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A spatially explicit framework for biodiversity intactness reporting in Africa

Tobias Landmann, Faith Ashiono, Vincent Magomere, Henri E. Z. Tonnang

International Centre of Insect Physiology and Ecology (icipe), Kenya

Abstract

Here we pioneer the use of multi-sensor earth observation (EO) data and insect *in situ* data collated from various "big data" data platforms (iNaturalists, GBIF, and GenBank.gov) to develop a framework that measures spatially explicit biodiversity intactness patterns over Africa. The used insect taxa are known to be sensitive to ecological changes due to unsustainable farming practices, urbanisation and/or logging. Insect diversity patterns have proven to be useful indicators of overall biodiversity intactness, at various spatial scales.

The UN Convention on Biodiversity Diversity (CBD) and its technical working group for the post-2020 framework has called for unbiased (i.e., accurate), measurable and scalable frameworks and indicators for biodiversity. These should ideally also consider drivers of biodiversity loss, be used to estimate planetary boundaries, and assess the ability of ecosystems to deliver ecosystem services (such as pollination services through insects). The UN Kunming-Montreal Global Biodiversity Framework, likewise, emphasis the need to connect biodiversity loss with ecosystem services and specifically focuses on the integrity of agro-ecological landscapes.

Within the framework, biodiversity intactness was estimated using the ratio between the actual (or currently observed) (o) and the historic or potential (p) estimated insect-based (bio)diversity. Spectral features from 10–20 m Sentinel-2 satellite data, 1-km WorldClim climate variables, 25-m tree heights from the Global Ecosystem Dynamics Investigation sensor, and 1-km human footprint data were used as predictors. The observed patterns (o) were error adjusted using the actual presence of insect taxa, from the big data collections. The pixel-based intactness predictions could be aggregated to individual countries, and conservation priority corridors. Across Africa, high biodiversity intactness could be measured in natural tropical forests, "sky island" mountain areas, islands in Lake Victoria, and arid countries (e.g. Namibia). The framework is adaptable to specific locally threatened species and shows stability over various climate zones, while it can be effectively and spatially aggregated.

Keywords: Africa, big data, biodiversity monitoring, UN convention on biodiversity diversity

Contact Address: Tobias Landmann, International Centre of Insect Physiology and Ecology (icipe), Icipe str. 1, 00100 Nairobi, Kenya, e-mail: tlandmann@icipe.org