International Conference on Ecological Sciences

October 22-25 2018, Rennes (France) – Couvent des Jacobins

SYMPOSIA – Sfecologie 2018, International conference on Ecological Sciences

Title of symposium
Monitoring Biodiversity: the Essential Biodiversity Variables Framework

Main organizer of the symposium
Point of contact:
DELAVAUD Aurélie, French Foundation for research on biodiversity (FRB)
aurelie.delavaud@fondationbiodiversite.fr

Moderator:
COUVET Denis, National museum of natural history (MNHN)
denis.couvet@mnhn.fr

Co-organizers of the symposium
ARCHAMBEAU Anne-Sophie, IRD/CNRS-MNHN-AFB
anne-sophie.archambeau@mnhn.fr
BAROT Sébastien, IRD
sebastien.barot@ird.fr
CALLOIS Jean-Marc, Irstea
jean-marc.callois@irstea.fr
CALLOU Cécile, CNRS
cecile.callou@mnhn.fr
CHATELIER Jean-Yves, Ineris
jean-yves.chatelier@ineris.fr
COUVET Denis, MNHN
denis.couvet@mnhn.fr
GOSSELIN Frédéric, Irstea
frederic.gosselin@irstea.fr
JOLY Dominique, CNRS
dominique.joly@cnrs-dir.fr
PICHOT Christian
INRA, christian.pichot@inra.fr
SILVAIN Jean-François, FRB
jean-francois.silvain@fondationbiodiversite.fr
SOUBELET Hélène, FRB
helene.soubelet@fondationbiodiversite.fr
TIXIER-BOICHARD Michèle, INRA
michele.tixier-boichard@inra.fr

TOUROULT Julien, CNRS-MNHN-AFB
julien.touroult@mnhn.fr
VIGNE Jean-Denis, MNHN
jean-denis.vigne@mnhn.fr

Session description

Biodiversity monitoring is a priority and is necessary to understand and predict biodiversity dynamics in interaction with the trajectories of human societies and global changes. In interaction with experimental and modeling approaches, the research and methodological challenges for monitoring biodiversity lie in the complexity of the interactions between the biological and ecological organization levels (from genes to ecosystems), abiotic factors and various pressures. Such issues underline the need to build an integrative scientific framework to monitor biodiversity. This framework should allow monitoring all aspects of biodiversity (from genes to ecosystems) and allow combining diverse types of biodiversity data gathered at different scales by different scientific disciplines. The gathered data should also support decision making and evidence-based environmental policies.

A national research infrastructure (RI), entitled "National Biodiversity Data Hub" (PNDB) has been set up in 2018 to better integrate and share data - by connecting existing systems - and to advance knowledge to improve our understanding of biodiversity state and dynamics in the context of Earth observation.

To help researchers and decision-makers to access and use data despite their heterogeneity, dispersion and provenance, the infrastructure will use the Essential Biodiversity Variables (EBVs) framework. The Essential Biodiversity Variables were developed to improve the detection of significant changes in biodiversity. This framework allows organizing complex biodiversity data from diverse ecosystems, species and sources into a limited set of biological variables. This provides a first level of abstraction between low-level primary observations (integrating remote sensing with in-situ observations) and high-level indicators of biodiversity. A list of 22 variables classified into 6 classes has been proposed: genetic composition, species population, species traits, community composition, ecosystem function and ecosystem structure.

This symposium presents the research infrastructure, the state of national thinking on EBVs' classes and its articulations with others Earth observation domains.

Speakers

Talk 1. (15') COUVET Denis, National museum of natural history (MNHN)

“Monitoring biodiversity: the Essential Biodiversity Variables framework”

We will introduce the research initiative scientific framework, based on biodiversity data complementarities and the Essential Biodiversity Variables (EBVs) concept.

Taking note of the three levels of biological organization, genetic, species and ecosystemic, the EBV concept proposes six different classes of EBV, framed at different levels of biological organization: gene, population, species, community and, at the ecosystem level, distinguishing between function and structure of ecosystems. As such, EBV provides a conceptual link between different scientific communities, using different monitoring methods, exploring biodiversity from different but complementary viewpoints.

A major objective of such harmonization is to provide a first step to high-level indicators of biodiversity, formalizing a unified data framework. Indicators should go beyond species diversity indices, recent subjects of controversy, as they provide ambiguous information. Indicators should provide sound information on the state and dynamic of biodiversity, at different spatial and temporal scales. They should relate to biodiversity models, providing inputs as well as outputs comparisons. Moreover, indicators ought to point to different aspects of biodiversity, depending on the way stakeholders relate with biodiversity.

Relevance, feasibility, and cost effectiveness should be major criteria to choose these variables. In this perspective, 22 variables, associated to different indicators, are proposed for monitoring. Relationships with climatic essential variables and hopefully essential social and cultural variables will be another objective to be pursued when EBV are framed.

Talk. 2 (15') ALLEAUME Samuel, LUQUE Sandra, FERET Jean-Baptiste, LANG Marc, DURRIEU Sylvie, GOSSELIN Frédéric, National research institute of science and technology for environment and agriculture (Irstea), TETIS, Montpellier, France

"Complementarity of in-situ and remote sensing data to operationalize key biodiversity characteristics"

Operational monitoring systems providing information about changes in ecosystems at local, regional and global scales are urgently needed to contribute to the efficient implementation of public and international policies dedicated to conservation planning within the framework of Essential Biodiversity Variables (EBVs). Large-scale biodiversity monitoring foreseen in the EBV framework would be strongly limited if based solely on ground observations. Remotely-sensed earth observation (EO) has a crucial and unavoidable potential to access quickly, repeatedly, synoptically at Remote-sensing-enabled EBVs (RS-enabled EBVs).

Yet, the increasing availability of open access satellite images provides enhanced possibilities with frequent revisit times, high/very high spatial resolution and multispectral information to open up to the operationalization of RS-enabled EBVs, but also opens up new challenges in terms of processing and software needs for biodiversity and conservation activities.

Four main classes of variables are currently identified within this category of RS-enabled EBVs: *i)* species populations (species occurrence), *ii)* plant traits (such as leaf area index, leaf mass per area, leaf pigment content and leaf water content), *iii)* ecosystem structure (distribution, fragmentation and heterogeneity, land cover, height), and *iv)* ecosystem function (vegetation phenology, primary productivity and leaf area index).

Nevertheless, monitoring biodiversity using RS cannot and will not be achieved without quality *in-situ* calibration and field data validation. The support of innovative descriptions involving tools such as drones (optical or lidar sensors), terrestrial lidar or spectroradiometers are also needed. One major key challenge for an improved contribution of RS to conservation is to strengthen multiple collaborative frameworks among remote sensing scientists, conservation biologists and ecologists in order to increase the efficiency of methodological exchange and draw benefits for successful conservation planning strategies.

Questions & conversation (15')

Talk 3. (15') BAROT Sébastien, French Research institute for development (IRD)

“Abiotic characteristics have to be taken into account in ecosystem EBV”
This talk presents the results of a workshop held in France and organized by the French ECOSOPE program and the Foundation for Research on Biodiversity.
Our first conclusion is that defining EBV for ecosystems requires first determining what we want to do with the collected datasets and the related scientific issues. In our opinion 5 broad goals can be distinguished: (1) Ecosystem functioning must be studied, which requires monitoring various ecosystem variables to analyze how they covary and how they are linked to biodiversity (cf. EBV describing populations and communities). This requires monitoring the abiotic environment and properties emerging from the interactions between this environment and organisms. (2) It is of crucial importance to monitor and predict the impact of global changes (and particularly climate changes) on ecosystem functioning and the feedbacks of ecosystems to these global changes. (3) It is now fully recognized that human societies tightly depend on the functioning of ecosystems through the provision of the so-called ecosystem services (e.g. production of food). It is thus important to monitor these services. (4) Human societies impact ecosystems through most of their activities either impacting organisms or their abiotic environment. This means that it is important to monitor human activities at relevant scales to link ecosystem functioning, biodiversity and these activities. (5) Finally, it is important to predict from the present state and functioning of ecosystems whether they are stable and will go on functioning similarly or whether they will endure drastic shifts.

From these general objectives it is possible to deduce the kind of variables we need to use as EBV for ecosystems. In particular, abiotic variables are crucial in this context. These variables are partially tackled outside GEO BON. Indeed, climatic variables are monitored within GCOS. Nevertheless, it seems important to measure such variables at temporal and spatial scales suitable to monitor ecosystems and populations. Moreover, many variables are abiotic but are tightly linked to the functioning of ecosystems and the organisms they host: they result from complex interactions between abiotic and biotic/ecological processes. We think they should be monitored within GEO BON. This is for example the case of many variables describing soils such as their pH, their structure, their content in organic matter, or organic nitrogen. This is also the case of variables describing water quality in marine or freshwater ecology (e.g. concentration in CO_2, dissolved organic matter, particulate organic matter). For the same type of reason, it seems to us important to document human pressures each time we monitor the functioning of an ecosystem. Taken together, we thus advocate for a very inclusive vision of EBVs addressing the ecosystem scale.

Talk 4 (15') TIXIER-BOICHARD Michèle, **SIMON Jean-Christophe**, National institute for agricultural research (INRA)

"EBVs: a synthetic approach to monitor biological diversity a genetic level"

The Essential Biodiversity Variables framework includes a category of variables on genetic composition. The objective is to describe the state of diversity at the within-species level, in order to assess both the structuration of diversity and to provide indicators of genetic diversity, for the whole species and at the different levels of organization within the species. Co-ancestry estimates, allelic diversity, population differentiation coefficients, and census data have been proposed but other parameters can be proposed, and concertation is needed to assess the meaning and usefulness of different parameters.

This category of variables is generally well documented for domestic species used in agriculture, where a large range of data already exists: genealogies, molecular markers and phenotypic data. Not all data are of public access and they are generally scattered across countries, except for demographical data which are reported by national coordinators to the FAO information system and are used to determine conservation status of populations on the basis of effective size.

The genomic revolution with the possibility to sequence whole genomes at an affordable cost is a major driving factor for the analysis of genetic composition. This new opportunity allowed by increased sequencing and computational capacities has greatly improved the accuracy and depth of knowledge on genetic diversity associated with domestic populations, but also enables to address the same questions on biodiversity in wild populations. New statistical and bioinformatics methods have been developed that offer unprecedented opportunities to extract knowledge from genomic dataset and analyze trends in biodiversity in terms of adaptation/selection signature across a wide range of environmental conditions in both domestic and wild populations.

Thus, updating and documenting EBVs on genetic composition becomes a leverage to share concepts and actions between scientific communities working on domestic and wild populations.

Questions & conversation (15')

Talk 5 (15') LE BRAS Yvan, National museum of natural history (MNHN)

“A "Pôle national de données de Biodiveristé" (PNDB) to advance knowledge to improve our understanding of biodiversity state and dynamics”

This national biodiversity data hub creation project has emerged in 2012 within the research infrastructure ECOSCOPE and, since the beginning of 2018, has extended its relationships with others communities (remote-sensing, non-academic naturalists…). It is now entitled “Pôle national de données de Biodiversité” (PNDB) and settled in the *Muséum national d’Histoire naturelle* (MNHN), with support of many institutions, namely the CNRS and the French Agency for Biodiversity (AFB).

The set of initiatives that will be gathered by the PNDB is documenting several variables and levels of biodiversity organization (from genes to ecosystems), and this for terrestrial, marine and freshwater habitats. It will also present the originality of providing access to the past distribution of species during the last 10,000 years, and to geological heritage data. These initiatives cover from networked observatories (eg. TEMPO for phenology…) to national information systems (eg. SINP-INPN-GBIF-France…) to organized research infrastructures (eg. AnaEE-France, LTER-France called RZA…). In addition, PNDB establishes collaboration with the “spatial-oriented” national research infrastructure (the Earth System RI) which is developing a portal to access to satellite imagery (thanks to a national grouped purchase) and expertise for users (DINAMIS).

Through the PNDB e-infrastructure, we will propose a data hub allowing diverse types of users (from scientists to policy makers) accessing heterogeneous data and diverse and powerful data analysis tools to advance knowledge consolidation to improve understanding of biodiversity state and dynamics.

Questions & conversation (15')