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Cicada: A Xylem Feeding Insect

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ABSTRACT: -

Cicadas are important xylem-feeding insects belonging to the order Hemiptera and family Cicadidae. They are widely distributed throughout the world except Antarctica and are well known for their characteristic loud sound production during summer. Cicadas possess piercing and sucking type mouthparts through which both nymphs and adults feed on plant sap. The present article highlights the biology, life cycle, habitat, classification, sound-producing mechanism, types and important characteristics of cicadas. The nymphal stages remain underground for several years feeding on roots of grasses, shrubs and trees, while adults emerge aboveground for mating and reproduction. Two major groups, namely annual cicadas and periodical cicadas, are commonly observed. Periodical cicadas exhibit unique 13- or 17-year life cycles. Cicadas damage several horticultural and forest plants mainly through oviposition injury causing twig drying and flagging. Their sound production occurs through specialized tymbal organs capable of producing high-frequency vibrations. Cicadas are among the loudest insects in the world and possess several unique biological adaptations including camouflage, evaporative cooling and prolonged life cycles. The article provides comprehensive information regarding the ecological importance and biological features of cicadas.

Keywords: *Cicada, xylem feeding insect, Hemiptera, Tymbal, Nymph, Periodical cicada, Annual cicada, Sound production, Life cycle, Oviposition injury.*

Introduction:

Cicadas are winged insects that produce a loud buzzing song that can be heard throughout the summer and they live on every continent except Antarctica. Annual cicadas appear each year in late June through August. Periodical cicadas, found only in parts of

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North America, emerge from late April through early May in a cycle that spans 13 or 17 years, depending on the species. Cicadas are among the largest Colorado insects in the order Hemiptera, which includes other sap-sucking groups with prominent beaks such as leafhoppers, aphids and spittlebugs. Despite their large size, cicadas cause little injury. The immature stages (nymphs) burrow in the soil and insert their beaks into roots and feed on plant fluids but develop slowly causing no detectable harm to the plants. The greatest injury occurs when large numbers of certain cicadas such as the Putnam's cicada (*Platypedia putnami*) insert eggs into stems of trees and shrubs (oviposition injury). Cicadas' wings are veined and transparent and darker veins near the tips of the wings in some species make the shape of a "W." They have no stingers and lack chewing mouthparts, so they can't bite. Adult females have a sharp ovipositor, a styluslike organ for egg laying and males have ribbed tymbals; exoskeleton structures of alternating stiff and flexible membranes on the first abdominal segment. When males rapidly expand and contract their tymbals, the vibration produces the cicada's distinctive summer song.

Life history and habitat

Cicada nymphs develop underground, feeding on fluids they have piercing and sucking type mouth part in which suck the cell sap from the roots of grasses, shrubs and trees. The nymphs are generally pale brown, rather hunch-backed and have stout forelegs they use to dig through soil. When full-grown, nymphs emerge from the soil. They crawl up a nearby plant or wall and the nymphal exoskeleton ("skin" or exuvia) splits along the back. The adult form then emerges, pulling themselves from the old skin. The new adult will then hang for several hours while blood is pumped to extend the wings. The new exoskeleton hardens and darkens rapidly and the adult cicada then flies away leaving behind the discarded nymphal skin. In most species only male cicadas "sing," which is done primarily to attract females by their characteristic songs. Most cicadas produce sound using a structure known as a Tymbal located on the abdomen of the insect. The tymbal can produce high frequency clicking that resonates within chambers of the body. Very loud songs can be produced in this manner. Some cicadas such as the Putnam's cicada lack tymbals and produce soft rustling songs using their wings. In these species females also can make return calls. Adult cicadas normally will live about four to six weeks after they emerge from the soil. This length of time can vary depending on weather conditions. After mating, the adult females lay their eggs which they insert into stems of plants. Egg laying punctures produce some plant wounding (oviposition wounds)

and may cause damaged twigs to break and die ("flagging"). A few weeks after eggs are laid, nymphs hatch from the eggs within 6 to 10 weeks, burrow into the soil and move to roots on which they feed.

of all insects. Most probably require 3-5 years to develop, but some may live as long as 13 to 17 years. In all cases, most of a cicada's life takes place underground. As juveniles or nymphs cicadas are white and resemble ants or

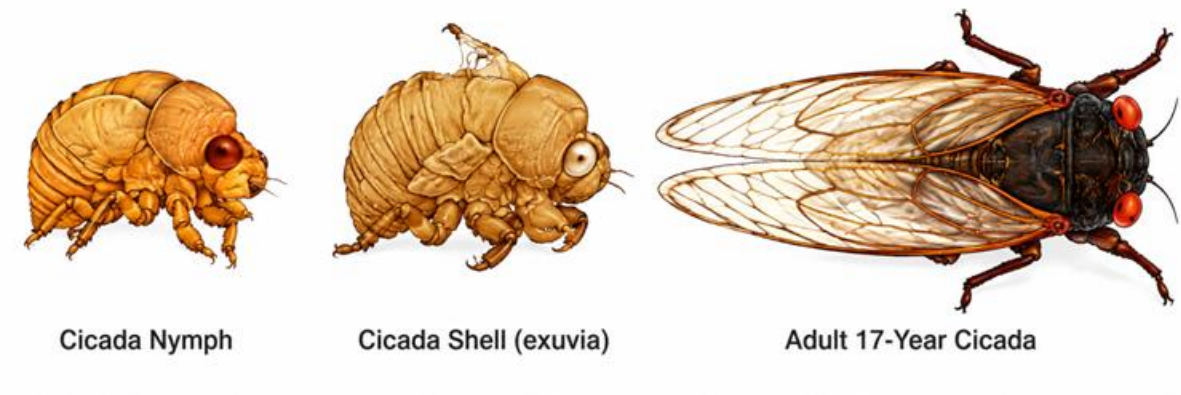

Figure.1: Development of nymphal stage

Figure.2: Life cycle of cicada (After eclosion of egg to adult)

The life cycles of cicadas take years to complete and they are among the longest lived

moulting through several nymph stages called instars. During the last instar stage, nymphs

emerge from their burrows. This aboveground nymph stage is wingless with a light-brown exoskeleton and large front limbs that it uses to anchor itself to trees, plants or tall grasses in preparation for the final moult into its adult form. When adults break out of the nymph exoskeleton their bodies are soft and white, but over the next few hours their wings unfurl and their adult exoskeleton hardens and darkens they are known as teneral adults during this transitional phase, while their bodies are still soft, It takes about four to six days for their exoskeletons to harden completely.

Scientific classification of cicada

Kingdom: Animalia

Phylum: Arthorpoda

Class: Insecta

Order: Hemiptera

Suborder: Auchenorrhyncha

Infraorder: Cicadomorpha

Superfamily: Cicadoidea

Family: Cicadidae

Subfamilies: Cicadettinae, Cicadinae, Tettigadinae and Tibiceninae

Types of Cicada

1. Annual cicada
2. Periodical cicada

1. Annual cicada:

Annual cicadas get their name because while nymphs may live underground for two to five years some members of the species emerge every year. In North America, annual cicadas are out from July to September. Various species of annual cicada can be found throughout the world. Annual cicadas are usually 1 to 1.5 inches long but some species may grow up to 2.5 inches long. Their bodies are typically shades of green, brown and black, though some species may have colours like orange, rust and tan. The veining in their wings is usually black or green.

3. Periodical cicada:

Periodical cicadas live underground for many years and emerge all at once. There are seven species of periodical cicadas. Three species have 17-year life cycles, while the other four have 13-year life cycles. The year they emerge, they wait until the soil reaches 64°F, usually late spring and early summer. Periodical cicadas are usually smaller than annual cicadas, ranging from 0.75 to 1.5 inches. They have black bodies, red eyes and reddish-orange wings. Some species may have yellow bands on their bodies. Sometimes a portion of periodical cicadas emerge on off years, usually a few years early or late. These are called stragglers. Scientists aren't positive why periodical cicadas have such long lifecycles. Some theories suggest that these long intervals underground give them the best chance to avoid predators. Cicadas damage many kinds of plants, especially trees and shrubs. Some commonly affected plants are *viz*., Oak trees, maple trees, apple trees, peach

trees, pear trees, cherry trees, citrus plants, grapevines, elm trees, willow trees, willow trees.

Sound Producing Mechanism

Cicadas' ability to produce such loud sounds, often reaching up to 120 decibels, makes them one of the loudest insects in the world. It is produce by the special gland called Tymbals. This process driven by powerful muscles is essential for generating the high-frequency sounds that cicadas are known for.

Tymbals: Tymbals are ribbed, membrane-like structures located on the sides of the first abdominal segment of cicadas. Each tymbal consists of a series of stiff, chitinous ribs interconnected by flexible membranes. When the tymbal muscles contract, they cause these ribs to buckle inward, creating a distinct clicking sound. Upon relaxation of the muscles, the ribs snap back to their original position, producing another click. This rapid buckling and unbuckling cycle generate the continuous sound pulses that form the cicada Tymbal is specific muscles of this insect they can contract and relax at frequencies up to 300 400 times per second, depending on the species. This rapid muscle activity is crucial for the production of the high frequency sound pulses. The speed and efficiency of these muscle contractions enable cicadas to produce their loud, distinctive calls (Pringle, 1954).

Important characteristics features

1. **Their mouth is a powerful straw:** Under Hemiptera order all insects has mouthparts designed for piercing and sucking. Cicadas are no exception and use their sharp, straw-like mouthparts to pierce plant tissues.

Figure: 3. Structure of the Tymbal (Male Cicada)

Specifically they suck fluid from the xylem or Xylem feeding insect which transfers nutrients and water from a vascular plant's roots to its leaves.

2. **Cicadas are big but sneaky:** Most cicada species have camouflage that blends in with the green of summer vegetation. For more examples of incredible animal camouflage, check out this post. They also tend to spend their time high in the trees, where we are less likely to find them.
3. **Immature cicadas spend many years underground feeding on plant roots:** Nymph of cicadas hatch from tiny eggs that their mothers put in small slits in the wood of tree branches and twigs. After sucking juices from the branch for a few days, they drop down to the ground. At this point, they are about the size of a grain of rice. These tiny nymphs burrow into the ground where they use their straw-mouths to suck on plant roots. As they molt and grow larger they move to larger plants. The smallest cicadas' nymph may start with grasses, while larger nymphs feed on tree roots.
4. They are the loudest insects in the world.
5. They are basically walking musical instruments.
6. Cicadas shared ancient landscapes with dinosaurs.
7. Cicadas have a repertoire of songs.
8. They live longer than most insects.
9. **They have built-in air conditioning:** Most people associate the sound of cicadas with, hot weather. This absolutely checks out; cicadas are often most active at the hottest times of day. They have been recorded singing when its 110°F (43°C) or more. Hanging out when its super hot actually has its advantages for the cicadas. Predators are less active when temperatures get sweltering in the mid-to-late afternoon. Meanwhile, cicadas have their own built-in cooling systems because of their way of eating. Since xylem sap is mostly water, they have to drink lots of it to survive. This also means that they need to get rid of lots of excess water. Cicadas can pass excess water through special ducts that evaporate it out of holes in their thorax, or main body section. Because they are constantly sucking in new water through their straw-like beak, they can keep the water coming. This continuous evaporative cooling lets cicadas bring their body temperatures down by 9°F (5°C) or more.
10. **Cicadas build tunnels with their pee:** Cicadas have to get rid of lots of excess water from the very watery sap that they drink. They ditch most of it by "peeing" a sugary, watery substance called honeydew. Sap-sucking insects like cicadas and

planthoppers produce loads of honeydew and sometimes you can see it literally shooting out of them. In fact, there's a group of insects known as sharpshooters for precisely this reason.

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