Unité Mixte de Recherche TETIS
Land, environment, remote sensing and spatial information
PhD Project Proposal 2017-2020
TR SYNERGIE

Title: Biotic homogenization and patterns of change across gradients of anthropogenic pressures: The use of BIG DATA in answer to conservation needs

Disciplines: Spatial information, Ecology, Landscape Ecology, Data mining Remote Sensing

Key words: global biodiversity, patterns of change, biodiversity gradients, landscape homogenization, heterogeneity, global change, anthropogenic drivers

Funds :
• ½ grant obtained from Irstea, France

Starting: September - December 2017.
Ending: September - December 2020.
Duration of the project: 3 years

PhD supervision: Sandra LUQUE (IRSTEA, TETIS France)

Co-supervision Maria Dornelas (CBD, University of St Andrews UK)

Dino Lenco (UMR TETIS-IRSTEA, France)

Doctoral school: GAIA, Université Montpellier II

Abstract

Ongoing species invasions and extinctions are changing biological diversity in different ways at different spatial scales. Yet the extent to which biodiversity change in local assemblages contributes to global biodiversity loss is still poorly understood. Worldwide, functional homogenization is considered to be one of the most conspicuous forms of biotic impoverishment induced by current global changes. Hitherto this process has hardly been quantified on a large scale and the relation between landscape disturbance and functional homogenization has hardly been established.

We propose then to focus in homogenization patterns across the globe to better understand functional similarity of regional biotas and changes over time. In particular we will use distribution of study locations at a global level, using BIOTIME[i] [i]in tandem with other data. We will include only terrestrial for the proposed

work. To add value to BIOTIME this research will use remote sensing data at different spatio-temporal resolutions to look at changes in structure and composition of the landscape across gradients of anthropic pressures. In particular, this thesis work will quantify change in biodiversity through time by analysing temporal trends in β diversity. Efforts will focus to disentangle heterogeneous rates of environmental change in relation to species range shifts associated to anthropogenic pressures leading to homogenization patterns. Particular interest will be based on the understanding of the influence of homogenization to explain different patterns of temporal β diversity to detect species loss vs. changes in community composition. The proposed work will also analyse implications for conservation strategies consulting stakeholders at different stages of the project.

Context

Research is needed to focus in homogenization patterns for different systems to better understand functional similarity of regional biotas and changes over time.

The **goal** here is to identify the fundamental changes that are occurring in ecosystems as a result of biotic and environmental homogenization and address the conservation implications of these changes particularly as they relate to the human dimensions within a spatial context. By doing so **we will enable directed research and an emerging synthesis that will define not only the manner in which this process threatens global biotas but also support the assessment towards CBD 2020 Aichi Biodiversity Targets**. In particular **outputs from this research can support evidential information for the indicators addressing Aichi Targets 5 and 12 that are typically constrained in their adequate geographic representation, the level of disaggregation they allow, their temporal resolution, and their scientific underpinning** (UNEP/CBD 2015). This thesis work proposes then to use distribution of study locations at a global level based on BioTime[1] database, extracting terrestrial data only. The work will be supported by the use remote sensing data at different spatio-temporal resolutions and scales to evaluate changes in structure and composition of the landscape to analyze anthropic pressures driving changes in patterns of β diversity

Within this framework, ***this thesis work will focus on the following key question:***

How spatial patterns of community similarity have change through time using existing global databases?

The work that will be undertaken will explore the consequences of homogenization in space and time for ecosystem function, in relation to anthropogenic pressures

WORK PLAN

Will focus efforts around five different related key issues that will structure the thesis chapters and related outputs and publications:

i) Develop a conceptual framework for assessing the potential ecological consequences of biotic and environmental homogenization
ii) Use existing data to explore patterns and trends of change in community similarity across different gradients of anthropogenic pressures at the global level
iii) Quantify how temporal and spatial patterns of change are occurring to gain understanding of the context and scale in which the homogenization process operates

iv) Analyse patterns and landscape configuration and morphology considering protected areas alongside anthropogenic gradients, as a proxy to measure the effectiveness of the protected area network globally to impede homogenization

v) Use findings to provide recommendations towards conservation targets and strategies needed for an integrated sustainable management

This thesis work will have the innovative approach of testing and using a mixture of remote sensing and biodiversity related databases which will require support from a strong broad committee of ecologists, biologist, modellers and remote sensing experts that will provide close collaboration and support to the candidate in order to encourage and guide his/her training on the newest capabilities and coupling modelling approaches. This innovative approach and the harmonized data base of species at a global level could be used for other applications worldwide after the life of this Thesis. It is also important to know that other thesis are taking place around the world working with BIOTIME but none of them using remote sensing to explain spatial patterns and related human pressures. Yet the candidate will have the opportunity to share his/her findings with a community of young researchers working on related key questions around biodiversity and conservation issues in Australia, Brazil, United States and United Kingdom.

Host lab

In order to implement the **work plan** in the best conditions this thesis will be supported by IRSTEA, France and the University of St Andrews, Scotland. The doctoral candidate will be mainly based in France working in Montpellier at the UMR TETIS (https://www.teledetection.fr/). One of the core strengths of TETIS is undoubtedly its integrated approach in terms of the methods and tools that could be developed to cover the whole chain of spatial information, from acquisition to processing, management and use by stakeholders. Within this vein, this work will **couple big data** from the most comprehensive worldwide spatio-temporal data base that exists in biodiversity along **with remote sensing data at different spatio-temporal scales**. The partnership with the University of St Andrews will ensure the support needed to work with BioTime and the top level expertise on biodiversity conservation and macroecology. ***S. Luque*** as main supervisor will be supporting all phases of the work plan and coordinating synergy with members of the Thesis committee that will provide specific support in key methodological tasks. ***Maria Dornelas***, as co-supervisor, will provide close support with BioTime and related β-diversity indicators through time. ***Dino Ienco*** will provide expertise on Spatio-Temporal Data Mining, Pattern Mining, Machine Learning and Remote Sensing Analytics. He will also support key methodological and data analysis steps (mainly on the use of Data Science approaches on time series data).

Efforts will also be oriented within the framework of this thesis work, to logically fit into the initiatives of the European coordination structure Life Watch, which should become the European section of the international project GEOBON. In all, the ongoing efforts from the community around BioTime are aligned with other similar international efforts such as IPBES and Future Earth among others. Finally, close exchanges will be held and collaborations built with the GOFC-GOLD LC Office and the GFOI R&D members during the life of the thesis via participation at conferences and exchanges of the 'Ecosystem functions' working group.

Candidate profile

We are looking for a candidate with ability to work in interdisciplinary environments having excellent English proficiency skills.

- Master in eco-informatics or equivalent with strong background on Spatial Information Systems remote sensing
- Solid interest for ecology, macro-ecology, landscape ecology.
- Experience/training: Data Mining, Machine Learning, geomatics and statistics
- High proficiency in at least one programming language among Python and R,
- Excellent communication and writing skills. Production of scientific publications expected.

In order to apply the candidate will need to send a complete CV and motivation letter to

https://pasi.irstea.fr/fr/campagne/7/sujet

Select topic N° 3168 - Homogénéisation biotique et patrons de changement dans des gradients de pressions anthropogéniques

N° 3168 - Biotic homogenization and patterns of change across gradients of anthropogenic pressures: The use of BIG DATA in answer to conservation needs

Enter the information requested on the web site

Deadline 15 MAY

Related key Références :

Battistella, L. et al. (2015) Protection levels for the terrestrial and marine ecoregions of the world as of August 2014. http://dopa.jrc.ec.europa.eu/content/map-protection-levels-terrestrial-and-marine-ecoregions-world

Cardinale, B.J. et al. (2012) Biodiversity loss and its impact on humanity. Nature 486, 59–67

Dornelas M, Gotelli NJ, McGill B, Shimadzu H, Moyes F, Sievers C, et al. (2014) Assemblage Time Series Reveal Biodiversity Change but Not Systematic Loss. Science, 344(6181):296-9.

Magurran, A. E., M. Dornelas, F. Moyes, N. J. Gotelli, and B. McGill. 2015. Rapid biotic homogenization of marine fish assemblages. Nature Communications 6.

[i] BioTIME database contains c. 12 million records, comprising 295 studies, nearly 42,000 species and 124 unique years from locations across the globe http://synergy.st-andrews.ac.uk/BioTime/BioTime-database/