strands supercontract to an even tighter configuration. The smartness of the tent is admittedly due to the work of the caterpillars themselves. Every day, the caterpillars add more silk to their tent, with each day's annex contracting to form a discrete layer external to the previous day's. The result is a multi-layered structure that helps the caterpillars thermoregulate. Thermoregulation in the Eastern tent caterpillar is a large topic. Here, we shall focus on how the tent aids the caterpillars in stabilizing their body temperatures at 30-35 degrees C. Caterpillars build their tent with the broad side perpendicular to the dominant light source, usually facing southeast. Like a greenhouse, the tent gathers radiant energy while reducing convective heat loss. Further, the temperature inside the tent increases as one progresses to the peripheral layers. To warm up, caterpillars congregate in the outermost layer of the tent, and press their bodies against the wall closest to the sun. To cool down, caterpillars migrate to the central layers of the tent. In cases of extreme overheating, caterpillars use behavioral tactics such as hanging off the shaded side of the tent by their abdomens, so that their bodies are cooled by convection.