

= Cricket ( insect ) =

Crickets ( also known as " true crickets " ) , of the family Gryllidae , are insects related to bush crickets , and , more distantly , to grasshoppers . The Gryllidae have mainly cylindrical bodies , round heads , and long antennae . Behind the head is a smooth , robust pronotum . The abdomen ends in a pair of long cerci ( spikes ) ; females have a long , cylindrical ovipositor . The hind legs have enlarged femora ( thighs ) , providing power for jumping . The front wings are adapted as tough , leathery elytra ( wing covers ) , and some crickets chirp by rubbing parts of these together . The hind wings are membranous and folded when not in use for flight ; many species , however , are flightless . The largest members of the family are the bull crickets , *Brachytrupes* , which are up to 5 cm ( 2 in ) long .

More than 900 species of crickets are described ; the Gryllidae are distributed all around the world except at latitudes 55 ° or higher , with the greatest diversity being in the tropics . They occur in varied habitats from grassland , bushes , and forests to marshes , beaches , and caves . Crickets are mainly nocturnal , and are best known for the loud , persistent , chirping song of males trying to attract females , although some species are mute . The singing species have good hearing , via the tympani ( eardrums ) on the tibiae of the front legs .

Crickets often appear as characters in literature . The Talking Cricket features in Carlo Collodi 's 1883 children 's book , *The Adventures of Pinocchio* , and in films based on the book . The eponymous insect is central to Charles Dickens 's 1845 *The Cricket on the Hearth* , as is the chirping insect in George Selden 's 1960 *The Cricket in Times Square* . Crickets are celebrated in poems by William Wordsworth , John Keats , and Du Fu . They are kept as pets in countries from China to Europe , sometimes for cricket fighting . Crickets are efficient at converting their food into body mass , making them a candidate for food production . They are used as food in Southeast Asia , where they are sold deep @-@ fried in markets as snacks . They are also used to feed carnivorous pets and zoo animals . In Brazilian folklore , crickets feature as omens of various events .

= = Description = =

Crickets are small to medium @-@ sized insects with mostly cylindrical , somewhat vertically flattened bodies . The head is spherical with long slender antennae arising from cone @-@ shaped scapes ( first segments ) and just behind these are two large compound eyes . On the forehead are three ocelli ( simple eyes ) . The pronotum ( first thoracic segment ) is trapezoidal in shape , robust , and well @-@ sclerotized . It is smooth and has neither dorsal or lateral keels ( ridges ) .

At the tip of the abdomen is a pair of long cerci ( paired appendages on rearmost segment ) , and in females , the ovipositor is cylindrical , long and narrow , smooth and shiny . The femora ( third segments ) of the back pair of legs are greatly enlarged for jumping . The tibiae ( fourth segments ) of the hind legs are armed with a number of moveable spurs , the arrangement of which is characteristic of each species . The tibiae of the front legs bear one or more tympani which are used for the reception of sound .

The wings lie flat on the body and are very variable in size between species , being reduced in size in some crickets and missing in others . The fore wings are elytra made of tough chitin , acting as a protective shield for the soft parts of the body and in males , bear the stridulatory organs for the production of sound . The hind pair is membranous , folding fan @-@ wise under the fore wings . In many species , the wings are not adapted for flight .

The largest members of the family are the 5 cm ( 2 in ) -long bull crickets ( *Brachytrupes* ) which excavate burrows a metre or more deep . The tree crickets ( *Oecanthinae* ) are delicate white or pale green insects with transparent fore wings , while the field crickets ( *Gryllinae* ) are robust brown or black insects .

= = Distribution and habitat = =

Crickets have a cosmopolitan distribution , being found in all parts of the world with the exception of

cold regions at latitudes higher than about 55 ° North and South . They have colonised many large and small islands , sometimes flying over the sea to reach these locations , or perhaps conveyed on floating timber or by human activity . The greatest diversity occurs in tropical locations , such as in Malaysia , where 88 species were heard chirping from a single location near Kuala Lumpur . A greater number than this could have been present because some species are mute .

Crickets are found in many habitats . Members of several subfamilies are found in the upper tree canopy , in bushes , and among grasses and herbs . They also occur on the ground and in caves , and some are subterranean , excavating shallow or deep burrows . Some make galleries in rotting wood , and certain beach @-@ dwelling species can run and jump over the surface of pools .

= = Biology = =

= = = Defence = = =

Crickets are relatively defenceless , soft @-@ bodied insects . Most species are nocturnal and spend the day hidden in cracks , under bark , inside curling leaves , under stones or fallen logs , in leaf litter , or in the cracks in the ground that develop in dry weather . Some excavate their own shallow holes in rotting wood or underground and fold in their antennae to conceal their presence . Some of these burrows are temporary shelters , used for a single day , but others serve as more permanent residences and places for mating and laying eggs . Crickets burrow by loosening the soil with the mandibles and then carrying it with the limbs , flicking it backwards with the hind legs or pushing it with the head .

Other defensive strategies are the use of camouflage , fleeing , and aggression . Some species have adopted colourings , shapes , and patterns that make it difficult for predators that hunt by sight to detect them . They tend to be dull shades of brown , grey , and green that blend into their background , and desert species tend to be pale . Some species can fly , but the mode of flight tends to be clumsy , so the most usual response to danger is to scuttle away to find a hiding place .

= = = Chirping = = =

Most male crickets make a loud chirping sound by stridulation . The stridulatory organ is located on the tegmen , or fore wing , which is leathery in texture . A large vein runs along the centre of each tegmen , with comb @-@ like serrations on its edge forming a file @-@ like structure , and at the rear edge of the tegmen is a scraper . The tegmina are held at an angle to the body and rhythmically raised and lowered which causes the scraper on one wing to rasp on the file on the other . The central part of the tegmen contains the " harp " , an area of thick , sclerotized membrane which resonates and amplifies the volume of sound , as does the pocket of air between the tegmina and the body wall . Most female crickets lack the necessary adaptations to stridulate , so make no sound .

Several types of cricket songs are in the repertoire of some species . The calling song attracts females and repels other males , and is fairly loud . The courting song is used when a female cricket is near and encourages her to mate with the caller . A triumphal song is produced for a brief period after a successful mating , and may reinforce the mating bond to encourage the female to lay some eggs rather than find another male . An aggressive song is triggered by contact chemoreceptors on the antennae that detect the presence of another male cricket .

Crickets chirp at different rates depending on their species and the temperature of their environment . Most species chirp at higher rates the higher the temperature is ( about 62 chirps a minute at 13 ° C in one common species ; each species has its own rate ) . The relationship between temperature and the rate of chirping is known as Dolbear 's law . According to this law , counting the number of chirps produced in 14 seconds by the snowy tree cricket , common in the United States , and adding 40 will approximate the temperature in degrees Fahrenheit .

In 1975 , Dr. William H. Cade discovered that the parasitic tachinid fly *Ormia ochracea* is attracted

to the song of the cricket , and uses it to locate the male to deposit her larvae on him . It was the first known example of a natural enemy that locates its host or prey using the mating signal . Since then , many species of crickets have been found to be carrying the same parasitic fly , or related species . In response to this selective pressure , a mutation leaving males unable to chirp was observed amongst a population of field crickets on the Hawaiian island of Kauai , enabling these crickets to elude their parasitoid predators .

= = = Flight = = =

Some species , such as the ground crickets ( *Nemobiinae* ) , are wingless ; others have small fore wings and no hind wings ( *Copholandrevus* ) , others lack hind wings and have shortened fore wings in females only , while others are macropterous , with the hind wings longer than the fore wings . In *Teleogryllus* , the proportion of macropterous individuals varies from very low to 100 % . Probably , most species with hind wings longer than fore wings engage in flight .

Some species , such as *Gryllus assimilis* , take off , fly , and land efficiently and well , while other species are clumsy fliers . In some species , the hind wings are shed , leaving wing stumps , usually after dispersal of the insect by flight . In other species , they may be pulled off and consumed by the cricket itself or by another individual , probably providing a nutritional boost .

*Gryllus firmus* exhibits wing polymorphism ; some individuals have fully functional , long hind wings and others have short wings and cannot fly . The short @-@ winged females have smaller flight muscles , greater ovarian development , and produce more eggs , so the polymorphism adapts the cricket for either dispersal or reproduction . In some long @-@ winged individuals , the flight muscles deteriorate during adulthood and the insect 's reproductive capabilities improve .

= = = Diet = = =

Captive crickets are omnivorous ; when deprived of their natural diet , they accept a wide range of organic foodstuffs . Some species are completely herbivorous , feeding on flowers , fruit , and leaves , with ground @-@ based species consuming seedlings , grasses , pieces of leaf , and the shoots of young plants . Others are more predatory and include in their diet invertebrate eggs , larvae , pupae , moulting insects , scale insects , and aphids . Many are scavengers and consume various organic remains , decaying plants , seedlings , and fungi . In captivity , many species have been successfully reared on a diet of ground , commercial dry dog food , supplemented with lettuce and aphids .

Crickets have relatively powerful jaws , and several species have been known to bite humans .

= = = Reproduction and lifecycle = = =

Male crickets establish their dominance over each other by aggression . They start by lashing each other with their antennae and flaring their mandibles . Unless one retreats at this stage , they resort to grappling , at the same time each emitting calls that are quite unlike those uttered in other circumstances . When one achieves dominance , it sings loudly , while the loser remains silent .

Females are generally attracted to males by their calls , though in nonstridulatory species , some other mechanism must be involved . After the pair has made antennal contact , a courtship period may occur during which the character of the call changes . The female mounts the male and a single spermatophore is transferred to the external genitalia of the female . Sperm flows from this into the female 's oviduct over a period of a few minutes or up to an hour , depending on species . After copulation , the female may remove or eat the spermatophore ; males may attempt to prevent this with various ritualised behaviours . The female may mate on several occasions with different males .

Most crickets lay their eggs in the soil or inside the stems of plants , and to do this , female crickets have a long , needle @-@ like or sabre @-@ like egg @-@ laying organ called an ovipositor . Some ground @-@ dwelling species have dispensed with this , either depositing their eggs in an

underground chamber or pushing them into the wall of a burrow . The short @-@ tailed cricket ( *Anurogryllus* ) excavates a burrow with chambers and a defecating area , lays its eggs in a pile on a chamber floor , and after the eggs have hatched , feeds the juveniles for about a month .

Crickets are hemimetabolic insects , whose lifecycle consists of an egg stage , a larval or nymph stage that increasingly resembles the adult form as the nymph grows , and an adult stage . The egg hatches into a nymph about the size of a fruit fly . This passes through about 10 larval stages , and with each successive moult , it become more like an adult . After the final moult , the genitalia and wings are fully developed , but a period of maturation is needed before the cricket is ready to breed .

The species *Gryllus bimaculatus* exhibits the reproductive pattern of polyandry . This sexual selective pattern increases the overall fitness of the species and promotes genetic variation . The females select and mate with multiple viable sperm donors and exhibit a distinct preference to novel mates .

= = = Inbreeding avoidance = = =

Female *Teleogryllus oceanicus* crickets from natural populations mate polyandrously and store sperm from multiple males . Female crickets exert a postcopulatory fertilization bias in favour of unrelated males to avoid the genetic consequences of inbreeding . Fertilization bias depends on the control of sperm transport to the sperm storage organs . The inhibition of sperm storage by female crickets can act as a form of cryptic female choice to avoid the severe negative effects of inbreeding .

In controlled @-@ breeding experiments with the cricket *Gryllus firmus* , seven inbred lines were tested , and during 14 generations of brother ? sister matings , nymphal weight and early fecundity declined substantially . This observed inbreeding depression appeared to be due to an increased frequency of homozygous combinations of deleterious recessive alleles generated by the inbreeding ( thereby decreasing fitness ) . These results support the general idea that the principal benefit of outcrossing is the masking of deleterious recessive alleles by wild @-@ type alleles .

= = = Predators , parasites , and pathogens = = =

Crickets have many natural enemies and are subject to various pathogens and parasites . They are eaten by large numbers of vertebrate and invertebrate predators and their hard parts are often found when the contents of animal 's guts are examined . Mediterranean house geckos ( *Hemidactylus turcicus* ) have learned that although a calling decorated cricket ( *Gryllodes supplicans* ) may be safely positioned in an out @-@ of @-@ reach burrow , female crickets attracted to the call can be intercepted and eaten .

The entomopathogenic fungus *Metarhizium anisopliae* attacks and kills crickets and has been used as the basis of control in pest populations . The insects are also affected by the cricket paralysis virus , which has caused high levels of fatalities in cricket @-@ rearing facilities . Other fatal diseases that have been identified in mass @-@ rearing establishments include *Rickettsia* and three further viruses . The diseases may spread more rapidly if the crickets become cannibalistic and eat the corpses .

Red parasitic mites sometimes attach themselves to the dorsal region of crickets and may greatly affect them . The horsehair worm *Paragordius varius* is an internal parasite and can control the behaviour of its cricket host and cause it to enter water , where the parasite continues its lifecycle and the cricket likely drowns . The larvae of the sarcophagid fly *Sarcophaga kellyi* develop inside the body cavity of field crickets . Female parasitic wasps of *Rhopalosoma* lay their eggs on crickets , and their developing larvae gradually devour their hosts . Other wasps in the family *Scelionidae* are egg parasitoids , seeking out batches of eggs laid by crickets in plant tissues in which to insert their eggs .

The fly *Ormia ochracea* has very acute hearing and targets calling male crickets . It locates its prey by ear and then lays its eggs nearby . The developing larvae burrow inside any crickets with which

they come in contact and in the course of a week or so , devour what remains of the host before pupating . In Florida , the parasitic flies were only present in the autumn , and at that time of year , the males sang less but for longer periods . A trade @-@ off exists for the male between attracting females and being parasitized .

= = Phylogeny and taxonomy = =

The phylogenetic relationships of the Gryllidae , summarized by Darryl Gwynne in 1995 from his own work ( using mainly anatomical characteristics ) and that of earlier authors , are shown in the following cladogram , with the Orthoptera divided into two main groups , Ensifera ( crickets sensu lato ) and Caelifera ( grasshoppers ) . Fossil Ensifera are found from the late Carboniferous period ( 300 Mya ) onwards , and the true crickets , Gryllidae , from the Triassic period ( 250 to 200 Mya ) .

Cladogram after Gwynne , 1995 :

A phylogenetic study by Jost & Shaw in 2006 using sequences from 18S , 28S , and 16S rRNA supported the monophyly of Ensifera . Most ensiferan families were also found to be monophyletic , and the superfamily Gryllacridoidea was found to include Stenopelmatidae , Anostomatidae , Gryllacrididae and Lezina . Schizodactylidae and Grylloidea were shown to be sister taxa , and Rhaphidophoridae and Tettigoniidae were found to be more closely related to Grylloidea than had previously been thought . The authors stated that " a high degree of conflict exists between the molecular and morphological data , possibly indicating that much homoplasy is present in Ensifera , particularly in acoustic structures . " They considered that tegmen stridulation and tibial tympanae are ancestral to Ensifera and have been lost on multiple occasions , especially within the Gryllidae .

More than 900 species of Gryllidae ( true crickets ) are known . The family is divided into these subfamily groups , subfamilies , and extinct genera ( not placed within the subfamilies ) :

= = In human culture = =

= = = Folklore and myth = = =

The folklore and mythology surrounding crickets is extensive . The singing of crickets in the folklore of Brazil and elsewhere is sometimes taken to be a sign of impending rain , or of a financial windfall . In Álgvar Núñez Cabeza de Vaca 's chronicles of the Spanish conquest of the Americas , the sudden chirping of a cricket heralded the sighting of land for his crew , just as their water supply had run out . In Caraguatatuba , Brazil , a black cricket in a room is said to portend illness ; a gray one , money ; and a green one , hope . In Alagoas state , northeast Brazil , a cricket announces death , thus it is killed if it chirps in a house . In Barbados , a loud cricket means money is coming in ; hence , a cricket must not be killed or evicted if it chirps inside a house . However , another type of cricket that is less noisy forebodes illness or death .

= = = In literature = = =

Crickets feature as major characters in novels and children 's books . Charles Dickens 's 1845 novella *The Cricket on the Hearth* , divided into sections called " Chirps " , tells the story of a cricket which chirps on the hearth and acts as a guardian angel to a family . Carlo Collodi 's 1883 children 's book " *Le avventure di Pinocchio* " ( *The Adventures of Pinocchio* ) featured " *Il Grillo Parlante* " ( *The Talking Cricket* ) as one of its characters . George Selden 's 1960 children 's book *The Cricket in Times Square* tells the story of Chester the cricket from Connecticut who joins a family and their other animals , and is taken to see Times Square in New York . The story , which won the Newbery Honor , came to Selden on hearing a real cricket chirp in Times Square .

The French entomologist Jean @-@ Henri Fabre 's popular *Souvenirs Entomologiques* devotes a whole chapter to the cricket , discussing its construction of a burrow and its song @-@ making . The account is mainly of the field cricket , but also mentions the Italian cricket .

Cricket has from time to time appeared in poetry . William Wordsworth 's 1805 poem The Cottager to Her Infant includes the couplet " The kitten sleeps upon the hearth , The crickets long have ceased their mirth " . John Keats 's 1819 poem Ode to Autumn includes the lines " Hedge @-@ crickets sing ; and now with treble soft / The redbreast whistles from a garden @-@ croft " . The Chinese Tang dynasty poet Du Fu ( 712 ? 770 ) wrote a poem that in the translation by J. P. Seaton begins " House cricket ... Trifling thing . And yet how his mournful song moves us . Out in the grass his cry was a tremble , But now , he trills beneath our bed , to share his sorrow . "

= = = As pets and fighting animals = = =

Cricket is kept as a pet and is considered good luck in some countries ; in China , they are sometimes kept in cages or in hollowed @-@ gourds specially created in novel shapes . The practice was common in Japan for thousands of years ; it peaked in the 19th century , though crickets are still sold at pet shops . It is also common to have them as caged pets in some European countries , particularly in the Iberian Peninsula . Cricket fighting is a traditional Chinese pastime that dates back to the Tang dynasty ( 618 ? 907 ) . Originally an indulgence of emperors , cricket fighting later became popular among commoners . The dominance and fighting ability of males does not depend on strength alone ; it has been found that they become more aggressive after certain pre @-@ fight experiences such as isolation , or when defending a refuge . Crickets forced to fly for a short while will afterwards fight for two to three times longer than they otherwise would .

= = = As food = = =

In the southern part of Asia including Cambodia , Laos , Thailand and Vietnam , crickets are commonly eaten as a snack , prepared by deep frying the soaked and cleaned insects . In Thailand , there are 20 @, @ 000 farmers rearing crickets , with an estimated production of 7 @, @ 500 tons per year and United Nation 's FAO has implemented a project in Laos to improve cricket farming and consequently food security .

The food conversion efficiency of house crickets ( *Acheta domesticus* ) is 1 @. @ 7 , some five times higher than that for beef cattle , and if their fecundity is taken into account , 15 to 20 times higher .

More and more small companies in western countries are processing crickets to convert them in powder ( often referred to as flour ) to produce processed food products like protein bars , cricket pasta , and cookies . This innovation is part of a general diffusion of edible insects as food . Crickets are reared on a large scale as food for carnivorous zoo and laboratory animals ; they may be " gut loaded " with additional minerals , such as calcium , to provide a balanced diet for predators such as tree frogs ( *Hylidae* ) .

= = = In popular culture = = =

Cricket characters feature in the Walt Disney animated movies *Pinocchio* ( 1940 ) , where Jiminy Cricket becomes the title character 's conscience , and in *Mulan* ( 1998 ) , where Cri @-@ kee is carried in a cage as a symbol of luck , in the Asian manner . The Crickets was the name of Buddy Holly 's rock and roll band ; Holly 's home town baseball team in the 1990s was called the Lubbock Crickets . Cricket is the name of a US children 's literary magazine founded in 1973 ; it uses a cast of insect characters . The sound of crickets is often used in media to emphasize silence , often for comic effect after an awkward joke , in a similar manner to tumbleweed .