Essential biodiversity variables’ framework: contribution of earth observation technologies for monitoring protected areas

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Presentation Outline

• Global Perspectives
• Impacts of Global Environmental Change
• Introducing EBVs
• RS EBVs
• Objectives
• Analysis Framework
• Examples of these EBVs
• Summary and key questions to note
Introduction

Globally, there is an unprecedented decline in biodiversity. These are some of the causes:
- Changes in land and sea use
- Direct exploitation of organisms
- Climate change
- Pollution
- Invasive species

[link to report]

Causes of wildlife decline globally

Based on analysis of 3,430 populations:

- Exploitation: hunting & fishing (42%)
- Habitat degradation (17%)
- Habitat loss (13%)
- Climate change (7%)
- Invasive species (5%)
- Pollution (2%)
- Disease (1%)

[IPBES Global Assessments, WWF Living Planet Report 2018]
SANParks manage about **four** million ha of land, with about **19** National Parks.

Of all the parks, smaller parks require intensive management, which entails understanding about:

- **Vegetation condition** and **animal numbers**
- **Land degradation**
  - Erosion, invasive species, fire, bush encroachment, overgrazing
- **Climate Change** - high frequency of drought, erratic rainfalls, and severe storms

There is a need for earth observation technologies.
Projections of changing annual average temperature (degrees C) over southern Africa for the period 2070-2099 relative to 1961-1990

Source: CSIR-CHPC

- ...increase in drought frequencies
Projections of changing annual rainfall over southern Africa for the period 2070-2099 relative to 1961-1990

Source: CSIR-CHPC

- Erratic precipitation
Essential Biodiversity Variables (EBVs)

Criteria of EBVs
- capture critical scales and dimensions of biodiversity
- biological
- a state variable (in general)
- sensitive to change
- ecosystem agnostic (to the degree possible)
- technically feasible, economically viable and sustainable in time

Rationale
- Local and regional policies, PA env. monitoring needs
- Aichi Biodiversity Targets by CBD, SDGs
- Limited harmonized observation system for delivering regular, timely data on biodiversity change

Source: GEOBON
Satellite Remote Sensing (SRS) - EBVs

Agree on biodiversity metrics to track from space

Ecologists and space agencies must forge a global monitoring strategy, say Andrew K. Skidmore, Nathalie Pettorelli and colleagues.

Global biodiversity loss is intensifying. But it is hard to assess progress towards the Aichi Biodiversity Tar-

Source: GEOBON

Satellite remote sensing is crucial getting long-term global coverage. It can rapidly reveal where to reverse the loss
Framing the concept of satellite remote sensing essential biodiversity variables: challenges and future directions

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Objective of the talk

To explore the concept of remote sensing EBVs as a framework for monitoring protected areas

Implementation objectives

- To determine, collate, develop and package EBVs to inform decision making at multiple scales
- To develop long-term and near real time monitoring of specific EBVs in the protected areas
- To determine landscape changes based on long term EBV observations
Pathways to satellite remote sensing (SRS) EBV generation

Field Data

Ancillary data

Raw SRS Data

Big Data

Accuracy Assessment

Each row is a type of ecosystem in a particular ecosystem taxonomy, e.g., one of seven biomes.

Ecosystem Extent EBV Data
Product (0/1)

EBV Data Products
Each cell contains a value in the indicated units

Ecosystem Extent Attributes
This EBV has two attributes, which are determined for each Ecosystem Class. These can be generated from the presence/absence data alone.

Ecosystem Fragmentation EBV
This EBV has three attributes. While Connectedness can be generated from presence/absence data alone, the other two also need information characterizing edge effects (e.g., degradation).

Raw data

Preprocessed SRS data

Big Data

Accuracy Assessment
Tree composition mapping – multi-phenology approach

- Lowveld tree species map for optimal period: April – WorldView-2 images
- 80% of the overall accuracy


Contents lists available at ScienceDirect
International Journal of Applied Earth Observation and Geoinformation
journal homepage: www.elsevier.com/locate/jag

Multi-phenology WorldView-2 imagery improves remote sensing of savannah tree species

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Tree Species Mapping

Fig 1. Sclerocarya birrea

Fig 2. Spirostachys africanus

Fig 3. Acacia nigrescens

Fig. Combretum (dominated by apiculatum)

Source: CSIR
Towards development of tree species diversity monitoring

Tree species diversity from the best (a) woody canopy cover (WCC) model, (b) factorial model involving NDVIMarch and WCC (c) factorial model involving NDVIApril and WCC (d) factorial model involving NDVIMay and WCC and (e) factorial model involving NDVIJuly and WCC

Madonsela et al. under review

Source: CSIR-NRE


Remote Sensing in Ecology and Conservation

Satellite remote sensing to monitor species diversity: potential and pitfalls

Duccio Rocchini, Doreen S. Boyd, Jean-Baptiste Féret, Giles M. Foody, Kate S. He, Angela Lausch, Harini Nagendra, Martin Wegmann, Nathalie Pettorelli

First published: 10 December 2015 | https://doi.org/10.1002/rse2.9 | Cited by: 26
Mapping trends in tree cover: bush encroachment

Trend analysis of tree-cover change 2001–2018 using Kendall correlation analysis. A = Kendall Tau coefficient, B = p-values and C = threshold of p < 0.05 highlighting the areas of significant increasing or decreasing tree-cover percentage.


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ALOS PALSAR (LiDAR cal/val) woody cover maps 2015 – South Africa

Source: CSIR-NRE
Absolute Anomaly based on NDVI
(Current - Long term average NDVI)
Empirical modelling of leaf N using simulated Sentinel-2 from Spectrometer data

Explaining Leaf Nitrogen Distribution in a Semi-Arid Environment Predicted on Sentinel-2 Imagery Using a Field Spectroscopy Derived Model

Abel Ramoelo 1,2,4 and Moses Azong Cho 1,3

May 2016

May 2016
Leaf N – WorldView-2 (Red Edge Band)
Mean Annual Biomass Maps (g/m²) from 2001 to 2015

EBVs provide potential for monitoring, but there are few questions.

• What are key environmental issues beyond each PAs?
• Uniqueness and representativeness of the PAs according to the EBVs?
• Who is working towards developing such variables, local, regional and international? Synergies?
• How can institutions be mobilized to contribute those EBVs for the management of the protected areas?
• How can we co-develop or co-produce these with various stakeholders?
• How can these data be collated, stored and further analysed for trends, etc? GEE? ARD?
• Monitoring, assessment and early warning tools
• At what scale, temporal, spectral and spatial?
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