Centre for Statistics in Ecology, Environment and Conservation Report 2018

University of Cape Town
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SEEC - Statistics in Ecology, Environment and Conservation

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1. Summary

1.1 Highlights of 2018

This year was an eventful year for SEEC with, among many things, contributions to SANBI’s BioGaps project, the hosting of David Warton who ran a course on multivariate data analysis, the successful organisation of the inaugural African Bioacoustics Community conference, and a number of high impact publications coming out.

Fracking in the Karoo now seems less likely to happen but the threat highlighted how little we knew about the distribution of species that make up biodiversity in the large arid tracts of South Africa. SEEC collaborated with the South African National Biodiversity Institute on the BioGaps project, which aimed at quantifying biodiversity patterns across parts of the Karoo. SEEC was involved with developing the sampling design and – as data started to come in – with the analysis of distribution data. Postdoc Dominic Henry developed hierarchical occupancy models diverse taxonomic groups, including butterflies, scorpions, reptiles, birds and more. Coming up with sampling protocols that were both feasible in the field and allowed us to account for the ever-present detection process was a challenge. We tested protocols that used time to first detection of a species and learned a lot about different types of occupancy models. We also had to be creative about how to combine data collected under different protocols and became fans of data fusion techniques.

The inaugural African Bioacoustics Community conference was organised and run by our very own Tess Gridley. The conference was a massive success, attracting 130 participants from across the globe and hosting eminent speakers such as Doug Gillespie, the creator of the well-known PAMGuard software.

The Cape peninsula is home to Rose’s mountain toad (*Capensibufo rosei*), which occurs nowhere else in the world. But who knew that this species also has an unusual and surprising life history? A few years ago, then Honours student Francois Becker analysed survival of these toads, using capture-mark-recapture data. He found a very strong relationship between rainfall and demography:
survival strongly declined with increasing rainfall, whereas in years with lots of rain, the toads stayed at the breeding puddles longer and apparently spent more resources reproducing than in dry years. These results suggest an unusual degree of life-history plasticity that is tightly linked to weather. Last year, these findings were finally published in the prestigious journal, American Naturalist [3].

1.2 Projects and research interests of the group

1.2.1 Seasonality in the Cape

In March 2018 we heard that we had been successful in securing almost R9 M NRF funding for a three-year Alliance for Collaboration on Climate & Earth Systems Science (ACCESS) grant. This grant is supporting projects under seven themes at five different institutions (UCT, SAEON, Stellenbosch University, University of Venda and the CSIR) under the overarching theme of "Seasonality in the Cape".

Climate change is likely to have much larger impacts in the Greater Cape Floristic Region (GCFR) relative to the rest of the world. Climate models predict that temperatures will continue to increase and that annual precipitation is likely to decrease over much of the GCFR. However, what is less appreciated is that climate seasonality is also being affected, i.e. relative changes in temperature and precipitation may be greater in a particular season relative to other seasons. For example, maximum temperatures in autumn have been increasing at a relatively greater rate than in other seasons across much of the GCFR. There is also some evidence to suggest that the winter rainy season is starting later in the year. The effects of such changes in climate seasonality on biodiversity
and ecosystem processes have been hardly investigated at all in this region. Our multi-institution, multi-project NRF ACCESS “Seasonality in the Cape” program is making a start to address this knowledge gap.

1.2.2 **SeaSearch**

Tess Gridley, who is part of our core team, is a founding director of Sea Search. Sea Search conducts high quality, internationally recognised research in the southern African marine realm, with a large focus on whales and dolphins. Tess has a particular interest in bioacoustics and published a number of papers in this field [26, 17]. The research Sea Search does feeds into education and policy recommendations.

1.2.3 **Marine benthic ecology**

Natasha Karenyi, one of our core team members and a lecturer in Biological Sciences, leads a marine benthic ecology group in that department. She focuses particularly on unconsolidated sediment habitats and is also interested in marine biodiversity research, and utilising new or uncommon statistical methods to analyse marine biodiversity data to answer ecological and conservation questions [19]. She also sits on SANBI’s Marine Ecosystem Classification Committee who is tasked with updating the marine ecosystem classification and map for the National Biodiversity Assessment.

1.2.4 **BioGaps**

The Karoo is, for the most part, poorly surveyed for biodiversity, hampering efforts to prioritise habitats for conservation. This is all the more concerning given that many new developments in shale gas extraction, farming, mining, renewable energy infrastructure and the Square Kilometre Array are planned for the Karoo.
Chapter 1. Summary

The SANBI BioGaps project was developed to address this shortcoming in biodiversity data and SEEC has been involved from the start in developing this project. Res helped design the sampling strategy and a number of our members have been involved in using occupancy modelling to develop maps of species distributions to assist with prioritising areas for conservation.

1.2.5 Occupancy modelling

SEEC has a lot of expertise in this statistical method which uses species occurrences and predictors of their occurrence and detectability to model a species’ probability of occurrence and detectability. As mentioned earlier, occupancy modelling conducted by SEEC members was pivotal in the BioGaps project. Allan Clark is an expert in Bayesian methods for occupancy modelling. This year SEEC published a number of papers using occupancy modelling [25, 10].

1.2.6 Population demography

Res has been involved in modelling population demographics for many years now and continues to use these skills to support a number of ecological questions and conservation measures [34, 33, 27, 3].
1.3 The team

1.3.1 Core team

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution &amp; Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Res Altwegg</td>
<td>UCT, Statistical Sciences (director)</td>
</tr>
<tr>
<td>David Borchers</td>
<td>University of St Andrews, SEEC Honorary Research Associate (HRA)</td>
</tr>
<tr>
<td>Allan Clark</td>
<td>UCT, Statistical Sciences</td>
</tr>
<tr>
<td>Jonathan Colville</td>
<td>South African National Biodiversity Institute, SEEC HRA</td>
</tr>
<tr>
<td>Greg Distiller</td>
<td>UCT, Statistical Sciences</td>
</tr>
<tr>
<td>Ian Durbach</td>
<td>UCT, Statistical Sciences / African Institute for Mathematical Sciences / University of St Andrews</td>
</tr>
<tr>
<td>Birgit Erni</td>
<td>UCT, Statistical Sciences</td>
</tr>
<tr>
<td>Tess Gridley</td>
<td>UCT, Statistical Sciences</td>
</tr>
<tr>
<td>Dominic Henry</td>
<td>Endangered Wildlife Trust, SEEC HRA</td>
</tr>
<tr>
<td>Natasha Karenyi</td>
<td>UCT, Biological Sciences</td>
</tr>
<tr>
<td>Sue Kuyper</td>
<td>UCT, Administrator</td>
</tr>
<tr>
<td>Michelle Louw</td>
<td>UCT, Biological Sciences, Technician</td>
</tr>
<tr>
<td>David Maphisa</td>
<td>South African National Biodiversity Institute, SEEC HRA</td>
</tr>
<tr>
<td>Annalie Melin</td>
<td>South African National Biodiversity Institute, SEEC HRA</td>
</tr>
<tr>
<td>Mzabalazo Ngwenya</td>
<td>UCT, Statistical Sciences</td>
</tr>
<tr>
<td>Kirsten Packer</td>
<td>UCT, Statistical Sciences, NRF Intern</td>
</tr>
<tr>
<td>Theoni Photopoulou</td>
<td>University of St Andrews, SEEC</td>
</tr>
<tr>
<td>Sulaiman Salau</td>
<td>UCT, Statistical Science</td>
</tr>
<tr>
<td>Jasper Slingsby</td>
<td>South African Environmental Observation Network, SEEC HRA</td>
</tr>
<tr>
<td>Vernon Visser</td>
<td>UCT, Statistical Sciences <em>and</em> ACDI</td>
</tr>
<tr>
<td>Henning Winker</td>
<td>Department of Agriculture, Fisheries and Forestry, SEEC HRA</td>
</tr>
</tbody>
</table>
1.3.2 Postgraduate students

**Ph.D.**
- Gordon Botha \(\text{Statistical Sciences}\)
- Francisco Cervantes Peralta \(\text{Statistical Sciences}\)
- Greg Duckworth \(\text{Statistical Sciences, graduated Dec 2018}\)
- Emmanuel Kabunga \(\text{Statistical Sciences}\)
- Emma Lockerbie \(\text{Biological Sciences, graduated 2018}\)
- Alecia Nickless \(\text{Statistical Sciences, graduated Dec 2018}\)
- Ariella Rink \(\text{Statistical Sciences}\)
- Matthew Rogan \(\text{Biological Sciences}\)
- Kim Stevens \(\text{Biological Sciences}\)
- Jessleena Suri \(\text{Statistical Sciences}\)
- Zoe Woodgate \(\text{Biological Sciences}\)

**M.Sc.**
- Luther Adams \(\text{Biological Sciences}\)
- Gciniwe Dlamini \(\text{Statistical Sciences, graduated Dec 2018}\)
- Peter Ivey \(\text{Statistical Sciences}\)
- Maphale Matlala \(\text{Statistical Sciences}\)
- Thina Ncube \(\text{Biological Sciences}\)
- Leila Nefdt \(\text{Biological Sciences}\)
- Jenicca Poongavanan \(\text{Statistical Sciences}\)

**Hons**
- Reetumetse Tlhakung \(\text{Statistical Sciences, graduated Dec 2018}\)
- Vhonani Tsanwani \(\text{Statistical Sciences, graduated Dec 2018}\)
- Jolando Njati \(\text{Statistical Sciences, graduated Dec 2018}\)
- Tessa Lloyd \(\text{Statistical Sciences, graduated Dec 2018}\)
- Saiheal Narayan \(\text{Statistical Sciences, graduated Dec 2018}\)
- Deepika Autar \(\text{Statistical Sciences, graduated Dec 2018}\)
- Romelon Chetty \(\text{Statistical Sciences, graduated Dec 2018}\)
- Matthew de Vries \(\text{Statistical Sciences, graduated Dec 2018}\)
- Andile Gigaba \(\text{Statistical Sciences, graduated Dec 2018}\)
- Sasha Paules \(\text{Statistical Sciences, graduated Dec 2018}\)
- Morne Valentine \(\text{Statistical Sciences, graduated Dec 2017}\)
- Alungile Gcaza \(\text{Statistical Sciences, graduated Feb 2018}\)
1.3 The team

1.3.3 Advisory Board

Susan Bourne    UCT, Dean of the Science Faculty
Francesca Little UCT, HOD Department of Statistical Sciences
Muthama Muasya UCT, HOD Department of Biological Sciences
Bob Scholes    University of the Witwatersrand
John Donaldson South African National Biodiversity Institute

1.3.4 Affiliates and partners

Affiliates
Raquel Garcia    Stellenbosch University
Fitsum Abadi Gebreselassie New Mexico State University
Astrid Jarre      UCT, Biological Sciences
Silvia Mecenero  South African National Biodiversity Institute
Etienne Pienaar  UCT, Statistical Sciences
Chevonne Reynolds University of the Witwatersrand
Peter Ryan       UCT, Biological Sciences

Partner academics
Iain MacDonald    UCT, Actuarial Science
Guy Midgley      Stellenbosch University
Les Underhill    UCT, Biological Sciences
2. Research

2.1 Research and capacity building

2.1.1 Metrics of performance

SEEC members produced 40 publications in 2018, which means an average of 2.28 publications per SEEC core member. Mean publication impact factor was 2.98.

<table>
<thead>
<tr>
<th>Year</th>
<th># publications</th>
<th># per core member</th>
<th>Mean impact factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>40</td>
<td>2.28</td>
<td>2.98</td>
</tr>
<tr>
<td>2017</td>
<td>46</td>
<td>3.28</td>
<td>3.81</td>
</tr>
<tr>
<td>2016</td>
<td>49</td>
<td>2.43</td>
<td>3.21</td>
</tr>
<tr>
<td>2015</td>
<td>41</td>
<td>2.16</td>
<td>3.46</td>
</tr>
</tbody>
</table>
2.1.2 Students graduated

- Greg Duckworth graduated with a PhD. In his thesis – entitled "Effects of Protected Areas and Climate Change on the Occupancy Dynamics of Common Bird Species in South Africa". Greg used occupancy models and data from the Southern African Bird Atlas Project to examine which bird species benefitted from protected areas. He found that insectivorous species tended to occur in protected areas at higher densities than outside, whereas granivorous species fared relatively better outside protected areas. Greg received his PhD certificate after a long graduation ceremony – it was dark outside when we left UCT’s Sarah Baartman hall – on 14 December.

- Alecia Nickless and Emma Lockerbie also graduated with a PhD in 2018. Alecia did her PhD in the Stats department and her thesis was entitled "Regional CO₂ flux estimates for
South Africa through inverse modelling”. Emma Lockerbie did her PhD under the supervision of Lynne Shannon and Astird Jarre in the MARE group and her thesis was entitled "A decision tree framework for assessing status of exploited marine ecosystems under changing environmental conditions".

- Gciniwe Dlamini received her MSc for her project entitled "Machine learning methods for individual acoustic recognition in a species of field cricket".

### 2.2 Co-publication

As a measure of current collaboration within the core team, we plotted 2018 publications that were co-authored between SEEC core members. In the figure below, the lines between team member’s names represent joint publications.

![Joint publications 2018](image)

### 2.3 Student supervision

SEEC trained 11 PhD, 7 Masters and 12 Honours students during 2018. Of these, 3 PhD students, 1 Masters student and all the Honours students graduated during the year.

As another measure of collaboration within SEEC, we plotted co-supervision of postgraduate students (MSc and PhD). Thin lines connecting team member’s names indicate joint supervision of
2.3 Student supervision

one student; thick lines represent co-supervision of two students.

Joint postgrad mentorship 2018
3. Partner organisations

We have a strong network of partners at three levels: within UCT (depicted below with a connecting semicircle), nationally, and internationally.
3.1 Within UCT

A number of SEEC members, Res Altwegg, Birgit Erni, David Maphisa, Mzabalazo Ngwenya, Jasper Slingsby and Vernon Visser, are partners with researchers in the Department of Biological Sciences and Environmental and Geographical Sciences on an NRF ACCESS-funded project, "Seasonality in the Cape". SEEC members collaborate with many other researchers in Biological Sciences, particularly with the FitzPatrick Institute for African Ornithology, the Plant Conservation Unit, and the Institute for Communities and Wildlife in Africa. Vernon Visser holds a research fellowship with the African Climate and Development Initiative.

3.2 National

A key partner outside UCT is the South African National Biodiversity Institute. Three SANBI scientists, Jonathan Colville, Annalie Melin and David Maphisa, are SEEC core members. In addition, Natasha Karenyi serves on SANBI’s Marine Ecosystem Classification Committee (MECC) and Greg Distiller serves on the Leopard Monitoring Committee. South African Environmental Observation Network’s Jasper Slingsby is a SEEC core member. Former SEEC postdoc Dominic Henry took up a position as ecological modelling specialist with the Endangered Wildlife Trust.
3.3 International

SEEC core member Henning Winker is a fisheries scientist in the Department of Agriculture, Forestry and Fisheries.

Guy Midgley from Stellenbosch University’s Department of Botany and Zoology is a SEEC partner. SEEC has several ongoing collaborations, and has signed a memorandum of understanding, with the Centre for Invasion Biology at the University of Stellenbosch. SEEC also collaborates with the Department of Geography & Environmental Studies, particularly Prof. Helen De Klerk.

Stefan Foord at the University of Venda and his MSc student, Ratshibvumo Tshikambu, are part of SEEC’s NRF ACCESS project.

We work with key conservation organisations: Cape Nature, the Endangered Wildlife Trust, and BirdLife South Africa on various projects.

3.3 International

Internationally, we collaborate with some of the leading groups in our field. One of them is the Centre for Research into Ecological and Environmental Modelling (CREEM) at the University of St Andrews. David Borchers from CREEM is a SEEC core member, Theoni Photopoulou is currently at CREEM as a Newton International Fellow and Ian Durbach has taken up a position at CREEM during 2018. We have an ongoing collaboration with Colin Beale at the University of York on analysing spatial biodiversity data and with Jim Nichols at the Patuxent Wildlife Research Centre of the USGS on using occupancy models for citizen science data. David Warton from the University of New South Wales visited SEEC in January 2018.
4. Outreach

4.1 SEEC Stats Toolbox Seminars

The SEEC Stats Toolbox Seminars were once again very successful in 2018, with another eight talks added to our growing collection. The material (slides, R code, example data files) are available on our web site (seec.uct.ac.za/stats-toolbox-seminars) for all of these seminars. We live-stream the seminars to enable people to participate who cannot physically attend the seminar. The seminars are also recorded and can be watched from our web site.
4.2 Workshops

4.2.1 Model-based multivariate analysis of abundance data using R

In January SEEC hosted David Warton, a Professor and Australian Research Council Future Fellow from the University of South Wales and leader of the Ecostats research group [http://web.maths.unsw.edu.au/~dwarton/](http://web.maths.unsw.edu.au/~dwarton/).

David champions the movement away from traditional methods of exploratory multivariate analyses to more predictive and testable model-based analyses in an effort to maintain the integrity of the data during analyses. To this end he has developed the `mvabund` R package.

While at UCT, David taught a model-based multivariate statistics course from 22-26 January attended by 35 ecologists and statisticians from all over South Africa. This course challenged our thinking about popular multivariate methods and introduced new methodologies which will hopefully become more common in ecology.
4.2.2 **SEEC-ACCESS Introduction to statistical modelling and data analysis course (18-20 July)**

SEEC members ran a condensed version of the STA2007/5014 course on behalf of ACCESS, which was attended by around 60 people. Feedback from the course participants was generally very positive. As a result of this success, SEEC has decided to run the course again in 2019.

4.3 **African Bioacoustics Conference**

Tess Gridley organised and ran this inaugural conference which was held from 2-7 December at UCT and supported by SEEC and the Department of Statistical Sciences. The conference was a massive success, attracting 130 participants from across the globe.

4.4 **Social media**

SEEC is now followed by 524 people on Twitter and 158 on Facebook (on 15 May 2019).

4.5 **SEEC student symposium 2018**

The annual SEEC Student Symposium was held on 28 May 2018 in the Postgraduate Student Room in the Otto Beit building. Sheona Schackleton (deputy director of the ACDI) presented the plenary and 13 SEEC students presented on their work.

This symposium continues to be an important event for promoting SEEC to a wider UCT audience and for learning about each other’s work.

4.6 **Advisory boards**

5. Funding

- Res Altwegg, Vernon Visser, Mzabalazo Ngwenya, David Maphisa, Birgit Erni, Jasper Slingsby - NRF ACCESS Annual Cycle and Seasonality grant of R8,500,000 (2018-2021)
- Jasper Slingsby, Vernon Visser, Res Altwegg - NRF SASSCAL grant of R2,155,000 (2019-2021)
- Vernon Visser - ACDI Fellowship support of R300,000
- Natasha Karenyi, Allan Clark - NRF Marine and Coastal Research grant of R1,325,000 (2019-2021)
6. Publications


7. Other research outputs

7.1 Conferences

7.1.1 Posters


7.1.2 Talks

Seasonality in the Cape. 4th South African National Global Change Conference, 3-6 December, Polokwane.