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SCIENTIFIC NOTE

Experimental Evidence for Alarm Pheromones in the Neotropical Longhorn Beetle, *Schwarzerion holochlorum* Bates (Coleoptera: Cerambycidae)

Distress-induced release of chemical signals has been reported from a wide variety of insect taxa (Blum 1985). While chemical communication is known within the Coleoptera (*e.g.,* Ginzel and Hanks 2003; Ginzel *et al.* 2003), there are few reported cases of alarm substances (Crowson 1981). Cerambycid collectors often observe flight responses elicited by the collection of nearby individuals (F. Hovore, pers. comm.), and this note provides the first experimental evidence suggesting the use of alarm pheromones in the Cerambycidae.

Although considered borers of large trunks and branches of fallen trees, the biology of the Neotropical cerambycid *Schwarzerion holochlorum* (Bates 1872) remains largely unknown. During fieldwork over the past 10 years in Costa Rica, Panama and Ecuador we have frequently found aggregations of *Schwarzerion* on dead or dying tree trunks and nearby flowers. As is widespread in many cerambycids (Crowson 1981), we found that when handling live individuals, both male and female *Schwarzerion* produce stridulatory calls. Moreover, we noted that individuals of *S. holochlorum* also produced a strong, sweet, ammonia-like odor when handled (HFG & PJD pers. obs.).

We conducted observations and experiments on *S. holochlorum* along a road-cut through mature premontane wet forest at about 1,400 m elevation in southwestern Costa Rica at the Las Alturas Field Station near the Valle de Coton (08°56′N–82°51′W). During June 1991 we found a large aggregation of *S. holochlorum* approximately 5–6 m above the ground on the foliage and inflorescences of a small tree growing along a road cut. We noted repeatedly that within minutes of netting or handling an individual *S. holochlorum* at the periphery of the aggregation, many others in the aggregation became agitated and flew away rapidly. This suggested the possibility that the handled individual was producing an alarm signal. To experimentally test this notion we retained one live male and one live female inside sealed glass jars and returned the next day at approximately 0900 h to the tree where beetles were aggregated. We stood quietly below the tree for 10 minutes and noted the position and behavior of 10 beetles on the foliage and inflorescences. Without removing the lids of the jars, we gently agitated the captive individuals by shaking the jars, and then observed the behavior of the aggregation for 10 min. We found no noticeable behavioral change in members of the aggregation during these trials. We then removed the lid of the jar, manipulated the beetles manually, and monitored the behavior of the aggregation. Four minutes after removing the beetles from the jar, at least 14 individuals dramatically flew away in all directions. This experiment was repeated on three subsequent mornings when 5, 2, and 7 beetles were visible and we were able to induce rapid flight behavior in $>$20, 12, and $>$20 individuals respectively. When the lid of the jar was removed, the aggregation dispersed after an average of 4.6 minutes. Each dispersal flight lasted a few seconds before no visible beetles remained. In all four experimental trials, aggregated beetles never left the tree before we removed the lid of the jar lid.

Subsequently in eastern Ecuador, we found a small aggregation (6 individuals) of *Schwarzerion* nr. *euthalia* (Bates 1879) on a fallen log in lowland rainforest. When we collected one individual the remaining beetles dispersed in a manner similar to that described here for *S. holochlorum.* We found that this species also produced the same distinctive odor noted in Costa Rican *S. holochlorum.*

The odor emitted by individuals of *Schwarzerion* that had been handled, and the lag time of the aggregated dispersal flight strongly suggests the production of an air-born chemical signal diffusing from the captive individuals to the responding aggregations. While auditory cues cannot be ruled out as a stimulus for provoking the dispersal flight, we think they are unlikely. Stridulations were produced the moment an individual beetle was first handled, but the absence of a detectable behavioral response by the aggregation argued against these sounds motivating the dramatic dispersal flights. We also believe visual cues are unlikely since all manipulated individuals were potentially visible to the aggregations during the trials either through the glass jars (evoking no reaction), or when hand held (evoking a delayed reaction).

Our field observations suggest that individuals of *S. holochlorum* produce a volatile chemical that causes a rapid dispersal flight in aggregations of congeners, and represent the first experimental evidence for alarm pheromones in the Cerambycidae. A better understanding of the cues involved in the apparent alarm response and mechanisms for *S. holochlorum* aggregation behavior will likely come from investigation of their pheromone chemistry.

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