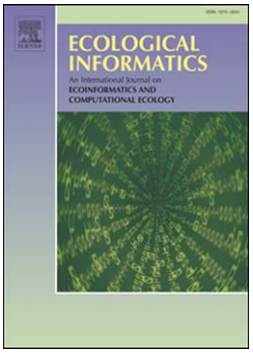

Identifying disturbed habitats: a new method from acoustic indices.

William Esteban Gómez, Claudia Isaza, Juan M. Daza

PII: S1574-9541(17)30135-8
DOI: doi:10.1016/j.ecoinf.2018.03.001
Reference: ECOINF 843

To appear in: *Ecological Informatics*

Received date: 17 May 2017
Revised date: 4 March 2018
Accepted date: 5 March 2018

Please cite this article as: Gómez, William Esteban, Isaza, Claudia, Daza, Juan M., Identifying disturbed habitats: a new method from acoustic indices., *Ecological Informatics* (2018), doi:10.1016/j.ecoinf.2018.03.001

Identifying disturbed habitats: a new method from acoustic indices.

William Esteban Gómez[a,*], Claudia Isaza[a], Juan M. Daza[b]

{*westeban.gomez, victoria.isaza, juanm.daza*}*@udea.edu.co*

[a]*SISTEMIC, Engineering Faculty, Universidad de Antioquia UdeA, Calle 70 No. 52-21, Medellín, Colombia*
[b]*Grupo Herpetológico de Antioquia (GHA), Biology Institute, Universidad de Antioquia UdeA, Calle 70 No. 52-21, Medellín, Colombia*

Abstract

Monitoring and preventing changes in ecosystems is one of the most difficult challenges for biologists. Currently, soundscape analysis (the analysis of acoustic sounds emitted by the ecosystems) have been accepted as a technique that allows assessment of the biodiversity in natural landscapes. To measure the quality of habitats using recordings, acoustic indices have been developed. These indices are divided into alpha indices (within-group indices) and beta indices (between-group indices). Alpha acoustic indices attempt to represent different attributes of a habitat (e.g., evenness, richness, and heterogeneity), unlike beta acoustic indices that focus on estimating dissimilarity between communities. However, there is not a single index that can abstract all the components from a complex biological system in order to characterize habitats. Furthermore, acoustic indices exhibit patterns along the day that hinder the direct analyzing of habitats. In this study, we go beyond the strategy of choosing a particular index, providing a methodology that includes an integration of several alpha acoustic indices. This integration is performed using classification methods (multilayer neural network and one-class support vector machine) that allow characterizing and identifying predefined habitat prototypes (mature forest, secondary growth, and pasture). An accuracy of 0,89 ± 0,01 was obtained using this methodology to classify these three habitats with different degree of disturbance. An additional experiment were performed to validate the methodology and prove that works a more finite resolution (identification of three forests). The results of the methodology represent the contribution of this study: the integration of the acoustic indices to identify types of habitats and a new monitoring complementary tool, which alerts if new samples taken in these habitats start to be distant to the prototype habitat behaviors.

Keywords: Acoustic indices, Neural networks, (ν-SVM), Colombia's reservoir.

1. Introduction

Biodiversity assessment in disturbed ecosystems is one of the most fundamental tasks to design and implement conservation plans in tropical countries. In these regions, many species are declining or even disappearing as product of human activities (Purvis et al., 2000; Myers et al., 2000). Traditionally, biodiversity is estimated mostly from species inventories but complete species lists require a significant amount of time and money (Hill, 2005). Species inventories also face others difficulties: detectability of cryptic species, low population abundance and inaccessibility to sampling sites. In the last decade, researchers have proposed new alternative and non- invasive techniques that can extract information from ecosystems (Sueur et al., 2008; Fuller et al., 2015; Sueur et al., 2014). One emerging technique is bioacoustics: the discipline that combines biology and acoustic activity analysis. Bioacoustics assumes that the acoustic activity is an attribute of the elements involved in the ecosystem. Acoustic activity can be a surrogate of the three dimensions of biodiversity: composition, structure and function (Noss, 1990). It can detect and quantify species presence, reproductive activity, territorial behaviour, species interactions, etc. In addition, with the advent of new sensor technology (e.g., portable recorders of Frontier Labs[1] and Wildlife Acoustics[2]) and bioacoustics analysis,

*Corresponding author. Tel: +57 3187691520
Email address: westeban.gomez@udea.edu.co (William Esteban Gómez)
[1]Frontier Labs, Brisbane, Australia.
[2]Wildlife Acoustics Inc, Maynard, MA, USA.