

# EXPLORE THE ISSUE BEING INVESTIGATED

## Pheromones Affect Sexual Selection in Cockroaches

Imagine you are a cockroach looking for a mate. How do you select a suitable mate from among many potential suitors? A suitor may not be nearby, and, besides, it is probably dark, too dark to see and judge the suitability of your suitor at a distance. Answer: you use chemicals called pheromones to guide your choice. Pheromones are chemicals released by an animal into its environment as a means of communicating with members of its own species. Pheromones are used for sending out an alarm, for tracking purposes such as locating a food source, and for attracting a mate. In all of these cases, the pheromone is released into the environment and animals of the same species use the pheromone for detecting directionality. They follow a concentration gradient of the chemical, which takes them to the source of the pheromone.

The powerful sex pheromone of moths is released into the air by a female to attract males, and all interested males “come to call.” The males usually have secondary sexual characteristics that they display to entice the female to “pick me.”

The male cockroach, by contrast, releases a male sex pheromone to entice the female. The female cockroach judges the quality of the pheromone as an indicator of the male’s underlying quality or condition. To a female cockroach, a higher quality pheromone means a genetically superior male.

However, this approach presents the male cockroach with a problem: In principle, the quality of the environment in which the male is raised might influence the quality of the pheromone he releases as much as his genes do! Additionally, a female raised in a lower quality environment might not detect the difference between high quality and low quality pheromone. Sexual selection, in other words, is likely to be influenced by both the male’s and the female’s condition. But which sex is more influential in sexual selection?

It is difficult to predict the outcome of an encounter when both mate choice and environmental quality affect the outcome. Often, conflicting possibilities seem equally likely. For example, one prediction for females in harsh conditions would be that females would be less choosy about selecting a mate because the probability of their own survival is low or the probability of finding a high quality male is low. A contradictory prediction would be that females would increase their choosiness in poorer environments because the variation in the quality of males is much greater, allowing for a more reliable choice.

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To address the question of the effect of environmental quality on mate choice, researchers from Middle Tennessee State University and the University of Kentucky examined the influence of high- and low-quality environmental conditions on male sex pheromones and on male courtship activity in the cockroach, *Nauphoeta cinerea*, by manipulating the quality of the environment during sexual maturation.

*N. cinerea* has well-developed and identifiable sexual behaviors, and the females discriminate among potential mates based on male pheromone as well as certain male courtship activities. The courtship interactions in *N. cinerea* involve eight behaviors following the release of male pheromone. The researchers examined all of the behaviors, learning that only a few of the behaviors seem to be influenced by the male.

To address the question of the effect of environmental quality on mate choice, the researcher examined two processes early in the courtship: 1. the influence of environmental quality on pheromone composition in the male; and 2. the timing of the first male-influenced behavior, called the “initial wing raise.”

Males and females were reared through sexual maturity in high-quality and low-quality environments. The pheromone composition was compared in males reared in high-quality environments and males reared in low-quality environments. The male pheromone consists of three chemicals blended together. The quantity and proportion of each component affects the quality of the pheromone. The “initial wing raise” behavior was also examined -- the speed with which the male responds could be a result of his conditioning, the higher quality male responding faster.