Large moths need to hear better

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The moth's worst enemy is the bat. Credit: Colorbox

Bats orient themselves through echolocation, and they find their prey by emitting calls and then process the echoes reflected back to them from the prey. Small insects reflect small echo signals, and large insects reflect large signals - simply because they are bigger. This makes it easier for bats to discover the large insects.

Large moths have to do something extra to avoid the bats, and their trick is to hear better. Their eardrums are larger and therefore more sensitive than ears of small moths, and this enables them to hear their enemies from at a greater distance. This gives them extra time to get away.

According to professor WSR Annemarie Surlykke from Department of

Biology at the University of Southern Denmark the better hearing is only developed in moths who need it.

Moths adapt to the bats, they share their living environment with. If the living environment's bats emit echolocation calls at a low frequency, the moths do not need to be able to handle high frequencies. Conversely - if bats emit calls at a high frequency, moths need to be able to hear the high frequencies if they want a chance to survive.

The pattern is the same all over the world - even if there are many different moths and bats, says Annemarie Surlykke. Together with Hannah M. ter Hofstede from Dartmouth College in New Hampshire, USA, she has examined the situation in England, Denmark and Canada.

All bats emit echolocation calls in the ultrasonic range, i.e. above 20 kHz, but from here on there is a big difference. Some operate at 20 or 30 kHz, while others operate at 50 or 60 kHz. It depends on the species, and it also depends on where in the world the different species live. In England there are two species from the horseshoe bat family (Rhinolophus), that operate at as high as 80 kHz.

Particularly in the areas of England where the horseshoe bats live, local moths can hear at 80 kHz, while this was not the case in the other two areas studied, Canada and Denmark, where the horseshoe bats do not exist.

"This is a fine picture of how moths and bats, prey and predators, evolve in an ever close race to outsmart the other", says Annemarie Surlykke.

The advantage of being able to hear at 80 kHz is obvious to the moth: it can detect the enemy in good time. But there are also disadvantages, says Annemarie Surlykke.

"These moths can hear much more than they need to hear. They get so many unnecessary sound impressions, and when they do not have a complicated brain to process the incoming sounds, they react at all sounds - even a small branch that breaks far away can put them on alert. For a human, it would be very stressful and for a moth it is a waste of energy and time to react as if there is danger, "says Annemarie Surlykke.

More information: The simple ears of noctuoid moths are tuned to the calls of their sympatric bat community, *Experimental Biology*, in press.

Provided by University of Southern Denmark