Improving automated identification methods for biodiversity monitoring in agricultural landscapes

Re·Ge·NL naar rendabele regeneratieve landbouw

Regenerative agriculture uses soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating, and supporting services, with the objective to enhance environmental, social, and economic dimensions of sustainable food production. It is however unknown which agricultural practices and business models contribute to regenerative outcomes. One set of these regenerative outcomes focuses on aboveground biodiversity, such as pollinators and farmland birds, but also connectivity between semi-natural habitats in the landscape.



Monitoring the biodiversity outcomes of agricultural practices/systems requires large amounts of biodiversity data. Due to limitations of traditional fieldwork methods (time, money, need for expert knowledge), collecting such amount of data using traditional methods is not feasible. This has led to a recent boom in the development of automated monitoring tools. Within the ReGeNL project, several automated tools will be used to monitor aboveground biodiversity.

The AI models used for species recognition and identification are often still not suitable for species identification with high taxonomical resolution. Therefore, we offer opportunities for two student projects aiming to develop and/or improve and validate classification algorithms for:

1) Insects based on camera trap images
2) Birds based on acoustic data from recorders

1. Improving automated sound recognition for bird monitoring

A total of 15 audio recorders (Song Meter Micro 2, Wildlife Acoustics) will be in agricultural fields until the end of July. Each day, they record the first four hours after sunrise. This results in a large amount of recording hours, containing many fragments of bird song and calls.

There are already several algorithms developed specifically for recognising and identifying these bird sounds. However, while these work relatively well for isolated bird sounds, the recognition and identification of birds from noisy soundscapes proves to be difficult. Besides, it has recently been shown that fine-tuning with local data can significantly improve neural network performance. Within this project, the main aim is to improve an existing algorithm(s), for example by fine-tuning using local bird recordings. Besides, data from traditional fieldwork will be available to validate the results from the automated recording and identification.

Literature:

Lauha, P., Somervuo, P., Lehikoinen, P., Geres, L., Richter, T., Seibold, S., & Ovaskainen, O. (2022). Domain-specific neural networks improve automated bird sound recognition already with small amount of local data. *Methods in Ecology and Evolution*, *13*(12), 2799–2810. https://doi.org/10.1111/2041-210x.14003

Kahl, S., Wood, C. M., Eibl, M., & Klinck, H. (2021). BirdNET: A deep learning solution for avian diversity monitoring. *Ecological Informatics*, *61*, 101236. https://doi.org/10.1016/j.ecoinf.2021.101236

Timing: negotiable, all data gathered by Jul – Aug

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2. Developing/improving automated image classification for insect monitoring

A total of 15 DIY insect cameras (Insect Detect) will be in agricultural fields until late August. These cameras will take pictures whenever it detects motion during several 1-hour intervals each day, and are charged using a solar panel. This will result in a large amount of pictures with insects, other animals and moving objects.

The development of classification tools for insects is still in its infancy, and the taxonomical resolution is therefore still rather poor. The main aim of this project would therefore be to improve the taxonomical resolution achievable with classification algorithms, either by improving an existing one or by developing a new algorithm. Besides, data from traditional fieldwork will be available to validate and compare the results from the automated classification.

Literature:

Bjerge, K., Geissmann, Q., Alison, J., Mann, H. M., Høye, T. T., Dyrmann, M., & Karstoft, H. (2023). Hierarchical classification of insects with multitask learning and anomaly detection. *Ecological Informatics*, *77*, 102278. https://doi.org/10.1016/j.ecoinf.2023.102278

Sittinger, M., Uhler, J., Pink, M., & Herz, A. (2024). Insect detect: An open-source DIY camera trap for automated insect monitoring. *PLoS ONE*, *19*(4), e0295474. https://doi.org/10.1371/journal.pone.0295474

Svenning, A., Mougeot, G., Alison, J., Chevalier, D., Molina, N. L. C., Ong, S., Bjerge, K., Carrillo, J., Hoeye, T. T., & Geissmann, Q. (2025). A general method for detection and segmentation of terrestrial arthropods in images. *bioRxiv (Cold Spring Harbor Laboratory)*. https://doi.org/10.1101/2025.04.08.647223

Timing: negotiable, all data gathered by Sep – Oct

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