

Sexual Communication and Behavioral Regulation in Ultrasonic Moths

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Lepidopteran insects use ultrasounds for sexual communication. Male moths generate ultrasonic signals in a courtship context to induce a female's freezing response and to avoid rivalry males' approach and interference. Because male courtship ultrasound has the repulsive function, acoustic moths are most likely to have evolved ultrasonic communications by exploiting the negative reaction to ultrasonic cries of echolocating bats. The evasive maneuvers in night flying moths can be caused by artificial ultrasonic pulse as well, indicating that ultrasonic generator would contribute to be one of the useful tools for pest control technique.

Bats and Moths

Predation pressure from echolocating insectivorous bats has driven the evolution of ultrasound-sensitive hearing in nocturnal insects. In response to bat cries, flying tympanate insects take various evasive actions, including turning away, steering/zigzagging flight, and ceasing flight. Most moth species, including agricultural pests, possess tympanal ears that are sensitive to ultrasounds, allowing them to avoid insectivorous bats.

Ultrasonic Communication in Moths

We recorded ultrasounds of a wide variety of moth species during mating bouts and found much greater numbers of species to use ultrasonic courtship songs than those previously thought¹⁻³). Basically, a male moth after orientation toward a female releasing sex pheromones produced ultrasonic song shortly before copulation, i.e. genital coupling. In the majority of moth species emitting ultrasounds, male courtship ultrasounds were not essential to mating; however, a male could not easily copulate with a female when the sound-producing organs of males or the tympanic ears of females were ablated^{1,2}).

Application of Pest Control with Ultrasound

In terms of pest management, flight disruption caused by artificial ultrasounds may contribute to reduce damage to crops; the gravid females lose their orientation toward host plants for their larvae³). To realize the pest control with artificial ultrasound, we developed functional ultrasound-emitting devices that can repel moth pests. For the noctuid moth in the strawberry greenhouses, the ultrasonic devices successfully mitigated the number of egg mass laid on the host plants and greenhouse facilities.

References

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