Leveraging foundational biodiversity information for observing global change

Jasper Slingsby, Lara Atkinson and the SAEON Team

BIM & FBIP FORUM

Cape St Francis, 13 August 2018
South African agency performing long-term (social-)ecological research (LTER & LTSER) and maintaining environmental research infrastructures

www.saeon.ac.za
1) Observation science and research infrastructure
Perform long-term studies at scales that are relevant to policy and management. Establish, operate and maintain highly-instrumented LTER research infrastructures.

2) Information Management and Decision Support
Collect, store and share long-term data. Develop and maintain online decision support systems.

3) Science Engagement and Human Capacity Development
Support secondary, tertiary and public science engagement
Seven Nodes

- Egagasini (Offshore-marine)
  Cape Town
- Elwandle (Coastal & Estuarine)
  Port Elizabeth
- Fynbos
  Cape Town
- Grassland, Forest & Wetlands
  Pietermaritzburg
- Ndlovu (Savanna)
  Phalaborwa
- Arid Lands
  Kimberly
- uLwazi (Data)
  Cape Town

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Species composition and diversity → Biotic functional traits

Slingsby et al. 2014
(adapted from Chapin et al. 1997 Science)
1. What determines the composition and diversity of communities and ecosystems?

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(adapted from Chapin et al. 1997 Science)
1. What determines the composition and diversity of communities and ecosystems?

2. How do composition and diversity affect ecosystem processes and societal benefits?

3. How do global change factors alter composition, diversity and ecosystem function?

Slingsby et al. 2014  
(adapted from Chapin et al. 1997 Science)
Ndlovu (Savanna)

local

1-yr  3-yr  No burn

e.g. Kruger NP  Burn Plots

continental

fire-herbivory-climate-land use-CO$_2$
effects and feedbacks
Ndlovu (Savanna)

Annual
3-yr
No burn

Solid line – Full exclusion
Dashed line – Open herbivory

local

Kruger NP Burn Plots
Annual herbaceous plant surveys (2006-2018)

Drought has caused a shift towards more palatable grasses!!!
Ndlovu (Savanna)

An underappreciated global change driver!!!

Reconstructed historical continental herbivory regimes using statistical models based on census data from protected areas.

An underappreciated global change driver!!!
Arid Lands

Tierberg
Grootfontein
Carnarvon

Plant biodiversity baseline

Invertebrate surveys of ephemeral wetlands in the Northern Cape

SKO's: Square Kilometre Observatories

herbivory-climate-land use-CO$_2$-fire effects and feedbacks
Arid Lands

Climate and large herbivore affects on vegetation

Long-term vegetation dynamics (40 yr) in the Succulent Karoo, South Africa: effects of rainfall and grazing

Margaretha W. van Rooyen, Annelise Le Roux, Conrad Geldenhuys, Noel van Rooyen, Nadine L. Broodryk & Helga van der Merwe

Scoping risks/impacts and management of severe episodic events

Locust times – monitoring populations and outbreak controls in relation to Karoo natural capital

Joh R. Henschel

Standardized monitoring protocols for an important climate change indicator species

Proposed long-term monitoring protocol and applications for Aloidendron dichotomum populations

H. Van der Merwe a, b, d, C. Geldenhuys c, e

herbivory-climate-land use-CO₂-fire effects and feedbacks
Grasslands

Brotherton trials

Thomlinson plots

Carbon, Water & Energy
Regular high or low fire return intervals (FRI) maintain unique plant communities, but variable FRI (similar to historic lightning-driven regimes) maintains highest diversity.

Potential for a native C₃ grass (that is expected to shift in distribution with changing climate and elevated CO₂) to alter fire regimes in our montane grasslands.
Grasslands

Resetting the baseline land cover for assessing land use change impacts on hydrology - WRC Research Project K5/2437

- Cluster SANBI VegMap (2012) vegetation types (~440) into hydrologically relevant units (128)

- Parameterize units using models based on available data:
  - Crop coefficients
  - Vegetation interception
  - Root depth and distribution
  - Surface cover

DWS use this baseline to determine water use licensing (WULA)
Hydrology/Freshwater Ecosystems

Catchment experiments, Wetlands, Rivers and Groundwater

Jonkershoek (Fynbos)

Letaba and Olifants (Ndlovu)

Baviaanskloof (Fynbos)

Cathedral Peak (Grasslands)

N Cape Pans (ALN)

Orange River Riparian Project (ALN)
Fynbos

- 298 spp in 1966
- 283 spp in 1996
- 261 spp in 2010

Day 1
- Day 40
- Day 70

Map showing vegetation plots, meteorology, and hydrology.
Evidence of species loss and compositional shifts due to climate change in Fynbos

1) Loss of species diversity
2) Shift in functional composition
3) Shift towards hot-adapted communities
Fynbos

Detecting biodiversity impacts using satellite remote sensing

Day 1  Day 40  Day 70

Recovery too fast - aliens!
Recovery too slow - drought!

Detect anomalies relative to expected post-fire recovery
Fynbos
Linking foundational biodiversity information with ecosystem function

- Traits data for 1370 spp from 850 Fynbos plots from the National Vegetation Database
- Used 398 with good data coverage (traits, NDVI, fire history)

What will the impact of changing functional composition be?
uLwazi (Data)

• Internal SAEON IT and data services needs

• National portals

• International initiatives/consortia
2018

Open Data Platform
- Shared Metadata
- Data Hosting
- Services
- Components/A
- PIs
- Brokers and Harvesters
- Linked Open Data

SAEOSS
SAEON Portals
DEA Portals

GEOSS DAB, ICSU WDS, ...
Global Infrastructures
Global Change

Community or Thematic Portals
- SASSCAL
- SANEIM
- NSPDR
- OCIMS
- SEACRIFOG

Physical Infrastructure
- Citizen Science
- Semantic Annotation

Data Providers
External Systems

Global Registries
- re3Data
- ORCID, DataCite, ...

Products
- SAEON Portals
- DEA Portals
- BioEnergy Atlas
- SARVA 3.0 / SDG

Global Change Other Disciplines

SAEON
DEA

Other Disciplines
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<th>Infrastructure</th>
<th>Research Data Management</th>
<th>Research Output Services and Tools</th>
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<td>Interoperability Standards and Specifications</td>
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<td>Systems Management and Configuration</td>
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<td>User Feedback, Config, and Annotation</td>
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<td>Metadata and Data Exchange Services, APIs, User Interfaces, Harvesters, Agents</td>
<td>Online Systems Operational Databases</td>
<td>Governance, Trust, and Stewardship</td>
<td>Infrastructures: SAEON NRF SASDI SARVA BioEnergy SAEOGSS MIMS SADC (OCIMS)</td>
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South African Risk and Vulnerability Atlas

Welcome to the South African Risk and Vulnerability Atlas (SARVA)

The Online Spatial Database 2.0 for SARVA directly supports and allows users free access to and visualisation of drivers, pressures, vulnerability, exposure and risks or hazards within a particular location, covering both spatial and non-spatial data sets. The facility is open, data is with few exceptions available under Creative Commons licenses, and contributions from grant-funded researchers and government departments in South Africa are welcomed. SAEON has a support team in place to assist you with data deposit and publication, and with access to data sets and decision support tools.

The portal offers comprehensive resources which include live web mapping, static maps, reports, case studies and integrated analysis which assist in an increased understanding of global change impacts, by building the evidence base for decision makers and the other stakeholders as well as the use and interpretation of scientific data for local level planning. The portal allows easy access through advanced search functionalities to data on other platforms from different research institutes, such as SASDI, the Bioenergy Atlas, SAEON, and SAEOSS.

While the portal is open to all stakeholders, it aims to equip decision-makers at national, provincial and local government as well as the NGOs and the private sector with information on impact and risk associated with global change. The data is essential in planning for current and projected global and climate change impacts and assists decision makers in implementing adaption strategies. The data adheres to internationally recognised data quality and cataloguing standards.

http://sarva2.dirisa.org/
uLwazi (Data)

http://bea.dirisa.org/
Elwande Node – estuarine and coastal

Pelagic Ecosystem Long-term Ecological Research Programme (PELTERP)

Collaborative Programme:
- Bay-scale pelagic ecosystem study
- SAEON/NMU/SAIAB
- Monthly sampling protocol
- CTD, nutrients, phytoplankton, zooplankton
- May 2010 – ongoing
- n = 85 months
- Diversity mapping: Phytoplankton (CoP Algoa Bay Project)
- Foundational diversity: Copepoda (FBIP Small Grants project)
Elwandle Node – Other coastal biodiversity projects

- Biogeography of marine **littoral diatoms** along the coast of South Africa
- **Phytoplankton** of the Southern Ocean & Agulhas Current
- **Subtidal reef** mapping, ascidian and benthic invertebrate taxonomy
- **Stereo-BRUV fish surveys** of shallow habitats in Algoa Bay and Tsitsikamma MPA
Egagasini Node – marine offshore

Long-term offshore invertebrate monitoring

Implemented in 2011, annual surveys on west and south coast over ± 68 000 nm$^2$

In collaboration with DAFF demersal surveys
Collect – Sort – Identify – Weigh – Count – Record - Photograph
410 offshore invertebrate species from 12 phyla

> 17 000 occurrence records (abundance & biomass)

4 species ‘rediscovered’ in South Africa (not seen for > 50 years)

15 new species distribution records

21 species brand new to science busy being described

Value and Uptake

• Define, characterise & map offshore ecosystems (NBA)
• Identify and map potential VME and species
• Support rational and boundaries of proposed MPAs
• Long-term cumulative impact assessment
• Detection and monitoring of alien species
• Enable quantification of future species or ecosystem changes

Informs management, policy and decision making
FBIP SeaKeys

Sept 2013 – Dec 2018

+ 13 Co-investigators, 16 Collaborators

Taxonomy and digitisation

Molecular research

Citizen science

Decision support tools

Applied Research & Monitoring

Science based management & policy

Blue Economy

Principal Investigator: Dr Kerry Sink, SANBI

Marine Programme

SANBI
Biodiversity for Life
South African National Biodiversity Institute

Unlocking Foundational Marine Biodiversity Knowledge

Department: Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF
National Research Foundation

SAEON
South African Environmental Observation Network
## Project Overview

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<th>Deliverables</th>
<th>Target</th>
<th>Progress</th>
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<tr>
<td>New distribution data</td>
<td>193 000</td>
<td>150 815 records *</td>
</tr>
<tr>
<td>Including Citizen science</td>
<td>10 000</td>
<td>31 683 records</td>
</tr>
<tr>
<td>Species listed in national inventories</td>
<td>6 608</td>
<td>7 471 species</td>
</tr>
<tr>
<td>Barcodes</td>
<td>250</td>
<td>284 species</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>131 BINS (193 expected)</td>
</tr>
<tr>
<td>Species pages</td>
<td>250</td>
<td>336 species</td>
</tr>
<tr>
<td>Redlist assessments</td>
<td>140</td>
<td>189 species</td>
</tr>
<tr>
<td>Students</td>
<td>9</td>
<td>26 postgrad students</td>
</tr>
<tr>
<td>Training courses &amp; workshops</td>
<td>12</td>
<td>22 events</td>
</tr>
<tr>
<td>Peer reviewed publications</td>
<td>13</td>
<td>42 (+2 in press &amp; more in prep)</td>
</tr>
<tr>
<td>Popular articles</td>
<td>10</td>
<td>46 articles</td>
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SeaKeys Monitoring Report

http://bgis.sanbi.org/Projects/Detail/182

Total instances of monitoring: 678
Monitoring location point: 639
Monitoring tracks/lines: 29
Monitoring areas: 10