

MSc thesis topic announcement Photo-based habitat quality monitoring for wildlife

Supervisors: Laura Amaya, Marie Perennes

Working Group: Provision of biodiversity in agricultural systems;
Provision of ecosystem services in agricultural systems.

Kontakt: LauraMarcela.AmayaHernandez@zalf.de, marie.perennes@zalf.de

Background:

Agricultural landscapes are facing a significant decline in biodiversity and associated ecosystem services, largely due to intensive land use and habitat loss (Ruck et al; 2024). Farmland covers over one-third of global land area, and biodiversity loss in these areas undermines essential services such as pollination, and natural pest control (Ruck et al; 2024).

However, biodiversity decline is not only a loss of species but also reflects the deterioration of habitat quality, which determines the ability of farmland to sustain wildlife populations and deliver ecosystem services. Structural elements such as vegetation cover, floral resources, and landscape heterogeneity are critical indicators of habitat quality, yet these are rarely monitored systematically at large scales (Benton et al; 2003, Fahrig et al; 2011). Recent policies like biodiversity net gain (BNG) from England which rely on coarse habitat *area* and *condition* metrics, but these may poorly reflect actual biodiversity outcomes. For example, Duffus et al. (2024) found that a combined habitat area–condition score showed no significant relationship with invertebrate species richness or abundance in farmland, underscoring the need to integrate more informative habitat attributes and direct measurements.

Despite the clear importance of biodiversity and habitat quality, monitoring them in agroecosystems remains challenging due to the scale and cost involved. Conventional field surveys are labor-intensive and costly, often requiring expert taxonomists or ecologists (Mäder et al; 2021). This limits their frequency, coverage, and the timely data needed to inform conservation or farm management decisions.

Advances in digital imaging and AI offer new opportunities to monitor vegetation-based indicators of habitat quality at different scales. Vegetation characteristics—such as plant cover, vertical structure, and diversity—often correlate with faunal biodiversity and ecosystem function. Complex, structurally diverse vegetation tends to support more niches and species, as classic ecology has long recognized (MacArthur & MacArthur, 1961; Tews et al; 2004). Vegetation can even serve as a surrogate for other taxa's diversity; for instance, Gillison et al. (2003) demonstrated that vegetation structural traits and functional types were good indicators of soil macroinvertebrate diversity along environmental gradients. Consequently, monitoring vegetation attributes can provide a powerful, indirect approach to assess habitat quality and biodiversity status.

Building on this potential, citizen science offers a way to collect such vegetation data at scale. By engaging farmers and volunteers to take digital photographs of fields and habitats, and applying AI to analyze these images, biodiversity monitoring can become more cost-effective and widespread

(McClure et al; 2020). Citizen science has already proven invaluable in generating large ecological datasets, while AI now achieves expert-level accuracy in species identification from images (Mäder et al; 2020). Tools such as the Flora Incognita mobile app illustrate how thousands of non-experts can contribute reliable plant records through smartphone photography (Mäder et al; 2020). Extending these approaches from single-species identification toward evaluating habitat quality and ecosystem functions could therefore fast-track ecological monitoring and conservation actions (McClure et al; 2020).

In this context, the project's overall goal is to identify vegetation parameters that indicate habitat quality for wildlife and key ecosystem services in agroecosystems, focusing on those features that can be measured via ground-based digital photography at multiple spatial scales (from plot-level plant details to an scenic context).

Specific Objectives:

- Identification of vegetation parameters from photos that indicates habitat quality for taxonomic groups such as butterflies, beetles and hoverflies
- Evaluate vegetation indicators from photos as proxies for habitat quality: relate photo-derived parameters to ecological functions such as pollination potential, habitat suitability, and/or structural complexity.

Methods:

- Photo-based field monitoring: Standardized collection of ground-based photographs across multiple agricultural sites, covering plot, field, and landscape scales.
- Image Processing and Vegetation Parameter Extraction: Process raw images using open-source or licensed image analysis software (e.g. ImageJ, Vegmeasure, eCognition, or Python-based tools).

Requirements:

- Enrollment in a master's program in (eco-)agricultural sciences, ecology, biology, computer science, or another related field.
- Willingness to conduct fieldwork.
- Knowledge of R or Python is desirable.
- Good command of English
- A valid driver's license is required.
- Willingness to publish the Master's thesis as a scientific paper

Proposed schedule:

Task	Month				
	1	2	3	4	5
Data collection					
Data analysis and results					
Writing Phase					

Application:

Please send your application (in PDF format) by email with the subject line:

MasterThesis-PhotoMonitoring-Name-2025 to: **LauraMarcela.AmayaHernandez@zalf.de** and **marie.perennes@zalf.de**

When you apply, we collect and process your personal data in accordance with Articles 5 and 6 of the EU GDPR solely for the purpose of processing your application and for purposes that may arise from possible future employment at ZALF. Your data will be deleted after six months.