Tropentag, September 20-22, 2023, hybrid conference

"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

An insect-based biodiversity metric for agroecological systems in Africa

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Abstract

Land degradation, pesticides and monoculture within agro-ecological systems can adversely affect insect biodiversity and result in insect pollinator species declines. As over 50 % of crops in Africa, specifically, are pollinator dependent, losses in pollinator abundance can negatively affect crop yields and food security. Moreover, the post-2000 Global Biodiversity Conservation (GBC) Framework of the UN requires countries to report on targets that include species or ecosystem-specific biodiversity status information. The GBC and other political frameworks require that localised biodiversity patterns are considered and the establishment of biodiversity status baselines. In this work, an easy to implement and spatial explicit (localised) insect biodiversity baseline metrics is introduced. The metric relies on readily available earth observation (EO) data and insect species data, collated from citizen science platforms, such as the iNaturalist. Butterflies, moths, and rove beetle species data were used as these groupings represent indicator species for overall ecosystem intactness. Specifically, the EO data was used together with the insect species data to predict species richness. Secondly, high resolution (10-meter resolution) EO data is used to heuristically predict the degree of per pixel human impact, or landscape naturalness. The two variables (species richness and naturalness) were then augmented to produce (beta-) biodiversity status estimates over wider areas in Africa. We found that data density of the occurrence data is a key limitation to scaling the method to the whole of Africa, thus only 6 % of the total surface area in Africa could be modelled. Localised results for Kakamega in Kenya and the St. Lucia region in South Africa were highlighted and discussed. In both areas, natural forests, gallery forests and wetlands, within highly transformed agro-ecological landscapes, exhibited the highest biodiversity status. This underlines the roles of these ecosystems as maintainers of biodiversity and important habitats for pollinators that help to sustain crop yields. The developed metric is applicable now and amendable once more insect data becomes available (from citizen science). The model we used is straightforward (well understood) and accurate, thus easy to understand and utilise by policy makers.

Keywords: Africa, biodiversity indicator, citizen science, insects, remote sensing

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