

Entomologists play matchmakers for cerambycid beetles

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Trap used to catch beetles. Image: Millar lab, UC Riverside

(PhysOrg.com) -- Cerambycid beetles, also known as long-horned beetles, can cause severe damage to standing trees, logs and lumber. How then might they be promptly detected and their numbers swiftly controlled? Two entomologists have devised a solution based on how male and female cerambycid beetles communicate with, and attract, each other.

First, UC Riverside entomologist Jocelyn Millar and University of Illinois entomologist Larry Hanks identified and then replicated in the

lab the very pheromones – chemicals insects emit to attract mates – that these beetles produce naturally. Next, they placed these attractant lures or "love potions" in traps as a sensitive and selective way of detecting the beetles and estimating their population size.

"Our method allows us to more efficiently find the beetles so that they can be controlled, especially when their populations are low or when the beetles are difficult to survey," said Millar, a professor of entomology. "For invasive species, it is much easier and cheaper to detect and try to eradicate invaders when they are still localized and their numbers are small, before they have a chance to disperse widely."

The researchers successfully identified pheromone blends for more than 30 species of the beetles, including several invasive pests. They also were able to identify reliable characteristics that researchers and regulatory officials can use to determine whether a new invader is likely to use attractive pheromones to bring males and females together. They found that adult beetles of 10 species do not use pheromones at all to attract the opposite sex. Instead, these beetles gather on host trees, drawn there by their attraction to volatile chemicals that the trees release.

Also called wood-boring beetles, cerambycid beetles deposit eggs in protected places on bark. The larvae typically feed on the inner bark, then bore into the sapwood or heartwood. Wood-boring beetles in the family Cerambycidae include many species that attack and kill fruit trees, ornamental trees and shrubs, timber, and wood in buildings.

"Before our project, little was known about the chemical ecology of cerambycid beetles or their use of attractant pheromones, and the pheromones of only a few species had been identified," Millar said. "Our longer-term goals are to gain a better understanding of which subfamilies, tribes, and genera are likely to use pheromones, and, within those groups, to determine the types of chemicals that are used as

pheromones. This will allow us to predict whether new invaders are likely to use pheromones that we can exploit, and, if so, what those pheromones may be.

"Conversely, if we can predict which species do not use attractant pheromones, there would be no point in looking for such compounds, and we could focus on finding the chemicals that attract these species to their host trees."

During the second year of the three-year project, Millar and Hanks identified two diagnostic characteristics, one behavioral and one based on external appearance, that allow entomologists to immediately assess whether a species is likely to have a male-produced attractant pheromone. Their study also found the first examples of powerful female-produced pheromones in the Cerambycidae family.

"These morphological features and specific behaviors are reliably associated with pheromone use by cerambycid beetles," Millar said. "Specifically, for a large group of species, we found males have a particular type of glandular structure to produce pheromones. These males adopted a very specific stance when they were releasing their pheromones, akin to doing pushups. Thus, from simply checking for the presence of the glands, or observing the behavior of a new invasive cerambycid species, or both, regulatory personnel can reliably predict whether a new species uses attractant pheromones that can be identified and exploited for its detection and management."

The study also showed that many cerambycid species produce large amounts of pheromone – hundreds of micrograms over a few hours per beetle. "This is critically important for lure design, because lures must release 5,000 to 25,000 micrograms of pheromone per day to be effective," Millar said. "This is in marked contrast to pheromone-baited traps for other insect species, where release rates from the trap lures are

typically a few micrograms per day. We are working to develop lures for field use that are capable of these high release rates for extended periods, such as weeks."

Cerambycid beetles, which affect a wide range of trees, can also transmit nematodes, fungi, and other pathogens that can kill the host trees. Cerambycids are also likely to transmit pitch canker and other fungal diseases as they feed and lay eggs.

The tunnels made by cerambycid larvae in host trees are roughly circular in cross section, and can be more than an inch wide. Some species bore in the sapwood and heartwood, whereas others feed in the cambium layers, effectively destroying the vascular tissues of the tree, and killing branches or the whole tree.

Provided by University of California - Riverside

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