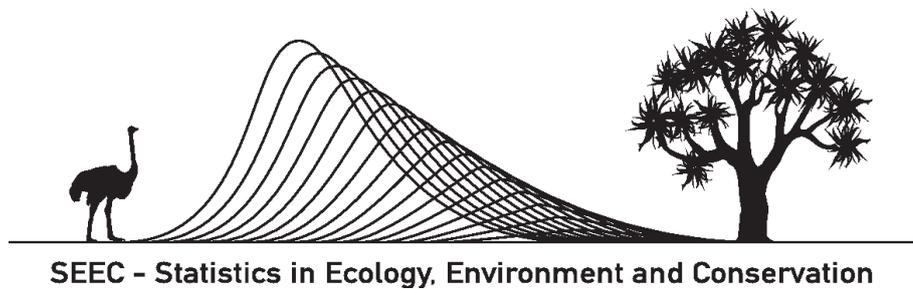


Statistics in Ecology, Environment and Conservation report

Jan 2014 to March 2015

16 March 2015



Our goals

- To be the leading group in statistical ecology and environmental analytics within South Africa
- To provide a hub connecting statisticians and biological / environmental scientists to ensure that the most important environmental questions are addressed with cutting edge statistical methods
- To develop methods that link data analysis and modelling into the conservation planning and management process



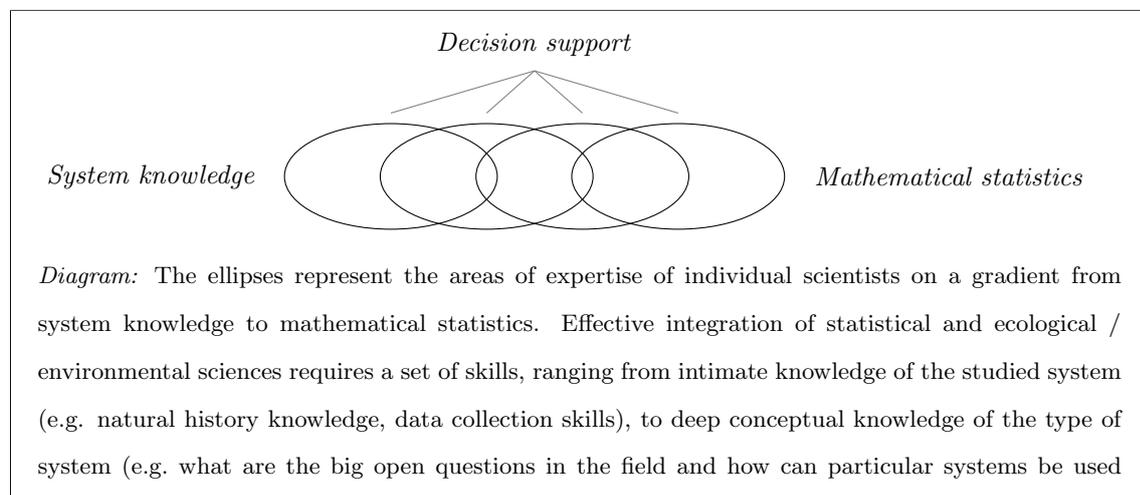
SEEC was accredited by the University Research Committee in January 2014. Our group started with a core team consisting of nine UCT academics:

Res Altwegg	Statistical Sciences
Allan Clark	Statistical Sciences
Greg Distiller	Statistical Sciences
Birgit Erni	Statistical Sciences
Astrid Jarre	Biological Sciences
Iain MacDonald	Actuarial Sciences
Peter Ryan	Biological Sciences
Les Underhill	Biological Sciences
Melvin Varughese	Statistical Sciences

Over the last year, several new members joined the SEEC core team:

Ian Durbach	UCT, Statistical Sciences
Fitsum Abadi	University of the Witwatersrand
Guy Midgley	Stellenbosch University
Henning Winker	South African National Biodiversity Institute
Jonathan Colville	South African National Biodiversity Institute
Jasper Slingsby	South African Environmental Observation Network

Henning, Jonathan and Jasper have Honorary Research Associate status with UCT that links them to SEEC officially. UCT seems to have no mechanism for officially linking with academics from other universities but this does not affect their status as SEEC core team members in practice. In 2014, we also had 10 postdocs affiliated with SEEC: Florian Weller, Laura Blamey, Natasha Karenyi, Petra Sumasgutner, Raquel Garcia, Robert Williamson, Sanet Hugo, Silvia Mecenero, Theoni Photopoulou, Yahkat Barshep.



to address them?), to broad statistical knowledge (e.g. what kind of data are most likely to carry the desired information and how will we extract the information?), to computational skills (efficient software implementation of statistical models) to mathematical statistics. Structured decision support is integrated into this chain of mechanistic understanding of systems and requires its own set of skills at the three-way intersection between system knowledge, quantitative skills and social skills. SEEC brings together people with skills from these different fields, with individual skills overlapping comfortably so that collaboration is effective.

SEEC works at the intersection between statistics on the one hand and ecology and environmental science on the other hand, with a third dimension in the field of structured decision support. Our philosophy is that interdisciplinary research is best achieved by collaborating groups of people with overlapping skill sets (see box above). The overlap is important for effective communication of ideas, which is the basis for us to be able to work together and leverage each other's specialist skills. Our group comprises of scientists with expertise in theoretical statistics, scientists with strong natural history and ecology expertise, scientist with expertise in decision support and others whose expertise falls more towards the middle of the continuum. This setup causes a few difficulties every now and then. Being based in the Department of Statistical Sciences, having group members who spend a lot of time collecting data understandably requires justification. On the other hand, team members on the mathematical statistics side have been accused of not being enough interested in the biological questions. However, I think overall, we had only small problems that have to be expected for this group that tries to bridge across disciplines.

At the moment, we don't have core team members with expertise in environmental science even though we work on problems that fall into this field (e.g. climate change). We have started collaborating with scientists from the Climate Systems Analysis Group to cover this gap.

1 Training

To achieve our goals, we need to train people with excellent skills both in statistics and ecology / environmental sciences. We want to attract quantitatively minded biology and environmental- and geographical science (EGS) students, and statistics students with an interest in ecology / environmental questions. At the moment, biology students only tend to understand the importance of statistics when they are far into their studies and most of the statistics students come from the commerce side with little interest in ecology and environmental sciences.

We have focused on modifying undergraduate courses to improve training at the intersection between statistics and biology / EGS. Greg Distiller and Res Altwegg now introduce R in STA1007, the first-year statistics course aimed at science students. This is followed up by R-based data analysis sessions in second- and third year biology courses, an initiative led by Tony Verboom with help of Res Altwegg. Birgit Erni, Greg Distiller, Theoni Photopoulou and Res Altwegg are

currently developing a second year statistics course for science students (STA2007) as an online course to make it more accessible to biology and EGS students, who previously claimed that they could not fit it into their curriculum.

Interdisciplinarity sometimes clashes with UCT structures. Ideally, we should co-teach courses across disciplines but the accounting system cannot cope with this. Biology staff get no credit for teaching on STA courses and statistical sciences staff get no credit for teaching on BIO courses. We still do it but this limits the amount of co-teaching that can be done.

Nevertheless, with the double major system, STA1007-STA2007 and additional 3rd year STA courses, students are now able to major in biology and statistics. If we get even just a handful of students who take this route every year, we will hopefully have a steady supply of students who are well prepared to do a postgraduate degree in statistical ecology.

At the postgraduate level, Henning Winker taught two statistics modules for the Biology honours students. Res Altwegg supervised two biology honours project in 2014. Melvin Varughese and Ian Durbach supervised a statistics honour project with a strong ecological focus in 2014.

At MSc level, we offered an Ecological Statistics module in the Statistics taught Masters course (STA5003W). Uptake of this elective module has so far been small but we are thinking about making this module available to other taught Masters courses (CB, ACIDI, MPhil in environmental sciences, Applied Marine Science). At this level, statistical skills vary widely among students coming from different study directions but because this is a highly specialised course, it should be possible to tailor it to the needs of the different groups of students.

We hold short themed data-analysis workshops. In February 2014, Roger Pradel (CNRS Montpellier) gave a workshop on capture-mark-recapture methods in E-SURGE. In October 2015, Marc Kéry and Michael Schaub (Swiss Ornithological Institute) will give a workshop on Bayesian population analysis. We are also planning to have regular workshops on more basic methods, linear models, planning and analysing experiments, generalised linear models, etc. But we have so far not had the capacity to teach these.

The Department of Statistical Sciences introduced new MSc and PhD degrees in Ecological / Environmental Stats by dissertation only (STA5013 and STA6002).

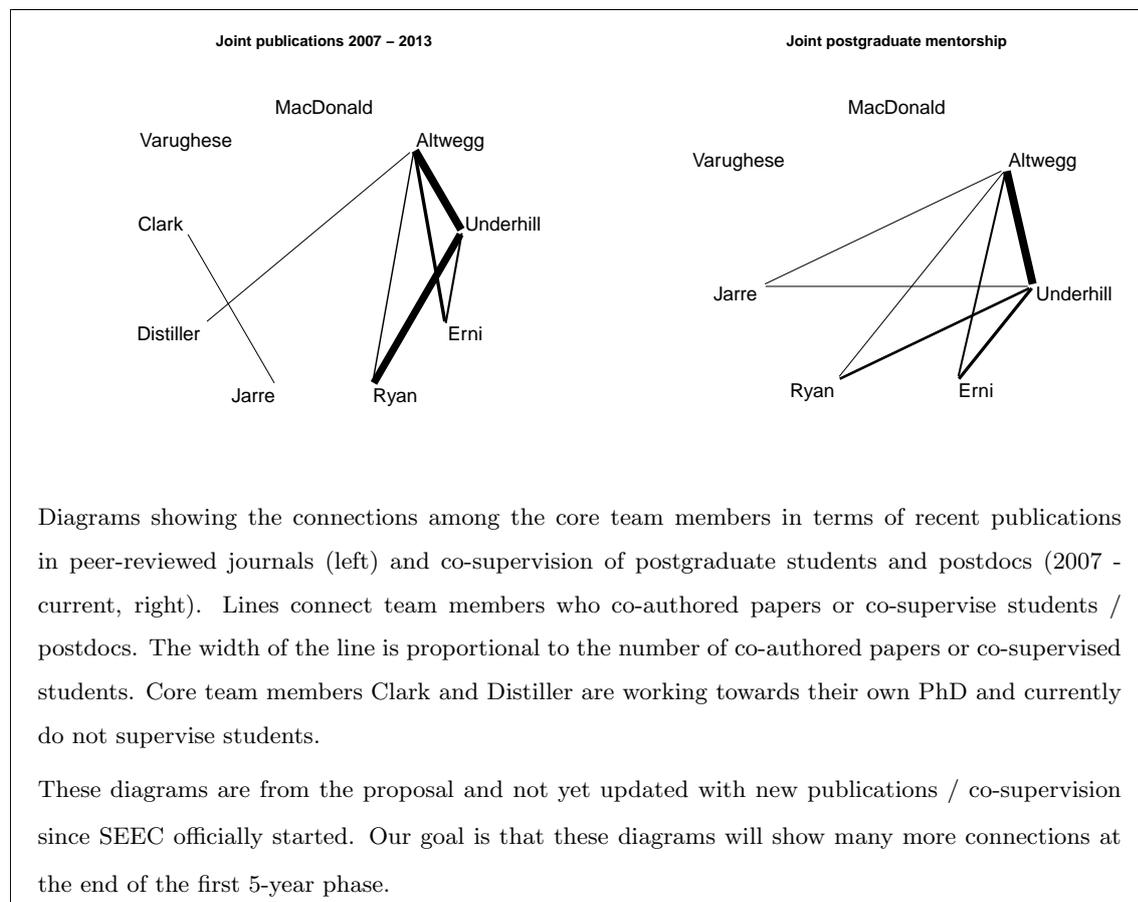
Postdocs are a fast way of getting expertise into our group. We want to involve them more in skills transfer (co-supervision, teaching) and at the same time train them as future academics.

SEEC has so far had 14 PhD students and 6 MSc students (see table at the end of report). On 6 August 2014, we held a very successful SEEC graduate student symposium. It was great to see the breadth of the topic our students are working on and I think we are doing well with our goal of training students at the intersection between statistics, ecology, and structured decision making. We will organise such a symposium annually.

2 Research

We had 9 peer-reviewed publications in 2014 (mostly during the second half because a few months passed after SEEC's accreditation until the first publications with a SEEC address appeared). In 2015, we have 13 papers published or in press so far. Another 16 manuscripts are currently in review with international journals.

While I think we are doing great in terms of publications, we constantly need to make sure that we are not just a group of people with similar interests; we want to be a group of people who closely collaborate. SEEC is meant to enable us to tackle projects that each of us alone could not have tackled by leveraging the advantages of our complementary skills.



We want our research to be relevant. We are therefore partnering with organisations that make decisions or support decision making in conservation (SANBI, CapeNature, EWT, BirdLife, SAEON). Due to the cross-cutting nature of our work, we partner with other research groups (CIB, Fitz, MaRe). We want to position ourselves so that we can join large consortia that can tap into large funding sources (ACCESS, IPBES, etc.). To start this process, we held a partner workshop on 5 August 2014. BirdLife South Africa, CapeNature, the CIB, SANBI and the EWT were present. Immediate results were that Greg Distiller is now co-supervising an EWT-funded MSc student. Res Altwegg has advised BirdLife and CapeNature on monitoring designs. It seems like the easiest benefits for SEEC to get from these partnerships are access to interesting data sets and student

funding through co-supervision. We agreed at the workshop that we will work towards joint funding applications. The danger for SEEC is that we do a lot of free consulting with little to show in terms of what matters to UCT (graduated students and high-impact publications; but perhaps we can push the outreach / responsiveness line).

We want to be well connected with organisations that do similar work as we do globally (CREEM, NCES, the French national Statistical Ecology Initiative, Patuxent). We maintain active collaborations with leading scientists in these organisations: David Borchers, Roger Pradel, and Jim Nichols. The benefits of these collaborations in 2014 were skill transfer, joint funding proposals, and also access to a network of highly skilled postdocs in our field. Another well-working international collaboration is with Colin Beale at the University of York. He is involved with several SEEC projects.

3 Students

PhD

Marc Burman	Biological Sciences
Zingfa Wala	Biological Sciences
Alecia Nickles	Statistical Sciences
Etienne Pienaar	Statistical Sciences
Greg Distiller	Statistical Sciences
Allan Clark	Statistical Sciences
David Maphisa	Statistical Sciences, submitted Feb 2015
Dorine Jansen	Statistical Sciences
Greg Duckworth	Statistical Sciences
Emily McGregor	Biological Sciences
Kate Watermeyer	Biological Sciences
Rachel Cooper	Biological Sciences
Chris Oosthuizen	University of Pretoria
Gordon Botha	Statistical Sciences

MSc

Ryan Daniels	Stellenbosch University, graduated 2014
Jessie Berndt	Biological Sciences, submitted Feb 2015
Yolokazi Galada	Biological Sciences
Danielle Boyd	Statistical Sciences
Francois Becker	Statistical Sciences
Ariella Rink	Statistical Sciences

4 Publications 2014

1. Altwegg, R., A. West, L. Gillson, and G.F. Midgley. 2014. Impacts of Climate Change in the Greater Cape Floristic Region. pp 299 - 320 In: Fynbos: Ecology, Evolution and Conservation of a Megadiverse Region. Eds. N. Allsopp, J.F. Colville, and G.A. Verboom. Oxford University Press. ISBN-978-0-19-967958-4.
2. Duckworth, G.D. and R. Altwegg. 2014. Environmental drivers of an urban hadeda ibis population. *Ardea* 102: 21-29.
3. Borchers, D., G. Distiller, R. Foster, B. Harmsen, and L. Milazzo. 2014. Continuous-time spatially explicit capture-recapture models, with an application to a jaguar camera-trap survey. *Methods in Ecology and Evolution* 5:656 - 665.
4. Sherley, R.B, F. Abadi, K. Ludynia, B.J. Barham, A.E. Clark, and R. Altwegg. 2014. Age-specific survival and movement among major African Penguin *Spheniscus demersus* colonies. *Ibis* 156: 716-728. doi: 10.1111/ibi.12189
5. Collingham, Y, B. Huntley, R. Altwegg, P. Barnard, O.S. Beveridge, R.D. Gregory, L.R. Mason, H.D. Oschadleus, R.E. Simmons, S.G. Willis, R.E. Green. 2014. Prediction of mean adult survival rates of southern African birds from demographic and ecological covariates. *Ibis* 156: 741-754. doi: 10.1111/ibi.12195
6. Lloyd P, F Abadi, R Altwegg T. E. Martin. 2014. South temperate birds have higher apparent adult survival than tropical birds in Africa. *Journal of Avian Biology* 45: 493-500. doi: 10.1111/jav.00454
7. Weller, F., L.-A. Cecchini, L. Shannon, R.B. Sherley, R.J.M. Crawford, R. Altwegg, L. Scott, T. Stewart, and A. Jarre. 2014. A system dynamics approach to modelling multiple drivers of the African penguin population on Robben Island, South Africa. *Ecological Modelling* 277: 38-56.
8. Jansen, D.Y.M., F. Abadi, D. Harebottle, and R. Altwegg. 2014. Does seasonality drive spatial patterns in demography? Variation in survival in African Reed Warblers *Acrocephalus baeticatus* across southern Africa does not reflect global patterns. *Ecology and Evolution* 4: 889-898.
9. Photopoulou T., M.A. Fedak, L. Thomas and J Matthiopoulos. 2014. Spatial variation in maximum dive depth in gray seals in relation to foraging. *Marine Mammal Science* 30(3):923-938

5 Publications 2015

5.1 Published or in press

1. Stevenson, B.C., D. L. Borchers, R. Altwegg, R. J. Swift, D. M. Gillespie and G. J. Measey. 2015. A general framework for animal density estimation from acoustic detections across a fixed microphone array. *Methods in Ecology and Evolution* 6, 3848 doi: 10.1111/2041-210X.12291
2. Péron, G., and R Altwegg. 2015. The abundant centre syndrome and species distributions: insights from closely related species pairs in southern Africa. *Global Ecology and Biogeography*, 24, 215225
3. Photopoulou T., P. Lovell, M.A. Fedak, L. Thomas and J. Matthiopoulos. 2015. Efficient abstracting of dive profiles using a broken-stick model. *Methods in Ecology and Evolution* DOI: 10.1111/2041-210X.12328
4. Altwegg, R., H. M. De Klerk, and G.F. Midgley. 2015. Fire-mediated disruptive selection can explain the reseeder-resprouter dichotomy in Mediterranean-type vegetation. *Oecologia* 177: 367-377. doi: 10.1007/s00442-014-3112-6
5. Salguero-Gómez, R., O.R. Jones, C.R. Archer, Y.M. Buckley, J. Che-Castaldo, H. Caswell, A. Scheuerlein, D.A. Conde, A. Baudisch, E. Brinks, H. de Buhr, C. Farack, F. Gottschalk, A. Hartmann, A. Henning, G. Hoppe, G. Römer, J. Runge, T. Ruoff, J. Wille, S. Zeh, D. Viereg, R. Altwegg, F. Colchero, M. Dong, D. Hodgson, H. de Kroon, J.-D. Lebreton, C.J.E. Metcalf, M. Neel, I. Parker, T. Takada, T. Valverde, L.A. Vélez-Espino, G.M. Wardle, M. Franco, and J.W. Vaupel. 2015. The COMPADRE Plant Matrix Database: an Open Online Repository for Plant Demography. *Journal of Ecology* 103: 202-218. doi: 10.1111/1365-2745.12334
6. Simmons, R. E., H. Kolberg, R. Braby, and B. Erni, B. 2015. Declines in wader trends from a winter quarter perspective. *Conservation Biology*: in press.
7. Moncrieff G.R., S. Scheiter, J.A. Slingsby, S.I. Higgins. 2015. Understanding global change impacts on South African biomes using Dynamic Vegetation Models. *South African Journal of Botany*: in press.
8. Mecenero, S. R. Altwegg, J.F. Colville and C.M. Beale. 2015. Roles of spatial scale and rarity on the relationship between butterfly species richness and human density in South Africa. *Plos One*: in press.
9. Bradshaw, P.L., J.F. Colville and P.H. Linder. 2015. Optimizing regionalisation techniques: Identifying centres of endemism in the extraordinarily endemic-rich Cape Floristic Region. *Plos One*: in press.

10. Seymour, C.L., R.E. Simmons, G.S. Joseph and J.A. Slingsby. 2015. On bird functional diversity: species richness and functional differentiation show contrasting responses to rainfall and vegetation structure in an arid landscape. *Ecosystems*: in press.
11. Péron, G., and R. Altwegg. 2015. Twenty-five years of change in southern African passerine diversity: non-climatic factors of change. *Global Change Biology*: in press.
12. Péron, G., and R. Altwegg. 2015. Low vertebrate diversity in the fynbos plant diversity hotspot: the Quaternary legacy hypothesis discussed using current Passeriformes distributions. *Ecography*: in press.
13. Bussière, E.M.S., L.G. Underhill, and R. Altwegg. 2015. Patterns of bird migration phenology in South Africa suggest northern hemisphere climate as the most consistent driver of change. *Global Change Biology*: in press. doi: 10.1111/gcb.12857

5.2 Submitted

1. Garcia, R.A., M. Cabeza, R. Altwegg, and M.B. Arajo. 2015. Do projections from bioclimatic envelope models and climate change metrics match? Submitted to *Global Ecology and Biogeography*.
2. Manning, J.C., P. Goldblatt, J.F. Colville and C. Cupido. 2015. Hopline beetle pollination in annual *Wahlenbergia* species (Campanulaceae) from western South Africa and the new species, *W. melanops*. Submitted to *South African Journal of Botany*.
3. Photopoulou T., M.A. Fedak, J. Matthiopoulos, B.J. McConnell and P. Lovell P. 2015. The generalized data management and collection protocol for Conductivity-Temperature-Depth Satellite Relay Data Loggers. Submitted to *Animal Biotelemetry*.
4. Best PB and T. Photopoulou. 2015. Patterns and dynamics of scarring on large whales attributed to a cookie-cutter shark *Isistius* sp. Submitted to *Journal of Mammalogy*.
5. Oosthuizen, W.C., M.N. Bester, R. Altwegg, T. McIntyre and P.J.N. de Bruyn. 2015. Decomposing the variance in weaning mass of southern elephant seals: detecting environmental signals in the presence of dominant maternal effects. Submitted to *Austral Ecology*.
6. Zuberogitia, I., J. A. Gil, J.E. Martnez, B. Erni, B. Aniz, and P. Lpez-Lpez. 2015. The flight feather moult pattern of bearded vultures (*Gypaetus barbatus*). Submitted to *Journal of Ornithology*.
7. Barshep, Y., B. Erni, L.G. Underhill and R. Altwegg. 2015. Ecological and life-history drivers of population change in South African waterbirds. Submitted to *Proceedings of the Royal Society of London, B*.

8. Jansen, D.M., A.M Wilson, R. Altwegg. 2015. Climatic variation influences survival of a migratory population of African Reed Warblers *Acrocephalus baeticatus* in South Africa. Submitted to *Ardea*.
9. McLeod, L. and J.F. Colville. 2015. Observations on unusual feeding and mating behavior in a monkey beetle genus *Amblymelanoplia* Dombrow (Coleoptera: Scarabaeidae: Hopliini). Submitted to *African Entomology*.
10. Broms, K., M. Hooten, D. Johnson, R. Altwegg, and L. Conquest. Dynamic occupancy models for explicit colonization processes. Submitted to *Ecology*.
11. Maphisa, D.H., H. Smit-Robinson, L.G. Underhill, and R. Altwegg. A literature review of habitat factors affecting birds in moist high-altitude grasslands in Southern Africa: implications for managing Ingula grasslands for avian diversity. Submitted to: *Bothalia: African Biodiversity and Conservation*.
12. Péron, G., R. Altwegg, G.A. Jamie, and C.N. Spottiswoode. Brood parasitism in a changing landscape: insights from the Southern African Bird Atlas Project, using occupancy models. Submitted to *American Naturalist*.
13. Péron, G., and R. Altwegg. Departures from the energy-biodiversity relationship in southern African passerines: evidence for behavior-mediated Quaternary legacies? Submitted to *PlosOne*.
14. Sherley, R.B., H. Winker, R. Altwegg, C.D. van der Lingen, S.C. Votier, and R.J.M. Crawford. Influence of a fishery closure on penguin demographics. Submitted to *Biological Conservation*.
15. Huntley, B., Y.C. Collingham, J.S. Singarayer, P.J. Valdes, P. Barnard, G.F. Midgley, R. Altwegg, R. Ohlemüller. Explaining patterns of avian diversity and endemism: Climate and biomes of southern Africa over the last 140,000 years. Submitted to *Journal of Biogeography*.
16. Clark, A.E., R. Altwegg, and J.T. Ormerod. A Variational Bayes approach to the analysis of occupancy models. Submitted to *Methods in Ecology and Evolution*.
17. Weller, F., R.B. Sherley, L.J. Waller, K. Ludynia, D. Geldenhuys, L.J. Shannon, A. Jarre. System dynamics modelling of the Endangered African penguin populations on Robben and Dyer islands, South Africa. Submitted to *Ecological Modelling*.