New Acoustic Methods for Termite Detection

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Reticulitermes flavipes worker (jpg courtesy of www.utoronto.ca/forest/termite/termite.htm)

Summary

The history of research on termite detection techniques includes numerous examples of abandoned attempts to develop practical acoustic sensing methods (Lewis 1997, Lewis & Lemaster 1991). Many acoustic systems have worked well in the laboratory, but were expensive, difficult to operate, or were unreliable in real-world, noisy conditions.

We have developed a portable termite detection device by adapting acoustic technology originally used for detection of hidden insect infestations in stored products and soil (Mankin et al. 2000). The present system contains an accelerometer that senses small vibrations, a portable amplifier, and a recorder with headphones. The accelerometer is attached magnetically to a nail inserted into wood or soil at the recording site. Recorded signals are analyzed using author-written computer programs that discriminate termite sounds from background noise.

The new termite detection system has been tested in a park in New Orleans to determine the feasibility of detecting infestations of *Coptotermes formosanus* in trees. We also have conducted studies of *Reticulitermes flavipes* activity patterns in the laboratory, and estimated the minimum detectable numbers of *R. flavipes* in small wood termite traps used to monitor termite infestations on the University of Florida campus. The initial results indicate that presently available acoustic technology can be easily adapted for rapid detection and spatial targeting of termite infestations. Termites can be detected rapidly compared to present survey methods, and signal processing technology now enables most noises to be distinguished from termite sounds.

Methods

Fig. 1A. Amplifier (left) and recorder (right) for portable acoustic detection system. Accelerometer is shown at S3 in Fig. 1B. Sounds can be monitored with headphones and/or analyzed with computer programs.

Fig. 1B. Example of test to monitor *C. formosanus* activity at an oak tree. S1-S4 indicate probes inserted into or near the tree. Accelerometer is shown at S3. Sounds detected easily at S3 were detected only faintly at S2 or S4 (15 cm away).

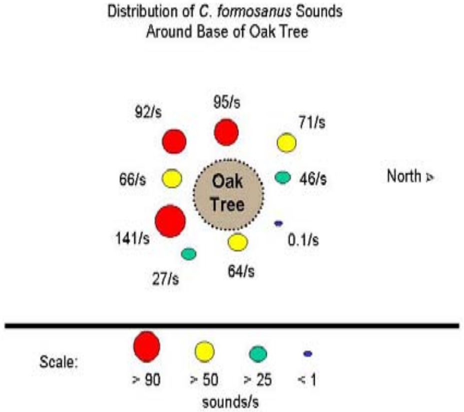
Fig. 1C. John Green adjusting metal can containing accelerometer system attached to wood trap infested with 100, 500, or 1000 *R. flavipes.* After recording, the accelerometer was detached from nail and the can was closed to reduce disturbance.

Results

Termite sounds can be identified relatively easily because they are short and have significant high-frequency components relative to machinery, cars, planes, and many other urban background noises (**Fig. 2A**). [VL indicates relative differences in the energy of vibration.]

Some oak trees supported large *C. formosanus* colonies that could be detected at many points around the tree base. **Fig. 2B** shows the rate of sounds at 9 points around one heavily infested tree (Distance scale ~1:10). Size and color of dot indicate sound rate. The sound rate was greatest on the S/SW side of the tree. **Fig. 2C** shows the distribution of *C. formosanus* sounds at different distances along a radius from the tree base. Insets show 1-s traces of sounds at each recording site.

Fig. 2B



Sounds made by infestations of 100-1000 *R. flavipes* in wood traps were not as loud or as frequent as *C. formosanus,* but they were nevertheless easily detectable. **Fig. 2D** shows a 30-s trace of *R. flavipes* signals.

Over a 30-day period, the rate of sounds made by infestations of 100-1000 *R. flavipes* in wood traps was proportional to the number in the trap (slope= 0.16±0.01 sounds/s per termite; intercept = -0.019±0.022; resid ms error = 0.027). From the regression line and the mean rate of sounds in the control, the minimum number of termites that could be detected in the trap reliably was ~55 **(see arrow in Fig. 2E).**

Fig. 2A

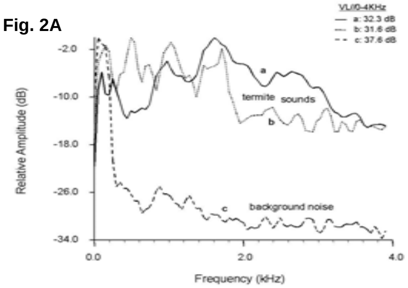


Fig. 2C

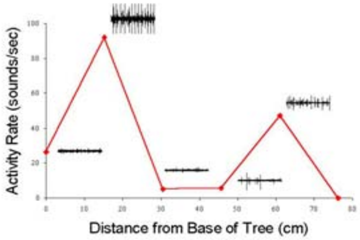


Fig. 2D

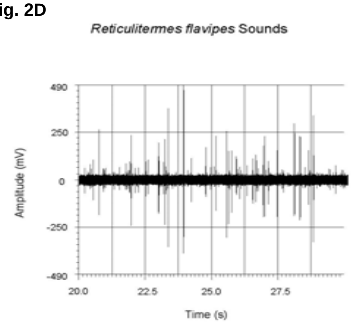
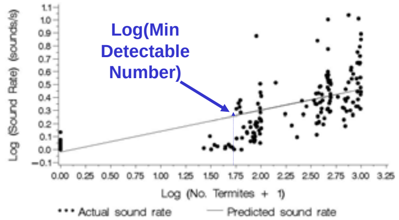


Fig. 2E



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