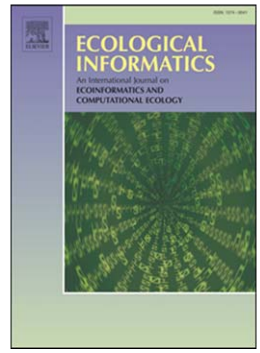

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Advancing species diversity estimate by remotely sensed proxies: a conceptual review

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Abstract

Many geospatial tools have been advocated in spatial ecology to estimate biodiversity and its changes over space and time. Such information is essential in designing effective strategies for biodiversity conservation and management. Remote sensing is one of the most powerful approaches to identify biodiversity hotspots and predict changes in species composition in reduced time and costs. This is because, with respect to field-based methods, it allows to derive complete spatial coverages of the Earth surface under study in a short period of time. Furthermore, remote sensing provides repeated coverages of field sites, thus making studies of temporal changes in biodiversity possible. In this paper we discuss, from a conceptual point of view, the potential of remote sensing in estimating biodiversity using various diversity indices, including alpha- and beta-diversity measurements.

keywords: biodiversity; distance decay models; remote sensing; spatial ecology

1. Introduction

Large-scale field sampling of biodiversity is challenging considering sampling efforts and costs (Palmer et al., 2002; Rocchini et al.,2006; Hernández-Stefanoni and Dupuy, 2007). However, there are available tools that allow ecologists and conservation biologists to obtain species information in a timely manner with a certain degree of confidence (He at al., 2011). As Skidmore et al. (2011) explicitly stated that "many [geospatial] applications are aimed at supporting conservation of biological diversity: biodiversity elements (species, communities) as well as ecosystem processes (providing goods and services)." (see also Edman et al., 2011; Rocchini and Neteler, 2012a). Among such geospatial tools, a robust and straightforward approach to predict biodiversity is based on the use of remotely sensed imagery which can identify unique reflectance or absorption features, parameters that can be related to the spatial distribution of species.

In some cases indicator species are used as a proxy of diversity over an area (see Judith et al., 2013). This is not only related to rare species but also to common species which may be considered as the most important structural part of species communities (see Gaston, 2008; Feilhauer et al., 2012).

Extending on Araujo and Rozenfeld (2014), given two species $sp1$ and $sp2$, the probability of co-occurrence (spatial overlap) is given by:

$$P(sp1 \cap sp2) = f(p_{sp1}, p_{sp2}, I_{sp1sp2}) \quad (1)$$

where p = probability of occurrence and I = interaction between species.

Hence, Eq.(1) could be reliably used to detect $sp1$ relying on its interaction with and the spatial distribution of $sp2$. This phenomenon is also known as cross-taxon surrogacy. These concepts can be reliably applied to remote sensing detection as an indirect method to estimate the distribution of hidden species based on