

The amazing world of cicadas *-with voiceless wives*

Madhurima Vinod¹ and Prakash H. T²

¹Assistant Professor, Entomology, Department of Entomology, KLE College of Agricultural Sciences, Tenikolla, Belagavi, Affiliated to University of Agricultural Sciences (UAS), Dharwad, Karnataka.

²Assistant Professor, Entomology, AICRP on Soybean, MARS, UAS, Dharwad-580005

Insects are the diverse group of hexapod invertebrates that play an essential role in ecosystems, with over a million described species worldwide. Insects are hexapod invertebrates of the class Insecta. They are the largest group within the arthropod phylum. Insects have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes, and a pair of antennae. With respect to number of species and individuals and in adaptability and wide distribution, insects are perhaps the most eminently successful group of all animals. They dominate the present-day land fauna with about one million described species; this represents about three-fourths of all described animal species. Entomologists estimate the actual number of living insect species could be as high as 5-10 million.

Insects are among nature's most extraordinary creatures, showcasing incredible adaptations, behaviour, and beauty that reveal the hidden wonders of the natural world. Some insects have evolved astonishing survival mechanisms. The bombardier beetles can spray boiling chemicals from their abdomen to deter predators, while assassin bugs use their dagger-like mouthparts and even camouflage with the corpses of their prey to hunt strategically. Bullet ants are known for their intense venomous sting, making them one of the most feared insects in the animal kingdom. Stick insects and praying mantis demonstrate remarkable camouflage, blending seamlessly into their surroundings to ambush prey or avoid predators. A list of such marvellous adaptations and unique survival strategies in insects will be infinite. One such amazing insect is cicada.



Cicadas are found in tropical and temperate areas worldwide and occur in deserts, grasslands, and forests. The earliest known fossil Cicadomorpha appeared in the Upper Permian period; extant species occur all around the world in temperate to tropical climates. They typically live in trees, feeding on watery sap from xylem tissue, and laying their eggs in a slit in the bark. Most cicadas are cryptic. The vast majority of species are active during the day as adults, with some calling at dawn or dusk. Only a rare few species are known to be nocturnal. Cicadas have long been used in folk medicines, as religious and monetary symbols, and as an important source of food for humans and many other organisms. The cicada appears in the mythology, literature, and music of many cultures, including those of some indigenous people in the Americas, and the males of certain Asian species have even been kept in cages for their melodious songs.

The cicadas belong to the super family, the Cicadoidea, of insects in the order Hemiptera (true bugs). They are in the suborder Auchenorrhyncha, along with smaller jumping bugs such as leafhoppers and froghoppers. The superfamily is divided into two families, the Tettigarctidae, with two species in



Australia, and the Cicadidae, with more than 3,000 species described from around the world. Many of the species have not yet been described yet. Cicadas come in varying shapes and sizes, the smallest ones measure not more than a centimetre to some as large as ten centimetres. Most cicadas have brownish body with transparent wings, however few have dark body with colourful wings, which are even comparable to butterflies in terms of their beauty, so much so that a famous French cicada biologist have referred them to as '**Butterfly cicadas**'.

Cicadas are medium to large insects, ranging in size from 2 to 5 cm (0.8 to 2 inches). They characteristically have short antennae, two pairs of transparent membranous wings, prominent compound eyes set wide apart, and three simple eyes (ocelli) that form a triangle between the compound eyes. Equipped only with sap sucking mouthparts, cicadas lack mandibles and thus do not bite. The insects also do not have the modified ovipositor (egg-laying organ) required for stinging. Major cicada species are generally easily recognized by differences in songs, behaviour, and morphology. They have an exceptionally loud song, produced in most species by the rapid buckling and unbuckling of drum-like tymbals. Male cicadas produce loud noises by vibrating membranes (tymbals) near the base of the abdomen. Males of each species typically have three distinct sound responses: a congregational song that is regulated by daily weather fluctuations and by songs produced by other males; a courtship song, usually produced prior to copulation; and a disturbance squawk, produced by individuals captured, held, or disturbed into flight. Most North American cicadas produce rhythmical ticks, buzzes, whines, or screams; although in some species the song is musical. Females lack tymbals, hence no sound production (So, *voiceless wives*) though some species use their wings to produce clicking or snapping sounds, often in response to the songs of the males.

The annual cicadas are species that emerge every year. Nearly all cicadas' species have annual life cycle with exceptions. Though these cicadas' life cycles can vary from one to nine or more years as underground nymphs, their emergence above ground as adults is not synchronized, so some members of each species appear every year. One exclusive, North American genus, *Magicicada* (the periodical cicadas), which spend most of their lives as underground nymphs, emerge in predictable intervals of 13 or 17 years, depending on the species and the location. The unusual timing and synchronization of their emergence may reduce cicada losses to predation by making them less reliable prey and by overwhelming predators with sheer numbers before significant losses occur.

All cicada species have a life cycle that consists of three stages: egg, nymph, and adult. Adult female cicadas usually lay their eggs in woody plant tissues. The newly hatched nymphs burrow into the ground where they suck

juices from roots of perennial plants. Nymphs usually undergo five moults during the year or more to reach maturity. When prompted to emerge—the biology of which is not well understood for long-lived species—mature nymphs often appear aboveground and undergo their final moult on nearby trees. The dorsal line of their exoskeleton splits, and the winged adults emerge slowly through this opening, leaving behind hollow casts known as exuviae. The winged adults live for only a few weeks, just long enough to find a mate and lay eggs. Although not ordinarily considered a pest, the females, if numerous, may damage young saplings during their egg laying.



The last instar nymph emerged out from soil for undergoing the final moult into adult; The adult cicada emerged out leaving behind the exuviae of the last instar nymph.

The "singing" of male cicadas is produced principally and in the majority of species using a special structure called a tymbal, a pair of which lies below each side of the anterior abdominal region. The structure is buckled by muscular action and, being made of resilin, unbuckles

rapidly on muscle relaxation, producing their characteristic sounds. Some cicadas, however, have mechanisms for stridulation, sometimes in addition to the tymbals. Here, the wings are rubbed over a series of midthoracic ridges. The male abdomen in some species is largely hollow, and acts as a sound box. By rapidly vibrating these membranes, a cicada combines the clicks into apparently continuous notes, and enlarged chambers derived from the tracheae serve as resonating chambers with which it amplifies the sound. The cicada also modulates the song by positioning its abdomen toward or away from the substrate (their perch). Partly by the pattern in which it combines the clicks, each species produces its own distinctive mating songs and acoustic signals, ensuring that the song attracts only appropriate mates. The tettigarctid (or hairy) cicadas have rudimentary tymbals in both sexes and do not produce airborne sounds, rather, both males and females produce vibrations that are transmitted through the tree they perch upon. They are considered as representing the original state from which other cicada communication has evolved.

During sound production, the temperature of the tymbal muscles was found to be significantly higher. Many cicadas sing most actively during the hottest hours of a summer day; roughly a 24-hour cycle. Most cicadas are diurnal in their calling and depend on external heat to warm them up, while a few are capable of raising their temperatures using muscle action and some species are known to call at dusk. *Kanakia gigas* and *Froggattoides typicus* are among the few that are known to be truly nocturnal and there may be other nocturnal species living in tropical forests. Cicadas call from varying heights on trees. Where multiple species occur, the species may use different heights and timing of calling.

Although only males produce the cicadas' distinctive sounds, both sexes have membranous structures called tympana (singular – tympanum) by which they detect sounds, the equivalent of having ears. Males disable their own tympana while calling, thereby preventing damage to their hearing; a necessity partly because some cicadas produce sounds up to 120 dB (SPL) which is among the loudest of all insect-produced sounds. The song is loud enough to cause permanent hearing loss in humans should the cicada be at "close range". In contrast, some small species have songs so high in pitch that they are inaudible to humans.

For the human ear, telling precisely where a cicada song originates is often difficult. The pitch is nearly constant, the sound is continuous to the human ear, and cicadas sing in scattered groups. In addition to the mating song, many species have a distinct distress call, usually a broken and erratic sound emitted by the insect when seized or panicked. Some species also have courtship songs, generally quieter, and produced after a female has been drawn to the calling song. Males also produce encounter calls, whether in courtship or to maintain personal space within choruses.

Cicadas use a variety of strategies to evade predators. Large cicadas can fly rapidly to escape if disturbed. Many are extremely well camouflaged to evade predators such as birds that hunt by sight. Being coloured like tree bark and disruptively patterned to break up their outlines, they are difficult to discern; their partly transparent wings are held over the body and pressed close to the substrate. Some cicada species play dead when threatened.



Cicadas feed on sap and do not bite or sting in a true sense but may occasionally mistake a person's arm for a plant limb and attempt to feed, sometimes causing slight discomfort. Cicadas are not major agricultural pests but in some outbreak years, trees may be overwhelmed by the sheer numbers of females laying their eggs in the shoots. Small trees may wilt and larger trees may lose small branches. Although in general, the feeding activities of the nymphs do little damage, during the year before an outbreak of periodic cicadas, the large nymphs feed heavily and plant growth may suffer. Some species have turned from wild grasses to sugarcane, which affects the crop adversely, and in a few isolated cases, females have oviposited on cash crops such as date palms, grape vines, citrus trees, asparagus, and cotton. Cicadas sometimes cause damage to ornamental shrubs and trees, mainly in the form of scarring left on tree branches where the females have laid their eggs. Branches of young trees may die as a result.

North east India is a unique; here we have diversity in indigenous cultures that are in intimate relationship with nature. The practice of eating cicadas as edible items is prevalent among the communities of Northeast and Southeast Asia. Rural folks can be seen using long bamboo poles with sticky natural glues concocted with plant resins to capture adult cicadas right off the trees. In several parts of Northeast, cicadas are considered a delicacy, there are caught in the evening by clapping two bamboo pieces and lighting a small fire, cicadas get attracted to the clapping sound of the bamboo sticks and the light from the fire; they come flying and rests on cut tree twigs that are inserted on the ground near the fire. Like many other communities across the globe, several tribal communities inhabiting Northeast India, cicadas are part of their traditional agrarian heritage and many folklores are woven around the humble cicadas. For instance, among some of the communities of Nagaland, cicadas are considered as harbingers of the arrival of seasons, each changing season is heralded by the changing call of a different species of cicada. For instance, the beginning of the

loud chorus of *Pomponia* and *Platylomia* species signals the timing for paddy cultivation. Among the Adis and Galo communities inhabiting Eastern Arunachal, cicadas referred as NyanyNyare or Goyeng, as per their folklore, they are said to have two sisters Yangi and YayaYaing, among them Yangi was considered a great singer because of her periodical melodious notes and buzzes and, she is therefore considered as an indicative of seasonal changes.

Cicadas have their own intricate role in the overall natural scheme of things. They may not be considered economically important, considering they do not offer us thing valuable as resources in the form of honey as in bees and silk from the silkworms. Neither are they involved in pollination. However, they constitute an important component of a forest ecosystem, and form an important component of the forest food web. They are prey to many animals including, frogs, snakes, birds and small mammals. Ecologically, they act as nutrient recyclers; their underground tunnels aerate the soil and contribute towards enrichment.

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