Headbanging termites send out smoke signals

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Communicating over long distances is difficult; for example, the sound of our voices can rarely be heard or understood further away than 100 m. Yet, long before the invention of the telephone or e-mail, humans were successfully communicating over hundreds of kilometres. Take, for example, the Great Wall of China, where soldiers alerted each other of an impending attack using smoke signals. Although this remarkable ability to communicate over long distances is said to be unique to humans, Wolfgang Kirchner and PhD student Felix Hager, from the University of Bochum, Germany, found out that some species of termites have also mastered the skill (p. 3249).

Kirchner explains that the African termite, Macrotermes natalensis, forms large colonies in subterranean mounds and operates on a caste system. The workers use the mound's maze of corridors to access the outside world to forage for food. As these outdoor excursions can take them over 10 m away from their colony, they are accompanied by another caste – the solider termites. In addition to protecting them, these soldiers will drum home warnings of an impending attack to the distant colony should a hungry aardvark appear.

Kirchner's initial work on termites' long-distance warnings began in the Ivory Coast but because of the political situation he decided travel to South Africa with Hager to carry on his work. As termites are difficult to find outside their colonies, the duo opened up the central chamber of a termite mound and used high-speed cameras to capture in detail how soldiers warn others of unwelcome intrusions. They saw the soldiers raising their heads upwards before bashing them into the ground at speeds of 1.5 m $s^{?1}$. Using carefully embedded accelerometers to detect vibrations, the duo found that the M. natalensis termites drummed their heads rapidly, 11 times per second. Each head bang generated vibrational pulses where the ground vibrated with acceleration amplitudes up to 0.7 m $s^{?2}$; this approximately corresponds to a 70 nm movement at a frequency of 500 Hz.

'Once we had described the signal, the next step was to look at signal perception – what intensity does the signal have to have in order to be recognisable for another individual?' says Kirchner. To do this, they carefully placed termites into Petri dishes and measured their responses over a range of vibrational frequencies and displacements. They found the termites were most sensitive to frequencies around 500 Hz, as long as the movement of the dish's surface was more than 0.012 m $s^{?2}$ (the equivalent of a miniscule 1–2 nm movement).

Satisfied that the soldiers were producing a vibrational signal that other termites could pick up, Kirchner says: 'We looked at how a signal is transmitted from the individual into the soil, how much is it attenuated with distance and how fast can it travel physically.' Mimicking a vibration pulse and placing accelerometers at set distances away from the signal, the team found that the vibrational wave could travel up to 171 m $s^{?1}$. They found that the vibrations were attenuated by 0.4 dB $cm^{?1}$ and calculated that after just 40 cm the ground would no longer vibrate enough for other termites to pick it up. However, drumming signals can be picked up at much further distances. Kirchner concludes that the only way this could occur is if there's social transmission of the signal. He likens it to a game of Chinese whispers, where one termite passes on the message to the next, and so forth. Only, in this case, the message is not distorted and it's drumming loud and clear – danger ahead!

More information: Vibrational long-distance communication in the termites Macrotermes natalensis and Odontotermes sp. *J Exp Biol* 2013 216:3249-3256. ; DOI: 10.1242/jeb.086991 , jeb.biologists.org/content/216/17/3249.abstract

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