Percy FitzPatrick Institute of African Ornithology

DST-NRF Centre of Excellence

University of Cape Town

Annual Report

2015

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Centre of Excellence Board 2015

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FRONT COVER: **Adult Bearded Vulture in the Drakensberg mountains (Photo: Sonja Krüger).**

REPORT LAYOUT: HILARY BUCHANAN

Contents

Director's Report

Director of the Fitz, Prof. Peter Ryan (Photo: Callan Cohen).

Dr Claire Spottiswoode.

2015 was a year of change both within the Fitz and more broadly. At the global scale, 2015 was the hottest year on record. The climate talks in Paris finally delivered some positive steps towards addressing the rampant growth in greenhouse gases; hopefully it's not a case of too little and too late. The strong El Niño that set in during 2015 resulted in widespread regional droughts and heat waves, drawing more attention to the threat posed by long-term climate change.

In South Africa, the Rand slumped to record lows against other currencies as the economy stuttered. At UCT, the Rhodes Must Fall movement morphed into Fees Must Fall, triggering widespread student protests around the country. The millions of Rands spent on additional security placed extra demands on already strained university resources. With protests likely to continue in 2016, and income streams unlikely to grow, university support for 'non-essential' activities is set to fall – and unfortunately research is likely to be one of the casualties. One of the key challenges facing the Fitz is how to remain competitive given the ongoing erosion of the Rand and reductions in local research funding. The Centre of Excellence (CoE) funding, while generous in South African terms, is equivalent to a modest individual research grant in Europe or North America. If we wish to continue to conduct cutting-edge research we increasingly shall have to source funds overseas, or work in collaboration with better-funded teams based overseas.

Within the Fitz, we have many positives to celebrate. The staff complement is almost back to full strength. Dr Susie Cunningham joined the academic staff in January 2015 and has impressed everyone with her ability to manage the conservation biology coursework while also running the behavioural component of the Hot Birds programme. A key priority is to find a way to retain Susie's services beyond the duration of the CoE. Dr Robert Thomson took up a senior lecturer position in August 2015, and is settling in to his new role with aplomb. Prof. Graeme Cumming's departure to Australia in July 2015 created the opportunity to lure Dr Claire Spottiswoode back to UCT from Cambridge University. She will retain close links with Cambridge, thanks to a part-time appointment as the Hans Gadow Lecturer in Ornithology, but we greatly look forward to having her join the Fitz from mid-2016. That will see the youngest, and arguably most 'birdy', academic staff team in the institute's history.

There has been a similar changing of the guard among the support staff. Gonzalo Aguilar took over most of Chris Tobler's responsibilities at the start of 2015, bringing a wealth of experience from his previous position in the Department of Botany. Susan Mvungi replaced Margaret Koopman as Niven Librarian at the end of July, and has already made a large contribution by producing pdfs of all Fitz publications back to 1980. Soon all Fitz papers will be available in this convenient format. Then towards the end of 2016 we were very sad to see Tania Jansen, the CoE Senior Secretary, leave to take up a permanent position in the Department of Maths and Applied Maths. We welcome her replacement, Denise Scheepers.

With two PhD students, five dissertation MSc and 12 conservation biology MSc students graduated and 138 peer-reviewed papers published, 2015 was as productive as ever. The PhD graduates were Owen Davies, Prof. Tim Crowe's final student, and Margaux Rat, one of Prof. Phil Hockey's final students (although her primary supervisors were Drs Rita Covas and Claire Doutrelant). Dr Rob Little Guest Edited a special issue of Ostrich in memory of Phil Hockey which attracted 20 papers, 17 with Fitz authors including 12 with Phil as co-author. In addition, the Fitz produced 76 popular articles,

making regular contributions to *African Birdlife*, *SANParks Times*, *Environment*, *Quest* and *Wild*. We especially congratulate Fitz Honorary Research Associates, Drs Rob Simmons and Ross Wanless, on co-authoring the Namibian and South African Red Data Books for Birds, respectively.

Thirty research projects were supported by the Fitz during 2015, including five new projects: drongo-cuckoo parasitic interactions, vulture conservation in Botswana, Lillian's Lovebirds in Zambia, intra-African bird migration, and the impact of human disturbance on waterbirds. Fitz members served on 26 journal editorial boards, reviewed at least 134 papers for 63 peer-reviewed journals, and participated on 63 advisory boards. We also continue to be active in advising conservation organisations, government departments and industry on a variety of issues. Dr Arjun Amar received the 2015 Claude Leon Merit Award for early career researchers which is a highly prestigious award recognising outstanding scholarly achievements. Arjun also received the 2015 College of Fellows Young Researcher Award, granted annually to young academics at UCT to support their demonstrated ability of making a significant contribution to their research field.

Susan Mvungi.

2015 saw several long-term visitors to the Fitz. Dr Claire Doutrelant and her family left in early 2015 after spending six months at the Fitz. Dr Francois Mougeot spent four months here as the Dean's visitor for 2015, accompanied by his partner Dr Beatriz Arroyo Lopez; they are co-supervising PhD student Marie-Sophie Garcia-Heras. Shorter visits were made by Dr David Grémillet, and Profs Stuart Bearhop, Bengt Gustafsson, Alexandre Roulin and Richard Primack. A highlight for the seabird research team was having the Second World Seabird Conference take place in Cape Town in October 2015. With 562 delegates from 52 countries, it offered a great opportunity for networking and showcasing our research. Otto Whitehead and Davide Gaglio were both placed in the top 10 student presentations. Finally, the winter student intern programme brought four students from Limpopo University in Polokwane to UCT for three weeks in June 2015. Ditiro Moloto from the 2014 group conducted her honours project through the Fitz in 2015, and will register to study for a MSc at the Fitz in 2016. We are extremely grateful to Prof. Derek Englebrecht at Limpopo for his assistance in selecting students for this programme.

Gonzalo Aguilar.

One of the outcomes of the Rhodes Must Fall movement is a suggestion that the Fitz should cut its ties with the colonial past and shorten its name to The Institute of African Ornithology. Although it would be hard to forego referring to the Institute as the Fitz and ourselves as Fitzies, the main cost would be the loss of brand identity built over more than 50 years. I have consulted UCT's transformation team and entertained arguments both for and against such a change by current and former Fitz staff; I look forward to hearing the Board's views on this subject.

Finally, at the start of 2016, we learned of the shocking murder of Emily Kisamo in Arusha, Tanzania, shortly before Christmas. Circumstances surrounding his death are still being investigated, but it is likely that the motive was linked to his position as Protection Manager at Tanzania National Parks. Kisamo was one of the 2001/02 cohort of conservation biology students. The outpouring of grief at his untimely death, especially among his former classmates, illustrates once again the strength of the bonds forged among CB students. Kisamo was widely regarded as a gentle giant of East African conservation, and his loss will be deeply felt. RIP Kisamo.

Denise Scheepers.

Peter Ryan, January 2016

Staff, Students and Associates

UCT GRADUATES

PhD
Owen Davies (June); Margaux Rat (Dec)

MSc
Jessie Berndt; Lisle Gwynn, Minke Witteveen, Blair Zoghby (June); Stefan Schoombie (Dec)

Conservation Biology MSc
Salamatu Abdu, Alex Atkins, Bruce Baigrie, Jenna Bowker, Kate Cronin, Marcela Espinaze, Francesca Fazey, Liezl le Roux, Juan Millan, Allie Russo (June); John Dickens, Dara Sands (Dec)

BSc Hons
Campbell Fleming, Gabriella Leighton

NEW UCT STUDENTS

Post-doctoral fellows
Sophie Lardy (Peter Ryan and Rita Covas); Tiwonge Gawa (Arjun Amar); Dayo Osinubi (Peter Ryan and Phoebe Barnard)

PhD
Daniël Cloete (Peter Ryan and Phoebe Barnard), Anthony Lowney (Robert Thomson)

MSc
Andrew de Blocq, Ben Dilley, Selena Flores (Peter Ryan); Beckie Garbett (Arjun Amar)

Upgrade from MSc to PhD: Davide Gaglio

Conservation Biology MSc
Thirteen students began the CB MSc in January 2015.

Staff

Director:
Prof. Peter Ryan, PhD (Cape Town)*

Academic and Research Staff:
Dr Arjun Amar, PhD (Aberdeen)*
Dr Susan Cunningham, PhD (Massey)
Prof. Graeme Cumming, PhD (Oxford)* Jan-Jun
Dr Robert Thomson, PhD (Oulu)* Aug-Dec

Honorary Professor:
Prof. David Cumming, PhD (Rhodes)

External CoE Team Members
Asst Prof. Rauri Bowie, PhD (Cape Town) – UC, Berkeley
Prof. Andrew McKechnie, PhD (Natal) – U. Pretoria
Dr Pierre Pistorius, PhD (Pretoria) – NMMU

Honorary Research Associates
Dr Phoebe Barnard, PhD (Uppsala)
Dr Rita Covas, PhD (Cape Town) Oct-Dec
Prof. Graeme Cumming, PhD (Oxford) Jul-Dec
Dr Tom Flower, PhD (Cambridge)
Dr David Grémillet, PhD (Kiel)
Dr Kristi Maciejewski, PhD (NMMU) Oct-Dec
Dr Lorien Pichegru, PhD (Strasbourg)
Assoc. Prof. Mandy Ridley, PhD (Cambridge)
Dr Rob Simmons, PhD (Wits)
Dr Ross Wanless, PhD (Cape Town)

Research Associates
Dr Steve Boyes, PhD (KwaZulu-Natal)
Dr Callan Cohen, (PhD, Cape Town
Dr Timotheé Cook, PhD (La Rochelle)
Dr Richard Dean, PhD (Cape Town)
Dr Claire Doutrelant, PhD (Paris)
Dr Derek Engelbrecht, PhD (Limpopo)
Dr Andrew Jenkins, PhD (Cape Town)
Dr Grant Joseph, PhD (Cape Town)
Dr Ian Little, PhD (Cape Town)
Dr Azwianewi Makhado, PhD (Cape Town)
Dr Rowan Martin, PhD (Sheffield)
Dr Martim Melo, PhD (Edinburgh)
Michael Mills, MSc (Cape Town)
Dr Antoni Milewski, PhD (Murdoch)
Prof. Sue Milton, PhD (Cape Town)
Dr Lizanne Roxburgh, PhD (Ben Gurion)
Dr Jessica Shaw, PhD (Cape Town)
Dr Colleen Seymour, PhD (Cape Town)
Dr Claire Spottiswoode, PhD (Cambridge)
Dr Antje Steinfurth, PhD (Kiel)
Anthony van Zyl, MSc (Cape Town)

Support Staff

Manager, DST-NRF CoE:
Dr Rob Little, PhD (Cape Town)

Principal Technical Officer: Gonzalo Aguilar*

Administrative Assistant:
Hilary Buchanan BA, HDipLib (Cape Town)*

Senior Secretary, DST-NRF CoE:
Tania Jansen, Jan-Oct
Denise Scheepers, Nov-Dec

Departmental/Accounts Assistant:
Anthea Links*

Library Manager:
Margaret Koopman, MSc (UCT)* Jan
Susan Mvungi MSc (Cape Town)* Jul-Dec

Library Assistant: Phelisa Hans

Ad Hoc Research Assistants:
Alexander Atkins, Jessie Berndt, Cassie Carstens, Yolanda Chirango, Mark Cowen, Andrew de Blocq, Oliver Goosen, Michelle Malan, Michelle Maritz, Robyn Milne, Frances Morling, Megan Murgatroyd, Alexis Osborne, Vonica Perold, Lucy Smythe, Eleanor Weideman

Students

Post-doctoral fellows
Dr Tiwonge Gawa, PhD (KwaZulu-Natal)
Dr Eleonore Hellard, PhD (Lyon)
Dr Sophie Lardy, PhD (Lyon)
Dr Alan Lee, PhD (Manchester)
Dr Lisa Nupen, PhD (Cape Town)
Dr Dayo Osinubi, PhD (Christchurch) Jul-Dec
Dr Margaux Rat, PhD (UCT) Jul-Dec
Dr Petra Sumasgutner, PhD (Vienna)

Doctoral
Julia Baum, MSc (KIT, Germany)
Kate Carstens, MSc (KwaZulu-Natal)
Hayley Clements, MSc (NMMU)
Daniël Cloete, MSc (Cape Town)
Owen Davies, BSc (Hons) (Cape Town)
Dominic Henry, BSc (Hons) (Cape Town)
Marie-Sophie Garcia Heras, MSc (Aix-Marseilles)
Davide Gaglio, MSc (Bologna)
Anthony Lowney, MSc (Manchester)
Alistair McInnes, MSc (KwaZulu-Natal)
Margaux Rat, MSc (Claude Bernard Lyon)
Chevonne Reynolds, MSc (Wits)
Dominic Rollinson, MSc (KwaZulu-Natal)
Gareth Tate, BSc (Hons) (Cape Town)
Tanja van de Ven, MSc (NMMU)
Rowen van Eeden, MSc (Cape Town)
Otto Whitehead, BSc (Hons) (Cape Town)

MSc by dissertation
Jessie Berndt, BSc (Hons) (Cape Town)
Andrew de Blocq, BSc (Hons) (Cape Town)
Ben Dilley, BSc (Hons) (Cape Town)
Selena Flores, BSc (San Diego)
Rebecca Garbett, BSc (Hons) (Kent)
Lisle Gwynn, BSc (Hons) (Plymouth)
Amanda Kyne, BSc (Wesleyan)
John Pallett, BSc (Hons) Wits
Jenni Roberts, BSc (Hons) (Cape Town)
Stefan Schoombie, BSc (Hons) (KwaZulu-Natal)
Kim Stevens, BSc (Hons) (Cape Town)
Noelle Tubbs, BSc (Rhode Island)
Minke Witteveen, BSc (Hons) (KwaZulu-Natal)
Blair Zoghby, BSc (Hons) (Wits)

Masters in Conservation Biology 2014/15
Salamatu Abdu, BSc (Hons) (Ahmadu Bello)
Alexander Atkins, BSc (Sussex)
Bruce Baigrie, BSc (Hons) (Cape Town)
Jenna Bowker, BSc (Hons) (Cape Town)
Kate Cronin, BSc (Hons) (Cape Town
John Dickens, BSc (Hons) (Rhodes)
Marcela Espinaze, BVet Sci (Astral de Chile)
Francesca Fazey, BSc (Hons) (Rhodes)
Kirsten Retief, BSc (Hons) (Cape Town)
Liezl le Roux, BSc (Hons) (Cape Town)
Juan Millan, BSc (De Los Andes)
Binah Motlogelwa, BSc (Botswana)
Alexandra Russo, BSc (Goucher)
Dara Sands, BSc (Queens)

Masters in Conservation Biology 2015/6
Jennifer Angoh, BSc (Hons) (York)
Christiaan Brink, BSc (Hons) (Pretoria)
Angela Ferguson, BSc (Hons) (Cape Town)
Gabriela Fleury, BSc (Hons) (James Madison)
Kyle Lloyd, BSc (Hons) (Rhodes)
Hermenegildo Matimele, BSc (Pedagogic)
Penny Pistorius, BSc (Hons) (KwaZulu-Natal)
Adele Pretorius, BTech (CPUT)
Jessleena Suri, BSc (Hons) (Cape Town)
Wataru Tokura, BAgric (Shinshu)
Julia van Velden, BSc (Hons) (Cape Town)
Elke Visser, MSc (Leiden)

Masters in Applied Marine Science 2014/5
Antoni Massot Mascaro

Masters in Applied Marine Science 2015/6
Andrea Plos, BSc (Cape Town)

BSc Honours
Campbell Fleming
Gabriella Leighton

Externally registered students

Doctoral
Cambridge – Gabriel Jamie
Edinburgh – James Westrip
NMMU – Rabi'a Ryjklief
Pretoria – Matthew Noakes, Ryan O'Connor; Darren Pietersen, Michelle Thompson
Stellenbosch – Anina Heystek Coetzee
Western Australia – Elizabeth Wiley
Zurich – Sabrina Engesser

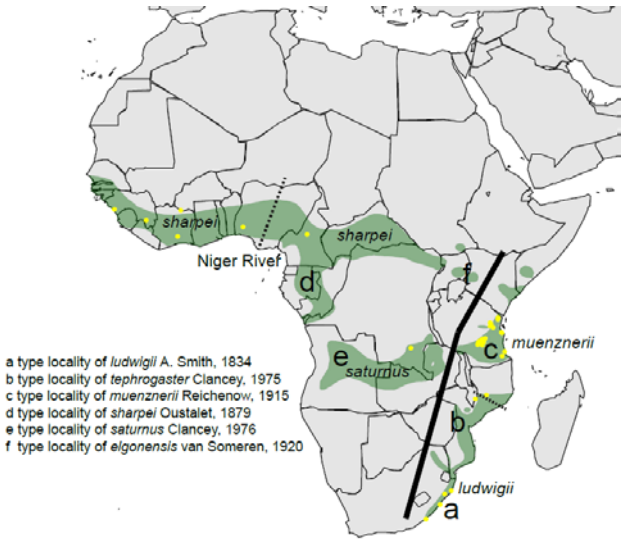
MSc by dissertation
Porto – Lara Broom, André Ferreira, Rita Fortuna, Liliana Silva
NMMU – Jonathan Botha, Jerry Molepo, Krista Oswald
Lisbon – Sofia Santos

Systematics and conservation genetics

Systematics unites taxonomy, phylogenetics and biogeography, and is essential to characterize biodiversity and to understand the processes that generate it. Systematic studies at the Fitz tackle questions across a range of temporal and spatial scales, from local dispersal and hybridisation to the origin of Africa's birds. Conservation genetics uses genetic tools to inform the conservation and management of threatened species

Drongos

Surprisingly, little is known about the extent of genetic structure within widely distributed African species that are not restricted to a particular habitat type. The few studies that have been conducted suggest that speciation among African vertebrates is tied to habitat and the dynamic nature of biome boundaries. In a recent paper Jérôme Fuchs and Rauri Bowie assessed the phylogeography of two sister-species of drongos, the Square-tailed Drongo *Dicrurus ludwigii* and Shining Drongo *D. atripennis*. Their results indicate that *D. ludwigii* consists of two strongly divergent lineages, corresponding to an eastern-southern lineage (*muenznerii*, *ludwigii*, *tephrogaster*) and a central-western lineage (*sharpei*, *saturnus*). The central-western lineage may be more closely related to *D. atripennis*, a species restricted to the Guineo-Congolian forest block, and should thus be recognised as a separate species (*D. sharpei*) from the eastern-southern lineage. Genetic structure is also recovered within the three primary lineages of the *D. atripennis-D. ludwigii* complex, suggesting that the true species diversity still remains underestimated.



The distribution of the primary lineages within *D. ludwigii sensu lato* as inferred from DNA analyses. The black line indicates the split between the two primary lineages within *D. ludwigii* (*saturnus-sharpei-elgonensis* to the west and *ludwigii-muenznerii-tephrogaster* to the east) whereas the dashed lines indicate the geographic locations of the putative breaks within each of the two primary lineages. Letters *a* to *f* indicate the approximate locations of type localities for named taxa; there is no available name for the lineage west of the Niger River (dotted line).

African Penguin immunogenetics and health

Genetic studies of the African Penguin *Spheniscus demersus* have continued with former Fitz PhD student Lisa Nupen working with the Centre for Conservation Science at the National Zoological Gardens in Pretoria, SANCCOB and the Fitz to investigate variation at genes of the immune system's major histocompatibility complex in wild and captive birds. These genes are involved in the adaptive immune response and the results will be used to inform the captive breeding programme and reintroduction of penguins. To complement this study Dr Jacqui Bishop carried out work with Honours students Vincent Naude and Gabriella Leighton to determine blood parasite prevalence data among breeding colonies of African Penguins. These studies aim to fill a number of knowledge gaps identified by the 2013 Biodiversity and Management Plan for African Penguins.

Black Sparrowhawks

PhD student Gareth Tate made good progress with the genetic component of his study on Black Sparrowhawks *Accipiter melanoleucus*, testing whether the recent colonisation of the Western Cape has resulted in a strong genetic founder effect. Preliminary results comparing birds from the Western Cape to individuals sampled from populations across its traditional summer rainfall breeding range indicate that Cape Town's population is highly variable and does not represent a subset of any particular area. The findings have interesting implications for better understanding the rapid change in morph ratios observed in the species across its range in South Africa. The genetic basis colour polymorphism is being investigated in a collaborative project

Drongo phylogeography suggests strongly divergent lineages with at least one new species (Photo: Peter Ryan).

between Arjun Amar, Jacqui Bishop and Robert Ingle (Molecular & Cell Biology, UCT). Working with MSc student Edmund Rodseth, the project is using advanced molecular methods to better understand the genes – and their patterns of expression – involved in adult sparrowhawk colouration.

Genetic connectivity in fynbos endemic birds

Campbell Fleming recently started work on his MSc under the guidance of Jacqui Bishop, HRA Phoebe Barnard and Peter Ryan exploring the phylogeographic history of Cape Sugarbirds *Promerops cafer* and Orange-breasted Sunbirds *Anthobaphes violacea*. The project builds on existing samples collected by Fitz post-doc Alan Lee, and will use mitochondrial and nuclear DNA markers to reconstruct recent evolutionary patterns of gene flow in these two species to help better understand the impacts that changing climate and resultant habitat availability will have on fynbos endemic birds.

Population structure of intra-African migratory birds

Fitz Post-doc Dayo Osinubi is working with Lisa Nupen and the National Zoological Gardens on a research project investigating movement ecology and genetic connectivity among populations of intra-African migratory bird species. Focal species include kingfishers, cuckoos and bee-eaters that undertake seasonal movements in Africa. Sampling commenced in Limpopo Province at the end of 2015, and will continue in west Africa (Ghana, Nigeria), east Africa (Kenya, Tanzania), and southern Africa (South Africa, Zimbabwe). The aim is to use genetic and other markers (e.g. stable isotopes) to infer movement patterns among these species. The study will investigate whether currently recognized subspecies are genetically distinct, and assess levels of genetic diversity within focal species. This will allow the detection of common patterns of genetic connectivity among populations and provide information about migratory pathways across Africa. Genetic data can also be used to infer historical population expansion or contraction, identify source and sink populations, and identify hybrid zones. Target species differ in many aspects of their ecology, but likely encounter common threats during their seasonal migrations. Identifying major migratory pathways and genetic breaks will contribute to future conservation efforts and improve our understanding of intra-African migrants.

Highlights:

- Owen Davies was awarded his PhD on the phylogenetics and biogeography of cisticolas in June 2015.
- Posters were presented at the Second World Seabird Conference on the systematics of *Fregetta* storm petrels and the new speicies of prion *Pachyptila* discovered on Gough Island.
- The long awaited paper on the diversity of *Fregetta* storm petrels was finally published in *Molecular Phylogenetics and Evolution*.
- Jérôme Fuchs and Rauri Bowie have a paper in press on the African drongos in *Zoologica Scripta*.

Key co-sponsors

DST-NRF CoE grant.

Research team

Prof. Peter Ryan (PFIAO)
Prof. Rauri Bowie (CoE Core Team member, UC Berkeley)
Dr Jacqueline Bishop (Biological Sciences, UCT)
Dawie de Swart (National Museum, Bloemfontein)
Dr Jérôme Fuchs (MNHN, Paris)
Dr Lisa Nupen (Post-doc, NZG)
Dr Rick Nuttall (National Museum, Bloemfontein)
Dr Dayo Osinubi (Post-doc, PFIAO)
Dr Bruce Robertson (U. Otago)
Dr Rob Simmons (HRA, PFIAO)
Dr Guinevere Wogan (Post-doc, UC Berkeley)
Prof. Gary Voelker (Texas A&M)

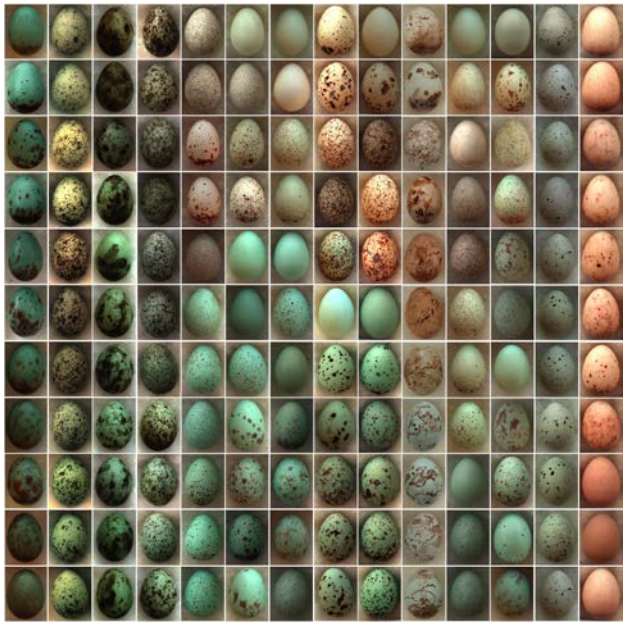
Students: Owen Davies (PhD), Edmund Rodseth (MSc)

Coevolutionary arms races in brood parasites and their hosts

Brood-parasitic birds provide an ideal opportunity to study coevolution in the wild. Arms races arise as hosts evolve defences such as rejecting parasitic eggs, leading to selection for counter-adaptations such as mimicry of host eggs. Africa has a wide diversity of brood parasites: cuckoos, honeyguides, whydahs, indigobirds and the Cuckoo Finch *Anomalospiza imberbis*. For the last ten years, Claire Spottiswoode has led a team studying the coevolution between Zambian brood parasites and their hosts.

In 2015, we published two papers in the *Proceedings of the Royal Society B* showing that the coevolutionary arms races between Cuckoo Finches and their hosts has shaped even more layers of adaptation and counter-adaptation than previously suspected. The first paper explored how hosts can escalate their defences against mimetic parasitic eggs. Our previous work showed that just as human signatures deter forgers, so hosts can evolve visual 'signatures' that make their eggs harder to copy. The colours, spots and squiggles on the eggs of prinias and cisticolas parasitised by Cuckoo Finches vary tremendously not only among species, but also among females of the same species. This makes it harder for a Cuckoo Finch to fool a high proportion of host females.

But there are limits to host variation; egg pigments can't produce a limitless diversity of colours and patterns, and some patterns might be too costly because they affect camouflage or thermoregulation. Faced with such constraints, hosts can make their eggs as distinctive as possible by ensuring that colour and pattern components are uncorrelated across females. For example, in the Tawny-flanked Prinia *Prinia subflava*, distinctiveness would be greatest if there were no way of predicting whether red or blue prinia eggs had blotched or scribbled markings. Eleanor Caves's MSc research tested whether this is an adaptation to parasitism or just a general property of warbler eggs. She calculated an index of the disorder in egg phenotypes between different females using the late Major John Colebrook-Robjent's vast egg collection. Eggs of parasitised warblers should show higher entropy than species that aren't parasitised. Eleanor also studied weavers, many of which are targeted by Diederik Cuckoos *Chrysococcyx caprius*. Both groups show a bewildering diversity of egg colours and patterns, but eggs of parasitised species always exhibit greater entropy than unparasitised species. This indicates that parasitism has driven hosts to evolve unpredictable combinations thus making their egg signatures harder for parasites to forge.



Eggs of different warbler and weaver species in Zambia. Species parasitised by Diederik Cuckoos and Cuckoo Finches have evolved signature-like variation in their egg colours and patterns to help them to detect foreign eggs that mimic their own, and so to reject them from their nests. Each column shows a different species, and eggs within columns all come from the nests of different individual females (Photo: Eleanor Caves and Claire Spottiswoode).

In the second paper we asked how parasites can exploit deception at all stages of the reproductive cycle. Many brood-parasites mimic host eggs; some species such as *Vidua* finches and certain Australasian cuckoos also mimic host chicks. But prior to the egg and chick stage, brood parasites need to get their egg into a host nest in the first place. We were struck by the close resemblance between female Cuckoo

Finches and female bishops and widows of the genus *Euplectes*. Does this help them to avoid being attacked by host parents when they lay their eggs? To test this hypothesis, we carried out field experiments and analyses of museum specimens together with Will Feeney (Australian National University). We confirmed that female Cuckoo Finches do indeed look more like female *Euplectes* than their own relatives, and prinia parents mob female Cuckoo Finch and *Euplectes* mounts equally (more so than males of either species). However, prinia parents are more likely to reject a foreign egg from their nest after mobbing an intruder, suggesting that the female Cuckoo Finch's innocuous-looking plumage probably is an adaptation to fool hosts, prinias are no longer fooled by this deception because they defend themselves against parasitic Cuckoo Finches and harmless female *Euplectes* alike. This appears to be the first time that such "wolf-in-sheep's-clothing" plumage mimicry has been experimentally shown to exist in an adult bird. It suggests that brood parasites exploit mimicry at all stages of the reproductive cycle: laying their egg, ensuring their egg is accepted, and ensuring their chick is fed.

Highlights:

- We facilitated a film shoot by the BBC Natural History Unit of Greater Honeyguide *Indicator indicator* chicks killing their foster siblings with their specially adapted bill hooks, in the deep, dark underground burrows of their main host species, the Little Bee-eater *Merops pusillus*. This was broadcast in the UK at the end of 2015 in a series called 'The World's Sneakiest Animals' and presented by Chris Packham. Claire co-presented our research for the international TV version of the series.
- The chick-killing behaviour of honeyguides means that hosts pay a high price if they are tricked into incubating a honeyguide egg. However, hosts blithely accept foreign eggs experimentally placed in their nests, even though they sometimes reject entire clutches containing a naturally laid honeyguide egg. This suggests that hosts may need multiple cues of parasitism before they reject eggs, because of the unusually high costs (losing their entire clutch) of making a mistake. Wenfei Tong and Nicholas Horrocks carried out an experiment to test this, which we published in *Ibis*. Most bee-eater parents were able to recognise a model honeyguide as an enemy and angrily attacked it (but didn't attack control barbets), but surprisingly this didn't trigger them to reject a foreign egg. In 2016 Luke McClean will carry out experiments to test additional potential cues of parasitism that might tip off hosts, as part of his CoE-funded MSc on Lesser and Greater Honeyguides' interactions with their hosts.
- A series of outreach talks was given to communities in and around our study area near Choma in southern Zambia, showing local communities the results of our research (which many in the audience contributed to by finding nests) and extracts from TV programmes made at the study site.
- A new project commenced on the Greater Honeyguide's remarkable mutualistic role with human honey-hunters whom it guides to bees' nests to gain access to its favourite food, wax. We are now studying coevolution between honeyguides and humans in the Niassa National Reserve of northern Mozambique, in collaboration with the Niassa Carnivore Project. Claire spent six weeks carrying out field experiments and trialling field methods.
- Jessie Walton and Rob Martin studied the parasitism of Karoo Prinias *Prinia maculosa* by Brown-backed Honeybirds *Prodotiscus regulus* near Botriver in the Western Cape for a second season. Once again, some prinia pairs raised two honeybird chicks, raising intriguing questions how the honeybird chicks discriminate between conspecifics and host chicks (which they kill soon after hatching).

Key co-sponsors
Biotechnology and Biological Sciences Research Council, UK; DST-NRF CoE grant; Leverhulme Trust.

Research team

Dr Claire Spottiswoode (U. Cambridge)
Dr Nicholas Horrocks (U. Cambridge)
Dr Rebecca Kilner (U. Cambridge)
Prof. Michael Sorenson (U. Boston)
Dr Wenfei Tong (Post-doc, U. Cambridge)

Student: Gabriel Jamie (PhD, U. Cambridge)

Research assistants: Charles Banda, Mbewe Banda, Kisswell Chonga, Silky Hamama, Lazaro Hamusikili, Oliver Kashembe, Kiverness Moono, Collins Moya, Gift Muchimba, Obvious Mudenda, Austin Muleya, Avedy Munkombwe, Refi Munkombwe, Sylvester Munkonka, Oliver Munsaka, Sanigo Mwanza, Sunnyboy Mwanza, Calisto Shankwasiya, Danny Siyapolo.

Cooperation and population dynamics in the Sociable Weaver

The Sociable Weaver research programme, based at Benfontein Nature Reserve, Kimberley, takes advantage of this species' fascinating social behaviour to investigate the evolutionary bases of cooperation and the mechanisms that allow it to persist. The long-term demographic data available on this study population is also revealing how social factors, climate and inter-specific interactions influence population trends.

Study into the evolution and maintenance of cooperation in a wild population requires a long-term investment and patience, but the pay-offs are well worth it. Fitz HRA Rita Covas, together with collaborator Claire Doutrelant (CEFE-CNRS, France, who was on sabbatical at the Fitz in 2015), continued the study on the Sociable Weaver *Philetarius socius* initiated in 1993 by now Birdlife South Africa CEO Mark Anderson. The detailed behavioural and life-history data that has been collected in more recent years is revealing that cooperation involves a fascinating mixture of benefits and unexpected costs.

Work by MSc student André Ferreira (Porto) revealed that parents work less when they are assisted by helpers at the nest, leaving not only part of the feeding, but also nest building and cleaning to these helpers. This is not without consequences, since helpers are less efficient than parents and bring smaller prey to the nest. Chicks raised with more helpers take longer to leave the nest and hence are exposed to snake predation in the nest for longer! Parents therefore appear to prioritise saving energy ahead of increasing their production or condition of their offspring.

Trading off parental survival for that of their young might be beneficial for a relatively long-lived species like these weavers. Former PhD student Matthieu Paquet (Montpellier), showed that Sociable Weaver females benefit from improved survival when they are assisted by helpers (Paquet *et al.* 2015 *Journal of Animal Ecology*). Surprisingly, however, males with helpers appear to have lower survival. This puzzling result may arise from competition with helpers to maintain dominant status.

The social hierarchy of Sociable Weavers and the benefits of being dominant, were studied in detail by Fitz student Margaux Rat, who completed her PhD in 2015. Margaux found marked dominance hierarchies in Sociable

Sociable Weavers have a fascinating social structure, with different levels of organization, and cooperate on multiple tasks. Our study aims to understand the evolutionary bases of these interesting behaviours (Photo: Rene van Dijk).

Weaver colonies, and that an individual's dominance status is signalled by its black bib (Rat *et al.* 2015 *Behavioral Ecology Sociobiology)*. More dominant birds have enhanced access to resources and tend to be more central in social networks. Further work conducted by former MSc student Paul Acker (Montpellier) also suggested a survival benefit of maintaining a high social status, as well as of having a low one (Acker *et al.* 2015 *Journal of Evolutionary Biology*). The costs and benefits of dominance on a physiological level are being studied further by MSc student Liliana Silva (Porto).

An unexpected result of cooperation was found hidden in the contents of Sociable Weaver eggs. Work by Matthieu Paquet and MSc student Sofia Santos (Lisbon) found that females vary the hormonal contents of eggs depending on whether or not they are assisted by helpers. During a short post-doc at the Fitz, Matthieu concluded a cross-fostering experiment showing that maternal effects influence begging behaviour in this species (Paquet *et al.* 2015 *Animal Behaviour*). These results suggest that females may attempt to 'manipulate' the

provisioning behaviour of helpers, and MSc student Rita Fortuna (Porto) is continuing this research by investigating the response of helpers and breeders to begging vocalisations.

Other work conducted in collaboration with René van Dijk and Ben Hatchwell from Sheffield, analysed the genetic structure of Sociable Weaver colonies. They found fine-scale genetic differences among colonies, confirming previous results that genetic structure in this species arises from sex-specific dispersal, with females often dispersing to breed, while males tend to remain in the natal colony (van Dijk *et al*. 2015 *Molecular Ecology*). Further work into some of the factors underlying dispersal and other demographic parameters was initiated by Fitz CB MSc student Kyle Lloyd, who showed that interactions between social effects, climate and predation result from population trends.

In 2015, Rita and Claire were awarded two major grants to investigate the direct benefits of cooperation (i.e. benefits that are not related to helping kin). These grants from the Portuguese (FCT) and French (ANR) national research agencies will run until 2019, allowing us to continue the long-term work and expand the research we have been conducting. Two post-docs have started working with us under the auspices of this new project. Sophie Lardy (Claude Léon Fellowship) is investigating the physiological and survival costs of helping. Arnaud Tognetti (IAST, France) has started experimental work to understand whether cooperative behaviour may be used to attract mates. A new PhD student will be investigating the reliability of cooperation.

Highlights

- Rita Covas and Claire Doutrelant were awarded two major research grants from the Portuguese Science and French Research Agencies.
- In 2015 the Sociable Weaver team published five papers in top ranking journals: *Animal Behaviour*, *Behavioral Ecology and Sociobiology, Journal of Evolutionary Biology, Journal of Animal Ecology* and *Molecular Ecology*.
- Claire Doutrelant (CEFE-CNRS, France) spent a 1-year sabbatical at the Fitz.
- Margaux Rat was awarded a PhD from UCT for her work on 'Dominance, social organisation and cooperation in the Sociable Weaver'.
- André Ferreira and Sofia Santos were awarded MSc degrees from the Universities of Porto and Lisbon, respectively.

Key co-sponsors

ANR; DST-NRF CoE grant; FCT; Marie Curie International Research Staff Exchange Scheme, NERC.

Research team

Dr Rita Covas (HRA, PFIAO and CIBIO, U. Porto)
Dr Claire Doutrelant (CEFE-CNRS, France)
Dr Res Altwegg (SEEC, UCT)
Dr Sophie Lardy (Post-doc, PFIAO)
Dr Matthieu Paquet (Post-doc, U. Edinburgh)
Dr Arnaud Tognetti (Post-doc, U. Toulouse)
Prof. Ben Hatchwell (U. Sheffield)
Dr René van Dijk (U. Sheffield)

Students: Margaux Rat (PhD); André Ferreira (MSc CIBIO, U. Porto), Rita Fortuna (MSc CIBIO, U. Porto), Sofia Santos (MSc, U. Lisbon), Liliana Silva (MSc CIBIO, U. Porto), Kyle Lloyd (CB MSc)

Research Assistants: Caterina Funghi, Maxime Passerault, Franck Theron.

There is a marked dominance structure within Sociable Weaver colonies that is conveniently signalled by the bird's black bibs and ritualised behaviours (Photo: Franck Theron).

Pied Babblers and Fork-tailed Drongos

Tim Clutton-Brock established the Kuruman River Reserve to study group living in meerkats, but it has become the focus of several other long-running animal studies. Amanda Ridley's Pied Babbler Research Project was initiated in 2003 and uses habituated, free-living groups of Southern Pied Babblers *Turdoides bicolor* to understand the causes and consequences of cooperative breeding behaviour. In 2006 Amanda expanded the study to include the local Fork-tailed Drongo *Dicrurus adsimilis* population, investigating interactions between drongos, babblers and other species. Tom Flower joined the drongo project in 2008 to continue research on species interactions, with a focus on the drongos' use of false alarm calls to steal food from other animals.

Amanda Ridley is a Fitz HRA based at the University of Western Australia and her research focuses on the causes and consequences of helping behaviour, population dynamics (including causes of local extinction), sexual selection, interspecific interactions, and vocal communication. Amanda's current Pied Babbler grant is focussed on the climatic versus social factors that influence group stability between years, and the influence of Allee effects on population dynamics. Several researchers from various institutions collaborated on the project during 2014-15. Post-doc Martha Nelson-Flower was based at the Fitz until the start of 2015, relating genetic patterns to cooperative behaviours. She continued her research on the Pied Babblers from her new position at the University of British Columbia, focussing on patterns of reproductive sharing among group members. Martha is also studying the effects of intrasexual competition on reproductive skew and dispersal strategies.

PhD student Elizabeth Wiley (based at UWA, supervised by Amanda Ridley) is conducting research on long-term population dynamics, and how this affects intra- versus inter-group stability between years. In particular, she is interested in the strength of the pair bond on group stability, as well as the social versus climatic influences on group size declines and extinction rates. PhD student Sabrina Engesser (Zurich University, supervised by Simon Townsend) is interested in the information encoded in Pied Babbler vocalizations, and has found evidence for syntax, which is considered a precursor to language. PhD student James Westrip (Edinburgh University, supervised by Matt Bell) is assessing how group members communicate, and how differences in the reliability/quality of information provided affects the efficiency of information transfer. James handed in his thesis at the end of 2015. This diversity of research is unravelling fascinating discoveries regarding the complexity of social life. A new collaboration between Amanda Ridley, Susan Cunningham and Claire Spottiswoode will start in 2016, with funding from the NRF. This research will look at whether sociality can buffer the impacts of climate change, combining aspects of physiological and behavioural research.

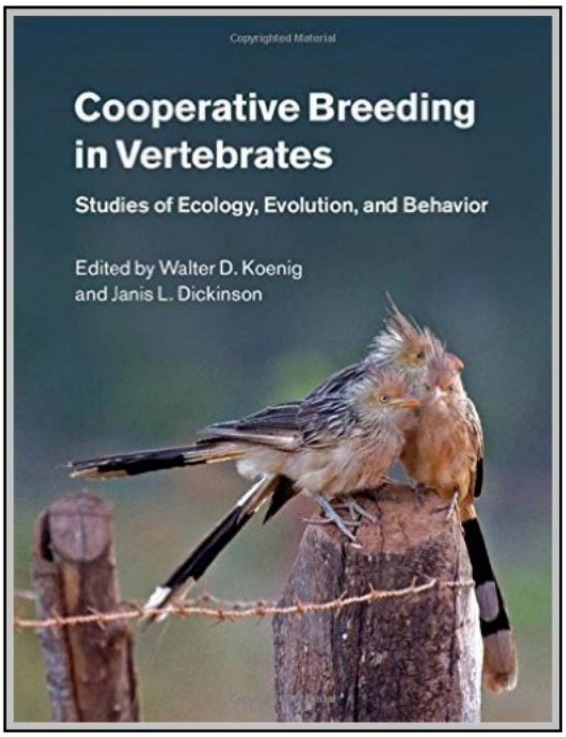
One of the key strengths of the Pied Babbler project is getting the daily masses of all group members with minimal disturbance (Photo: Peter Rvan).

Tom Flower became a Fitz HRA in 2015 after he joined Simon Fraser University (Canada), from where he has continued his research on a population of 200 habituated Fork-tailed Drongos in the Kalahari. Tom's group has studied interactions between drongos and other species, illuminating our understanding of how different species shape the evolution of each other's behaviour. In particular, his work has gained international recognition for providing fascinating insights into food theft, vocal mimicry and deceptive communication. This work, published in top journals including *Science*, has featured in numerous popular magazine and newspaper articles as well as in radio and television programs both in South Africa and internationally.

In 2014/15 Tom expanded his work in collaboration with Dr Claire Spottiswoode to investigate coevolution between drongos and their two brood parasites, the African Cuckoo *Cuculus gularis* and Jacobin Cuckoo *Clamator jacobinus*. Unlike most host species that raise the young of a single brood parasite species, drongos have two different brood parasites requiring different tactics to prevent parasitism and also resulting in competition between brood parasite species for access to hosts. An early manuscript from this research has identified this unusual system and future manuscripts are poised to reveal the coevolution of new strategies in arms races between parasites and their hosts.

Highlights

- Tom Flower published a paper in *Ostrich* revealing that brood Fork-tailed Drongos are, unusually, hosts for two different cuckoo species, the African Cuckoo and Jacobin Cuckoo. Further research is under way to reveal how and why this occurs and what the consequences are for these species behaviour.
- Tom Flower was awarded a prestigious Banting Fellowship to begin research on interactions between nest predators and breeding birds. This work will inform our understanding of species conservation where human land use alters predator abundance and behaviour, causing increased nest predation on threatened birds.
- A chapter on the Pied Babblers by Amanda Ridley was included in the latest edition of the very successful book '*Cooperative Breeding in Vertebrates: studies of ecology, evolution and behaviour* edited by Walter Koenig and Janis Dickinson.



- Celebrity wildlife biologist, Chris Packham visited the Kalahari to produce a natural history documentary for the BBC featuring research from both the Pied Babbler and Fork-tailed Drongo research projects.
- Pied Babbler research was featured in several publications (*PLOS One, Behavioral Ecology & Sociobiology, Behavioral Ecology*) and presented at several international conferences (ISBE, Behaviour).

Key co-sponsors

DST-NRF CoE grant; The Australian Research Council; The National Environmental Research Council.

Research team

Assoc. Prof. Amanda Ridley (HRA, PFIAO and UWA)
Dr Matt Bell (U. Edinburgh)
Dr Tom Flower (HRA, PFIAO)
Prof. Marta Manser (U. Zurich)
Dr Martha Nelson-Flower (U. British Colombia)
Dr Simon Townsend (U. Zurich)

Students: Sabrina Engesser (PhD Zurich), James Westrip (PhD Edinburgh), Elizabeth Wiley (PhD UWA)

Research assistants: Ben Ashton, Elisabeth Espy, Simon Kotze, Ryan Olinger, Aurelie Quinard, Elizabet Zottl.

Sociable Weaver nests as a resource

Sociable Weavers *Philetairus socius* build nests that are home to hundreds of weaver individuals, but also host a wide range of other avian and non-avian species. Descriptive accounts have documented some of the other species that use these nests, most notably the Pygmy Falcon *Polihierax semitorquatus*. However, despite the fame and conspicuousness of this system, the importance of Sociable Weaver nests to the broader animal community remains largely unstudied.

A ringed female Pygmy Falcon perches near her nest. She may be helped during chick rearing by offspring from a previous brood, as well as one or more mates (Photo: Andrea Santangelli).

This project is a new addition to the Fitz. Project leader Robert Thomson joined the Fitz at the beginning of August 2015, as did PhD student Anthony Lowney. The study was initiated in 2011 linked to a fellowship granted by the Academy of Finland. The funding impetus provided by the project's move to the Fitz promises an exciting time, with an expanding team and broader questions to be addressed in this fascinating system. In late 2015 a post-doc position was advertised that will be filled in 2016. The main study area is Tswalu Kalahari Reserve, Northern Cape. In a 100 km^2 section of the reserve we have mapped ca. 250 Sociable Weaver nest colonies.

Weaver nests as a resource

This project examines the importance of Sociable Weaver nests to the Kalahari animal community. The objective is to investigate the diversity of animals associated with the nests and the interactions between the species utilizing this resource. We also aim to understand how the 'ecological engineer' potential of these nests may have community-wide impacts on structure and function; and how this impact may change as environmental harshness increases across the weaver's range.

Ecological engineers are organisms that directly or indirectly impact the availability of resources to a substantial proportion of species in a community. In hot arid environments, species that create thermal refugia, such as Sociable Weaver nests, are likely critical ecological engineers that play a prominent role in the system. We shall test predictions that the facilitative ecological engineer role of Sociable Weaver nests will increase in importance as environmental harshness increases.

As a first step, PhD student Anthony Lowney has begun investigating the diversity of species that use Sociable Weaver nests in detail within the study area. He is also looking at how nest use by other species changes seasonally. This

involves frequent night visits to document roosting bird species, and observations and camera traps to document other species. Anthony's thesis will also take a spatial component, to investigate the use of nests by different animal communities across the weavers' range. For this component, we will collect data from sites across the Sociable Weaver distribution range incorporating an aridity (harshness) gradient, south-east to north-west in the Kalahari.

Interaction between nest associates

Our initial data shows that Sociable Weaver nests are islands of animal diversity in the Kalahari. But while providing an important resource for a multitude of other species, weavers also continue to use the nests and surrounding ecosystem resources themselves. Their nests offer a resource to predator, prey, competitor, parasite, and commensal species, with net consequences that may be positive or negative to the weavers. Between-species interactions of various nest associates present a unique system in which to study interactions and co-evolution centred on a single resource. This component of the project will use experimental approaches to tease apart the interplay of positive and negative interactions between weavers and associate species, and between associate species

Pygmy Falcon in focus

A notable associate, and also an obligate one, is the Pygmy Falcon. This small raptor, which roosts and breeds exclusively in Sociable Weaver nests in southern Africa, but also preys on Sociable Weaver nestlings and even adults, albeit rarely. This demonstrates an intricate relationship between the species, the nature of which remains unclear and is a key question in this project. Obligate associations between vertebrates are rare and subject to little empirical work; understanding the nature of these interactions between hosts and obligate associates will highlight the evolutionary mechanisms leading to associations of this type.

An Acacia Pied Barbet occupies a Sociable Weaver nest cavity (Photo: Aija Lehikoinen).

Robert Thomson checking nest chambers in a huge Sociable Weaver nest (Photo: Aija Lehikoinen).

The study area hosts ca. 35 Pygmy Falcon territories, which have been followed for four years. Initial focus was to gain an understanding of the life history of the falcon. More than 300 falcons have been marked up to the end of 2015, and the full study population is followed annually. The social breeding system has been revealed as cooperative with young, mostly male offspring delaying dispersal and remaining in their natal territory for a year or more. This study will be written up soon. However, cases of multiple unrelated males in the same group persist, and genetic parentage analyses will be performed to determine the genetic consequences of these cases.

Key co-sponsors
Academy of Finland; DST-NRF CoE grant; Tswalu Foundation; University of Turku collegium for Science and Medicine (Finland); University of Cape Town launching grant.

Research team
Dr Robert Thomson (PFIAO)

Student: Anthony Lowney (PhD)

Impacts of power infrastructure

Over the last few years the Fitz has been involved in projects to mitigate the impacts of power generation infrastructure. Initial attention was focused on collision impacts associated with powerlines, which mainly affect large, open-country birds such as bustards and cranes that are unable to react rapidly when they encounter aerial obstructions. More recently the project has considered the impacts of renewable energy technologies, including wind and solar power generation.

Powerline collisions

The project to assess and mitigate the impacts of powerline collision mortality has been run in conjunction with the Endangered Wildlife Trust (EWT), Eskom, the Namibia Nature Foundation (NNF) and NamPower. During 2015, former student Jess Shaw published three papers arising from her PhD study on the impacts of powerlines on large birds in the Karoo. Her long-term experiment to test the efficacy of line marking (using flappers or static flight diverters) continued in the De Aar region of the eastern Nama Karoo. Analyses at the end of 2015 show a benefit to marking lines for Blue Cranes *Anthropoides paradiseus*, but not for Ludwig's Bustards *Neotis ludwigii*; these findings will be prepared for publication in 2016. Little progress was made with MSc student John Pallet's monitoring of collision mortality on powerlines in Namibia during 2015 due to John's work commitments. He will not register in 2016, but plans to re-register once he has time to complete his thesis.

Renewable energy impacts – wind farms

Run in conjunction with BirdLife South Africa's Samantha Ralston, a former CB MSc student, this project is designed to assess and mitigate threats to birds posed by renewable energy projects. Wind and solar generation have much less environmental impact than the coal-fired power stations on which South Africa relies for most of its power generation, but both technologies can have significant impacts at a local scale. Wind turbines are well known to kill birds and bats, sometimes in significant numbers, and a large industry has developed to assess the impacts of proposed wind farm developments. Working through the Birds and Wind Energy Working Group, BLSA and the EWT have played a leading role in developing and updating best-practice guidelines for assessing and monitoring the impact of wind energy facilities on birds, and Peter Ryan has acted as an external reviewer for successive versions of these guidelines.

A Sociable Weaver nest next to the Khi Solar One power tower between Upington and Keimoes (Photo: Peter Ryan).

The entire southern African population of Bearded Vultures *Gypaetus barbatus* is restricted to the Maloti-Drakensberg Mountains of South Africa and Lesotho, where it is threatened by planned wind farms in the Lesotho highlands. Post-doc Tim Reid used Sonja Kruger's GPS tracking data from this population to build a 3-D risk map to help developers to site wind farm in the least damaging locations. The results, published in the *Journal of Applied Ecology* in 2015, have been made available in digital form to developers (see p. 17 for more detail).

PhD student Megan Murgatroyd, supervised by the ADU's Les Underhill and Arjun Amar, collected fine-scale tracking data for Verreaux's Eagles *Aquila verreauxii*. Based on their close similarity to Golden Eagles *A. chrysaetos*, Verreaux's Eagles are expected to be prone to collision mortality with wind turbines, and at least five have already been killed by windfarms in South Africa. Megan compared movements of eagles breeding in mountainous regions with those breeding on isolated inselbergs that mainly forage over flat terrain. Surprisingly she found that the latter group, which relied more

on thermals for lift, were more efficient foragers than the former birds that relied mainly on ridge soaring; the results were published in *Condor* in 2016. Megan has now started a post-doc with the Fitz to expand her research on GPS tracking to investigate lift availability and flight probabilities for Verreaux's eagles to help reduce the risk of collisions with wind turbines at a fine spatial scale.

Fitz Research Associate Andrew Jenkins led a very detailed study of collision risk to Great White Pelicans *Pelecanus onocrotalus* commuting to and from their breeding site on Dassen Island through a proposed windfarm development site south of Darling. Initial observations suggested a significant risk to pelicans, especially on their departure from the colony. Andrew teamed up with Rhonda Millikin from Echotrack to use sophisticated short-range radars to confirm flight heights and trajectories for the pelicans. They were able to show that five of the planned 35 turbine placements pose the greatest threat to pelicans, offering a possible mitigation approach. However, much depends on how pelicans react to the turbines, and until these are erected, any estimate of potential impact remains unacceptably speculative. A paper reporting these findings is being readied for submission.

Large-scale solar power generation

The cost of solar generation has decreased rapidly, making it competitive with traditional generating techniques. The South African Department of Energy has already received 422 applications for more than 20,000 MW of solar generating facilities. Three technologies are being used: photovoltaic (PV) panel 'farms' and two concentrated solar power (CSP) approaches, power troughs and power towers. PV farms generate electricity directly into the national grid but cannot generate power towards base demand at night, requiring off-site storage options such as pump-storage schemes. Power troughs use parabolic mirror arrays to heat a synthetic oil to almost 400°C, which is used to create steam to drive a generating turbine, or to maintain a liquid salt heat store that allows power generation to continue after dark. Power towers use thousands of large, flat mirrors to reflect the sun's energy onto towers.

Very little has been published on the impacts of solar-generating technologies on birds. Collision mortality is the main threat associated with PV plants, especially for waterbirds which apparently can perceive the large panel arrays as waterbodies when flying over at night. CB MSc student Elke Visser spent three months at the Jasper 96 MW plant near Postmasburg in the Northern Cape, one of South Africa's largest PV facilities. Elke conducted regular surveys for collision mortalities, and estimated the detection probability of such events by estimating observer and scavenger bias. She found very few mortalities, and even accounting for a fairly high scavenger removal rate of small birds, it is unlikely that significant numbers of any bird species are being killed by the facility. The bird community in the plant area differed significantly from adjacent untransformed land mainly as a result of open-country species being favoured following the removal of bush cover.

Highlights:

- Jess Shaw published three papers in 2015: one on the population size and trends of Ludwig's Bustards and other large terrestrial birds in the Karoo (*Bird Conservation International*), one inferring movement patterns and the main breeding areas of Ludwig's Bustards from stable isotope signatures of their feathers (*Austral Ecology*), and one reporting winter scavenging rates of bird carcasses in the Karoo (*South African Journal of Wildlife Research*).
- Andrew Jenkins concluded a study using radar tracking to confirm the threat posed by a proposed windfarm development to Great White Pelicans commuting to and from their breeding site on Dassen Island.
- Elke Visser assessed the impacts on birds of one of South Africa's largest photovoltaic solar plants for her CB MSc project.

Key co-sponsors
Endangered Wildlife Trust-Eskom Strategic Partnership; Mazda Wildlife Fund.

Research team
Prof. Peter Ryan (PFIAO)
Dr Arjun Amar (PFIAO)
Samantha Ralston (BLSA)
Dr Andrew Jenkins (ADU, UCT)
Dr Tim Reid (former Post-doc, PFIAO)
Dr Jess Shaw (RA, PFIAO)
Dr Rob Simmons (HRA, PFIAO)

Students: Megan Murgatroyd (PhD); John Pallett (MSc) Elke Visser (CB MSc)

Conservation of Bearded Vultures in southern Africa

The Bearded Vulture *Gypaetus barbatus* is a Critically Endangered species in southern Africa and their entire range in the Southern Hemisphere falls within the Maloti-Drakensberg mountains of South Africa and Lesotho. Following Sonja Krüger's PhD on the decline of this population, we have been exploring the potential to reintroduce the species to parts of its former range.

Adult Bearded Vulture in the Drakensberg mountains (Photo: Sonja Krüger).

The Bearded Vulture population in southern Africa has declined by up to 50% over the last 30-50 years, and only around 100 pairs remain. In 2015 we published a paper in *Condor* exploring the likely reasons for territorial abandonment in this species. We tested three hypotheses related to i) human impact, ii) food availability and iii) climate change. The strongest support was for the human impact hypothesis, with abandonment more likely in territories with higher densities of power lines and human settlements.

In addition to the existing pressures identified thus far, the population is now facing another major and potentially catastrophic threat from multiple wind farms which are planned for the Lesotho highlands. Because of their high soaring flights and their wide ranging nature, the species is considered particularly vulnerable to collision with wind turbines. We wanted to ensure that any future wind farm developments can be placed in the least damaging locations. To achieve this we created habitat use models to identify intensively used areas. This research was published in the *Journal of Applied Ecology*, and a user friendly version of the risk maps provided to developers to help with their planning processes.

Reintroduction: a feasibility analysis

In light of the rapid levels of decline in the Bearded Vulture population, and the emerging threat of wind farms, the Bearded Vulture Task Force decided at a meeting in early 2015 that it was time to consider the options for a potential reintroduction into parts of the species' former range, which previously extended to the Western Cape. The species lays two eggs, yet only ever raises one chick and previous work in Europe has shown that the second egg can be successfully removed, hatched in captivity and contribute to a successful release programme.

To explore the potential of such a reintroduction project, CB MSc student Christiaan Brink undertook a feasibility analysis. This aimed to identify suitable candidate sites for a reintroduction, and to then undertake a cost-benefit analysis to identify which site might be best. The initial analysis identified five potential sites that were suitable in terms of topography and climate. These five sites were then compared and contrasted in terms of threats (e.g. powerlines, human settlement densities, established or proposed wind farms) or benefits (e.g. presence of protected areas, food supplies). These analyses identified two clear winners, both within the Eastern Cape. Further analyses examined at a finer scale where, within the potential release sites, would be most suitable for a release.

The second part of Christiaan's research project was to explore how to best to undertake such a release project. For this he used the

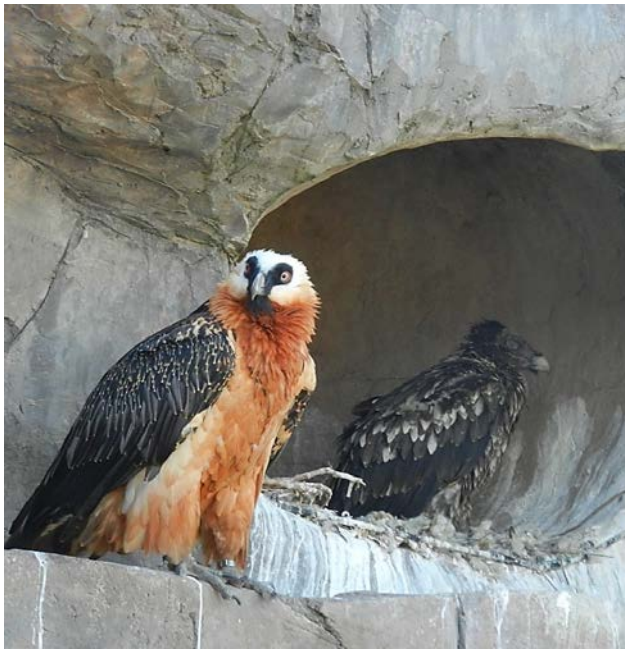
A recently hatched Bearded Vulture chick being puppet reared as part of the captive breeding programme (Photo: Sonja Krüger).

programme Vortex to model population growth rates under three scenarios: 1) all birds harvested from the wild released straight into a reintroduction programme; 2) all birds harvested from the wild placed into a captive breeding programme to subsequently produce young for a reintroduction programme; or. 3) a combination approach, whereby some birds harvested from the wild are released and some are used to start a captive breeding programme. These models suggested that releases straight into the wild would not be an effective approach with the reintroduced population having a very low chance of survival. The other two scenarios were more successful, each having different merits.

These results will allow such a conservation programme to move forward and the Bearded Vulture Task Force are in discussions with a range of stakeholders in this regard. Christiaan's research will be vital in ensuring the success of any such project.

Highlights:

- Sonja presented her research at several conferences including at the EWT's Birds of Prey conference in Ithala, Ezemvelo KZN Wildlife's Symposium of Contemporary Science and Annual meeting for the Bearded Vulture in Europe.
- A paper on how anthropogenic activities influence the abandonment of Bearded Vulture territories in southern Africa was published in *Condor* in 2015.
- A paper on modelling habitat use by Bearded Vultures in the region to help with wind farm placement was published in the *Journal of Applied Ecology* in 2015. This paper was also presented by Sonja at a Windfarm Conference in Berlin.
- A paper on reduced genetic diversity in Bearded Vultures appeared in *Ibis* in 2015.
- Sonja Krüger's PhD was awarded the Purcell Memorial Prize for the best dissertation of 2015 within the Science Faculty, UCT.
- An article covering this research was published in *The Conversation* and subsequently published in *The Guardian* and has so far been accessed >7 000 times.
- Christiaan Brink completed his CB MSc thesis on examining the feasibility of the reintroduction of the Bearded Vulture into parts of its former range and will graduate in June 2016.



Adult Bearded Vulture (foreground) with a newly fledged Bearded Vulture (background) raised at the African Birds of Prey Sanctuary as part of a conservation breeding programme (Photo: Sonja Krüger).

Key co-sponsors
DST-NRF CoE grant; Endangered Wildife Trust; Ezemvelo KZN Wildlife; Natural Research Ltd; Wildlands Trust.

Research team
Dr Arjun Amar (PFIAO)
Dr Sonja Krüger (PFIAO)
Dr Tim Reid (former Post-doc, PFIAO)
Dr Phil Whitfield (Natural Research Ltd)

Student: Christiaan Brink (CB MSc)

Conservation of Martial Eagles

The Martial Eagle *Polemaetus bellicosus* is Africa's largest eagle and is one of the defining species of the African savannah, where it functions as an important apex predator. Recent analysis suggests that the species may be in trouble in South Africa, with declines recorded even within our large protected areas. We are undertaking several research projects to understand why this is happening.

Concerns regarding the conservation status of Martial Eagles in South African have increased in recent years, and in 2013, were quantified in detail by CB MSc student Daniël Cloete. Daniël compared reporting rates of the species in SABAP1 with SABAP2 and revealed a 60% decline across South Africa. We confirmed the validity of these declines by showing that declines recorded from SABAP1 and 2 mirror real declines in numbers of breeding pairs within the Kgalagadi Transfrontier Park; this paper was published recently in the journal *Ostrich*. Worryingly the declines detected in this protected area have also been found for many of South Africa's other large protected areas, resulting in the species being globally up-listed to Vulnerable by the IUCN, and to the recent regional uplisting to Endangered in the 2015 Red Data Book of Birds in South Africa, Lesotho and Swaziland.

Within the Kruger National Park, which is generally considered to be one of the species' strongholds, reporting rate declines of up to 54% have been recorded. In response to these concerns Rowen van Eeden commenced his PhD research in 2013 to understand what might be driving the changes.

Rowen's research has focussed on exploring the species' ranging behaviour and habitat preference. This has been achieved by fitting adults (n=6) and juveniles (n=9) with GPS tracking tags. These tags also allowed for the detection of mortalities and the causes of these mortalities to be identified. Additionally, Rowen has been monitoring nesting success within Kruger.

Our tracking study demonstrated that adult Martial Eagles occupy enormous territories averaging 110km^2. These territory sizes suggest that Kruger's carrying capacity likely ranges between 127-216 pairs. Adult birds preferred landscapes characterised by high tree cover and dense bush rather than open grasslands, and preferred areas close to rivers. These results are important considering the changes in Kruger's habitat over the last half century, where tree cover has declined by over 60% in part due to increasing elephant densities. Thus the very nature of the areas important for Martial Eagles may be undergoing changes that affect the carrying capacity of the landscape.

Martial Eagles in the Kruger National Park have experienced 54% declines in reporting rates over the last 20 years. GPS tagging, ringing and nest checks are conducted to understand movement patterns, habitat requirements, threats, survival rates and productivity. This information provides insights into the potential drivers of these declines (Photo: Rene van der Schyff).

Our tracking devices also highlighted that adult Martial Eagles were at risk of electrocution both within park borders and in the surrounding landscape. One nomadic individual was deliberately killed in rural Mozambique.

To understand these impacts and eventually calculate survival rates, we colour ringed 25 adults within the park. We have been very grateful to the public for all the re-sighting information, which continues to stream in.

Juvenile birds spend 200-270 days within the natal territory. Once they disperse, they traverse much of the Lowveld, with home ranges up to twice the area of Kruger (ca 20 000 km^2). The juveniles have similar habitat preferences to adults, avoiding areas that are highly transformed by human activities. Three juvenile mortalities were detected. A third year bird, apparently starved, a common cause of death in juvenile eagles establishing a territory and developing hunting skills. In the other two cases the exact cause of mortality could not be determined, but at least one was likely due to a powerline collision.

Rowen will be writing up his thesis in 2016, during which time all of the data he has gathered will be analysed and published in peer reviewed journals. The project will continue in Kruger in 2016.

Karoo study

In 2015, MSc student Jessie Berndt submitted her thesis assessing the environmental factors that influence Martial Eagle territory densities and locations along South African transmission lines. This study aimed to reliably estimate the size of this population and its relative importance to the national population. Jessie's habitat association models predict that the South African transmission grid supports 130 –159 breeding pairs of Martial Eagles – similar to that found in Kruger. This is the first time such a figure has been estimated, and suggests that 36% of the national breeding population could reside in the commercial ranchlands of South Africa nesting on man-made structures.

Martial Eagles are prone to electrocution. This eagle was recovered on a power line in KNP and was ringed during a previous study 22 years ago (Photo: Rowen van Eeden).

Martial Eagles are ringed with unique colour combinations to calculate survival rates and territory sizes. 25 Martial Eagles were ringed between 2013 and 2015 (Photo: Chris Gouws).

Highlights:

- We colour ringed 25 adults as part of our research into survival rates.
- We GPS tagged nine juveniles and six adults to understand ranging behaviour and causes of mortalities.
- We completed our third consecutive year of breeding monitoring in Kruger National Park.
- We successfully completed aerial nest surveys covering the entire Kruger National Park.
- A paper validating declines in the field from SABAP1 and 2 was published in *Ostrich.*
- Jessie Berndt graduated with a MSc in June 2015. Her thesis examined nesting by Martial Eagles along transmission lines.

Key co-sponsors

ABAX Foundation; African Bird Club; Columbus Zoo and Aquarium; DST-NRF CoE grant; National Geographic Society; Natural Research Ltd; Raptor Research Foundation; Riverbanks Zoo and Garden; University of Cape Town Research Committee.

Research team

Dr Arjun Amar (PFIAO)
Dr Res Altwegg (SEEC, UCT)
Andre Botha (Endangered Wildlife Trust)
Dr Andrew Jenkins (ADU, UCT)
Dr Phil Whitfield (Natural Research Ltd, UK)

Students: Rowen van Eeden (PhD); Jessie Berndt (MSc)

Conservation of vultures in Botswana

Vulture populations across Africa have been receiving considerable attention recently due to the large declines that are being detected. Within Botswana, all five species of vultures are now either endangered or critically endangered. However, we currently have no information on the population trends of any of the species within this country.

Working with the NGOs Raptors Botswana and Kalahari Research & Conservation, we recently initiated a new study aimed at understanding the changes in vultures and other raptor populations within Botswana over the last 20 years. Beckie Garbett is conducting this research as part of her MSc at the Fitz, supervised by Arjun Amar. We have the opportunity to repeat the extensive raptor road counts conducted in the 1990s by Marc Herremans.

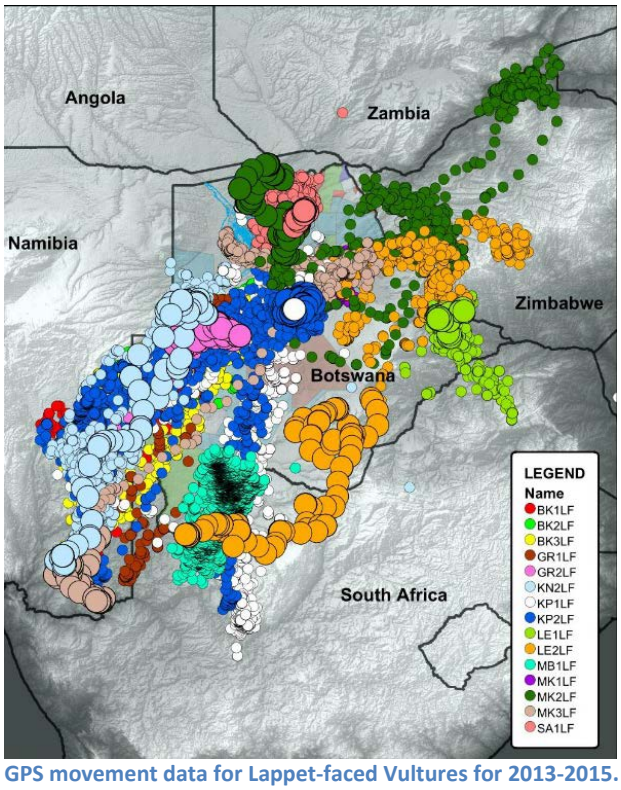
In 2015, we completed 13 700 km of road counts throughout the north of the country, and will undertake a further 10 000 km in 2016. These surveys will allow us to quantify the changes in vulture and other raptor populations throughout the north of the country. We also hope to compare whether changes differ inside or outside of protected areas and hunting areas.

Our research is also exploring the threat of lead poisoning to vultures. Beckie's previous research has found that 31% of White-backed Vultures *Gyps africanus* exhibit elevated blood lead levels. We suspect that the main source of this lead comes from fragmented ammunition in carcasses on which vultures feed, which is supported by the highest blood lead levels being associated with hunting farms, and during the hunting season. To further explore other possible sources of lead, Beckie is also testing water samples and domestic cattle blood samples. In this way, alternative environmental sources of lead contamination can be identified or eliminated.

One of the vulture species in Botswana to have been recently elevated in their conservation status is the Lappet-faced Vulture *Torgos tracheliotos*, which is probably the least abundant of Africa's vultures, and one of the least studied species. We have therefore initiated research on their movements and breeding success in Botswana, which will form a major component of Beckie's PhD.

We have fitted GPS tracking units to adult Lappet-faced Vultures in Botswana. Several of these birds have crossed international borders, travelling into all neighbouring countries, and moving up to thousands of kilometres per day. Common routes have been from northern Botswana to the Karas region of southern Namibia and the Northern Cape of South Africa. These vast trans-boundary movements pose significant challenges and highlight the necessity for international conservation efforts if actions are to be effective in conserving this species.

The tracking data also show that Lappet-faced Vultures spend most of their time outside of protected areas, which raises questions on how useful these areas are as a conservation tool for this species. Over 230 000 GPS locations have been recorded which will be analysed to determine foraging ranges, time spent in areas of different land use type with a particular focus on protected areas and hunting farms, and seasonal effects on ranging behaviours.



GPS movement data for Lappet-faced Vultures for 2013-2015.

A tagged Lappet-faced Vulture – death caused by poisoning (Photo: Beckie Garbett).

Mortalities of tagged birds have so far all been attributed to either direct or indirect poisoning events by farmers in communal farming areas.

The Makgadikgadi Pans National Park is an Important Bird Area (IBA) and a stronghold for breeding Lappet-faced Vultures in Botswana. Breeding monitoring in the park in 2014 and 2015 has seen low breeding success rates (30%) in comparison with studies carried out in other parts of Africa which have averaged 40-50%. Tagged birds are also being monitored throughout the breeding season and information on numbers of breeding and non-breeding birds will be used to estimate population productivity. Breeding monitoring will continue in 2016.

Lappet-faced Vulture patiently waiting for a feeding opportunity (Photo: Beckie Garbett).

Highlights:

- A paper describing the levels of lead found in White-backed Vultures was published in *Vulture News.*
- We successfully completed several mass captures to test vulture blood for lead levels.
- 13 700 km of repeat road transects were completed throughout northern Botswana.
- Transmitters have been attached to 15 Lappet-faced Vultures
- Several breeding pairs of Lappet-faced Vultures were monitored within Makgadikgadi Pans NP.

Key co-sponsors
Columbus Zoo; DST-NRF CoE grant; Peregrine Fund; Rufford Foundation.

Research team
Dr Arjun Amar (PFIAO)
Dr Glyn Maude (Raptors Botswana)
Pete Hancock (Raptors Botswana)

Student: Beckie Garbett (MSc)

Black Harriers – ecology and fitness

The Black Harrier *Circus maurus* has been the subject of 15 years' of monitoring at the FitzPatrick Institute and the resultant data base of over 450 nests is now paying dividends in the form of new genetic and health data emanating from this scarce, endemic bird of prey.

The species' conservation status was revised in 2015 with both South Africa (Taylor *et al*. 2015) and Namibia (Simmons *et al*. 2015) up-listing it to Endangered from Vulnerable due to habitat loss and degradation. This is overlaid on the finding that it is genetically depauperate (Fuchs *et al*. 2014) making its future persistence uncertain in the face of further climate change. It has an estimated world population of less than 1 000 mature breeding birds. The reasons for the scarcity of this species needs further investigation, but its breeding productivity in natural vegetation, the species' sensitivity to contaminants and pesticides in the environment ,and its migration strategies are all being investigated by the Black Harrier group.

Carrying on the research initiated by HRA Rob Simmons in 2000, Marie-Sophie Garcia-Heras' PhD studies are focusing on factors influencing Black Harrier breeding success, in particular diet, prey abundance and habitat quality in different areas. She is also assessing movements between breeding and non-breeding areas, and levels of connectivity between subpopulations, which may influence the level of genetic mixing. Other threats such as the impact of contaminants (e.g. polychlorinated biphenyls PCBs and dichlorodiphenyltrichloroethane DDT) have recently revealed some unexpected results. Marie-Sophie's research is supervised by Rob Simmons and Beatriz Arroyo and François Mougeot (CSIC, Spain).

Once the adult birds were measured, weighed, and sampled they were released within 20 -30 minutes (Photo: Rob Simmons).

Health status

Our laboratory analyses on organochlorine pesticides showed that both Black Harrier adults and chicks carry contaminants in their blood. PCBs that arise from industrial sources were at higher levels in nestlings than in adults. Another toxic chemical is the pesticide DDT which was banned in the 1980s but is still used legally to combat malaria in north-eastern South Africa. To our surprise, both DDT and DDE (a breakdown product of DDT) were found in sampled individuals in the Western and Northern Cape. Even more disturbing, levels of p,p'DDT were at higher levels in nestlings than in adults. This suggests a local and recent contamination, which is curious because malaria is found in neither the Western nor the Northern Cape, and therefore DDT should not be used in this part of the country. The levels of p,p'DDT found in nestlings may arise from contamination through their prey (i.e. from migratory birds moving from DDT areas into harrier breeding areas), or from contamination via the soil (DDT's half-life can range from 22 days up to 30 years), or it may indicate possible illegal use of DDT in the Black Harrier's breeding areas. While adult harriers may pick up contaminants during the non-breeding season in their summer quarters in the Eastern Cape and Lesotho, this is unlikely to explain the high levels of DDT in nestlings. We also are investigating the possibility of maternal

transfer of DDT/DDE from the females to their young via the eggs, which would explain the high levels found in the nestlings.

Genetic status

Following on from the findings that Black Harriers are genetically depauperate in mitochondrial DNA (Fuchs, Simmons, Bowie *et al*. 2014) a study of the phylogeny of the entire harrier group led by Dr Graeme Oatley (Oatley *et al*. 2015) found that:

- the harriers diversified 4.9 -12.2 mya from the accipiters, coinciding with the Miocene, when grasslands were spreading rapidly across the world, particularly on the African plains.
- This appears to have precipitated the emergence of the Black Harrier from its closest relative the migratory Eurasian Pallid Harrier *Circus macrourus*,
- The African Marsh Harrier *C. ranivorus* was sister to another Eurasian migrant, the Western Marsh Harrier *C. aeruginosus* that regularly occurs in southern Africa.
- That and the additional finding that the Northern Harrier *C, hudsonius* (in North America) and the South American Cinereous Harrier *C. cinereus* are also sister species all make bio-geographical sense, supporting the rapid diversification of the harrier genus north and south.

Blood sampling of both chicks and adults allowed us to assess levels of pesticides and stress hormones in a sample of birds (Photo: Rob Simmons).

Highlights:

- Field work was conducted in two main areas in order to identify differences between breeding populations in coastal areas along the South African west coast versus inland areas surrounding Nieuwoudtville, Northern Cape.
- During the 2013/14 breeding season, 46 nests were monitored and data from 91 chicks and 32 adults were collected on condition and health (biometric measurements, blood samples for carotenoids, contaminants and parasite analyses, stress hormone levels and pictures for external ornamentation). Very few data were collected in 2015 because of poor breeding in the heat and drought.
- Our laboratory analyses revealed the presence of PCBs and DDTs levels in Black Harrier nestlings and adults
- Automated cameras placed at 18 nests in 2014, confirmed that Black Harriers feed primarily on small mammals (67.6%), birds (18.6%) and lizard (13.8%). Interestingly, individuals breeding in the interior-mountain regions consumed more birds than small mammals and bred more poorly.
- Three satellite transmitters and six GPS/GSM transmitters were fitted to adult birds during the 2013-2015 breeding seasons, providing accurate data on the foraging habitats and deaths of migrant Black Harriers. Updates are provided on a blog site. Tracked birds have confirmed the west-east-west migration routes and have identified non-breeding (summering) areas in Lesotho and the Eastern Cape.
- Marie-Sophie attended the November 2015 annual conference of the Raptor Research Foundation in Sacramento, California, where she presented her first contaminants results.

Key co-sponsors
DST-NRF CoE grant; Golden Fleece Merinos.

Research team
Dr Rob Simmons (HRA, PFIAO)
Dr Beatriz Arroyo (CSIC, Spain)
Dr Francois Mouget (CSIC, Spain)
Dr Graeme Oatley (Palacký University of Olomouc)
Dr Jérôme Fuchs (MNHN, Paris)

Student: Marie-Sophie Garcia-Heras (PhD)

Southern Ground-Hornbill conservation

Southern Ground-Hornbills (SGH) *Bucorvus leadbeateri* are globally Vulnerable, but their conservation status in South Africa has been up-listed to Endangered. They have experienced a two-thirds reduction in their national range, and presumably population size, in the past 100 years. Since 2000, their habitat use, reproductive success as well as natal and breeding dispersal, have been studied at the Fitz, largely to inform activities of the Mabula Ground-Hornbill Project (MGHP) and the national SGH Action Group who are our partners in implementing the national SGH Species Recovery Plan.

The study area is the Associated Private Nature Reserves (APNR) adjacent to Kruger National Park (KNP), and supporting about 30 SGH groups. We have reproductive histories spanning a decade for more than 20 groups. We have found that breeding success increases with group size and strongly influenced by rainfall.

Movement patterns and roost site selection

MSc student Blair Zoghby used fine-scale spatial movement data from satellite tracking to investigate the seasonal changes in movement patterns and habitat use and patterns of roost site selection and use by SGHs. Blair found that daily travel distances averaged 7.4 ± 2.2 km.day^{-1} and were greater during the breeding season, when birds were constrained to forage close to their nest, and were lower in winter, when birds ranged more widely. In summer, hourly travel distances were bimodally distributed, with a minimum during the middle of the day when ambient temperatures exceed 25°C. Acacia-dominated vegetation and riparian habitats were favoured disproportionately during the heat of the day in summer, presumably because they offer more shade than other habitats. Optimal habitat configurations for ground-hornbills include a mosaic of habitat types, including open areas for foraging and dense trees for shade.

With regards to roost site selection, the number of roost sites used per month averaged 15.4 ± 4.7 across all groups, indicating little preference for specific sites. This number was least when groups were breeding, decreasing throughout October-December and was lowest during January–March when actively breeding groups frequently roosted close to the nest (54–83% of roosts <1 000 m of the nest). Riparian habitats were preferred for roosting during the breeding season, whereas disturbed areas, as well as Combretum- and Mopane-dominated habitats were preferred during the dry non-breeding season. Adequate large trees not only for nesting, but also for roosting, particularly in riparian habitats, may therefore be an important and potentially limiting factor for the successful reproduction of SGHs.

Highlights:

- Blair Zoghby graduated in June 2015.
- Blair's seasonal movements chapter was published in the special Phil Hockey memorial issue of *Ostrich* in 2015, and the roost site selection chapter has been accepted for publication in *Ostrich* during 2016.

Artificial nests as a conservation tool

PhD student Kate Carstens continued her research investigating the effectiveness of artificial nests as a conservation tool. Using data from the long-term study monitoring breeding success and group composition, Kate will provide valuable insights into the impact that the installation of these nests had on groups in the area. Her PhD will also provide insights into dispersal in this species for the first time, using resightings of ringed individuals, as well as investigating group composition and pair turn over using DNA from

Wild groups are caught and blood samples taken to investigate levels of group relatedness and dispersal (Photo: Cassie Carstens).

blood samples from nestlings and wild caught individuals.

Capture of wild male for release programme

The MGHP has initiated a wild release 'bush schools' programme. This involves the release of harvested second-hatched chicks together with a wild male to act as a mentor. The result is a functioning group of wild and hand-reared birds where additional harvested birds can be released and taught how to be "wild". The Fitztitute successfully captured a wild sub-adult male for this programme. This male, originating from the Timbavati Private Nature Reserve, was released together with two hand-reared harvested immature birds onto Loskop Nature Reserve, Mpumalanga. A second release took place on a reserve in Limpopo using additional second-hatched chicks harvested from the Fitztitute's study site in the APNR. Both groups are being monitored by trained shepherds.

Highlights:

- The capture of a wild sub-adult male for the wild-release 'bush schools' programme.
- The release of four harvested second-hatched chicks from our study site onto reserves in Mpumalanga and Limpopo provinces.

Nest monitoring and harvesting second-laid eggs

Reintroduction protocols depend on the availability of birds for reintroduction. Ground-hornbills almost always lay two eggs, yet invariably rear only a single chick. Second-laid, insurance eggs hatch a few days after the first, and the chicks usually die of dehydration if the first chick is healthy. Second chicks are therefore available for harvest and captive rearing. A harvesting programme to carefully remove second chicks, providing their sibling was healthy, was initiated to rear them for captive breeding and reintroduction programmes. Chicks from the APNR and KNP are transported by MGHP staff to partner facilities at Loskop Dam, Boscia Birds, Montecasino Bird Gardens and the Johannesburg Zoo where they are reared for the captive breeding and reintroduction programmes.

The 2014/15 season saw 11 active nests with six chicks fledged successfully, and five second-hatched chicks harvested for the captive breeding and wild-release programmes. One week before fledging, we colour-ringed, measured and took blood samples from the nestlings.

Komatiland Forestry donated a stockpile of pine logs for new artificial nests. Some of these have already been used to replace old nests that were falling into disrepair. Two that were replaced in the winter of 2015 were immediately occupied by the resident groups the following season.

One of the second-hatched chicks harvested from a nest in the Timbavati Private Nature Reserve (Photo: Cassie Carstens).

Highlights:

- Since 2010, the APNR has contributed 29 second-hatched chicks for the species action group, of which nine are ear-marked for wild-release.
- Ongoing repairs to and replacement of artificial nest boxes ensure that ground-hornbills can continue to thrive in an area which has a paucity of natural nest cavities.

Impact of the project

This project has contributed to the basic science underpinning the national SGH Species Action Plan and to the SGH Reintroduction Plan, and has substantial applied components assisting with the implementation of these plans. Rob Little and Kate Carstens represent the Fitz on the national SGH Action Group while Rob is also Vice Chairman of the MGHP management board. During 2015, the project published four articles in the local magazine *Klaserie Chronicle* which is distributed to surrounding private reserves and the greater Hoedspruit community.

Key co-sponsors

Associated Private Nature Reserves; Dept of Trade & Industry's Technology & Human Resources for Industry Programme (THRIP); Dow Southern Africa (Pty) Ltd; Hans Hoheisen Charitable Trust; Senelala Estates.

Research team

Prof. Peter Ryan (PFIAO)
Dr Rob Little (PFIAO)

Students: Kate Carstens (PhD), Blair Zoghby (MSc)

Research Assistant: Cassie Carstens.

Threatened grassland birds

South Africa's grasslands comprise around 16.5% of the country's land surface and are one of the most threatened ecosystems in South Africa, with more than 60% irreversibly transformed and only 2.8% formally protected. This threatened biome also hosts a multitude of rare, threatened and/or range-restricted species, with one such species being the Yellow-breasted Pipit *Anthus chloris*. Yellow-breasted Pipits are restricted to well-managed grasslands along the eastern escarpment of South Africa. Concerns were raised that this species' total population size and range are decreasing, which resulted in a study being launched to investigate the causes of these declines.

Even in the hand pipits can look the same. A selection of pipit specimens from the East London Museum collection. The species are (from left to right): Plain-backed Pipit *Anthus leucophrys*; Buffy Pipit *Anthus vaalensis*; African Rock Pipit *Anthus crenatus*; African Pipit *Anthus cinnamomeus*; Striped Pipit *Anthus lineiventris*; Tree Pipit *Anthus trivialis*; Bushveld Pipit *Anthus caffer*; non-breeding Yellow-breasted Pipit and Golden Pipit *Tmetothylacus tenellus* (Photo: Darren Pietersen).

To better understand the factors that restrict this Endangered species to its specific habitat, we set out to fit ten Yellow-breasted Pipits with light-weight VHF transmitters and to monitor their movements throughout the breeding season. We planned to simultaneously place transmitters on ten sympatric African Pipits *Anthus cinnamomeus* to gather comparative data on this widespread generalist species, and to monitor nests of both species, as well as undertake field observations of diet to investigate whether there are any noticeable biological traits that can explain how the African Pipit can be a widespread generalist, while the Yellow-breasted Pipit is a range-restricted habitat specialist. However, after two field seasons we had only managed to catch three Yellow-breasted Pipits (and more than 20 African Pipits), and it became apparent that this species was far more difficult to catch and study than we had initially anticipated. Attempts to monitor active nests also had to be abandoned as it was not possible to gather accurate data without disturbance of the nest.

We therefore changed the focus of the study; we have retained aspects looking at the current distribution and habitat requirements of Yellow-breasted Pipits, but have decided to employ a molecular approach to investigate whether this species' habitat specificity may be related to its

phylogenetic position. It stands to reason that if Yellow-breasted Pipits are an ancient lineage, they may have adapted to a climate and habitat that is receding owing to changes in the environment (both natural and anthropogenic). If this is the case, the eventual extinction of this species may be a foregone conclusion. However, if Yellow-breasted Pipits are not a basal taxon, or the habitat transformation is largely anthropogenic, then there is definitely something that we could (and should) do.

We are aiming to collect tissue samples from as many pipit species in sub-Saharan Africa as possible, to ensure that the resultant phylogeny is both accurate and robust. In order to achieve our sampling aims we are actively sampling birds in South Africa, and are collecting tissue samples from additional taxa from toe pads of museum samples, or from tissue samples in established tissue banks. The sampling of toe pads is the preferred method to sample archived (museum) samples as it causes the least damage to the specimens, DNA yield is sufficient for accurate analyses and conclusions, and thus far toe pads are not of taxonomic importance and therefore the sampling of a single toe pad from a museum specimen has a negligible detrimental effect on its future use in other studies.

Despite Yellow-breasted Pipits proving nearly impossible to capture, we are continuing with efforts to obtain contemporary samples from as many populations as we can, to facilitate a population genetics study. This study will enable us to investigate whether there is still gene flow between the fragmented and purportedly isolated Yellow-breasted Pipit populations. These results will be of direct conservation importance.

Key co-sponsors
DST-NRF CoE grant; Endangered Wildlife Trust; Rufford Small Grants Fund; Tshwane University of Technology.

Research team
Prof. Andrew McKechnie (CoE Core Team Member, U. Pretoria)
Prof. Ray Jansen (Tshwane University of Techology)
Dr Ian Little (Endangered Wildlife Trust)
Student: Darren Pietersen (PhD, Pretoria)

Typical Yellow-breasted Pipit *Anthus chloris* habitat – well-managed, short, moist grassland (Photo: Darren Pietersen).

Lovebirds of the Zambezi Basin

The Lilian's or Nyasa Lovebird *Agapornis lilianae* is a small parrot restricted to the wooded valleys of the Zambezi basin. It is categorised as Near-threatened on the basis of population declines linked to the loss of Mopane woodlands and mass mortality events caused by pesticide poisoning of waterholes. Using a combination of field research and cutting-edge remote-sensing techniques to detect its habitat, this project aims to understand the processes under-pinning lovebird distributions and to address these threats.

The research is being led by Tiwonge Gawa, a former CB MSc student who re-joined the Fitz in 2015 as a post-doctoral fellow following completion of her PhD at UKZN on the ecology of Lilian's Lovebirds in Liwonde National Park, Malawi. Tiwonge has been able to use her in-depth knowledge of the species to plan research into the factors that more broadly determine its distribution by focusing on the core of its range in Zambia. Tiwonge works closely with Arjun Amar and Fitz Research Associate Rowan Martin, Director of the World Parrot Trust's Africa Conservation Programme. The project is in collaboration with researchers at the University of Edinburgh's School of GeoSciences who developed the remote sensing techniques to understand the status of southern African woodlands.

Using historical distributional records and environmental maps, Tiwonge was able to develop a predictive model for the species' historical distribution in its core range in Zambia. This model was used to identify survey points throughout the Zambezi, Luano and Luangwa Valleys. From May-September 2015, Tiwonge led a series of field surveys collecting data in over 80 locations on the presence of Lilian's Lovebirds in relation to habitat characteristics. She was joined by PhD student Hemant Tripathi from Edinburgh who ground-truthed satellite data used to develop models for the distribution of mature Mopane woodlands and surface water – two habitat features hypothesised to be key determinants of the species' range. The team also recorded other woodland birds at each site and measured levels of human and large herbivore disturbance to determine how the impact of disturbance relates to the functional diversity of avian communities, a core aim of Hemant's PhD research. Members of the Museum of Malawi, Birdwatch Zambia and undergraduate students from the University of

Lilian's Lovebird (Photo: Dominique Schreckling).

Zambia and Copperbelt University provided invaluable assistance in the field.

Members from the Museum of Malawi, Birdwatch Zambia and two undergraduate students from the University of Zambia and Copperbelt University provided invaluable assistance to the team. Between May and July the team travelled over 6 000 km and conducted detailed surveys in over 80 locations.

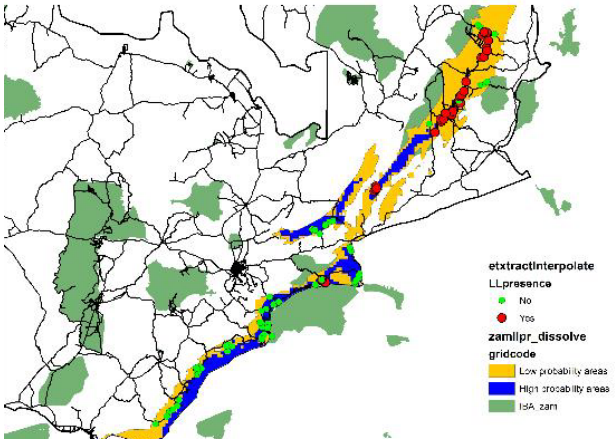
Fieldwork began in the Zambezi Valley, in the western extreme of its historical distribution close to Livingstone and moved northeast through the Luangwa Valley to North Luangwa National Park. No lovebirds were seen during the first 11 days of field work, sampling areas where human damage to Mopane woodlands was obvious in both protected and unprotected areas. They also were absent in the areas to the north of Lower Zambezi including the Luano Valley which had never been previously surveyed for the species, but was considered to contain suitable habitat. Overgrazing, logging and clear cutting for fields was evident throughout. Lovebirds were only observed in Lower Zambezi National Park and along the Luangwa Valley from southern Munyamadzi to

areas to just north of North Luangwa National Park. Very few lovebird sightings were made outside of protected areas, highlighting the importance of ensuring these areas are adequately protected from human disturbance.

Back in the office, the field measurements were related to the remotely-sensed data to develop a model of Mopane, Miombo and other woodland types throughout the species' historical range in Zambia. This is the first time remote-sensing data have been used to distinguish between these woodland types, opening the door for subsequent research into the status of Mopane woodland and the factors driving its decline throughout southern Africa. Radar data were used to identify areas of high woody biomass at a fine-scale, which can be used as a proxy for mature woodlands. Stands of 'Cathedral' Mopane are favoured nesting and roosting locations for Lilian's lovebirds and are hypothesised to be a key resource driving their distribution. To test this hypothesis we shall explore spatial associations between recent occupancy records and newly created maps of the distribution of different habitat types. If key habitat features can be identified, they will provide crucial insights into the lovebird's conservation status and inform management actions to ensure their protection.

Lilian's Lovebirds are only one of many species that have a close association with Mopane woodlands and this research builds an important knowledge and skills base for future research which may prove vital for the conservation of this unique ecosystem. The research programme also will be expanded to include the closely-related and globally Vulnerable Black-cheeked Lovebird *Agapornis nigrigensis* which inhabits the Mopane woodlands of the upper reaches of the Zambezi basin.

The research team and members of the Zambia Wildlife Authority at Lower Zambezi National Park (Photo: Hemant Tripathi).



Distribution of Lilian's Lovebird sightings during the field surveys

Highlights

- Systematic surveys at over 80 sites throughout the historical range of Lilian's Lovebirds in Zambia identified significant range contractions, with the species now almost entirely restricted to protected areas (National Parks and Game Management Areas).
- Local research capacity was enhanced through partnerships with BirdWatch Zambia and training of students from University of Zambia and Copperbelt University
- The model of the distribution of Mopane, Miombo and other woodlands was 96% accurate. The model uses cutting-edge techniques and newly-available data sources to determine ecosystem status with broad applicabilty for the conservation of other species and natural resource management.
- Data collected on avian functional diversity across a range of disturbance regimes in Mopane woodlands will give insights into the impact of large-herbivore and human disturbance on Mopane bird communities.

Key co-sponsors

BirdWatch Zambia; DST-NRF CoE grant; Pamela Isdell; The British Ecological Society's Ecologists in Africa Programme; World Parrot Trust.

Research team

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Dr Rowan Martin (World Parrot Trust and PFIAO)
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Student: Hemant Tripathi (PhD, Edinburgh)

Saving Cape Parrots and their forests

The Cape Parrot *Poicephalus robustus* is an endangered species endemic to a few Afromontane forest patches in South Africa. With fewer than 150 individuals remaining in the wild, it is threatened by a diversity of impacts ranging from habitat loss to illegal trade and disease. Tackling this array of threats makes it a useful model for developing and testing different conservation strategies, and it is a valuable flagship species for conserving its habitat.

The Cape Parrot is confined to small, isolated populations in Afromontane forest patches from the Amathole Mountains through the Transkei highlands, southern Drakensberg, and remote parts of the southern Soutpansberg near Magoebaskloof. Threats to Cape Parrots include historical persecution as a crop pest, continued habitat loss, poor nesting success due to the paucity of nest cavities and suitable food resources, a resurgence of the illegal wild-caught bird trade, and an outbreak of Psittacine Beak and Feather Disease (PBFD). Vulnerability to this disease is exacerbated by a food bottleneck after the breeding season when the parrots moult. Prevalence of PBFD peaked in the Amathole region in 2011, when all parrots sampled tested positive for the disease. Since then the infection rate has decreased yearly to only 23% in 2014. Only one sick Cape Parrot was handed in by the public in 2013. This bird was rehabilitated and is now ready for release into the wild. Provisioning PBFD-positive parrots with yellowwood *Afrocarpus falcatus* fruits reduces viral loads in the blood to below detectible levels. The oils in the seed kernel have a strong anti-microbial activity that may also combat secondary infections like *Pseudomonas* spp., avian tuberculosis and influenza.

The Cape Parrot Project (CPP) is a long-term research and conservation initiative in partnership with the government, local stakeholders, conservation partners, research collaborators, and local communities. It aims to ensure the persistence of Cape Parrots in the wild by restoring parrot habitat through the installation of nest boxes and planting important food trees. Our community-based conservation initiatives come under the umbrella of the iziKhwenene Project, which aims to support the establishment of new forest reserves, oversee the planting of over one million indigenous trees, clear alien vegetation, attract ecotourism investment, and establish a UNESCO Biosphere Reserve along the Amathole Mountain Range.

Cape Parrots living free and looking healthy in the wild (Photo: Rodnick Biljon).

Highlights:

- We received over R1.6 million of leveraged funding during 2015. Land agreements and partnerships have been sought to support long-term sustainability of the project.
- The appointment of a management couple to be based in Hogsback and run the day-to-day operations of the CPP.
- The CPP co-ordinated the annual Cape Parrot Big Birding Day in Hogsback on behalf of the Cape Parrot Working Group (UKZN); a total of 14 counters took part in Hogsback. Prof. Colleen Downs of UKZN released the count results in August 2015.
- "Lady Grey", a 5-10 year old female Cape Parrot, was successfully rehabilitated and approved for release by Avian Veterinarian,

Dr Pete Wood. Levels of PBFD virus in her blood were too small to quantify and no symptoms of infection remained. She is, however, still a carrier as most of the local population are assumed to be. She was released back into the wild population.

- A total of 28 Cape Parrots were captured by David Nkosi and blood samples taken for use in research into beak and feather disease viral genome and the potential for a vaccine that could be used in the wild via yeast cell delivery to the host. The research target was 25 samples. A new student, Melie Buyse, from the Microbiology Lab of Prof. Ed Rybicki (UCT) has been assigned to the CPP.
- Published two manuscripts on beak and feather disease viruses circulating in Cape parrots in the *Archives of Virology*.
- New data collection protocols set up for parrot sightings, where GPS locations, behaviour and dietary item consumed are recorded into GIS mapping software, with information obtained from staff, volunteers, tourists, BIRDLASSER app and a growing public network associated with the CPP group on Facebook.
- Successful implementation of DEA:NMR:LUI2 project funds through partnership with Wildlands Conservation Trust. These funds enabled the employment of 18 staff from local communities who cleared 100 ha of alien invasive plants and planted 3 000 indigenous trees, especially yellowwood species which the Cape Parrot depends on for food and nest cavities. This forest restoration effort is keystone to the long-term security and stability of our largest-remaining Cape Parrot population, as well as hundreds of other endemic species dependent on the Afromontane forest biome.
- Focus on growing of indigenous trees for planting: successful germination trials of several indigenous tree species to support nursery productivity and output.
- Taught a team of six people how to identify when a seed/fruit is ready to be collected. The team collected over 200 000 yellowwood seeds and a further 50 000 seeds of other important indigenous species. These seeds are then cleaned and planted in germination beds or taken to germination nurseries.
- Started a very successful compost project that will allow more germination of trees, with germination trials started.

New growth in planted yellowwood trees gives hope for the reforestation of degraded Afromontane habitat (Photo: Donovan and Abigail de Swardt).

- The CPP team has been working with a local school in Zingcuka Village to set up their own composting project. The team has also engaged with Hobbiton Outdoor Education Centre, which hosts under-privileged children, to share information about the Cape Parrots and the ecology of the Afromontane forests with all children visiting the centre.

Key co-sponsors

Abax Foundation; Disney Worldwide Conservation Fund; Ford Wildlife Foundation; Roland and Dawn Amall Foundation; DEA; NRM via Wildlands Conservation Trust.

Research team

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Dr Inga Hitzeroth (Microbiology, UCT)
Abigail de Swardt (Wild Bird Trust, Community Partnerships manager)
Donovan de Swardt (Wild Bird Trust, Reforestation manager)

Disturbing the peace

Human population densities are greatest in coastal areas and around wetlands. As a result, many coastal and water birds face significant threats from direct human disturbance. Some species appear to be able to tolerate disturbance, whereas others are decreasing in numbers. A key question is how tolerance develops among populations; is it learned, or is it the result of selection for more tolerant individuals? This programme considers the impacts of disturbance and development on coastal and water birds.

Coastal birds

Surveys of coastal birds that repeat counts made in the early late 1970s and early 1980s indicate that although the total numbers of these birds have remained relatively constant, community composition has changed dramatically, at least along the south and west coasts of southern Africa. HRA Dr Rob Simmons published a paper in *Conservation Biology* showing that long-distance migrants visiting Namibia's main coastal wetlands generally have fared poorly, confirming an earlier paper by Peter Ryan showing decreases of up to 90% among smaller bodied migrants in the Western Cape. The fact that decreases occurred irrespective of local disturbance patterns, suggests that factors operating outside South Africa are largely responsible for the negative population trends.

There have been both winners and losers among local species. African Black Oystercatchers *Haematopus moquini* have increased throughout their range, in part due to the ban on off-road vehicles on South African beaches, but also linked to the spread of the invasive mussel *Mytilus galloprovincialis*, which has greatly increased the availability of food for oystercatchers. The commemorative issue of *Ostrich* for Phil Hockey published in 2015 included several papers on African Black Oystercatchers by Phil and former students Doug Lowenthal and Dane Paijmans. However, numbers of another coastal-breeding shorebird, the White-fronted Plover *Charadrius marginatus*, have decreased in the Western Cape, especially on the Cape Peninsula and around False Bay. Their decreases have been greater in open access areas than in reserve areas, suggesting that direct disturbance is to blame, resulting in local extinction in some areas. Previous work by former CoE manager Dr Penn Lloyd showed that at Kommetjie, high chick predation was the main problem, with pet dogs being the main culprits.

One of the few broods of White-fronted Plovers to hatch in the Plettenberg Bay region (Photo: Selena Flores).

Selena Flores measures a White-fronted Plover (Photo: Gilles Raye).

MSc student Selena Flores is working with the Nature's Valley Trust to assess the impacts of human disturbance on breeding plovers in the Plettenberg Bay region. She has been assisted by a team of interns, and has managed to monitor

more than 80 breeding attempts and complete numerous nest approach experiments. Breeding success has been poor, and Selena is attempting to identify the factors causing nest failure, from nest microhabitat choice to the impacts of disturbance on adult activity budgets and egg exposure. Her results will provide appropriate local management recommendations to mitigate human impacts on this declining species

Wetland birds

Tourism development at the De Hoop Nature Reserve, CapeNature's flagship reserve, resulted in a contract with the Fitz to investigate the potential impacts of boat-based tourism on waterbirds. The De Hoop Vlei is listed as an internationally important wetland for waterfowl under the Ramsar Convention, and the use of boats on the vlei has been strictly controlled. However, the De Hoop Collection, which runs all tourism activities in the reserve, applied for permission to run boat-based tours for visitors. MSc student Andrew de Blocq was appointed to run the project, using a before-after, experiment-control design to tease apart the impact of the planned tourist boat trips. Unfortunately this plan was thrown into disarray when we first visited the site only to discover tours had already commenced without the approval of CapeNature.

Despite this setback, Andrew still counted waterbirds on days with and without boat trips, and compared the spatial use of birds on the vlei in relation to areas where boat trips take place, and sanctuary areas. Interpretation of these counts is complicated, however, by changes in vlei water levels over the course of the year. Andrew also has collected a large amount of information on flight initiation distances by different bird species in response to approaches by the tour boat and a canoe. He plans to conduct similar approaches by canoe on wetlands with regular boat traffic to assess the extent to which different waterbird species might become acclimatised to the passage of small boats.

Highlights:

- Former student Dane Paijmans published two papers from his MSc on African Black Oystercatchers in the special issue of *Ostrich* in memory of Phil Hockey.
- Minke Witteveen obtained her MSc with distinction on the influence of changing conditions on the breeding biology and diet of Kelp Gulls.
- Rob Simmons' paper on long-term decreases in migrant shorebirds in Namibia was published in *Conservation Biology*.
- A collaboration was established with Josie Jackson, PhD student at Bath and Cardiff Universities, UK, to investigate the conservation genetics of southern African waders.
- A documentary featuring White-fronted Plover research was filmed for an upcoming wildlife series by Cape Town's Homebrew Studios.

MSc student Andrew de Blocq takes a group of UCT under-grad students on a boat trip on De Hoop Vlei to assess the impact of boat-based tourism on the vlei's waterbirds (Photo: Peter Ryan).

Key co-sponsors
BirdLife Plettenberg Bay; Cape Nature; DST-NRF CoE grant; Knysna Toyota; Wader Quest

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Research assistants: Audrey Bonk, Chloë Brookes, Alexandra Cook, Craig Midgley, Jennifer Parker, Twan Slagter

Conserving Benguela endemics

All three seabirds endemic to the Benguela upwelling ecosystem that rely on anchovies and sardines are threatened by a reduction in the availablity of their preferred prey. Small pelagic fish have greatly reduced in abundance off the South African west coast, where fishing effort is concentrated and most seabird breeding islands are located. Fish stocks have increased off the south coast, where fishing pressure is low and there are very few suitable breeding locations. The main challenge is to ensure adequate spatial management of this fishery.

African Penguins

African Penguin *Spheniscus demersus* research at the Fitz is under the leadership of Lorien Pichegru and Antje Steinfurth, in collaboration with Richard Sherley (Bristol), Ross Wanless and Taryn Morris (BirdLife SA), and Rob Crawford and Azwianewi Makhado (DEA). Much of this research has centred on the possible conservation benefits of stopping fishing around key penguin breeding colonies. After the Island Closure Task Team presented its findings to the meeting of the International Stock Assessment Review Panel in December 2015, the panel once again endorsed the conclusion that fishing closures benefit penguins. They recommended that the experiment be continued for the next few years, in order to refine our understanding of the extent of the impact of fishing and no-take zones on breeding success of penguins and their survival.

One concern over the past few years has been the poor knowledge of fish distributions. Working with Lorien Pichegru, PhD student Alistair McInnes developed an inexpensive method to estimate fish abundance using a recreational fish-finder, which was validated against a scientific echosounder. He has used this method to relate penguin and fish distributions over four years of surveys in Algoa Bay, showing that purse-seine fishing impacts African Penguin foraging effort when controlling for natural drivers of prey distribution and abundance.

MSc student Jenni Roberts tracked pre- and post-moult African Penguins from Dassen Island off the west coast and Bird Island off the south coast for three consecutive years. West coast penguins consistently travelled farther from their colonies during both periods, suggesting that the combination of low fish abundance and high fishing pressure off the west coast forces adults to work harder to accumulate sufficient reserves to moult, putting them at higher risk of not surviving the annual moult. Worringly, several of the birds with satellite transmitters disappeared at sea off Lambert's Bay, suggesting that predation (possibly by fur seals) may also contribute to their low survival.

Finally, Lorien Pichegru recently found that female African Penguins suffered higher mortality than males, which might be linked to their higher foraging effort when breeding. Three of her MSc students from Rhodes, Amsterdam and Brest found that two-thirds of offspring produced on Bird Island were males. Male chicks grew faster and fledged heavier than females, possibly enhancing their first year survival. Female parents adjusted their investment in their reproductive attempt, making longer foraging trips and higher investment than male parents when they had male chicks. This discrepancy in sex production and survival may eventually lead to a bias in the sex ratio of the adult population, further exacerbating the species' conservation status.

Cape Gannets

Lorien Pichegru and Fitz HRA David Grémillet continued their long-term study of the foraging ecology of Cape Gannets *Morus capensis* breeding on Malgas Island. This species shows greater diet flexibility than the African Penguin, as it also exploits fishery discards, and has a much greater foraging range while breeding. These traits have allowed it to better withstand regional changes in fish abundance, but innovative data from stomach temperature recorders combined with GPS and depth recorders in breeding gannets over two years showed a very low success rates of foraging dives of Cape Gannets breeding on Malgas Island (<30%), again emphasizing the poor conditions these gannets face when breeding. The results were published in *Marine Biology*.

CoE core team member Pierre Pistorius (NMMU) continued a number of research projects on Cape Gannets at Bird Island, Algoa Bay, which now supports more than two-thirds of all Cape Gannets. Two of Pierre's former MSc students published papers on gannet diets and colony attendance patterns. The latter was determined using an automated radio-logging system, which was also installed at Malgas Island in 2014, where gannet numbers are dwindling, and the comparison of the two colonies will form a key component of Rabi'a Rijklief's PhD research.

Swift Terns

The Swift Tern *Thalasseus bergii* is unusual among Benguela seabirds in that it feeds predominantly on small pelagic fish yet its population is increasing. PhD student Davide Gaglio is studying diet and productivity to resolve this conundrum. He has photographed more than 24 000 prey items from at least 47 species, and has developed an accurate method to estimate the prey size without causing any disturbance to breeding birds. This confirms that anchovies are their main prey, although their size differs depending on chick size. Davide's project also investigates the influence of kleptoparasitism on chick body condition, and monitors juvenile dispersal using field-readable colour rings.

Highlights:

- The first deployments of video cameras on African Penguins revealed fascinating insights into their foraging strategies, including surface pursuit of larval fish and group foraging at bait balls.
- Alistair McInnes published his paper on the use of recreational fish finders to sample fish abundance in *PLoS One.*
- Former Fitz MSc student Rowen van Eeden published his study on fine-scale foraging cues for African Penguins in *Marine Ecology Progress Series.*
- Former NMMU MSc student David Green published two papers from his MSc on long-term changes in Cape Gannet diet, one in the *ICES Journal of Marine Science* and one in *Marine Ecology Progress Series.*
- Former NMMU MSc student Gavin Rishworth published two papers from his MSc on colony attendance patterns by Cape Gannets, one in *Marine Ecology Progress Series* and one in *PLoS One*.
- Almost all students presented papers or posters at the Second World Seabird Conference, and Davide Gaglio was placed among the top 10 student presentations.
- Pierre Pistorius received the NMMU Researcher of the Year award in 2015

Davide Gaglio has identified almost 30 new prey species from Swift Terns (Photo: Davide Gaglio).

Key co-sponsors

BirdLife International; BirdLife South Africa; Charl van der Merwe Foundation; DST-NRF CoE grant; Raggycharters Seaworld; Whale Watching.

Research team

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Dr Azwianewi Makhado (Oceans & Coasts, DEA)
Prof. Christopher McQuaid (Rhodes)
Dr Lorien Pichegru (NMMU)
Dr Pierre Pistorius (CoE Core Team member, NMMU)
Dr Richard Sherley (U. Bristol)
Dr Antje Steinfurth (RA, PFIAO)
Dr Andrea Thiebault (Post-doc, NMMU)
Dr Ross Wanless (HRA, PFIAO and BLSA)

Students: Alistair McInnes (PhD), Rabi'a Rijklief (PhD, NMMU), Davide Gaglio (PhD), Jenni Roberts (MSc), Noelle Tubbs (MSc), Jonathan Botha (MSc NMMU)

Conserving Southern Ocean seabirds

Seabirds are among the most threatened groups of birds because they face challenges both at their breeding sites and at sea. Almost one-third of all seabirds are on the global Red List, and they comprise nearly half of all threatened birds in South Africa. The Fitz's Seabird Research Programme assesses the severity of threats faced by seabirds, and attempts to provide practical management solutions to reduce these threats. This section deals with Southern Ocean species, which face threats at sea through fishing mortality and climate change.

Accidental fishing mortality

One of the major impacts that fisheries have on seabirds is through direct mortality, typically when birds get entangled in fishing gear, such as longlines or demersal trawl warps and nets. Much of the work combating these problems is conducted by NGOs, notably BirdLife's Albatross Task Force (ATF). We work closely with the ATF and Fitz HRA Dr Ross Wanless, head of BirdLife South Africa's seabird division. Currently, most work focusses on the pelagic longline fishery for tunas and swordfish, which remains the most problematic fishery for seabird bycatch in our region. PhD student Dominic Rollinson spent four months testing the efficacy of Lumo Leads to reduce seabird bycatch. These leads ensure additional weight can be added to longlines without compromising crew safety. Numerous weighting regimes were tested to identify a protocol which does not compromise fish catches. Unfortunately the vessel spent most of the trip in areas with low seabird abundance and thus no seabirds were caught on either control or experimental lines. Further trials will be conducted by the ATF in areas with high seabird abundance during 2016.

Dom also completed an analysis of seabird bycatch by the pelagic longline fishery for the last decade, building on former student Samantha Petersen's PhD findings up to 2005. He found that the bycatch rate has decreased significantly in the last three years, approaching the interim national target of 0.05 birds killed per 1 000 hooks. He also has a paper in press on the diving ability of Grey Petrels *Procellaria cinerea*. One of the key mitigation measures to avoid bird bycatch is to prevent birds reaching the bait while it remains close to the surface. *Procellaria* petrels can dive to much greater depths than albatrosses, and thus can facilitate albatross mortality by bringing baited hooks to the surface. He will complete his PhD in 2016.

A number of albatross species are commonly recorded as bycatch in the South African pelagic longline fishery. Here a fisherman displays a Shy Albatross caught by a local tuna vessel (Photo: Dominic Rollinson).

Tracking birds at risk

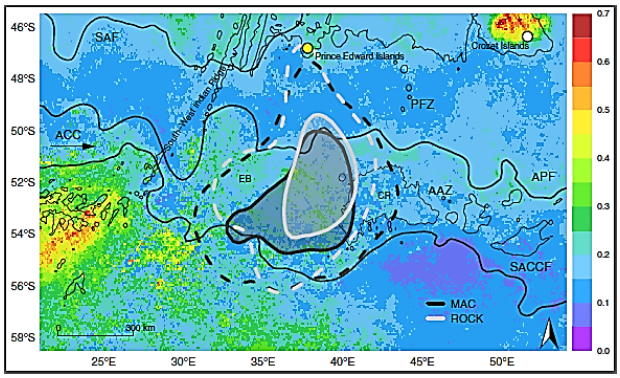
In order to understand the threat level posed by fisheries bycatch, we need a better understanding of where seabirds go, so we can estimate their overlap with different fisheries. Working with partners in France, Spain and the UK, we continue to deploy GPS and geolocator data loggers on seabirds breeding at Marion and Gough Islands. Stefan Schoombie analysed the movement patterns and population trends of the two species of sooty albatrosses *Phoebetria* spp. for his MSc. Surprisingly, the population trends of these species have reversed over the last 8 years, with Dark-mantled Sooty Albatrosses *P. fusca* numbers increasing to their highest ever levels on Marion in 2015, whereas Light-mantled Albatross *P. palpebrata* numbers have decreased over the same period.

Kim Stevens started a similar project on the foraging range and demography of Grey-headed Albatrosses *Thalassarche chrysostoma* during her year on Marion in 2013/14. She upgraded to a PhD in 2016 and will return to Marion for a year

from April 2016. Tracking with data loggers is largely confined to adult birds where there is a reasonable chance of recovering the devices. Much less is known about the dispersal of juvenile seabirds. In collaboration with DEA and BLSA (who have funded the much more expensive PTT satellite transmitters), we have started tracking dispersal of juvenile albatrosses from both Marion and Gough Islands.

Penguins and climate change

The crested penguins *Eudyptes* spp. are the largest genus of penguins; all seven species are threatened globally. The reasons why numbers of Macaroni *E. chrysolophus* and Southern Rockhopper *E. chrysocome* Penguins have decreased sharply at South Africa's Prince Edward Islands since 1995 are poorly understood. PhD student Otto Whitehead has been working on Marion Island's crested penguins since 2012, tracking their movements during the breeding season and pre-moult period with GPS loggers, and over-winter movements with a combination of geolocators and PTTs (the latter in collaboration with DEA). Penguins, being flightless, are more spatially constrained than most other seabirds, and so must have reliable foraging areas within commuting distance of their breeding and moulting islands. In his first thesis paper Otto showed how both species depend on a region 500-1000 km south of Marion Island during the pre-moult period. During a year of low productivity, and presumably lower prey availability, the penguins spent more time foraging at sea. An inability to accumulate sufficient resources before their annual moult is crucial for adult survival. Insights also have been gained into the winter distribution of Rockhopper Penguins; immediately after moulting they target similar areas to during the pre-moult period. They then disperse within the Polar Frontal Zone during the core winter months and target the sub-Antarctic Front from spring until their return to the island in early summer. Otto's research identifies vital foraging grounds that should be protected against anthropogenic pressures (e.g. krill fisheries).



Otto Whitehead has shown where Macaroni and Southern Rockhopper Penguins from Marion Island forage during their pre-moult exodus. The solid lines show the 50% kernel use areas, and the dashed lines are 90% use kernels.

Highlights:

- Dominic Rollinson demonstrated that Lumo Leads do not reduce tuna catches in the large pelagic longline fishery.
- Stefan Schoombie completed his MSc on the population trends and foraging ecology of sooty albatrosses at Marion Island, graduating in December 2015.
- Otto Whitehead published a paper in *Marine Biology* on the habitat use and diving behaviour of pre-moult Macaroni and Rockhopper Penguins from Marion Island.
- Several students presented their research at the Second World Seabird Conference; Otto Whitehead placed fourth among the large number of student presentations.

Key co-sponsors

Agreement on the Conservation of Albatrosses and Petrels (ACAP); CNRS; DST-NRF CoE grant; European Union; Royal Society for the Protection of Birds; South African National Antarctic Programme; WWF Australia.

Research team

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Dr Richard Phillips (British Antarctic Survey)
Dr Pierre Pistorius (NMMU)
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Dr Antje Steinfurth (PFIAO)
Dr Ross Wanless (HRA, PFIAO and BLSA)

Students: Dominic Rollinson (PhD), Otto Whitehead (PhD), Stefan Schoombie (MSc), Kim Stevens (MSc)

Research assistants on Marion Island: Alexis Osborne, Vonica Perrold (2014/15), Stefan Schoombie, Janine Versteegh (2015/16).

Conserving islands and their birds

Oceanic islands hold a disproportionately large amount of terrestrial biodiversity, yet are extremely vulnerable to introduced species: more than 90% of recent bird extinctions have been of island birds. Fortunately, eradicating invasive species can restore island ecosystems, provided there are strict controls on the import of people and materials. Birds are flagships for the conservation-management and restoration of island ecosystems. Our work focusses on South Africa's Prince Edward Islands as well as the UK's Tristan da Cunha archipelago.

Greyheaded Albatross chicks attacked by introduced House Mice on Marion Island (Photo: Peter Ryan).

Gough Island's giant mice

It is only in the last decade that House Mice *Mus musculus* were discovered to be significant predators of seabirds. The phenomenon was first discovered by Fitz field workers on Gough Island, once touted as the world's most important seabird breeding island. The mice on Gough are unusually large, leading to a collaborative investigation into their genetics with the University of Wisconsin's Bret Peyseur. A lab population of Gough mice established in 2009 is finally delivering insights into how Gough mice differ from other populations. A paper on the genetic basis of their large size was published by Bret's former post-doc Melissa Gray in the leading journal *Genetics* in 2015. This followed a paper on the origins and demographic history of the Gough mice in *Molecular Ecology* in 2014.

2014 was an exceptionally bad year for birds on Gough, with fewer than 10% of Tristan Albatrosses *Diomedea dabbenena* raising a chick. Ben Dilley and Delia Davies, who were based on the island for the year, used remote camera systems to study how mice kill seabird chicks. They published their observations in two papers in 2015, one describing attacks on albatross chicks (*Avian Conservation and Ecology*), and one on petrels (*Antarctic Science*). Ben upgraded his MSc to a PhD after expanding his study from the impact of introduced predators on Marion Island to include information from Gough. Fortunately,

mouse predation returned to more 'normal' levels in 2015, but Ben and Delia's footage of mouse attacks proved invaluable in convincing the RSPB to push forward with plans to eradicate mice in winter 2019; a project manager has been appointed, and fund-raising has started to find the £7 million needed for the project.

Mice run riot on Marion Island

Like Gough Island, mice were introduced to Marion by sealers in the 1800s. Cats *Felix catus* were introduced to control mice around the South African weather station in 1949, but instead had devastating impacts on the island's birds, especially the burrow-nesting petrels, leading to a massive eradication operation that finally rid the island of cats in 1990. Two students have studied how petrel numbers have recovered following the removal of cats from the island. Mia Cerfonteyn published a paper from her MSc showing how petrels still comprise less than one third of skua diet on Marion, similar to the situation in 1989, in stark contrast to Prince Edward Island, where petrels comprise about 96% of skua diets. And Ben Dilley's paper reporting how little petrels have recovered since the height of the cat era, based on repeat surveys of Mike Schramm's 1979 transects, is finally in press with *Polar Biology*.

One of the stumbling blocks to Ben's paper being accepted was the lack of direct evidence that mice are killing petrel chicks on Marion. Sadly this knowledge gap was filled in 2015, when mice went on the rampage on Marion. Since 2002, field workers on Marion have observed a few Wandering *Diomedea exulans* and Sooty *Phoebetria fusca* Albatross chicks with wounds typical of mouse attacks, but there have been no confirmed attacks. But in 2015, large numbers of wounded and dead albatross chicks from all four breeding species were recorded throughout the island and mice were filmed attacking chicks of three albatross species and two petrel species. The attacks on nearly-fledged summer-breeding albatross chicks were surprising; because this was the first time we've seen mice attack well-feathered chicks. Most attacks were on the chicks' heads, where feathers are shorter, allowing easier access for the mice. We published a paper in *Antarctic Science* reporting this novel 'scalping' behaviour, which gives additional impetus to calls to eradicate mice from Marion Island. The discovery in late 2015 that mice were killing adult Laysan Albatrosses *Phoebastria immutabilis* breeding on Midway Island shows that mice can be even more destructive than has been the case to date on Gough and Marion.

Fortunately it isn't all bad news from Marion. Common Diving Petrels *Pelecanoides urinatrix* were found breeding on the island in 2015 for the first time since they were extirpated by cats. Clearly mice remain a problem for birds on the island, but they cause less damage than did cats.

Highlights:

- The RSPB has finally announced their intention to attempt to eradicate mice from Gough Island in winter 2019.
- Three papers were published on the impacts of mice on seabirds at Gough and Marion Islands, and a further paper is in press showing limited recovery of burrowing petrel populations since cats were eradicated from Marion Island.
- Mia Cerfonteyn published a paper in *Antarctic Science* showing that skua diet hasn't changed on Marion Island since the eradication of cats from the island.
- A paper on the rapid evolution of gigantism in Gough Island mice was published in *Genetics*, and a description of the biology of Gough Island mice is in press with the *Journal of Mammalogy*.
- Common Diving Petrels were discovered breeding on Marion Island for the first time since they were apparently extirpated by cats.
- Ben Dilley and Delia Davies were employed by the Tristan government to help train Tristan Conservation Department staff.

Key co-sponsors

Agreement on the Conservation of Albatrosses and Petrels; BirdLife International; DST-NRF CoE grant; Royal Society for the Protection of Birds; South African National Antarctic Programme; UK Overseas Territories Environment Programme.

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Research assistants: Michelle Risi, Chris Jones, Werner Kuntz (2014/15), Jan Bradley, Derren Fox, Chris Taylor (2015/16).

Hot Birds – Climate change and desert birds

The 'Hot Birds' project seeks to predict the ways in which climate change will affect birds living in hot, arid environments. Although most work is focused on bird communities of the southern Kalahari Desert, the project also considers Fynbos birds as well as desert birds in the southwest USA and Australia.

A male White-browed Sparrow-weaver panting as he looks for food in a hot, dry Kalahari riverbed. These hardy, sociable birds are a key model species for both behavioural and physiological studies within the Hot Birds Project (Photo: Tanja van de Ven).

Hot Birds research focuses on the links between temperature, behaviour, physiology, and ultimately fitness. During 2015, we began work on the effects of rising temperatures on the stability of social structures, using birds as models. PhD student Michelle Thompson showed that thermoregulatory costs might be dependent on social rank, with implications for both individuals and societies. We have appointed a new post-doctoral fellow, Dr Margaux Rat to investigate further. We also succeeded with a NRF grant bid that will allow appointment of a new PhD student collaboration with the Pied Babbler Project.

Societies and climate change

In 2015, Margaux Rat joined the Hot Birds Project as a post-doctoral fellow to investigate the effects of high temperature on the social network structure of Sociable Weavers *Philetairus socius* and White-browed Sparrow-weavers *Plocepasser mahali*. These two species are ideal candidates to investigate societal risks driven by climate change, as their social organisation is shaped by dilemmas familiar to human societies (i.e. cooperation versus conflict).

At the time of writing, Margaux is conducting preliminary field studies with Sociable Weavers on Farm Murray in the Northern Cape, exploring whether the social structure of groups changes according to natural temperature variations. In 2016, she will bring wild-caught groups of Sociable Weavers and White-browed Sparrow-weavers into temperature-controlled rooms at the University of Pretoria, to experimentally test the effect of changes in temperature regime on group social structure. The results will allow us to assess the impacts of climate change on group social organisation generating useful insights for all cooperative societies.

Fitness and the importance of behaviour

In February 2015, PhD student Tanja van de Ven finished her final season of data collection on the effect of high temperatures on the breeding performance of Southern Yellow-billed Hornbills *Tockus leucomelas* in the Kalahari. This summer, the Kalahari experienced extremely dry conditions and only four of the twelve monitored breeding pairs succeeded in fledging one chick each. Hornbill females are sealed inside the nest cavity until their chicks are sufficiently grown to reach the entrance themselves and receive food from the provisioning male through a tiny slit. At this point the female breaks out of the nest and the chicks reseal the entrance. Tanja observed that females left the nest earlier in 2015 than in other years and chicks were too young to be able to reseal the nest cavity after the female left, which resulted in nest predation on at least two occasions. We suspect that harsh climate conditions resulted in lower provisioning due to increased pressures on provisioning males and increased heat stress for females, resulting in their earlier nest exit. Tanja also showed that

male body mass across the entire breeding period is dependent both on chick age and daily maximum temperature (T_{max}), and that males are unable to maintain body condition on days when T_{max} exceeds 38.3°C

Tanja's research and earlier work on Southern Fiscals *Lanius collaris* by Susie Cunningham and Southern Pied Babblers *Turdoides bicolor* by Kate du Plessis, all suggest that birds face trade-offs between important behaviours such as foraging and nest provisioning, and thermos-regulation. These trade-offs result in "fitness thresholds" – air temperatures above which body condition and breeding success of birds begin to decline. In 2015, we were successful in attracting funding for a new PhD student addressing the question of whether social behaviour can buffer these fitness costs. The new student (yet to be appointed) will be co-supervised by Susie Cunningham and Mandy Ridley and will work in collaboration with the Pied Babbler Project. The babblers will be used to understand how physiological and behavioural effects of heat stress might be mitigated by group size; and whether larger groups face reduced trade-offs between thermoregulation and behaviours such as chick rearing, as temperatures rise.

Hot Birds in the Fynbos

In 2013, the Hot Birds team made its first foray into the Fynbos, joining forces with Alan Lee and Phoebe Barnard of the Climate Change and Fynbos Birds team, and Nelson Mandela Metropolitan University lecturer Ben Smit (formerly a PhD student of the Hot Birds project) to co-supervise CB MSc student Robyn Milne. Robyn used field respirometry techniques to investigate physiological thermal tolerances of Fynbos endemic passerines, showing that Cape Rockjumpers *Chaetops frenatus*, had lower thermal tolerances than similar-sized species from other regions of the world. In 2015 'Fynbos Hot Birds' expanded with the addition of two MSc students, Krista Oswald and Jerry Molepo, who have joined Ben Smit's group at NMMU. Both students are co-supervised by Susie Cunningham and Alan Lee.

Krista is currently investigating behavioural and physiological mechanisms linking Cape Rockjumpers to their restricted climate envelope. Krista will have completed her physiological data collection on seasonal heat and cold tolerances in rockjumpers by early

A male Southern Yellow-billed Hornbill sits on a perch attached to a load-cell at the entrance to his nest-box. PhD student Tanja van de Ven used these load-cell "perch scales" to monitor the body mass of breeding birds (Photo: Dean Portelli).

2016, and in addition, has collected a substantial data set on behavioural response to temperature over the 2015/2016 summer seasons using radio-tagged birds. Krista's preliminary results suggest that Cape Rockjumpers do have some capacity to adjust their thermal physiological responses between winter and summer. However, despite slight elevations in heat tolerance after exceptionally hot weather during the 2015/2016 summer, daily activities of rockjumper family groups are still limited to deeply shaded rocky outcrops when air temperatures exceed 30 °C. Krista plans to submit her MSc dissertation by July 2016, and will then register for her PhD, which will involve deeper investigation of behavioural changes in response to heat in rockjumpers.

Jerry Molepo started behavioural and physiological work on Cape Sugarbirds *Promerops cafer* in 2015. Jerry aims to determine if there are differences in daily feeding patterns and heat tolerance between male and female Cape Sugarbirds to understand why female sugarbirds have reduced body mass as the climate has warmed over the last 30 years; but males have not (as indicated by SAFRING data). So far, Jerry has compared flower visitation rates between male and female

sugarbirds at different times of the day, and among days that varied in maximum air temperature. Despite expected higher energy demands of female sugarbirds, males generally dominated flower resources throughout the day. These results suggest that female sugarbirds are more prone to energy and water stress during hot and dry summers in the Fynbos region. During 2016 Jerry will determine if there are physiological differences between male and female sugarbirds that could play a role in temperature-related responses in behaviour.

Highlights:

- Susie Cunningham was appointed as Lecturer at the Fitz, paid through the CoE.
- CB MSc student Salamatu Abdu graduated in June 2015 with her thesis on the importance of shade at waterholes for Kalahari birds.
- CB MSc student Penny Pistorius submitted her thesis on the effects of temperature on flight initiation distances in Kalahari birds in February 2016.
- Robyn Milne's paper on the physiological responses of Fynbos birds to high temperatures was published in *Conservation Physiology*.
- Susie Cunningham and Rowan Martin published a paper each in the Phil Hockey memorial issue of *Ostrich.*
- Preliminary results on Cape Rockjumper work by Krista Oswald and Alan Lee were presented in a poster and mini-presentation at the BOU 'Birds in Space and Time' conference in Leicester, UK in April.
- Margaux Rat set up a website for the Hot Birds Project: www.hotbirdsproject.com

Thermoregulation in the heat

Another major research theme of Hot Birds focuses on the physiological mechanisms that allow birds in hot environments to maintain body temperatures below environmental temperatures. Work in this area during 2015 focused on heat tolerance and evaporative cooling capacity in nightjars, a group of birds whose habit of roosting and breeding in exposed, sunlit sites means that they experience extraordinarily challenging thermal conditions. Another focus area was intraspecific variation in heat tolerance; Matthew Noakes completed his MSc on how thermoregulation at high air temperatures varies among populations of White-browed Sparrow-weavers. A paper from

Matthew Noakes and Michelle Thompson catching White-browed Sparrow-weavers at night. Work on sparrow-weaver populations at sites across South Africa has revealed that populations that inhabit hot areas have significantly greater heat tolerance than populations from cooler areas (Photo: Andrew McKechnie).

this study has subsequently been accepted in the *Journal of Experimental Biology*. In addition, work continued on analysing and writing up physiological data collected for around 45 bird species from the deserts of North America, southern Africa and Australia as part of a collaborative project with Blair Wolf at the University of New Mexico.

PhD student Ryan O'Connor is currently investigating thermoregulatory capacity in two southern African nightjar species, Rufous-cheeked *Caprimulgus rufigena* and Freckled *C. tristigma*. Ryan has found that both species display a pronounced capacity for heat tolerance, being able to maintain body temperatures well below high air temperatures. For instance, Rufous-cheeked and Freckled Nightjars maintained body temperatures of 41.5 and 40.7 °C, respectively, at an air temperature of 52 °C. Nightjars show a large capacity for evaporative cooling at high air temperatures due to large increases in evaporative water loss with minimal increases in metabolic rate. Low metabolic rates limit their endogenous heat

production, allowing them to shed large environmental heat loads. These data are currently being written up for publication.

Matthew Noakes registered for his PhD in 2015, aiming to identify the sources of intraspecific thermoregulatory variation in White-browed Sparrow-weavers and other Afrotropical passerines. In particular, he is monitoring patterns of seasonal metabolic variation within Kalahari Desert passerine populations over successive years, while simultaneously measuring fluctuations in potential environmental drivers of these patterns (e.g., food availability and climate). He will also conduct acclimation and aviary translocation (acclimatization) experiments over the next two years, to investigate the roles of phenotypic flexibility *vs* genotypic adaptation in determining inter-population thermo-regulatory differences.

Validating a behavioural index of avian sensitivity to heat stress

Over the past few years, a major focus of the Hot Birds project has been the development of an index of vulnerability to heat stress in birds using easy-to-collect data on heat dissipation behaviour. We term this index the "HD50", or air temperature at which 50% of birds of a given species will be display noticeable heat dissipation-related behaviour (e.g. panting). PhD student Michelle Thompson is now working to verify the use of the HD50 as a proxy for species' vulnerability to climate change. To date, she has maintained seven Kalahari bird species with differing HD50s in large outdoor aviaries, including Sociable Weavers, Fawn-coloured Larks *Calendulauda africanoides*, African Red-eyed Bulbuls *Pycnonotus nigricans*, Cape Glossy Starlings *Lamprotornis nitens*, Cape Turtle-Doves *Streptopelia capicola*, Laughing Doves *Streptopelia senegalensis* and White-browed Sparrow-weavers. Michelle examined functional links between heat dissipation behaviour, activity patterns, body temperature and hydration status on days differing in T_{max}. Michelle has found that for most species, captive birds show similar HD50 values to wild populations. Michelle's results also suggest that on hot days, when water is not available, birds reduce their activity levels and allow body temperature to rise in order to save water that would otherwise be expended on evaporative cooling (e.g. via panting). In 2016, Michelle will examine how different species respond to dehydration on hot days by analysing total body water measurements taken over 6 hours during the hottest part of the day. She will also add Namaqua Doves *Oena capensis* and White-backed Mousebirds *Colius colius* to her study.

Highlights:

- Maxine Whitfield received an MSc *cum laude* from the University of Pretoria for her dissertation entitled *Hot birds in the Kalahari: avian heat tolerance and evaporative cooling capacity in a southern African desert*.
- A paper from Maxine Whitfield's MSc was published in the *Journal of Experimental Biology*, and was short-listed for the journal's Best Paper of the Year award.
- Matthew Noakes was awarded an MSc *cum laude* from the University of Pretoria for his dissertation entitled *Spatial and seasonal variation in thermoregulatory limits in a widespread southern African passerine.*
- Andrew McKechnie presented a paper at the 9th International Congress of Comparative Physiology and Biochemistry, held from 23-28 August 2015 in Kraków, Poland.
- Andrew McKechnie published an invited commentary in *Functional Ecology.*

Key co-sponsors

DST-NRF CoE grant; National Science Foundation, USA; University of Cape Town Research Committee.

Research Team

Prof. Andrew McKechnie (CoE Core Team member, U. Pretoria)
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Dr Alex Gerson (U. Massachusetts)
Dr Alan Lee (Post-doc PFIAO/SANBI)
Dr Rowan Martin (Research Associate, PFIAO)
Dr Todd McWhorter (U. Adelaide)
Dr Margaux Rat (Post-doc PFIAO/U. Pretoria)
Dr Ben Smit (NMMU)
Dr Blair Wolf (U. New Mexico)

Students: Jerry Molepo (MSc, NMMU), Matthew Noakes (PhD, Pretoria), Ryan O'Connor (PhD, Pretoria), Michelle Thompson (PhD, Pretoria), Tanja van de Ven (PhD), Krista Oswald (MSc, NMMU), Penny Pistorius (CB MSc)

Research Assistants: Alex Atkins, Cathy Bester, Rachel Bucksey, Josephine Bruning, Carla Dodd, Ashleigh Donaldson, Pieter Erasmus, Samantha Fourie, Alexandra Howard, Ryno Kemp, Craig Kenny, Noxolo Kinzela, Vuyiseka Mbiko, Robyn Milne, Dean Portelli, Aurélie Quinard, Pauline Ruffenach, Sue-Joy Schultz, Lauren Stansfield, Mervyn Uys, Tim Vink, Natasha Visser.

Climate change vulnerability and adaptation of fynbos endemics

The fynbos biome is the rich, wild, but also deeply threatened core of the Cape Floral Kingdom, and one of the planet's smallest biodiversity hotspots. South Africa is solely responsible for ensuring the long-term future of the biome and its birds. Our team focuses on identifying the vulnerability and adaptation options of the six songbirds and one buttonquail endemic to mountain fynbos, using the lenses of global change biology, population and spatial ecology, epidemiology, stress ecology and conservation biology.

This work started in 2008 as part of the Fitz's Climate Vulnerability and Adaptation Programme. It asks how fynbos birds are affected by global change, and what conservation measures can be taken to help their persistence through the next few centuries of rapid environmental change.

The research team, led by Fitz HRA Phoebe Barnard from the South African National Biodiversity Institute (SANBI), includes ornithologists, pollination ecologists, population and stress ecologists, behavioural ecologists, modelers, epidemiologists, and a network of volunteer observers, assistants, and bird-ringers. Intensive survey work by post-doc Alan Lee has quantified habitat preferences and global population estimates, and establishment of marked populations has borne fruit in resightings and recaptures, allowing us to start building a picture of population ecology, movements, behaviour and phenology.

Pollination mutualisms and vulnerability

Plant-pollinator relationships are central to understanding vulnerability of the fynbos to rapid environmental change. Anina Heystek Coetzee's PhD thesis, submitted in late 2015, gave rise to publications in 2014 and 2015 on Orange-breasted Sunbird *Anthobaphes violacea* and Cape Sugarbird *Promerops cafer* pollination as driving forces on *Erica* and *Protea.* She is drafting another on how nectarivores use urban nectar resources.

PhD student Daniël Cloete started an important new study of pollination services in fragmented environments in the Nature's Valley area, co-supervised by Mark Brown (Natures Valley Trust) and Claire Spottiswoode.

Phenology, the timing of life-cycle events in species' lives, is an important aspect of climate vulnerability. French collaborator Marie-Pascale Colace, a phenology and montane ecology specialist, worked with Phoebe throughout 2015 to document changing phenology at project sites, and to establish a national phenology network.

Highlights:

- Anina Heystek Coetzee's PhD thesis was received with outstanding praise from her examiners.
- Marie-Pascale Colace, the late Johan Johansson (field assistant) and Phoebe gathered important phenology data on flowering Proteaceae and their use by fynbos endemics on the Cape Peninsula.

Alan Lee flushes a Hottentot Buttonquail in the Baviaanskloof in the first biome-wide survey for this species (Photo: Hennie Swanevelder).

Conservation futures and palaeolandscapes

Leverhulme Trust funding for our collaborations with Durham and Cambridge universities ended in late 2014, but residual papers are still being published. A paper on conservation lessons from the climate modeling work is underway.

Alan Lee's post-doc work continued to produce excellent and detailed analyses of the fynbos endemic songbirds, showing that all are vulnerable to climate change to varying degrees. The previous co-supervision by Alan, Susie Cunningham and Ben Smit of Robyn Milne's 2014 MSc thesis on thermal tolerances of the fynbos endemic songbirds shed great light on why this might be the case. Alan and Dale Wright from BirdLife SA also began detailed surveys of Hottentot Buttonquails *Turnix hottentottus*, with funding from BirdLife South Africa.

In 2015, we initiated a study of the limits of dispersal and palaeogene flow in collaboration with Jacqui Bishop, to frame species' climate change adaptation options. MSc student Campbell Fleming will start this in 2016.

Long-term SAFRING records show that female Cape Sugarbirds weigh less in hot years. In 2015, CoE-funded MSc student Jerry Molepo (based at NMMU) investigated whether gender differences in foraging strategies and physiology account for this.

Highlights

- Our paper reviewing patterns of avian endemicity in southern Africa over the past 140 000 years appeared online in late 2015 in the *Journal of Biogeography.*
- Alan Lee and Phoebe Barnard published papers assessing the conservation status of fynbos endemics under climate change in *Bird Conservation International*, population metrics of the fynbos endemics with the late Phil Hockey in the special commemorative issue of *Ostrich,* and spatial and temporal patterns of insect activity in *Journal of Entomology and Zoology Studies*.
- Phoebe Barnard, Martine Maron and others published a highly read paper on the role of resource bottlenecks and weather events for declining populations under climate change in *Diversity & Distributions.*
- CB MSc student Robyn Milne published the results of her thermal-chamber experiments in *Conservation Physiology.*

Climate adaptation and urban landscapes

Increasingly, urban landscapes such as Cape Town's Cape Flats have become seas of inhospitable habitat which fynbos birds cannot cross. In collaboration with Anton Pauw of Stellenbosch University, Bongani Mnisi of the City of Cape Town and Sjirk Geerts of the Cape Peninsula University of Technology, Phoebe Barnard advised a SANBI/STEPS Caretakers film, "Stepping Stones in Fragmented Environments" (www.caretakers.co.za) on Bongani's Iingcungcu Restoration Project (isiXhosa for "long-billed sunbird"). The Fitztitute provided additional funding for this film, which shows his work with schoolkids, teachers, city horticulturalists and other scientists to restore patches of pollinator-friendly fynbos vegetation across the Cape Flats.

Key co-sponsors

BirdLife South Africa; DST-NRF CoE grant; Leverhulme Trust; SANBI; University of Cape Town Research Committee.

Research team

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Dr Res Altwegg (SEEC, UCT)
Dr Wendy Anneke (SANParks)
Dr Jacqueline Bishop (Biological Sciences, UCT)
Dr Mark Brown (Nature's Valley Trust)
Marie-Pascale Colace (CNRS, Grenoble)
Dr Yvonne Collingham (Durham)
Dr Susie Cunningham (PFIAO)
Dawie de Swardt (National Museum Bloemfontein)
Dr Brett Gardner (Johannesburg Zoo)
Dr Sjirk Geerts (CPUT)
Prof. Rhys Green (Cambridge; RSPB)
Prof. Brian Huntley (Durham)
Dr Emily Lane (National Zoo, Pretoria)
Dr Alan Lee (Post-doc SANBI/PFIAO)
Dr Martine Maron (Queensland)
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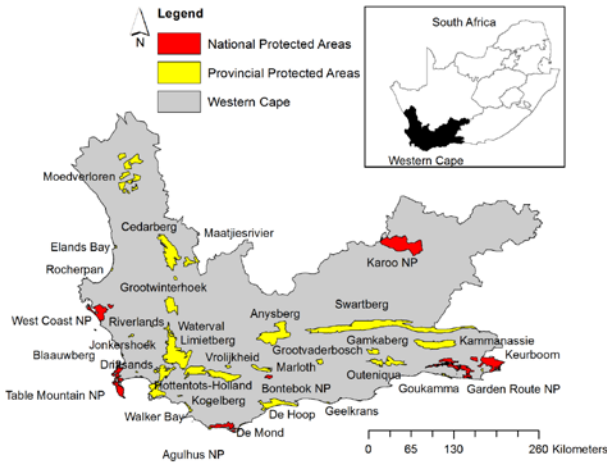
Bongani Mnisi (City of Cape Town, Stellenbosch)
Prof. Anders Pape Møller (Université de Paris-Sud)
Assoc. Prof. Anton Pauw (Stellenbosch)
Dr Ben Smit (NMMU)
Dr Helène Steenkamp (National Zoological Gardens)
Ross Turner (UKZN)
Dr Timo van der Niet (NBC, Netherlands)
Prof. Marcel Visser (NIOO, Netherlands)
Dale Wright (BirdLife South Africa)

Students: Daniël Cloete (PhD), Anina Heystek Coetzee (PhD, Stellenbosch)

Research Assistants: Rene Delport, Mike Ford, Francis Hannay, Johan Johansson (deceased 2015), Lindelwa Mtirara, Julia Robinson, David Swanepoel.

Spatial resilience of protected areas

The protected areas programme focuses on understanding influences on the long-term sustainability of protected areas in South Africa, the contributions of protected areas to the national biodiversity estate, and the ways in which they function as both members and creators of socioeconomic networks. With Graeme Cumming's departure from the Fitz, this programme is winding down.



Map of the Western Cape Province of South Africa with South African National Parks (SANParks) coloured in red, and Provincial Protected Areas (Cape Nature) in yellow.

Protected areas are one of society's preferred strategies for achieving conservation goals. Given their widely assumed importance for conservation, and the many case studies that have focused on individual reserves, there has been surprisingly little comparative work on protected areas. For instance, little is known about the long-term dynamics of most protected areas; patterns in their creation and collapse are poorly understood; and their overall contribution to biodiversity conservation remains unclear, particularly within the private sector.

Protected area managers exchange information, resources, or even wildlife, thereby forming a protected area network. Ecological theory suggests that connectivity between protected areas will increase their resilience by facilitating dispersal, recolonisation and genetic mixing. In a similar manner, socioeconomic interactions between managers should enhance the spread of effective management strategies and the sharing of scarce resources.

In recent times, South Africa has seen the rise of an intriguing phenomenon: protected areas on private land. Such private reserves make up a significant portion of the country's conservation estate. Additionally, private communities are being awarded ownership over land in many erstwhile state-owned protected areas as part of the country's restitution programme. Thus, it is important to understand the dynamics and functioning of privately-owned protected areas; their rise and fall, their overall contributions to the national biodiversity estate and their contribution to the sustainability and resilience of our protected area network.

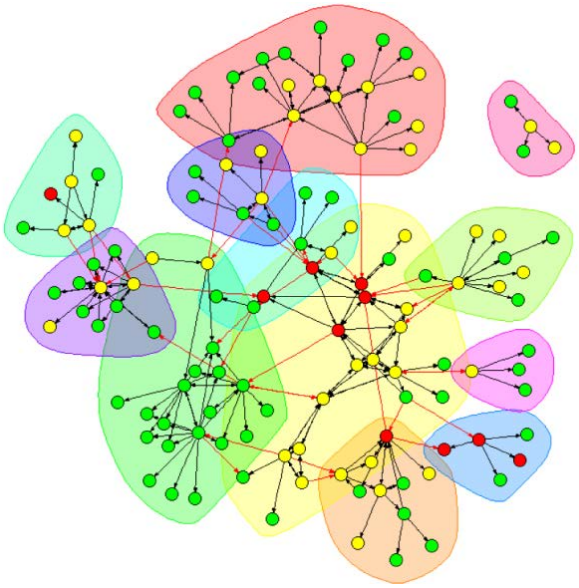
Private protected areas, unlike public reserves, receive minimal institutional funding and are therefore dependent on private funds and/or ecotourism, hunting and game breeding enterprises to generate the income necessary for their persistence. Little is known about the economic objectives of private reserves or how these objectives influence reserve management (e.g. the types of business models employed and their impact on species stocking rates, tourist number management etc.). By quantifying and modelling the interactions between economic incentives and ecological management, we can explore the implications for private protected area resilience.

Can we rely on private nature reserves to support biodiversity conservation over the next 50-100 years? Can we predict where they will be successful and where they fail? How do they contribute to both social and ecological elements of conservation goals and strategies? And how resilient will they be, in an uncertain future, to the winds of social, economic, and ecological change? The answers to these questions depend heavily on spatial patterns and relationships: where reserves occur along biophysical and socio-economic gradients, how their location relates to infrastructure, and how – or whether – membership in networks of such things as animal exchanges, transactions, and information processing influences their long-term viability. We have adopted a comparative, spatially explicit, and network-based approach to analyse and understand the dynamics that drive pattern-

process relationships relating to private protected areas.

Highlights:

- This programme has received considerable external funding support: a Complexity Scholar award from the James S. McDonnell Foundation in 2012, an NRF Competitive Programme for Rated Researchers grant in 2013, and a NRF Blue Skies grant in 2015. These external funds have helped it to grow rapidly and be highly productive.
- Julia Baum completed her PhD on the socioeconomic interactions between private protected areas and the relevance of location and network membership for protected area resilience.
- Hayley Clements continued her PhD research on the conservation and economic objectives and long-term sustainability of private protected areas. Hayley's first thesis chapter has been accepted for publication in *Biological Conservation* pending minor revisions.
- Programme post-docs Kristi Maciejewski and Alta de Vos moved on to permanent positions, Kristi with the Organization for Tropical Studies and Alta as a lecturer at Rhodes University.



Community visualisation of the Protected Area Network in the Western Cape where every coloured bubble represents a different community. Node colours represent scale of governance: national protected areas are red, provincial protected areas are yellow and private protected areas green. All edges between the different communities are painted red.

- Alta de Vos assembled a first comprehensive map of private protected areas in South Africa, and analysed the role of spatial variation (e.g. connectivity, location along gradients, context) on the numbers of tourists visiting SANParks. She also mapped the protected areas pending or settled under South Africa's land restitution programme.
- John Heydinger, who graduated with an MSc in December 2014 is now pursuing a PhD at the University of Minnesota focusing on the development of scientific theories of species extinction as linked to social-ecological system concerns.
- With several collaborators from Germany, Graeme led a review paper that was published in *Nature*.
- The group published eight peer-reviewed journal articles on protected areas over the reporting period.
- CB MSc student Jenna Bowker completed her degree and graduated in June. Jenna's paper on her thesis was submitted to *Conservation Biology* and is currently under review.

Key co-sponsors

DST-NRF CoE Grant; James S. MacDonnell Foundation's Complex Systems Program; NRF CPRR & BS grants; SANParks; numerous private nature reserve owners and managers.

Research team

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Dr Oonsie Biggs (Stockholm Resilience Centre)
Prof. Andreas Buerkert (U. Kassel)
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Marna Herbst (SANParks)
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Zaccheus Mahlangu (ZWA)
Prof. Eva Schlecht (U. Kassel)
Dr Colleen Seymour (SANBI)
Prof. Jane Southworth (U. Florida)
Prof. Teja Tscharntke (U. Gottingen)
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Students: Julia Baum (PhD), Hayley Clements (PhD), Jenna Bowker (CB MSc)

Research Assistants: Robyn Milne, Christine Moore, Judith Ament

Ducks, dispersal and disease

In this programme we use a combination of count data, satellite telemetry, tissue samples, and molecular methods to understand the complex inter-relationships between landscape heterogeneity, wetland dynamics, the movements of waterfowl, the bird communities in which our study species occur, and the occurrence of pathogens and parasites

Movement is a dominant theme in evolution, biogeography, community ecology, conservation and management. Southern African waterfowl, with their high movement capability and semi-nomadic lifestyle, provide an intriguing test case for understanding poorly known elements of movement ecology. Despite decades of ringing and counting efforts, little is known about the causes and consequences of the long-distance movements of most southern African ducks.

Uncertainties over the nature and frequency of waterbird movements create challenges for waterfowl conservation and management, as well as the health of South Africa's poultry stocks and ultimately human health and wellbeing. If a virulent pathogen such as the H5N1 strain of avian influenza were to enter southern Africa, how far and how fast could wild birds carry it? And what burden does avian malaria place on bird populations that may already be stressed by habitat modification and climate change?

Since 2007, the Fitz has been working on improving our understanding of the movement ecology of waterfowl and the epidemiology of their pathogens. Tracking data for Red-billed Teal *Anas erythrorhyncha* and Egyptian Geese *Alopochen aegyptiaca* have allowed us to address questions of habitat selection, environmental drivers and scales of waterfowl movement. Our results highlight the importance of agricultural habitats in meeting the life history needs of ducks. We can also test how these birds balance trade-offs between using habitats that are safe from predators and those that provide high quality forage. Rainfall and primary productivity seem to be the dominant environmental drivers of both teal and goose movements.

We have also been investigating the influence of the composition of bird communities on the prevalence of avian malaria (*Plasmodium and Haemoproteus*). These blood parasites infect a wide range of bird species but the community

GPS satellite transmitter attached to an Egyptian Goose from Voëlvlei Dam, Western Cape (Photo: Chevonne Reynolds).

dynamics of infection patterns are poorly known. One of the challenges is to summarise the community in a way that makes sense for the epidemiology of the parasite – grouping birds according to their capacity to introduce or maintain the disease. Fundamental questions on the relative importance of birds' life-history traits (e.g., reproductive rate, development rate, lifespan) and behaviour (e.g., foraging, roosting and movement ecology) in explaining differential infection risks of bird species are being investigated. We have used network analysis to assess the vulnerability of the Ostrich *Struthio camelus* production network to outbreaks of avian influenza.

Extending our focus beyond disease, we have investigated how waterbird movement may affect other aspects of aquatic ecology. Waterbirds often disperse propagules of aquatic plants and invertebrates, which is important for colonising isolated aquatic systems and for maintaining genetic continuity among populations. Samples collected from multiple waterbird species across three wetland sites in South Africa confirm that waterbirds have a high capacity for dispersing seeds and invertebrates

either transported attached to feathers or passing through the gut. In some cases over 80 seeds have been germinated from a single faecal sample. We have also conducted experiments with captive waterbirds to gauge the time taken for seeds to pass through the digestive tract and which seed traits facilitate their survival through the gut. Dispersal of aquatic invasive species by waterbirds is plausible (especially for invertebrates) and has to be considered when managing these invasive species.

Highlights:

- Christine Moore demonstrated that network metrics can be used to track changes in the resilience of a network of ostrich producing farms to Avian Influenza outbreaks. This research is published in the *Journal of Applied Ecology*.
- Dominic Henry completed his PhD in mid-2015 and has been working on submitting his thesis chapters to peer-reviewed journals. His first paper was accepted for publication in *Movement Ecology*. Dominic will graduate in June 2016.
- Chevonne Reynolds submitted her PhD at the end of 2015. After a large amount of field work and data collection, Chevonne has been busy writing and has now published four of her thesis chapters (*Diversity & Distributions*, *African Zoology*, *Basic & Applied Ecology*, and *Freshwater Biology*).
- Eléonore Hellard has been working on the complex interrelationships between bird communities and haematozoon parasties ('avian malaria'). Communities rich in ecological functions favour disease and she has found evidence that the prevalence of more pathogenic parasites is primarily driven by host susceptibility, while that of less pathogenic parasites is primarily driven by host exposure. Some of this research has been published in *Ecosphere*.
- Jordan-Laine Calder's 2014 CB MSc project on weaver movements, based on Dr Dieter Oschadleus' long-term ringing data, which showed that weavers move easily through the urban matrix is now published in *Biological Conservation*.
- Marcela Espinaze completed a CB MSc project on tick-host interactions. She showed that juvenile ticks are more generalist than adults and that evolutionary history can constrain host breadth. This research has been published in *Parasitology*.
- Graeme Cumming and collaborators completed a major review of waterfowl breeding patterns across southern Africa. They identified five major breeding patterns in African waterfowl and found support for the hypothesis that juvenile food availability and predation pressure drive the timing of reproduction in these species. This research and the accompanying data set of ca. 22 000 nest records are published in the open access journal *Ecology & Evolution*.

Field assistant, David Nkosi prepares mosquito traps for avian malaria research (Photo: Chevonne Reynolds).

Key co-sponsors

DST-NRF CoE grant; University of Cape Town Research Committee.

Research team

Prof. Graeme Cumming (PFIAO)
Dr Celia Abolnik (Onderstepoort Veterinary Inst.)
Dr Alexandre Caron (Cirad, Harare)
Dr Nicolas Gaidet (Cirad, Montpellier)
Dr John Grewar (Veterinary Services, Elsenburg)
Dr ivan Horak (Onderstepoort, U. Pretoria)
Dr Eléonore Hellard (Post-doc, PFIAO)
Prof. Jeffrey Peters (Wright State U. Ohio, USA)

Students: Dominic Henry (PhD), Chevonne Reynolds (PhD), Marcela Espinaze (CB MSc)

Understanding urban raptor populations

The world is experiencing rapid urban expansion, with natural landscapes being transformed at an alarming rate. Consequently, urbanisation is identified as one of the biggest environmental challenges of our time, yet we lack a clear understanding of how urbanisation affects behaviour, physiology and disease susceptibility of free-living organisms. In this regards, urban raptors are of specific interest, since predators can have cascading effects within ecosystems.

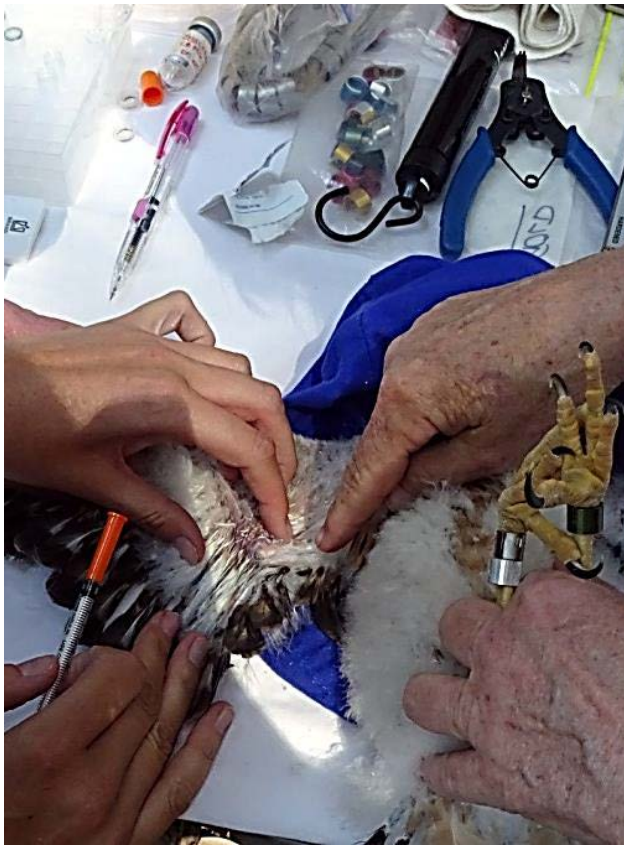
We have several research projects focused on the Black Sparrowhawk *Accipiter melanoleucus* population in Cape Town, aimed at disentangling different aspects on how raptors cope with urban environments. Juan Millàn (CB MSc) explored the behavioural plasticity of how the species copes with competition from Egyptian Geese *Alopochen aegyptiaca*, that frequently usurp their nests. Since nest building is energetically costly, strategies are expected to have evolved to cope with nest usurpation. Such strategies might be especially important in the face of global urbanisation, when individuals colonise a new habitat and may have to cope with increased or novel competition for shared resources. Juan's results suggest that the raptor avoids direct conflicts with Egyptian Geese, instead allocating more resources to multiple nest building. This strategy is effective, because birds that built multiple nests did not suffer reduced seasonal productivity. The findings highlight the importance of behavioural plasticity for city-dwelling species in the face of global change.

A female Black Sparrowhawk, already on eggs, fixes her nest; note the nest lining with fresh greenery (nest camera).

Jessleena Suri (CB MSc) focused on the potential negative impact of urbanisation on the health status of the Black Sparrowhawk. She examined diet composition and prey abundance across different urban and non-urban habitats, and measured the health of nestlings through body condition, blood parasite and stress indices. Surprisingly, no negative health impacts were found. In fact for one blood parasite, *Leucocytozoon*, we found a positive association between the degree of urbanisation and infection, potentially because this parasite's vectors (black flies) require running water to breed. There was no change in diet composition, suggesting that prey species of Black Sparrowhawks were equally abundant across habitat types. Our findings help to understand the success of the species in this newly colonised urban environment.

Many raptors add fresh green plant materials to their nests, but the function of nest decoration in Black Sparrowhawks remains unknown. Campbell Fleming (BSc Hons) explored whether nest decoration could protect nestlings against parasites. The plant species used as lining material tend to be rich in volatile aromatic compounds, supporting the hypothesis that greenery functions as an insecticide against ecto parasites. This suggests that the timing of nest decoration is consistent with the parasite avoidance hypothesis, with greenery cover peaking during the nestling stage. However, there was no association between the amount of greenery and the prevalence of haemosporidian parasites.

Post-doctoral fellow Dr Petra Sumasgutner received a Claude Leon Foundation Fellowship from 2016 under the supervision of Arjun Amar,



Blood is taken from a Black Sparrowhawk to measure cell damage, dietary antioxidants and immune assays in collaboration with Lund University, Sweden, in order to unravel the physiological costs of urban living (Photo: Eléonore Hellard).

Res Altwegg and Andrew Jenkins. This two-year project aims to understand the response of predators to increasing urbanisation and climate change using integrated population models to predict likely population changes under contrasting future scenarios. Climate change is predicted to have a particularly high impact on the Cape Peninsula. Thus, our study with access to long-term data of individually colour ringed raptor populations provides an important model system to predict the impact of such changes.

During her previous CoE fellowship, Petra explored potential factors influencing both offspring survival and their subsequent recruitment. The research suggested that young produced by pairs of contrasting colour morphs have higher survival rates than young fledged from pairs of the same morphs. The association between recruitment and morph was more complex. Recruitment of offspring from dark morph fathers was more likely when fledging earlier in the season, whereas recruitment of offspring from light morph fathers was higher later on. This result might be connected to different hunting success of the fathers depending on their morph and local weather conditions: dark morph males may hunt more successfully in rainier and cloudier conditions which occur more frequently earlier in the breeding season and light morph males may be more successful when weather conditions become increasingly brighter and drier.

Highlights

- A paper was published on Black Sparrowhawk brooding behaviour in relation to chick age and weather variation in the *Journal of Ornithology*.
- Two other papers were accepted for publication in 2016 on the importance of polymorphism in Black Sparrowhawks: one showing the impact on survival and recruitment (*Journal of Animal Ecology*) and one showing how the influence of light levels on foraging success could explain the maintenance of polymorphism (*Ecology Letters*).
- Juan Millàn obtained his CB MSc in June and Campbell Fleming and Gabriella Leighton their BSc Hons degrees in December.
- A talk on the urban ecology of Black Sparrowhawks was presented at several national and international congresses, including the Conference of the European Ornithologists' Union in Spain, the Conference of the Raptor Research Foundation in California and the Annual meeting of the Endangered Wildlife Trust in South Africa.
- Petra Sumasgutner received the Leslie Brown Memorial Grant for African Raptor Research to pursue her work on Black Sparrowhawks.

Key co-sponsors

DST-NRF CoE grant; University of Cape Town Research Committee.

Research team

Dr Arjun Amar (PFIAO)
Dr Res Altwegg (SEEC, UCT)
Dr Eléonore Hellard (Post-doc, PFIAO)
Dr Andrew Jenkins (ADU, UCT)
Ann Koeslag (Volunteer)
Margaret MacIver (Volunteer)
Dr Petra Sumasgutner (Post-doc, PFIAO)

Students: Gareth Tate (PhD), Juan Millàn (CB MSc), Jessleena Suri (CB MSc), Campbell Fleming (BSc Hons), Gabriella Leighton (BSc Hons)

Managing Egyptian Geese on golf courses

In the past 30 years, Egyptian Goose *Alopochen aegyptiaca* populations have increased in many areas. These increases are believed to be a response to increases in the number of farm dams, an expansion of agricultural land and the introduction of urban green spaces. These green spaces include golf courses which have few natural predators and therefore provide a safe landscape for the geese to occupy. As a result, Egyptian Geese have become a nuisance species in the Western Cape, where they irritate golfers and greenkeepers by obstructing play, creating disturbance and fouling greens and fairways. Researchers at the Fitz have been investigating solutions for the issue

Previously, Beth Mackay (BSc Hons) described how geese on golf courses prefer particular areas within which they feel safe. The fact that birds and mammals choose to occupy areas based on their fear of predators is well documented. In many animals, this 'landscape of fear' phenomenon is so strong that they will avoid areas even when feeding and nesting opportunities are plentiful.

Nuisance goose populations can be controlled by lethal or non-lethal means. Lethal options are often contentious and are thus deemed unacceptable, therefore non-lethal solutions are often advocated. However, there are few effective non-lethal techniques available to reduce problem bird species and the efficacy of most remains untested. One non-lethal method is to manipulate the landscape of fear to reduce the areas where geese feel comfortable. This can be done by manipulating their habitat; for example by planting tall vegetation around water bodies and along fairways to reduce access to the safety of the water, by obstructing their views and by reducing the amount of open space. Another way is to introduce a predator into the system, thereby mimicking their natural habitats.

The use of falconry, with trained hawks, is one potential way to increase their fear of predation. However, the efficacy of falconry to reduce goose numbers on golf courses has not been tested. During late 2014 and 2015, Alex Atkins (CB MSc) experimentally investigated the impact of falconry on geese on golf courses. He found that falconry resulted in an 82% reduction in the number of geese on the golf course compared to the month prior to the start of falconry. The number of geese killed during the five month study represented less than a third of the total reduction, meaning that most of the population left the course because of the increased fear of predation. This suggested that falconry is an effective way of creating an environment where the geese no longer feel safe, and therefore choose to leave the property and find safer areas to live elsewhere.

Falconry can be a useful relatively non-lethal management tool to reduce the impact of geese on golf courses (Photo: John Dickens).

Harris' Hawks *Parabuteo unicinctus* are flown from golf carts to test the efficacy of falconry in reducing goose numbers on golf courses (Photo: John Dickens).

To confirm whether this increased fear of being attacked was the reason why the geese left the golf course Alex also studied their vigilance levels (the amount of time the geese spend scanning their surroundings for potential predators) to determine how threatened they felt. He found that under normal conditions when the threat of predation is low, geese spend on average 20% of their time scanning for potential threats. This increased to 37% when the geese were exposed to falconry on a weekly basis, confirming that the decrease in goose abundance was largely due to their increased level of fear. Furthermore, because the falconry hawks were flown from a golf cart, vigilance levels increased most in the presence of a golf cart, suggesting that geese learned to associate carts with the threat of predation, further enhancing the non-lethal impacts of the treatment and providing evidence that sustained learning could be an additional inducible defense. This indicates that falconry can be a useful relatively non-lethal management tool to reduce the impact of geese on golf courses.

Highlights

- The falconry project was conducted in collaboration with Steenberg, Westlake and Rondebosch golf courses.
- Alex Atkins graduated in June 2015 with distinction.
- This research has been submitted as a paper to the journal *Behavioral Ecology.*

Key co-sponsors
DST-NRF CoE grant.

Research team
Dr Arjun Amar (PFIAO)
Dr Rob Little (PFIAO)
Dr Steve Redpath (U. Aberdeen)

Student: Alex Atkins (CB MSc)

Research Assistants: Salamatu Abdu, Alan Clemo (Raptor Force), Hank Chalmers (Raptor Force), Francesca Fazey, Frances Morling.

Plastics in the ocean

Plastics are used in a plethora of applications because they are lightweight, durable, have excellent barrier properties and are relatively cheap. These properties also make inappropriately handled waste plastics a significant environmental threat. Plastic litter persists for many years, is readily dispersed by water and wind, and has been accumulating in the sea for decades. It entangles and is eaten by a wide diversity of marine fauna, killing them directly, or reducing their appetite. Concerns about 'microplastics' introducing persistent organic pollutants (POPs) into marine foodwebs, combined with the discovery of 'garbage patches' in all the main ocean gyres, has sparked renewed interest in the subject in the last decade.

Plastic ingestion

The most significant impacts of plastics on marine organisms arise from plastic ingestion. It is thus important to understand why organisms ingest plastic, and to track trends in plastic ingestion. A major milestone for the project in 2015 was Peter Ryan completing a review of plastic ingestion for Hideshige Takada and Hrissi Karapanagioti's book *Hazardous Chemicals Associated with Plastics in the Environment*. This stimulated several other papers, including one on regional differences in ingestion rates among Southern Ocean fur seals and albatrosses, and one challenging a recent claim that some petrels digest plastic articles within a few weeks of ingestion.

An unusually large stranding event of post-hatchling Loggerhead Turtles *Caretta caretta* along the southern Cape coast in autumn 2015 resulted in a collaborative paper with researchers from NMMU and the Two Oceans Aquarium. George Hughes was among the first researchers to record plastic ingestion by marine turtles, when he found plastic in post-hatchling Loggerheads stranded on the Cape coast in the late 1960s and early 1970s. Compared to these early records, the amounts and types of plastics ingested has increased dramatically. Plastic contributed to the deaths of at least 16 turtles, but more than 180 were successfully rehabilitated and released.

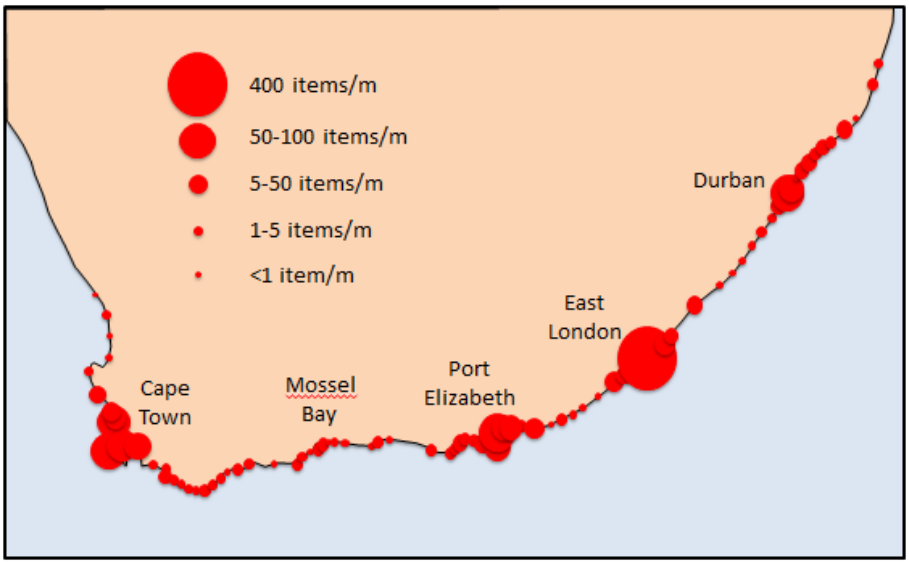
Beaches as windows to plastic at sea

Peter Ryan studied the impacts of plastics on seabirds for his MSc in the mid-1980s. Given very little information on the amounts and types of marine plastics in southern Africa at that time, he surveyed macro (>10 mm) and meso (1-10 mm) plastic items on 50 South African beaches in the winter of 1984. These surveys have been repeated every five years until 1999, and again from 2005, which made 2015 the seventh survey. From 1994, every second survey has covered more than 80 beaches from just south of the Olifants River mouth in the Western Cape to Cape Vidal in northern KwaZulu-Natal. Fortunately, Alexis Osborne and Vonica Perold, the two field assistants from Marion Island in 2014/15, were available to assist with sampling, which took more than three weeks to complete.

The survey collected more than 63,000 items, at an average density of 13.3 macro- and 723.4 meso-items per metre of beach – 95% of which were made of plastic. Long-term trends in large plastic items (e.g. bags and bottles) have remained fairly constant, reflecting the steady increase in formal beach cleaning efforts over the last three decades. However, the abundance of smaller macro-litter items has increased markedly, despite the recent expansion of the government's EPW '*Working for the Coast*' progamme. The highest densities of both macro- and meso-litter were close to the major urban centres, which confirms that local, land-based sources account for most litter on South African beaches (and by extension, in coastal waters). These findings were presented at the *Working for the Coast* implementer launch in Johannesburg, to highlight the importance of collecting smaller items when cleaning beaches.

Out of sight, but not forgotten…

Much of the recent research in this project has focused on understanding how plastics move through marine systems, and how this affects estimates of plastic abundance. Surveys of plastic debris drifting at sea off South Africa and in the Southern Ocean found that only relatively



The density of meso-plastic debris (1-10 mm) on 80 beaches clearly shows local concentrations around all the urban centres.

large and/or buoyant litter items were observed far from major land-based litter sources, suggesting that small items with little inherent buoyancy sink more rapidly to the sea floor than large, buoyant items. This makes sense, because small items have a relatively larger surface area on which fouling organisms can settle, decreasing buoyancy to the point where they sink out of surface waters.

Francesca Fazey conducted an *in situ* experiment to test the importance of plastic size and buoyancy on the time taken for biofouling to cause litter items to sink for her MSc CB project. Her trials showed the predicted relationship between the volume of a plastic object and the time taken to sink, providing a plausible mechanism for the millions of tons of 'missing' litter reported by surveys of floating litter. The importance of this finding was further supported by a steady increase in the size and buoyancy of items stranding on beaches at increasing distances from Cape Town, a major point source of plastic litter.

Sampling the seabed

Our buoyancy data suggest that there is much more litter on the sea floor or suspended in mid-water than previously suspected. Senior Technical Officer in the Biological Sciences Department, Andrea Plos, has devised a simple system for sampling seabed litter in shallow water systems for her MSc in Applied Marine Science. We are also working with Prof. Colin Attwood to examine video footage of the continental shelf edge for litter. Finally, a monthly clean-up of intertidal litter at Muizenberg corner run in conjunction with a volunteer group commenced in March 2015, generating interesting data on litter types and amounts relative to the adjacent sandy beach.

Highlights

- Peter Ryan published a paper in *Environmental Research Letters* suggesting how the surface area to volume ratio affects the sinking rate of floating debris due to the differential impact of biofouling.
- Francesca Fazey was awarded her CB MSc in 2015 for her study of how size-dependent biofouling affects the rate of buoyancy loss of drifting plastic items. She has already published one paper that demonstrates this effect experimentally in *Environmental Pollution*, and has a second paper submitted to *Marine Pollution Bulletin*.
- Antoni Massot Mascaro was awarded his AMS MSc in 2015 for his study of surf-zone plastic litter in False Bay.
- Peter's history of marine plastics research was the first chapter in the book *Marine Anthropogenic Litter* published in 2015, and a review chapter on the ingestion of plastics by marine organisms will be published in 2016.

Key co-sponsors
Plastics SA.

Research team
Prof. Peter Ryan (PFIAO)
Assoc. Prof. Coleen Moloney (MaRe, UCT)
Prof. Hideshige Takada (Tokyo)

Students: Francesca Fazey (CB MSc), Antoni Massot Mascaro (AMS MSc), Andrea Plos (AMS MSc),

Conservation Biology Masters programme 2015

The 23rd cohort of CB students started their studies in January 2014, with 14 participants from eight countries: Botswana, Chile, Colombia, Ireland, Nigeria, South Africa, the UK and USA. Unfortunately one student dropped out during the coursework component to pursue an alternative career option, but the remaining 13 students completed the coursework, with 12 submitting their mini-theses by the mid-February deadline. Alex Atkins was awarded his degree with distinction.

The 2015 intake of CB students, our 24th cohort, comprised 13 students from India, Japan, Mauritius, Mozambique, South Africa, the UK, USA and Zimbabwe. Thanks to teething problems associated with the new Home Affairs visa regulations, the arrival of two students was delayed for several weeks, but despite arriving late, both managed to successfully catch up with the rest of the class. Unfortunately one student from the UK did not finish the coursework component for personal reasons, but the remaining 12 students completed the course, with 11 submitting their mini-theses by the mid-February deadline. This cohort was exceptionally strong academically with five distinction level grades in the coursework component, so we hold high hopes for the outcome of the thesis examination component.

The 25th cohort of students started in early 2016. The new Home Affairs visa regulations continue to bite, and two foreign students who initially accepted offers had to relinquish their places on the course because they were unable to obtain a visa in time while residing outside their country of birth, even though not in South Africa. This is likely to be an ongoing issue. The new class comprises 14 students from Australia, South Africa, Spain, Sudan, the USA and Zimbabwe.

Course structure and teachers

The course structure underwent an overhaul in 2015, in part a response to the loss of Prof. Graeme Cumming, who left to take up a post in Australia, and Dr Peter Carrick, who gave notice that 2015 would be his final year teaching the Restoration Ecology module. This process involved interviewing employers of past CB students to ensure the course was still providing requisite skills and knowledge, reviewing student evaluations from the past five years of the course, and canvassing help from across the UCT and wider community including stake-holders from SANBI, the Nature Conservation Corporation and further afield. A day-long workshop was led by Dr Claire Spottiswoode, who has been offered the Pasvolsky Chair in Conservation Biology, and Dr Susie Cunningham, which resulted in the drafting of a new course structure. Most modules were retained, but with increased emphasis on the teaching of practical conservation, statistical analyses and research planning. A new module on Conservation Leadership was introduced to teach conflict resolution and managerial skills. We are extremely grateful to everyone who contributed to this process, and to all those both within and outside UCT who continue to provide support and input to the course.

New teachers in 2016 include Dr Wendy Foden, latterly of the IUCN, currently employed at Stellenbosch University, who will lead the new module on Conservation Leadership; Dr Claire Spottiswoode leading a week on Project Planning, and Dr Robert Thomson who will co-lead the Community Ecology module with Prof. Timm Hoffman. HRA Dr Kristi Maciejewski, a former post-doc of Prof. Graeme Cumming, will take up the reins of the Conservation Planning and GIS module. Dr Sebataolo Rahlao has also joined the teaching team and will aid Assoc. Prof.

2015 Course co-ordinators
Dr Susan Cunningham
Prof. Peter Ryan

2015 Module Leaders
Dr Arjun Amar (PFIAO)
Assoc. Prof. Colin Attwood (BioSci, UCT)
Dr Guy Balme (Panthera)
Dr Jacqueline Bishop (BioSci, UCT)
Dr Peter Carrick, (BioSci, UCT)
Prof. David Cumming (PFIAO)
Assoc. Prof. Lindsey Gillson (BioSci, UCT),
Prof. Timm Hoffmann (BioSci, UCT)
Assoc. Prof. John Hoffmann (BioSci, UCT)
Prof. Justin O'Riain (BioSci, UCT)
Dr Cecile Reed (Biological Sciences, UCT)
Dr Robert Thomson (PFIAO)
Dr Gladman Thondlhana (Rhodes)
Dr Jane Turpie (Economics, UCT & Anchor Consultants)

Students on the 2015 Conservation Biology Masters course take a well-earned rest on a field trip to Myburgh Waterfall Ravine. The students visited Chapman's Peak and the Ravine to learn about the biodiversity of the Cape Peninsula and see the famous Red Disa in flower. The trip was led by experienced guide and former Fitz PhD student Dr Callan Cohen (Photo: Callan Cohen).

John Hoffman in Invasion Biology, with a view to taking over this module once John retires. Dr Ross Wanless (BirdLife SA) will add input to the Conservation in Practice module together with Dr Guy Balme (Panthera) and Prof. Justin O'Riain. Finally Dr Tamar Ron from the Angolan Ministry of Environment will bring input into conservation politics as a part of Wendy Foden's Conservation Leadership module. Dr Phoebe Barnard (SANBI) continues to contribute both in Climate Change and Conservation Leadership, and Dr Gladman Thondhlana will return to teach Conservation and Society in 2016.

We were very pleased to retain Prof. David Cumming teaching the introductory module Big Picture & Philosophy of Science, as well as rounding off the course with a summary at the end. Prof. Cumming is extremely well respected by the students and provides an excellent introduction to the course.

Other module leaders from within UCT included Dr Arjun Amar (Statistical Analyses and Project Planning), Assoc. Prof. Colin Attwood (Marine Ecology), Dr Jacqueline Bishop (Conservation Genetics), Prof. Peter Ryan (Demography & PVA) and Dr Jane Turpie (Resource Economics). In addition, many other people continue to contribute through guest lectures, field trips and discussions. This diversity of perspectives adds greatly to the value of the course.

Challenges and opportunities

New course co-ordinator Dr Susie Cunningham began her tenure as the main administrator for the course in 2015, and is settling in to the role with invaluable support from the Fitz team, most especially Peter Ryan and Hilary Buchanan. After receiving very positive evaluations from the 2015 cohort, she will teach the Biodiversity module for the second time in 2016.

2016 sees the bedding in of the new course structure including the new Conservation Leadership module and a fair amount of turnover in module leaders, making it an exciting time for the course. We look forward to the students' evaluations of the new course structure.

MSc Conservation Biology projects 2015

Angoh, Jennifer: The birds, the bees and Ericas: vulnerability of plant-pollinator communities in fragmented fynbos landscapes (Supervisors: Mark Brown, JeremyMidgley)

Brink, Christiaan: The reintroduction of Bearded Vultures in South Africa: a feasibility analysis (Supervisors: Arjun Amar, Sonja Krüger)

Ferguson, Angela: Using Conditioned Food Aversion (CFA) to reduce Pied Crow (*Corvus albus*) predation of plover nests (Supervisors: Robert Thomson, Tom Flower)

Gabriela Fleury: Environmental change in Riemvasmaak, Northern Cape, South Africa twenty years after resettlement (Supervisors: Timm Hoffman, Simon Todd)

Lloyd, Kyle: An experimental approach to assess the role of nest predation in the population dynamics of the Sociable Weaver (*Philetairus socius*) (Supervisor: Rita Covas)

Matimele, Hermenegildo: An assessment of the distribution and conservation status of endemic and near endemic plant species in Maputaland (Supervisors: Timm Hoffman, Domatilla Raimondo, Jonathan Timberlake)

Pistorius, Penny: Understanding host-tick interactions: risk assessment of mammalian infection in South Africa (Supervisors: Susan Cunningham, Rowan Martin)

Pretorius, Adele: Of mice, birds and Protea, do diet patterns of nectar production reflect pollinator dependence in the threatened Fynbos biome? (Supervisor: Sandy-Lynn Steenhuisen)

Suri, Jessleena: Street-wise: does prey abundance buffer Black Sparrowhawks (*Accipitier melanoleucus*) from the negative health impacts of urbanisation (Supervisor: Arjun Amar)

Tokura, Wataru: Understanding changes in plant productivity using EVI satellite data in Tswalu Kalahari Reserve (Supervisor: Timm Hoffman)

Van Velden, Julia: Cranes and crops: investigating the viability of Blue Cranes in agricultural lands of the Western Cape (Supervisors: Peter Ryan, Tanja Smith)

Visser, Elke: The impact of South Africa's largest photovoltaic solar energy facility on birds in the Northern Cape, South Africa (Supervisors: Peter Ryan, Samantha Ralston)

The CB class spend much of their time in their teaching facility, which features individual work areas around the periphery of an open area which can be set up for lectures or discussions (above left). However, they always relish the opportunity to get into the field, especially with experts in their field. Above right, former Fitz student and renowned naturalist guide Dr Callan Cohen explains some of the finer points of plant ecology (Photos: Wataru Tokura).

Niven Library

The departure of Margaret Koopman at the end of January 2015 was a sad loss to the Fitztitute, given Margaret's major contribution to the Niven Library over the last decade. Fortunately Phelisa Hans was available to stand in and keep the library ticking over until the appointment of Susan Mvungi in July 2015. The main focus for 2015 was to bring the Niven Library into the digital era, by creating a digital archive of all the Percy FitzPatrick Institute scientific publications.

Overview

The Percy FitzPatrick Institute keeps a record of all its scientific and semi-popular publications. Until recently the collection of publications were in the print medium, but with increasing demand for pdfs to be shared over the internet, the need arose to digitise all publications. The digitising project began in August 2015 and by April 2016, all scientific publication papers from 1980 onwards will be available as pdfs. All scientific papers published by the Fitz dating back to 1980 will be available online by the end of the year.

Staff Development

Phelisa Hans did a brilliant job keeping the library running between Margaret's resignation and the appointment of Susan Mvungi as the new Niven Librarian in July 2015. Phelisa remains employed part-time in the Niven while studying further towards a degree in Library and Information Science. She is currently engaged in an ongoing project dealing with the Richard Brooke reprint collection. This collection consists of 18th and 19th century articles and manuscripts, and most of the collection before 1986 is not available on the catalogue. She also began adding the reprint collection to the Amlib library management system for all 45 000 reprint records, as well as adding theses donated by UCT to the Amlib catalogue system.

Susan Mvungi has attended training on the Amlib Library Management; an Altmetrics webinar and a Library marketing webinar, both hosted by UCT Library. There were a number of cataloguing errors encountered when moving from the old library management system to the new Amlib library management system. A plan has been put in place to update the catalogue records during 2016.

New Developments

The self-issue system has been given a new look, designed by Deric Smith from Sabinet. The colours on the system are now synonymous with the University of Cape Town library logo colours. Instructions on how to use the self-issue system are explained implicitly on the main screen. The self-issue system will allow users to print a slip with details of the books loaned out and the date that the books are due back with the library.

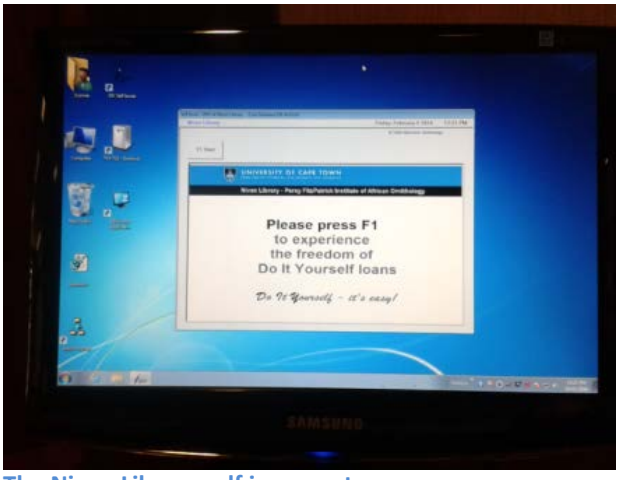
Collection Management

The Niven Library received a donation of 18 books from Dave Hidden of the Hidden Valley Wine Estate, as well as authored books from Richard Primack, Chevonne Reynolds, Rob Simmons and Ross Wanless. Duplicate books donated to the library were sold, raising R 1 934 in October 2015.

Library use and requests for Information

The Niven Library reading room was used for numerous interviews, presentations, meetings, and seminars during 2015, as well as a contract signing ceremony when The French Institut de Recherche pour le Développement (IRD) signed the International Centre for Education, Marine and Atmospheric Science over Africa (ICEMASA) agreement with the University of Cape Town.

Requests for information from the Niven Library from staff and students of the FitzPatrick Institute amounted to roughly 40% of the total requests received, the rest coming from all over the world.



The Niven Library self issue system screen.

Social Responsiveness 2015

Apart from research, education and training, the Fitztitute also engages regularly with social responsiveness activities to profile our research and to provide outreach for our ornithological achievements.

PhD student Davide Gaglio with a school group in the Fitz CoE stand at the launch of the DST National Science Week fair at the North-West University Mafikeng Campus during August 2015. (Photo: Hanneline Smit-Robinson)

Fitz Centre of Excellence members published 76 semi-popular articles in the public media and seven books and chapter contributions to semi-technical books, and presented over 50 seminars and illustrated talks at numerous universities, bird clubs and membership-based societies during 2015. We also participate on 63 membership fora and advisory services.

In addition, apart from the primary authors, seven Fitz members contributed 11 species assessments in The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland and two members contributed three species assessments for Birds to Watch in Namibia: Red Data and Endemic Species, both published in 2015. Numerous Fitz members also acted as reviewers for the species assessments in these two books. Both are listed as books published by Fitz members, since both have a Fitz Research Associate as an author, Dr Ross Wanless and Dr Rob Simmons, respectively.

Dr Rob Little and Davide Gaglio presented a Fitztitute CoE stand at the launch of the National Science Week fair at the North-West University Mafikeng Campus during August 2015. The National Science week, launched by the Minister of Science and Technology, Naledi Pandor, is a countrywide celebration of science, initiated by the Department of Science and Technology (DST) in partnership with South African Agency for Science and Technology Advancement (SAASTA) and the North-West Department of Education, and various other stakeholders. The National Science Week initiative of DST aims to contribute to the development of a society which values and appreciates science, engineering and technological fields, and to provide a platform for scientists to instil interest in learners to follow careers in the scientific community. The National Science Week programme ran from 1 to 8 August 2015, and some of the activities for learners from over 50 schools included career

exhibitions from 82 exhibitors from across the country, representing various stakeholders in the scientific community, public lectures, seminars and presentations on the latest innovations made through scientific research.

Fitz students Ben Dilley, Kim Stevens and Otto Whitehead and research assistant Delia Davies assisted with the arrangements and manned a Fitztitute stand at the South African National Antarctic Programme (SANAP) SA Agulhas II Open Day on 12-13 June 2015. Following the event, a letter was received on behalf of the Deputy Director-General: Oceans and Coasts (Dept Environmental Affairs) which expressed sincere gratitude to the Fitz CoE for involvement in the SA Agulhas II Open Days as these were recognised as a great success. The letter also stated that members of the public and the learners really appreciated the informative and interesting work undertaken by the Fitz including research done at all the SANAP research bases, i.e. Marion and Gough Islands, and including Antarctica. The department is looking forward to many more years of worthwhile association with us.

Prof. Peter Ryan, Dr Rob Little and Dr Steve Boyes gave input to the drafting of the Department of Environmental Affairs (DEA) Norms and Standards for avian invasive species management (NEMBA) and for the Avian Associations (specifically with regards to drafting NEMBA regulations and their subsequent implementation). Peter Ryan also assisted THE DEA's Working for the Coast Programme (DEA's Extended Public Works Programme) to improve beach cleaning efforts, and gave the keynote address at the Project Implementation Launch of Working for the Coast in Johannesburg. Prof. Andrew McKechnie acted as an expert reviewer for the South African National Standard SANS 10386 for the care and use of animals for scientific research, Annex C (Birds).

Learners at the Fitz stand at the South African National Antarctic Programme (SANAP) SA Agulhas II Open Days during June 2015. (Photos: Ben Dilley and Delia Davies)

Scientific publications 2015

Names in **bold** are members of the Fitztitute or the Centre of Excellence.
IF = Impact Factor.

Acker, P., Grégoire, A., Rat, M., Spottiswoode, C.N., van Dijk, R.E., Paquet, M., Kaden, J.C., Pradel, R., Hatchwell, B.J., **Covas, R.** and Doutrelant, C. 2015. Disruptive viability selection on a black plumage trait associated with dominance. *Journal of Evolutionary Biology* 28: 2027-2041. IF 3.804

Amar, A. 2015. Using independent nest survey data to validate changes in reporting rates of Martial Eagles between the Southern African Bird Atlas Project 1 and 2. *Ostrich.* IF 0.431

Baylis, A.M.M., Orben, R.A., **Pistorius, P.**, Brickle, P., Staniland, I. and Ratcliffe, N. 2015. Winter foraging site fidelity of king penguins breeding at the Falkland Islands. *Marine Biology* 162: 99-110. IF 2.569

Bray, T.C. and **Hockey, P.A.R.** 2015. Population genetics and demographic inferences in a recovering shorebird, the African Black Oystercatcher *Haematopus moquini*. *Ibis* 157: 171-176. IF 1.861

Brown, R.M., **Techow, N.M.S.M.**, Wood, A.G. and Phillips, R.A. 2015. Hybridization and back-crossing in giant petrels (*Macronectes giganteus* and *M. halli*) at Bird Island, South Georgia and a summary of hybridization in seabirds. *PLoS ONE* 10: e0121688. IF 4.015

Cáceres, A., **Melo, M.**, Barlow, J., Cardoso, P., Maiato, F. and Mills, M.S.L. 2015. Threatened birds of the Angolan central escarpment: distribution and response to habitat change at Kumbira Forest. *Oryx* 49: 727-734. IF 1.914

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Cook, T.R., Bonnet, X., Fauvel, T., Shine, R. and Brishoux, F. 2015. Foraging behavior and energy budgets of sea snakes: insights from implanted data loggers. *Journal of Zoology* 298:82-93. IF 2.108

Cressey, E.R., Measey, G.J. and Tolley, K.A. 2015. Fading out of view: the enigmatic decline of Rose's Mountain Toad *Capensibufo rosei*. *Oryx* 49: 521-528. IF 1.914

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Cumming, G.S., Allen, C.R., Ban, N.C., Biggs, D., Biggs, H.C., **Cumming, D.H.M.**, **De Vos, A.**, Epstein, G., Etienne, M., **Maciejewski, K.**, Mathevet, R., **Moore, C.A.**, Nenadovic, M. and Schoon, M. 2015. Understanding protected area resilience: a multi-scale, social-ecological approach. *Ecological Applications* 25: 299-319. IF 4.126

Cumming, G.S., Harebottle, D.M., Mundava, J., Otieno, N. and Tyler, S.J. 2015. Timing and location of reproduction in African waterfowl: an overview of >100 years of nest records. *Ecology and Evolution* 6:631-646. IF 2.415

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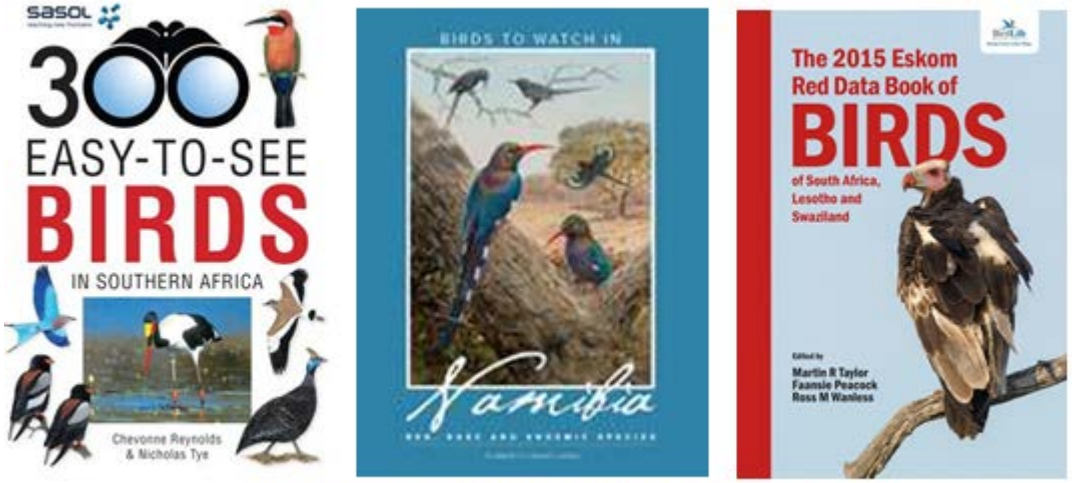

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