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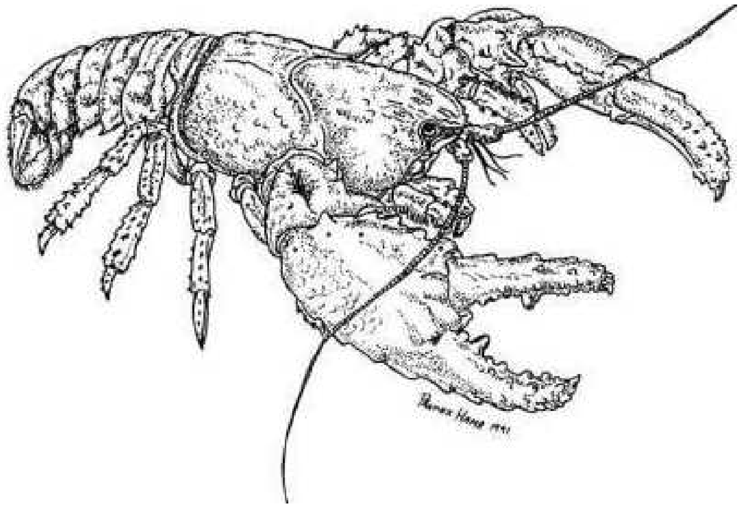

The Silent cicada and Other Natural Sounds

by **Sarah Lloyd**

Tasmanian hairy cicada (*Tettigarcta tomentosa*) (Photo by Geoff Fenton)

I know our roof cavities are full of ants because I see them walk the beams like they were footpaths and an intriguing collection of discarded pupal cases, *pimelea* corolla tubes, buds and flowers of the local eucalypt, small twigs and woollen insulation falls to the floor and accumulates in piles below their nests. On warm summer days I hear the muffled shuffling of thousands of tiny animals stirring in the ceilings; but it’s the tap-tap-tapping sound coming from above that’s had me mystified for many years.

Ants mostly communicate by pheromones, and this is well documented in the book by Bert Holldobler and E.O. Wilson called simply: *The Ants* (Holldobler 1990). In that large tome, 28 pages are devoted to chemical communication, with the internal structure of a typical worker ant (described by the authors as 'a walking battery of endocrine glands') illustrated with many beautiful line drawings - one looking for all the world like an Aubrey Beardsley print. Just 2 pages are needed to cover acoustical communication; it doesn't happen that much among ants.

Ants are nearly deaf to airborne sounds but are sensitive to vibrations in the substrate. Consequently the ants that do make sounds are usually arboreal and the sounds they make are achieved by either stridulation or by tapping.

The mysterious tapings and accumulation of debris in our house suggest that there are at least five nests of *Polyrhachis* sp. in our ceiling. Fortunately these ants are non-smelly, non-biting, medium sized insects with a placid, rather endearing disposition and a curious habit of curling their gaster under their bodies, presumably in response to perceived danger. Although these nocturnal *Polyrhachis* are often found mooching around our kitchen they usually inhabit small cavities in dead wood and it may be that their propensity for sound making has not yet been fully documented. It has, however, been studied in other *Polyrhachis* species and the related genera *Camponotus*. In these ants the workers tap the substrate with their mandibles and gasters while rocking their bodies back and forth.

The functions of the sound signals in ants, which are often used in conjunction with chemical signals, include alarm, recruitment, the termination of mating by females and the modulation of other communication and forms of behaviour.

Tasmania has the distinction of having one of only two species of silent cicadas in the world, the endemic Tasmanian Hairy Cicada (*Tettigarcta tomentosa*) in the genus *Tettigarcta*. (The other species is found in mountainous regions in south eastern New South Wales and Victoria.)

Although the silent cicadas do possess tymbals and associated muscles (the sound producing mechanisms found in singing cicadas) they are poorly developed and produce no audible or inaudible high-frequency sounds. Furthermore there are no air sacs in the abdomen, which in the singing cicadas act as resonating chambers.

But are they really silent? It may be that they, like their close relatives with similarly constructed tymbals, the leafhoppers, planthoppers and froghoppers, communicate by sound transmitted via the substrate. These insects produce low intensity sounds that vibrate through the plant on which they land and can be detected by other individuals in contact with the some plant. All legs of *Tettigarcta* possess tarsal empodia (a.k.a bristly feet!) which probably act as substrate sound receptors. Singing cicadas don't have such things.

The singing Cicadas in the family Cicadidae produce some of the most familiar sounds of summer. At almost 120 decibels, the males of some cicada species emit the loudest of all insect sounds that at close range approach the pain threshold of the human ear. The sounds are generated by the tymbals, ribbed membranes that are situated on either side of the abdomen. Muscles attached to the tymbals control the 'click' mechanism which is akin to a tin lid being clicked in and out. A tensor muscle, also attached to the tymbals, adjusts the volume by stiffening the tymbal membrane. Air sacs, which amplify the sound, take up most of the space in a male's abdomen while the other organs, those used for inhalation and digestion, take up minimal space.

Although the main purpose of the cicada's song is to attract a mate, the loud sound is known to repel their major predators, birds. The sound is not only painful to birds' ears it also interferes with avian communication. Furthermore, the ventriloqual nature of the sounds means that the vertebrate ear has difficulty pinpointing its source.

Invertebrates don't have a vocal organ equivalent to our larynx or a bird's syrinx, but use other methods for sound production including percussion (as in the polyrachis ants), vibration (the 'silent' *Tettigarcta*), click mechanisms (singing cicada) and occasionally air expulsion, a method of sound production more often encountered in vertebrates. Stridulation (humans 'stridulate' when they run a fingernail along the teeth of a comb or play a stringed instrument, like a violin) is a widespread method of sound production in arthropods and is used by insects, arachnids and crustaceans.

Crickets and grasshoppers (Orthoptera) are masters of stridulation. The two most commonly used methods are the tooth and comb technique and the washboard technique. The former involves rubbing specialised veins on the base of the forewings; the latter relies on friction between a row of pegs on the inside of the leg which, like a file, is drawn across a pronounced vein on the forewing. Relative to size, the sound a cricket produces can be extraordinarily loud, mainly because of the design of its sound producing organ. In addition, some species of bush crickets build complex underground chambers that amplify the sounds and enable them to be heard almost 2 km away.

As in other species, sound is mainly used by males to advertise territory, for defence, or to attract mates. In some families the males and females sing mating duets.

The ears of crickets and grasshoppers are found either on their abdomen or on their legs, and some have such acute hearing that they are able to detect bats 30 meters away – long before the bats locate them.

Many birds also produce non-vocal sounds. Grey Shrike-thrushes, common in eucalypt forests throughout the country, often punctuate their melodious vocal repertoire with the sound of clapping mandibles. Some birds, including grebes, herons, crows, storks and penguins incorporate bill fencing in their ritualised mating displays. Whether the sounds produced are significant or simply incidental to the performance is difficult to determine.

Woodpeckers make irregular tapping sounds as a by-product of their search for insects or nest excavation activities. Some species also make deliberate rapid drumming sounds which replace the territorial and mating vocalisations of songbirds. The rhythm, speed and intensity of the drumming can identify a species.

When searching for suitable nesting sites some woodpeckers seek trees with fungal infections as nesting hollows take less time to excavate when fungi have already softened the wood. How woodpeckers locate the decay remains a mystery. They either detect it by the visible presence of fungal fruits or they may tap the trunks and listen for a telltale resonance.

Ground dwelling birds such as quails and pigeons sometimes take flight with a startling flap of their wings, possibly to momentarily distract would-be predators. The low boom of the emu, which originates in the syrinx, can be heard up to 2 km away because an inflatable sac in the oesophagus acts as a resonating chamber.

But of all the non-vocal avian sounds those made by Manakins are perhaps the most intriguing because, unique among the vertebrates, they are achieved by stridulation.

Manakins are a large group of small, stocky, brightly-coloured birds that inhabit the tropical forests of central and South America. Naturalists, including Charles Darwin, first became aware of their astonishing sound generating abilities in the 1800s and since then they have been closely studied.

Like grouse, bowerbirds, birds-of-paradise and some other polygynous birds, manakins congregate at traditional courting places known as leks or courts. Depending on the species, traditional courts are either in the trees or on the ground and incorporate props such as saplings, twigs or branches. Males, either individually or cooperatively, again depending on the species, perform to the visiting female who will mate with the male she considers to have the most impressive vocal and visual display.

Manakins eat fruit and as fruit is an abundant and ever present commodity in lush tropical forests little time is needed for foraging. The males, who play no part in nest building or the rearing of young, devote their time to performing spectacular courtship dances. A cooperative event can include up to 60 males, each with a small area but within metres of the neighbouring rival. They hop, leap, jump and slide and enhance their highly ritualised movements with an extraordinary array of non-vocal sounds. The firecracker-like pops, whooshing noises, growls and in one species, a violin-like sound are all produced by their modified wing feathers.

For many years the Club-winged Manakin has been known to produce a clear violin-like sound with its wings, but it is only recently that researchers, equipped with digital cameras that can record 1,000 frames a second, have determined exactly how this is achieved.

When the bird raises its wings over its back, it shakes them back and forth over 100 times a second (some small hummingbirds flap their wings 80 times a second) thus producing the sound. On each wing there is a feather with a series of ridges; sitting alongside this ridged feather is one with a stiff rounded tip. With each shake of its wings, the tip rakes across the ridges of the adjacent feather and emits a sound with a frequency of 1400 cycles a second.

Meanwhile, at Black Sugarloaf where the lack of city noises ensures a quiet sound environment the lengthening days and warming temperatures are stirring animals from their winter repose; ceiling shuffling is resuming and birds are returning to their breeding territories, tentatively rehearsing for their full performance in spring.

Many animals emit sounds too low or too high for our ears. How fascinating it would be if we could detect the ultrasonic clicks of moths, the abdominal vibrations of lacewings, or the signals transmitted through spiders' webs, sounds beyond our range of hearing.

References:

- Alcock, J. (2001) 'Understanding bird behaviour'. In *Handbook of Bird biology* (S. Podulka, R. Rohrbaugh, Jr., and R. Bonney, eds) The Cornell Lab of Ornithology. Ithaca, NY.

- Conner, R.N., Saenz, D., Rudolph, D.C. & Schaefer, R.R. (2004) 'Extent of Phellinus pini decay in loblolly pines and red-cockaded woodpecker activity trees in eastern Texas'. In *Fungi in ecosystems: Systematics, Diversity and Ecology*. The New York Botanical Gardens.

- Davies, W.J. (2000) 'Sound production: non-vocal sounds'. In *Interpretive Birding Bulletin Vol.3 no.5*

- Ewing, A. W. (1989) *Arthropod bioacoustics: neurobiology and behaviour*. Cornell University Press, Ithaca.

- Holldobler, B. & Wilson, E.O. (1990) *The Ants*. Harvard University Press, Massachusetts.

- Moulds, M.S. (1990) *Australian Cicadas*. New South Wales University Press, Sydney.

- O'Toole, C. (1995) *Alien Empire. An exploration of the lives of Insects*. BBC Books, London

- O'Toole, C (Ed) (2002) *The New Encyclopedia of Insects and their allies*. Oxford University Press. Oxford.

- Podulka, S. (2001) 'Winnows, snaps and spring thunder – non-vocal sounds'. In *Handbook of Bird biology* (S. Podulka, R. Rohrbaugh, Jr., and R. Bonney, eds) The Cornell Lab of Ornithology. Ithaca, NY.

- Zimmer, C. (2005) 'A new kind of birdsong: music on the wing in the forests of Ecuador'. *New York Times, Aug 2nd 2005*. Drawing from: Holldobler & Wilson (1990)

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