Noldus
Information Technology

Video tracking of grasshopper nymphs

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Using EthoVision for Zoology Research

In the field, grasshopper nymphs may disperse from 'spatially hostile' homogeneous environments to heterogeneous habitats (longer grass) where there is adequate cover from predation or inclement weather [1]. However, it is difficult to assess the velocity of walking and jumping movements of nymphs in the field as accurate assessment of the distance moved and the dependence of behavior on the prevailing meteorological conditions are significant problems technically. A camera system monitored with EthoVision was used in controlled laboratory conditions to determine the movement velocity of nymphs of the grasshopper, *Chorthippus parallelus*, throughout their development in homogeneous and heterogeneous environments.

Experimental setup

The experiment was conducted under constant temperature (23°C) laboratory conditions. Lighting was situated directly above the experimental area to prevent shade. Spatial movements of all four instars were tracked in a circular 36 cm diameter arena, which had 40 cm high plastic walls to prevent nymphs from escaping. A high-resolution video camera was situated at approximately 80 cm above the arena on a steel gantry. The camera was connected to a computer with EthoVision 3.0 and all nymphal movements were recorded in real-time and visually displayed on the monitor (Figure 1). Two environments of 36 cm diameter were created from white (to contrast with brown nymphs) polystyrene tiles: homogeneous and heterogeneous. The homogeneous environment was devoid of any obstacles such as vegetation, whereas the heterogeneous arena had dense areas of grass representing tussocks.

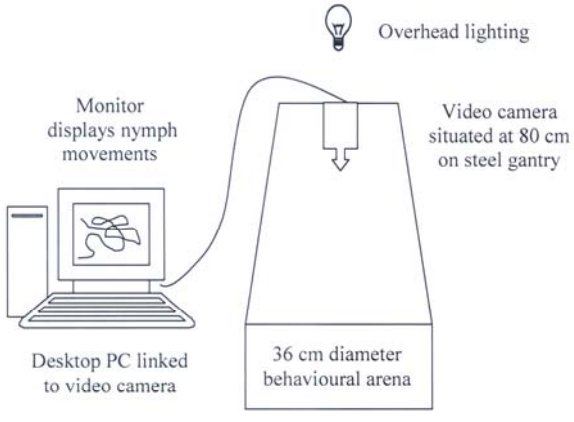

Figure 1. The experimental set-up

Data analysis

Nymphs of all instars were introduced into the arena and the movement velocity (cm/s) was calculated for each tracking session. The subtraction method of object detection and recording of one sample per second was used to avoid recording and identifying the movements of legs or antennae – a problem that was observed to reduce the

reliability of the data. The problem of tracking the jump of a nymph was overcome by using the last known position function, the point of take-off was then joined by a straight line with the landing position.

Editorial note

Instead of reducing the sample rate, there is another solution for the observed problem here. EthoVision offers an erosion and dilation filter to remove sticking-out bits such as tails, legs or antennae. EthoVision also offers the option to define a 'minimum distance moved' filter to eliminate apparent movements such as body motion or pivoting on the spot. Both of these options enable EthoVision to track animals reliably at a high sample rate.

Results and discussion

Movements of nymphs in the homogeneous environment generally seemed to be random for all instars, with a high occurrence of jumping (many straight lines; Figure 2). However, in the heterogeneous environment, jumping was less frequent (few straight lines; Figure 2) and consequently movement velocities, particularly of late instars (3-4), were significantly lower than in the homogeneous environment.

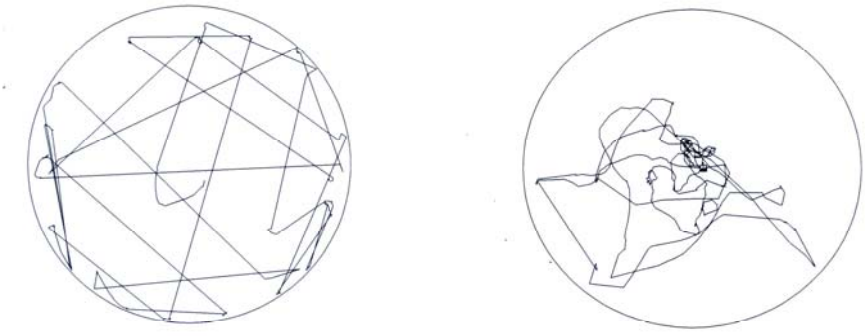

Figure 2. Movement of mature grasshopper nymphs (instar 3) in the homogeneous (left) and heterogeneous (right) environments

EthoVision provided a user-friendly system for monitoring nymphal movements accurately. The authors were initially concerned that extensive jumping movements would mean that nymphs were easily lost to the camera. This problem was overcome by connecting the last recorded position with a straight line to the new co-ordinates.

Although tracking of grasshoppers is challenging with regard to the natural characteristics of these insects, EthoVision is a useful tool for accurately determining movement velocity in grasshoppers.

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Reference

1. Gardiner, T.; Hill, J. (2004). Directional dispersal patterns of *Chorthippus parallelus* (Orthoptera: Acrididae) in patches of grazed pastures. *Journal of Orthoptera Research*, **13**, 135-141.