Flight and echolocation behaviour of *Myotis nattereri* foraging close to vegetation

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Introduction

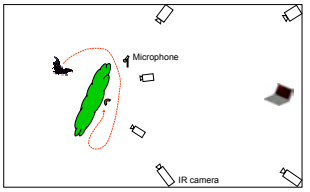
Myotis nattereri is specialised in foraging close to vegetation. Navigating and foraging at the edge of background structures requires special adaptations in flight and echolocation behaviour.

We want to investigate how the bats adopt their flight behaviour to a varying degree of difficulty and how the structure of the echolocation signals is influenced by easy and difficult prey detection tasks.

Methods

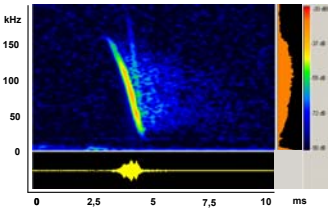
Data recording

- Five Natterer's bats were trained to catch mealworms tethered close to an artificial hedge in a flight room of ~13 m x 6 m x 2 m. Prey was offered at five different distances to the background structure (2, 5, 10, 20 and 40 cm).
- Flight behaviour was recorded with 6 synchronised IR-cameras (illumination by IR-LED strobes).
- Echolocation calls were recorded and synchronised with the videos by a custom made device (PCTape).



Data analysis

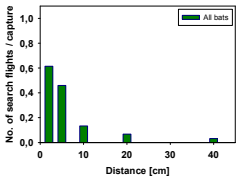
- Simi°Motion Software was used to reconstruct the flight paths of the bats in 3D.
- The number of unsuccessful search flights (flights in which the bat approached the hedge but did not try to catch the mealworm) was counted per distance. We assume that the bat did not detect the prey during these flights.
- We counted how often a bat turned around in front of the hedge before it caught the mealworm.
- Echolocation signals of one bat were analysed with a custom made programme (Selena, FFT 256). Start and terminal frequency were measured at 20 dB below the peak frequency. Pulse intervals and pulse durations were calculated.

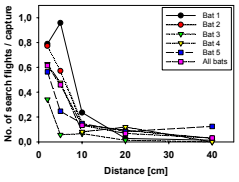


Results

Flight behaviour

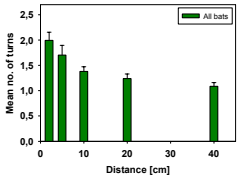
Number of unsuccessful search flights per capture

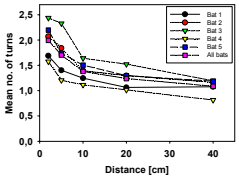




The distribution of the unsuccessful search flights over the five distances differed highly significantly from the distribution of the successful catches ($p<0.0001$). The number of unsuccessful search flights per capture increased with decreasing distance between prey and hedge, indicating a more difficult detection task.

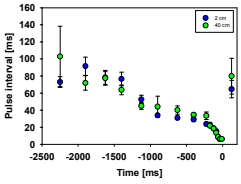
Mean number of turns before the capture

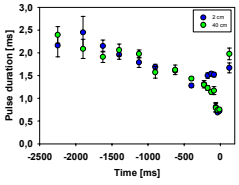


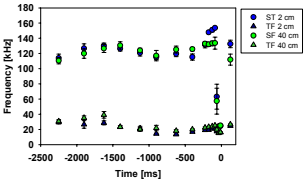


With a longer distance between prey and vegetation the bats made fewer turns in front of the hedge before they caught the mealworm.

Echolocation behaviour







0 ms = time of capture, SF = start frequency, TF = terminal frequency, $n_{2\,cm} = 6$ and $n_{40\,cm} = 5$ echolocation sequences of one bat

The pulse intervals did not depend on the distance between prey and background structure. 200 – 75 ms before the capture we recorded an increase in pulse duration and of the start frequency at 2 cm distance between prey and vegetation. This might be an adaptation to the difficult task of catching prey close to clutter since it did not occur at 40 cm distance.

However, because of a high directionality and a low amplitude of the echolocation calls we can not exclude that these differences are artefacts that were caused by the orientation of the bat's sonar beam relative to the microphone.

Conclusions

The distance between prey and background structures influenced the flight behaviour of *Myotis nattereri*.

At shorter distances

- **the number of unsuccessful search flights per capture increased**
- **the bats made more turns in front of the hedge before the capture**

Further studies including a microphone array will be necessary to investigate the influence of easy and difficult prey detection tasks on the echolocation signals of the bats.

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