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Conference Abstract

Smart Insect Cameras

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Abstract

Recent studies have shown a worrying decline in the quantity and diversity of insects at a number of locations in Europe (Hallmann et al. 2017) and elsewhere (Lister and Garcia 2018). Although the downward trend that these studies show is clear, they are limited to certain insect groups and geographical locations. Most available studies (see overview in Sánchez-Bayo and Wyckhuys 2019) were performed in nature reserves, leaving rural and urban areas largely understudied. Most studies are based on the long-term collaborative efforts of entomologists and volunteers performing labor-intensive repeat measurements, inherently limiting the number of locations that can be monitored.

We propose a monitoring network for insects in the Netherlands, consisting of a large number of *smart* insect cameras spread across nature, rural, and urban areas. The aim of the network is to provide a labor-extensive continuous monitoring of different insect groups. In addition, we aimed to develop the cameras at a relatively cheap price point so that cameras can be installed at a large number of locations and encourage participation by citizen science enthusiasts. The cameras are made smart with image processing, consisting of image enhancement, insect detection and species identification being performed, using deep learning based algorithms. The cameras take pictures of a screen, measuring ca. 30×40 cm, every 10 seconds, capturing insects that have landed on the screen (Fig. 1). Several screen setups were evaluated. Vertical screens were used to attract flying insects. Different screen colors and lighting at night, to attract night flying insects such as moths, were used. In addition two horizontal screen orientations were used

(1) to emulate pan traps to attract several pollinator species (bees and hoverflies) and (2) to capture ground-based insects and arthropods such as beetles and spiders.

Figure 1.

Example of image from smart insect camera.

Time sequences of images were analyzed semi-automatically, in the following way. First, single insects are outlined and cropped using boxes at every captured image. Then the cropped single insects in every image were preliminarily identified, using a previously developed deep-learning-based automatic species identification software, Nature Identification API (https://identify.biodiversityanalysis.nl). In the next step, single insects were linked between consecutive images using a tracking algorithm that uses screen position and the preliminary identifications. This step yields for every individual insect a linked series of outlines and preliminary identifications. The preliminary identifications for individual insects can differ between multiple captured images and were therefore combined into one identification using a fusing algorithm. The result of the algorithm is a series of tracks of individual insects with species identifications, which can be subsequently translated into an estimate of the counts of insects per species or species complexes.

Here we show the first set of results acquired during the spring and summer of 2019. We will discuss practical experiences with setting up cameras in the field, including the effectiveness of the different set-ups. We will also show the effectiveness of using automatic species identification in the type of images that were acquired (see attached figure) and discuss to what extent individual species can be identified reliably. Finally, we will discuss the ecological information that can be extracted from the smart insect cameras.

Keywords

machine learning, camera traps, biodiversity, insects

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