University of Florida Book of Insect Records
Chapter 24 *Loudest*

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The African cicada, Brevisana brevis *(Homoptera: Cicadidae) produces a calling song with a mean sound pressure level of 106.7 decibels at a distance of 50 cm. Two species of North American cicadas,* Tibicen walkeri *Metcalf and* T. resh *(Haldman), produce an alarm call with a mean sound pressure level of 105.9 dB(50 cm).* Brevisana brevis *is likely the loudest insect species on record. Cicada songs are species-specific and play a vital role in communication, reproduction, and possibly defense.*

In the context of this paper, "loudest insect" is defined as the insect species capable of producing the most intense sound between 20 Hz and 20 kHz, the range audible to normal human hearing. Loudness will be quantified by the sound pressure level (SPL) in decibels (dB) produced by a single insect measured at a distance of 50 cm using a reference value of 20 N/m^2. The greatest published sample mean SPL for a species will determine the champion. The biological significance of the sound production is discussed.

Methods

Initial candidates were provided through personal communications, an Internet search for the "loudest insect" using Yahoo, and posting a request for help on the ENTOMO-L Bulletin Board. CD-ROM versions of CAB (1985-present) and AGRICOLA (1970-present) were searched to obtain other candidates and SPL measurements. Secondary literature was used to interpret and equalize the SPL values obtained. SPL values were standardized according to Peterson (1967).

Results

The ENTOMO-L Bulletin Board was the most productive source of potential candidates providing numerous species from the orders Orthoptera and Homoptera. Suggested orthopteran species include a large field cricket from Malaysia (*Brachytrupes achatinus*), the bladder grasshopper (*Bullacris membracoides*), an acridid (*Circotettix rabula*), and the European mole cricket (*Gryllotalpa vinae*) registering 96 dB at a distance of 50 cm (Bennet-Clark 1970), the highest recorded SPL for these contestants. Homopteran contenders include male cicadas of the family Cicadidae. The range of mean sound pressure levels for samples of calls from the 68 species considered is 69.1-106.7 dB (Sanborn & Phillips 1995; Villet 1987; Young 1990). A maximum SPL of 108.9 dB was measured in an alarm call produced by *Tibicen walkeri* Metcalf (Sanborn & Phillips 1995). Mean and maximum SPL levels for finalists are presented in Table 1.

Most male cicadas produce an alarm call and calling song that vary in SPL. I award the loudest insect record to the species *Brevisana brevis* (Homoptera: Cicadidae) for a mean calling song SPL of 106.7 dB (Villet 1987). *Tibicen walkeri* Metcalf and *T. resh* (Haldman) deserve honorable mention for sharing the highest mean alarm call SPL of 105.9 dB (Sanborn and Phillips 1995).

Discussion

Sound is produced by cicadas when muscles buckle the tymbals, rib-strengthened chitinous membranes located on the dorsolateral surfaces

Table 1. Sound pressure levels for loudest insect species finalists.

Species	Song	Mean SPL[1]	Max. SPL	Reference
Brevisana brevis	call	106.7(10)	107.5	Villet 1987
Pyena semiclara	call	106.2(11)	108.0	Villet 1987
Diceroprocta apache (Davis)	call	106.2(8)	107.9	Sanborn & Phillips 1995
Tibicen walkeri Metcalf	alarm	105.9(8)	108.9	Sanborn & Phillips 1995
Tibicen resh (Haldman)	alarm	105.9(9)	107.2	Sanborn & Phillips 1995
Cyclochila australasiae[2]	call	105.7(8)	107.8	Young 1990

[1] dB re 20 μN/m^2 measured at 50 cm (sample size).
[2] Adjusted to 50 cm from 20 cm.

of the first abdominal segment (Sanborn & Phillips 1995). The sound pulse is modified by several body components and radiated through the tympana (Young 1990; Young & Bennet-Clark 1995).

Sanborn and Phillips (1995) found that sound pressure levels for both calling songs and alarm calls of 59 species of North American cicadas correlate directly with insect body mass (R^2 = 0.325 and 0.451, respectively). The dry weight of *Brevisana brevis* is approximately 0.3 g. *Tacua speciosa* and *Pomponia imperatoria*, southeast Asian cicadas, have dry weights of about 1.5 and 2.0 g, respectively. Anecdotal accounts of the songs of *P. imperatoria* suggest they are deafening. It is likely that *B. brevis* holds the record only because of a lack of investigation in southeast Asia (M. H. Villet, personal communication).

Most male cicadas attract mates with their calling song (Sanborn & Phillips 1995) giving larger males a competitive advantage in sexual selection. The calling song also stimulates aggregation of conspecific males (Simmons et al. 1971); and when males are in close proximity, it may repell, resulting in a minimum distance between individuals (Doolan 1981).

Smith and Langley (1978) examined the immediate and short-term effects of the male desert cicada *Diceroprocta apache* (Davis) alarm song on prey handling ability of an aggressive generalist predator, the southern grasshopper mouse *Onychomys torridus* (Coues). While the irritating call was not sufficient to deter attacks, increased handling time reduced predatory efficiency and enhanced the probability of the insect's escape.

The noise produced by cicadas could be interpreted as an advertisement for predators. At close range, the painfully intense sounds can also have a repellant effect on bird predators. Simmons et al. (1971) theorize the coexistence of different frequencies of songs produced during the simultaneous emergence of acoustically isolated sympatric cicadas may jam the hearing of predators better than one species by itself.

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