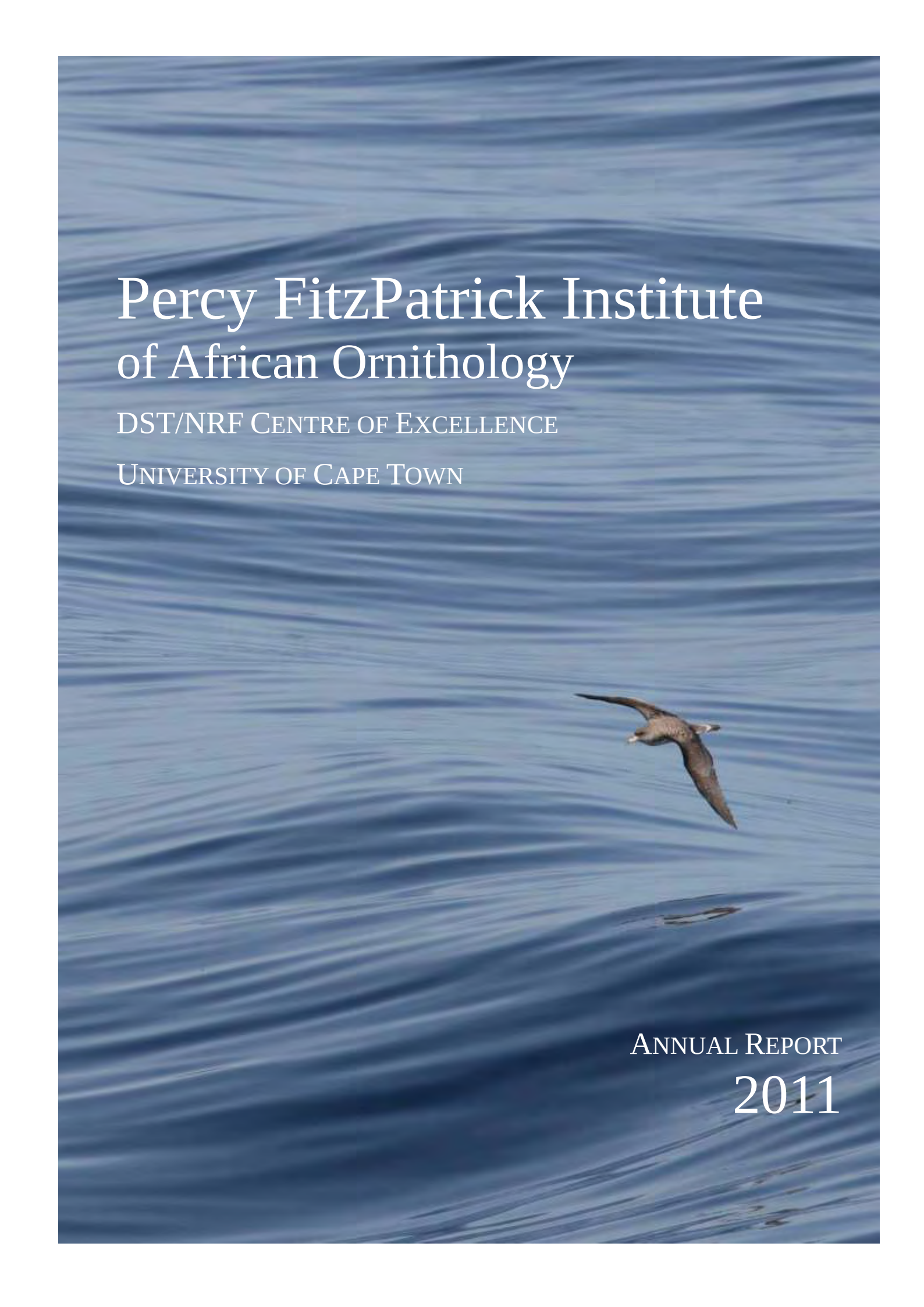


A photograph of a bird, possibly a frigatebird, in flight over a vast, blue ocean. The bird is captured in mid-flight, with its wings spread wide, showing dark feathers. The water is a deep blue with gentle ripples. The overall scene is serene and expansive.

Percy FitzPatrick Institute of African Ornithology

DST/NRF CENTRE OF EXCELLENCE

UNIVERSITY OF CAPE TOWN

ANNUAL REPORT
2011



Percy FitzPatrick Institute of African Ornithology

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FRONT COVER: **Cory's Shearwater** *Calonectris diomedea* (Photo: Peter Ryan)

HALF TITLE PAGE: **African Scops Owl** *Otus senegalensis* (Photo: Phil Hockey)

OPPOSITE: **Swallow-tailed Bee-eater** *Merops hirundineus* (Photo: Samantha Hockey)



Director's Report



Director of the Fitz, Prof. Phil Hockey.
(Photo: Samantha Hockey)

The end of 2010 almost saw the end of our 50th Anniversary celebrations – a little more of that later. It also saw the upgrading of the Institute to a fully funded Centre of Excellence. A big thank you to the DST and NRF for that and an equally big thank you to all the Fitz staff and students whose hard work ensured that the potential upgrade became a reality. Even at relatively short notice, the upgrade allowed us to take on one more Post-doctoral Fellow and three more PhD students in 2011.

Among the first new students to arrive at the start of 2011 were the Conservation Biology (CB) Masters students. These represent the 20th cohort of CB students, attesting to the national and international standing of this course, which has now graduated well in excess of 200 students. The course reached another milestone this year. After more than a decade of teaching on the course, Norman Myers, doyen of conservation biology and originator of the concept of Biodiversity Hotspots, lectured to the students for the last time. We are hugely grateful for all the knowledge, insight and enthusiasm that Norman has imparted to the CB class over the years.

As the CB class was preparing to take up residence, Peter Ryan, Doug Loewenthal and I represented the Fitz at the 5th Biodiversity Conservation Academy held at Potberg Environmental Education Centre in De Hoop Nature Reserve from 17–21 January. This is a joint venture between two Centres of Excellence - the Centre for Invasion Biology at Stellenbosch University and the Fitz. The Academy targets previously disadvantaged undergraduates from universities across the country, as well as interns from SANBI. The aim of the Academy is to broaden the students' knowledge of conservation in a South African context and to encourage them to pursue post-graduate studies in Conservation Biology. This year, all 14 student participants were black, and nine of them were women.



At the Centres of Excellence Annual Day, Phil discusses aspects of the Fitz CoE with Minister Naledi Pandor (Science and Technology), Dr Max Price (VC, UCT) and Dr Albert van Jaarsveld (CEO and Director, NRF). (Photo: Lisa Nupen)

Shortly after this, in February, Rob Little, some senior Fitz students and I attended the NRF/DST CoE Annual Day. This was an important event, attended by top-ranking representatives from the NRF and DST, including the NRF's CEO and Minister Naledi Pandor. At this meeting, I gave an overview of how the activities of the Fitz and its Centre of Excellence contribute to the South African Government's 'Outcomes Approach'. This is the framework within which government departments work and assess their level of delivery, so constitutes the reporting framework within which we too must operate. Beyond the end of 2014, the fates of the original six National Centres of Excellence remain undecided, so it is vital that we present ourselves well at meetings such as this when the opportunity arises.

April saw the final celebratory event of the Fitz's 50th Anniversary calendar with a visit to the Institute by media and conservation icon, Sir David Attenborough. His visit had been on the cards for a while, following his life-long friendship with veteran Board member, Patrick Niven but this was only confirmed in early 2011. Unfortunately,

Patrick passed away in 2009, but Sir David nonetheless fulfilled his long-standing promise. I was the first to know that the visit had been confirmed, and happened to be teaching the CB class at the time. When I asked the CB students who, in the broad field of conservation, they would most like to meet in the world, Sir David came out a hands-down winner – lucky class of 2011! And what a visit it was!

Sir David is not a young man, but his energy and enthusiasm are infectious and his memory prodigious. In addition to keeping several media appointments, he also gave a Vice-Chancellor's Open Lecture at the Baxter Theatre on the topic of Darwin and Wallace and their independent efforts to unravel the secrets of natural selection. Tickets for this lecture were free, but had to be collected from the Baxter and could not be pre-booked. It seems that UCT had somewhat underestimated the response – several hours before the ticket booths opened (and in the dark), queues were stretching down Rondebosch Main Road. By the time the University's *Monday Paper* arrived to document the event, all the tickets had gone, the ticket booths were closed and the crowds had dispersed! If we do this again, maybe we should book the ArtsCape Theatre! But those who had queued from the early hours were treated to a consummate display of lecturing skill and both biological and historical insight. The following day Sir David hosted a three-hour student question-and-answer session at Kirstenbosch Botanical Gardens. This was again attended by a packed house of staff and students of the Fitz, UCT's Zoology Department and SANBI. All-in-all it was an extraordinary way to finish the anniversary celebrations, and one that I think might be hard to top in the years to come. Sir David is owed a big thank you by the aspirant conservation scientists of Cape Town.

But back to the nitty gritty of science and students. In June, a new penguin research vessel, "Winkle", was launched at the Algoa Bay Yacht Club in Port Elizabeth. This boat is armed with some state-of-the-art equipment for tracking the movements of fish – whilst we know quite a lot about the movements of penguins it is becoming increasingly clear that only by understanding movement patterns of their prey can we really come up with conservation answers for this ailing species.

In August, the Patrick Niven Conservation Biology Award, worth R12 000, was presented to Sarah Lewis as the top CB student for 2010/2011 at a special cocktail event in the Niven Library. The award was sponsored by the Johnson Family Trust, and was handed over to Sarah by Peter Johnson, a long-standing member of the Fitz's Advisory Board. It came as a real shock to us all when Peter died suddenly at his home only two months later, on 20 October. Perhaps all the bad news should come at once, because earlier in the year, Dan Niven – Patrick's brother and another long-serving Board member – also died (5 July). We will remain forever indebted to them for their long and valuable support of the Fitz and our thoughts go out to the families of both Peter and Dan.

However, following this sad news, 2011 was a record year in terms of graduating students, with no fewer than 9 PhDs, 13 MScs and 8 Honours degrees being awarded to Fitz-supported students. Despite this large number passing through the portals, the total number of students the Fitz will be hosting in 2012 is set to rise from the 64 of 2011 to some 73 (I wonder where we are going to put them all!). It can safely be said that 2011 was not only the



Sir David's student question-and-answer session at Kirstenbosch was a huge success. (Photos: Cheryl-Samantha Owen)



Phil Hockey and Peter Johnson congratulate the recipient of the first Patrick Niven Conservation Biology Award, Sarah Lewis, top MSc Conservation Biology student 2010-11. (Photo: Rob Little)

MISSION STATEMENT

To promote and undertake scientific studies involving birds, and contribute to the practice affecting the maintenance of biological diversity and the sustained use of biological resources.



Photo: Peter Ryan

year in which the Fitz had its greatest number of graduates in history, but was also the year in which it hosted the greatest numbers of students. Whilst this all sounds like good news, it does carry with it some hard work. In 2012, our student numbers will be nearly twice the numbers we had in 2004, but the number of UCT-funded support staff expected to cope with this growth is exactly the same as we had in 2004 (the year prior to the initiation of the Centre of Excellence). Hilary's student paperwork mountain and her 'mothering' load mushroomed; Chris has become a part-time fleet manager as well as coping with a doubled IT load; and Anthea and Tania fill out seemingly endless expense claims for field work (that I have to sign); and Margaret deals with growing literature demands. I would like to use this opportunity to thank both the academic and support staff, funded both by UCT and elsewhere, for their unerring ability to cope with the growing work load and for doing so in such a good-natured manner.

And while on matters statistical, in 2011 the Fitz had 79 papers published in peer-reviewed journals, including 17 in journals with SCI impact factor ratings of 3.5 or higher (and that's no small achievement in the life sciences). We also published five contributions to semi-technical books and 41 semi-popular articles. Fitz members served on the editorial boards of 16 scientific journals, and on 35 membership and advisory services, as well as reviewing 97 papers for 50 different, peer-reviewed international and local journals. They also attended 18 different conferences, of which 11 were international.

On the subject of media exposure, you may recall mention in the last annual report that the Fitz had a Facebook site (for the Cape Parrot Project). We now have two more – both institutional rather than project-specific. One functions as a forum for interactions between Fitz alumni, whereas the other is a portal for news, events etc. The latter was set up in November of 2011 and already receives 200-400 'hits' per week. You can find these by searching on the Fitz's full name. The parrot project is also on Twitter (described by the Head of FutureWorks as a 'human seismograph'), but as yet we haven't followed this route institutionally. The idea of a bunch of ornithologists 'tweeting' at each other has the potential to generate a grid-lock of inanity and guarantee the site-manager's insanity!

What can sometimes be overlooked in reports such as this is the importance of students. All too often, and in many media, students are reported as statistics, or even as achievement targets (yes, we have those too). However, those of us charged with compiling or satisfying such statistics/targets should never lose sight of the fact that students are the lifeblood of the Fitz. Students hugely outnumber staff and are responsible for the majority of our research: they thus constitute our most valuable resource. I sincerely wish to congratulate the Fitz students on what they have achieved and continue to achieve. It is a privilege to work with a group of people that interact so well with one another, are generous to a fault with their knowledge and skills, yet never flinch when asked to do something for the corporate good. I and the other Fitz staff are honoured to be working with you (and hope that the sentiment is, at least to some degree, reciprocated!).

Phil Hockey



PhD graduates Graeme Oatley, Ian Little and Genevieve Jones celebrate. (Photo: Bryan Little)

Staff, Students and Associates

GRADUATES

PhD

UCT:

Justine Braby, Callan Cohen (June 2011); Adams Chaskda, Genevieve Jones, Ian Little, Graeme Oatley, Ângela Ribeiro (Dec 2011)

Stellenbosch University:

Sampath Lokugulapatti

University of Bristol:

Krystyna Golakek

MSc

UCT:

Gregory Mutumi (June 2011)

Conservation Biology MSc

Petra de Abreu, Katherine England, Sharon George, Clova Jurk, Andre Krahner, Sarah Lewis, Gina Louw, Sofia Solano Fernandez, Vincent van der Merwe, Dale Wright (June 2011) Kate du Plessis, Dane Marx (Dec 2011)

BSc Hons

UCT:

Ben Dilley, Koebrara Peters, Alexa Prinsloo, Gareth Tate, David van Beuningen, William Wyness (Dec 2011)

Stellenbosch University:

Lara Croxford, Anina Heystek

NEW STUDENTS

Postdoctoral Fellows

Maelle Connan (Peter Ryan), Alan Lee (Phil Hockey and Phoebe Barnard), Ralf Mullers (Arjun Amar), Graeme Oatley (Tim Crowe and Rauri Bowie)

PhD

Sonja Krüger (Arjun Amar), Zingfa Wala (Phil Hockey and Phoebe Barnard). Owen Davies and Alex Thompson upgraded their MSc studies to PhD level.

MSc

Mia Cerfonteyn (Peter Ryan); Lisle Gwynn (Phil Hockey); Dominic Henry (Graeme Cumming)

Conservation Biology (CB) MSc

Thirteen students began the CB MSc in January 2011, of which 12 completed the course.

Staff

Director

Prof. Phil Hockey, PhD (Cape Town)*

Academic and Research Staff

Prof. Tim Crowe, PhD (Cape Town)*

Prof. David Cumming, PhD (Rhodes)

Prof. Graeme Cumming, PhD (Oxford)*

Assoc. Prof. Peter Ryan, PhD (Cape Town)*

Dr Arjun Amar (PhD (Aberdeen)*)

External CoE Team Members

Prof. Paulette Bloomer, PhD (Pretoria) – Univ. Pretoria

Asst Prof. Rauri Bowie, PhD (Cape Town) – UC, Berkeley

Assoc. Prof. Andrew McKechnie, PhD (Natal) – Univ. Pretoria

Dr Pierre Pistorius, PhD (Pretoria) – NMMU

Honorary Research Associates

Dr Phoebe Barnard, PhD (Uppsala)

Dr David Grémillet, PhD (Kiel)

Dr Mandy Ridley, PhD (Cambridge)

Dr Rob Simmons, PhD (Wits)

Dr Ross Wanless, PhD (Cape Town)

Research Associates

Dr Rita Covas, PhD (Cape Town)

Dr Richard Dean, PhD (Cape Town)

Dr Andrew Jenkins, PhD (Cape Town)

Dr Martim Melo, PhD (Edinburgh)

Michael Mills, MSc (Cape Town)

Dr Antoni Milewski, PhD (Murdoch Univ.)

Dr Claire Spottiswoode, PhD (Cambridge)

Anthony van Zyl, MSc (Cape Town)

Support Staff

Manager, DST/NRF Centre of Excellence

Dr Rob Little, PhD (Cape Town)

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Administrative Assistant

Hilary Buchanan*

Senior Secretary, DST/NRF Centre of Excellence

Tania Jansen

Departmental/Accounts Assistant

Anthea Links*

Library Staff

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Phelisa Hans

Webmaster

Melissa Stander

Research Assistants

Jessie Berndt

Marie Cochet

Mzwandile Ntamo

Roubert Botha

Morgan Commings

Sieglinde Rode

Donna Boyd

Alister Fyfe

Anthony Schultz

Jan Bradley

Amogelang Gill

Rheinhardt Scholtz

Criszanne Burger

Henk Louw

Barend Visser

Jordan Calder

Kate Meares

John Cooper

David Nkosi

* Denotes permanent member of the UCT staff establishment.

Students

Post-doctoral Fellows

Dr Steve Boyes, PhD (KwaZulu-Natal)
 Dr Maelle Connan, PhD (P&M Curie), Sept-Dec
 Dr Timotheé Cook, PhD (La Rochelle)
 Dr Susan Cunningham, PhD (Massey)
 Dr Doug Loewenthal, PhD (Cape Town)
 Dr Alan Lee, PhD (Manchester), Dec
 Dr Rowan Martin, PhD (Sheffield)
 Dr Ralf Mullers, PhD (Groningen), Dec
 Dr Felix Nchu, PhD (Pretoria) Jan-Oct
 Dr Graeme Oatley PhD (Cape Town) July-Dec
 Dr Lorient Pichegru PhD (Strasbourg)
 Dr Tim Reid, PhD (Tasmania)

Doctoral

Justine Braby BSc Hons (Cape Town)
 Viviane Barquete Costa, MSc (Furd, Rio Grande)
 Adams Chaskda, MSc (Jos, Nigeria)
 Callan Cohen, BSc (Hons) (Cape Town)
 Owen Davies, BSc (Hons) (Cape Town)
 Genevieve Jones, MSc (Cape Town)
 Dr Grant Joseph, (MBChB, MSc) (Cape Town)
 Potiphar Kaliba, MSc (Cape Town)
 Sonja Krüger, MSc (KwaZulu-Natal)
 Ian Little, MSc (Cape Town)
 Tshifhiwa Mandiwana Neudani, MSc (Cape Town)
 Mduduzi Ndlovu, BSc (Hons) (NUST, Zimbabwe)
 Lisa Nupen, MSc (Cape Town)
 Graeme Oatley, BSc (Hons) (Cape Town)
 Sharon Okanga, MSc (Nairobi)
 Ângela Ribeiro, MSc (Porto)
 Jessica Shaw, MSc (Cape Town)
 Alex Thompson, BSc (Hons) (Cambridge)
 Zingfa Wala, MSc (Jos, Nigeria)

MSc by dissertation

Mia Cerfonteyn, BSc (Hons) (Stellenbosch)
 Lisle Gwynn, BSc (Hons) (Plymouth)
 Dominic Henry, BSc (Hons) (Cape Town)
 Gregory Mutumi, BSc (Hons) (NUST, Zimbabwe)
 Rowen van Eeden, BSc (Hons) (Cape Town)

Masters in Conservation Biology 2011

Nikki Best, BSc (Hons) (Long Island)
 Emily Cressey, BSc (Hons) (Bristol)
 Lauren de Vos, BSc (Hons) (Cape Town)
 Jeremy Goss, BSc (Hons) (Cape Town)
 Joanne Gwilt, BSc (Hons) (Leeds)
 Hlengiwe Mbatha, BSc (Hons) (Wits)
 Jenneca McCarter, BSc (Hons) (Arkansas)
 Christine Moore, BSc (Hons) (Western Ontario)
 Edward Rice, BSc (Hons) (KwaZulu-Natal)
 Maurice Schutgens, BSc (Hons) (Nottingham)
 Lovelater Sebele, BSc (Hons) (NUST, Zimbabwe)
 Darlington Tuagben, BSc (Hons) (Kwame Nkrumah)
 Dan Wright, BSc (Hons) (North Carolina)

Masters in Conservation Biology 2010

Petra De Abreu, BSc (Hons) (Cape Town)
 Kate Du Plessis, BSc (Hons) (UC Santa Cruz)
 Katherine England, BSc (Hons) (Western Ontario)
 Masumi Gudka, BSc (Hons) (East Anglia)

Clova Jurk, BSc (Hons) (Edinburgh)
 Andre Krahner, BSc (Hons) (Liebniz)
 Sarah Lewis, BSc (Hons) (Nottingham)
 Gina Louw, BSc (Hons) (Cape Town)
 Dane Marx, BSc (Hons) (Cape Town)
 Sofia Solano Fernandez, BSc (Hons) (Costa Rica)
 Vincent van der Merwe, BSc (Hons) (Pretoria)
 Dale Wright, BSc (Hons) (Cape Town)

Honours

Ben Dilley, Dip Nature Conservation (CPUT)
 Koebraa Peters, BSc (Cape Town)
 Alexa Prinsloo, BSc (Cape Town)
 Kirsten Retief BSc (Cape Town)
 Gareth Tate, BSc (Cape Town)
 David van Beuningen, BSc (Cape Town)
 William Wyness, BSc (Cape Town)

Externally registered students

PhD

David Humphries – Maquarie
 Sampath Lokugalapatti – Stellenbosch
 Matthieu Paquet – Montpellier
 Ben Smit – Pretoria
 Martin Stervander – Lund

MSc by dissertation

Alexandra Jansen van Rensburg – Pretoria
 David Green – NMMU
 Asefa Mitiku – Pretoria
 Gavin Rishworth – NMMU

Honours

Lara Croxford – Stellenbosch
 Anina Heystek - Stellenbosch

FitzPatrick Institute Advisory Board 2011

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 Dr Marilet Sienaert (Director, Research Office, UCT)
 Prof. Danie Visser (DVC Research, UCT, Chairperson)



White-bellied Storm Petrel *Fregetta grallaria* (Photo: Peter Ryan)

CHACTERISING BIODIVERSITY

A FAIRLY SMALL PROPORTION OF THE WORLD'S BIODIVERSITY HAS BEEN DESCRIBED TO SCIENCE. RELATIVE TO MOST OTHER TAXA, BIRDS ARE CONSIDERED WELL KNOWN, BUT MODERN MOLECULAR TECHNIQUES ARE CONSISTENTLY REVEALING THE EXISTENCE OF 'CRYPTIC SPECIES'. THESE ARE ENTITIES THAT BASED ON APPEARANCE ALONE MIGHT BARELY WARRANT A SECOND GLANCE, BUT FOR WHICH CAREFUL INSPECTION OF THE EVOLUTIONARY BLUEPRINT LOCKED IN THEIR GENES REVEALS THEM TO BE QUITE DIFFERENT TO ANYTHING ELSE WE KNOW. THESE CRYPTIC SPECIES ARE BY NO MEANS ALL SMALL, DRAB AND LIVING IN DARK FORESTS: ONLY IN THE LAST FEW YEARS HAS IT BEEN REALISED THAT THE GREAT ALBATROSSES – THE BIRDS WITH THE LARGEST WINGSPANS OF ALL - FORM A COMPLEX OF CRYPTIC SPECIES. AND ONE OF THESE – THE TRISTAN ALBATROSS THAT WE STUDY ON GOUGH ISLAND – IS IN DEEP TROUBLE, HIGHLIGHTING THE IMPORTANCE OF SOUND TAXONOMY AND SYSTEMATICS IN INFORMING CONSERVATION.

Systematics – the foundation of Evolutionary and Conservation Biology



Karoo Scrub-Robins are facultative co-operative breeders that use female-biased dispersal as a mechanism to avoid local inbreeding. (Photo: Peter Ryan)

STUDIES OF THE RELATIONSHIPS AMONG ORGANISMS ARE ESSENTIAL FOR CHARACTERIZING BIODIVERSITY AND UNDERSTANDING THE PROCESSES THAT GENERATE IT. THE FIELDS OF TAXONOMY, PHYLOGENETICS AND BIOGEOGRAPHY INCREASINGLY ARE BEING UNITED THROUGH STUDIES THAT COMBINE DATA FROM DNA, ANATOMY, BEHAVIOUR AND ECOLOGY. STUDIES CONDUCTED UNDER THIS BROAD FRAMEWORK AT THE FITZ TACKLE QUESTIONS THAT SPAN A VAST RANGE OF TEMPORAL AND SPATIAL SCALES, FROM LOCAL, SEX-LINKED DISPERSAL OF KAROO SCRUB-ROBINS *CERCOTRICHAS CORYPHOEUS* TO THE ROLE OF PLATE TECTONICS IN THE ORIGINAL RADIATION OF GAMEBIRDS SOME 80 MILLION YEARS AGO.

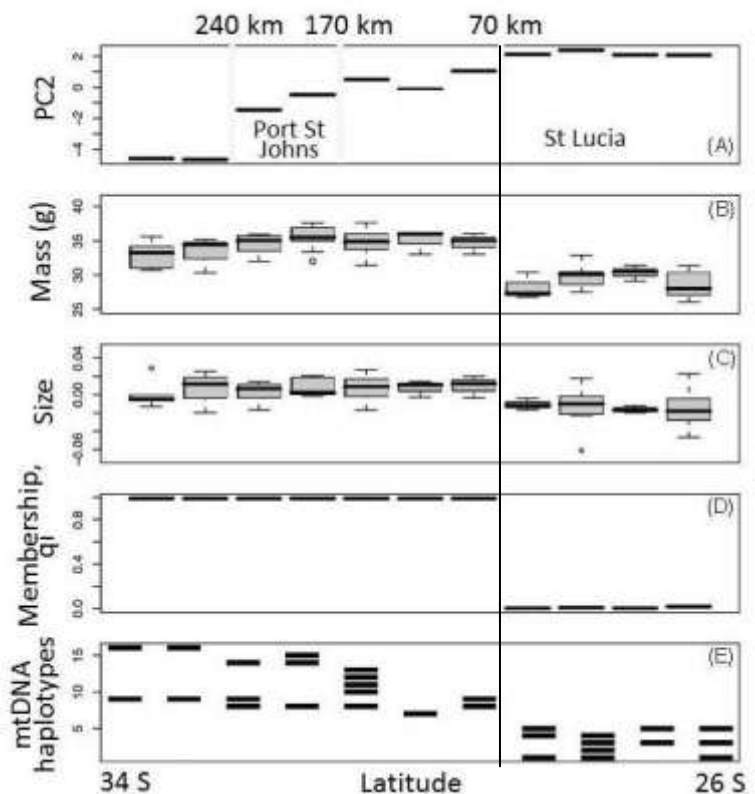
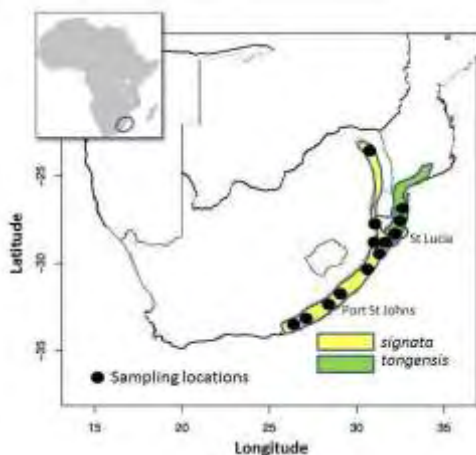
Population-level variation

At the finest scale, Ângela Ribeiro explored the genetic consequences of facultative cooperative breeding among Karoo Scrub-Robins as part of her PhD that was awarded in December 2011. Building on Penn Lloyd's multi-year study of Karoo Scrub-Robins at Koeberg Nature Reserve, she was able to show how female dispersal offsets extreme male philopatry (lack of male dispersal). Penn showed that most male scrub-robins stay close to home, seldom recruiting more than two territories away from where they were born. This strategy offers males the best chance of gaining a breeding territory, but as Ângela's recent paper in *Molecular Ecology* shows, it also results in strong genetic relatedness among neighbouring males. Female scrub-robins tend to disperse longer distances, outside their local genetic neighbourhood, thus avoiding the problems of inbreeding.

Also at a population level, PhD student Lisa Nupen came towards the end of her PhD

research into the conservation genetics of threatened Benguela seabirds. She has found similar patterns in the levels, and distribution of, genetic diversity and the inferred dispersal patterns for her three primary study species: African Penguins *Spheniscus demersus*, Cape Gannets *Morus capensis* and Cape Cormorants *Phalacrocorax capensis*. Neither the distance between the principal breeding regions (along the coastlines of South Africa and Namibia), nor the philopatric tendencies of these species, has resulted in population differentiation between breeding regions – in other words, the populations (even those far from one another) have not undergone any significant genetic separation. These results are based on mitochondrial and nuclear sequence data and they provide useful information to conservation agencies, especially with respect to re-introduction programmes and the possible establishment of new colonies. The final part of her study will use microsatellite markers to

Angela Ribeiro's PhD work showed that Brown Scrub-Robins show a marked change in size (Panels B & C) and genes (nuclear D and mitochondrial E) linked to climatic differences (Panel A) over a short distance in KwaZulu-Natal. (Image: Angela Ribeiro)



provide a better understanding of the connectivity between populations of these threatened species.

Understanding speciation

At a slightly larger scale, recent PhD graduate Ângela Ribeiro found evidence of incipient speciation among Brown Scrub-Robins *Cercotrichas signata*. Working with Penn Lloyd, Richard Dean, Mark Brown and Rauri Bowie, she showed consistent genetic and morphological differences between the scrub-robins associated with South Africa's scarp forests and the lowland population confined to the coastal plain of Zululand and southern Mozambique. The two forms differ in both nuclear and mitochondrial markers, suggesting that there is little if any gene flow between the two populations (which currently are recognised as subspecies). Whether this cessation of gene flow was the cause or the consequence of environmental-driven and/or social selection remains unclear. Further work is needed in the archipelago of small forest patches at the narrow boundary between the two subspecies to understand the factors preventing gene flow between these populations. Possible candidates include divergent selection on physiological tolerances, given climatic differences between the two subspecies' ranges, and/or sexual selection on

plumage, size or song.

Graeme Oatley, another PhD student who graduated in 2011, studied the phylogeography of white-eye evolution in southern Africa. He suggested that two species should be recognised within the Cape White-eye - *Zosterops virens* and *Z. capensis*. In addition to using genetic markers, he focused on the utility of song and contact call characters in the differentiation of these taxa. Graeme will remain at the Fitz as a Post-doctoral Fellow, using field-based and genomic analyses (large-scale sampling of the genetic composition of an organism) to characterize the outcomes of



Graeme Oatley completed his PhD on the systematics of African white-eyes, and concluded that the grey-flanked western form of Cape White-eye *Zosterops [virens] capensis* is distinct from the green-flanked eastern form *Z. [v.] virens*. (Photo: Peter Ryan)



PhD student Martin Stervander holds a large- and small-billed form of Inaccessible Bunting in the coastal lowlands of Inaccessible Island. (Photo: Peter Ryan)

secondary contact between white-eye taxa, hopefully identifying the genes that are under positive selection through adaptation to different biomes.

Another project taking a genomic approach is the ongoing study of the evolution of *Nesospiza* finches or buntings at Tristan da Cunha. This classic example of an adaptive radiation has seen parallel radiations of large and small-billed morphs on Nightingale and Inaccessible Islands, with differing levels of segregation, making for an ideal study system into the ecological factors driving speciation in island finches. Island finch radiations have contributed significantly to our understanding of speciation processes (although Charles Darwin failed to recognise the relationships among Darwin's finches when he was in the Galapagos Islands). MSc student Alexandra Jansen van Rensburg completed her thesis and graduated with distinction from the University of Pretoria in 2011. She looked at a set of candidate genes that might underpin differences between the taxa, including BMP4, the gene linked to bill size in Darwin's finches, but failed to find any differences. Using a larger set of microsatellites, she was able to confirm that small- and large-billed forms on each island were each other's closest relatives, rather than birds with the same bill size on different islands being each other's closest relatives (Ryan *et al.* 2007, *Science* 315:1420-1423). However, contrary to our previous results, she only found support for two (not three) populations on Inaccessible Island.

PhD student Martin Stervander (registered at Lund University) carried this project forward

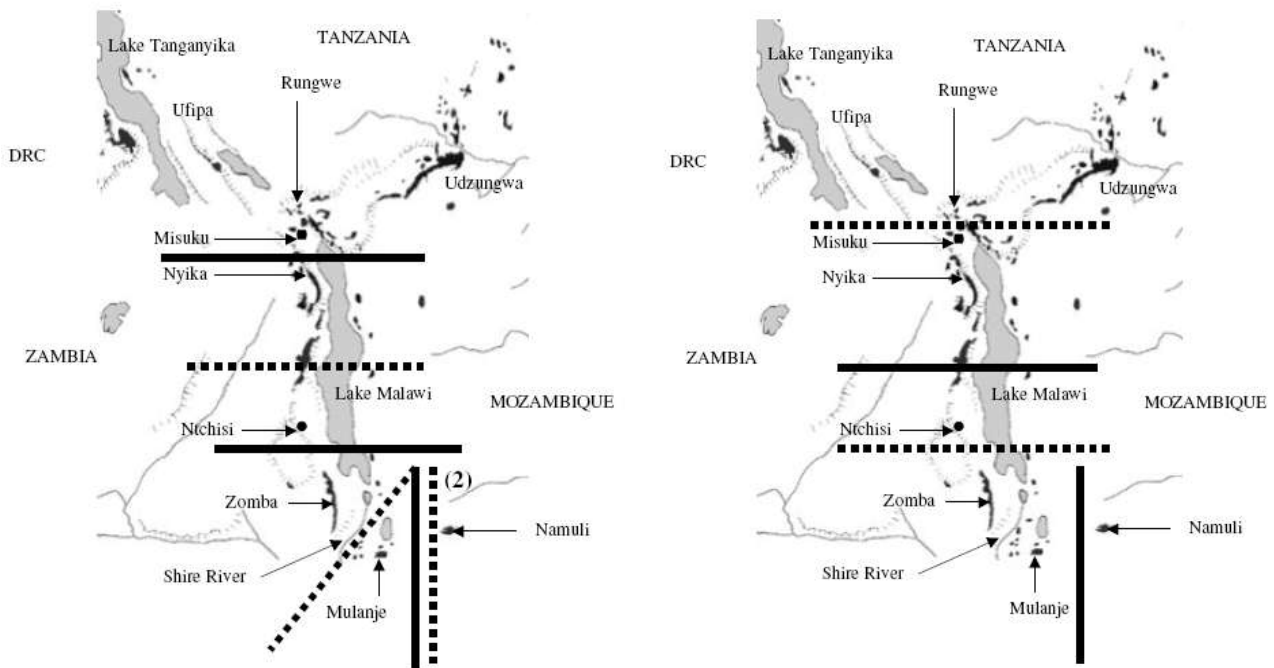
using a genomic approach. He was fortunate to be able to join Peter Ryan on a three-week visit to Inaccessible Island in September-October 2011 through the South African National Antarctic Programme. They were joined by Martim Melo (CIBIO, Portugal) who has been working on a similar system of island finch radiation on islands in the Gulf of Guinea. In addition to familiarising Martin and Martim with the study system, we also collected more blood and stable isotope samples from a diversity of bunting types. Martin is now obtaining the full genome sequence for *Nesospiza* in collaboration with the Beijing Genomics Institute, Hong Kong. Subsequent RAD sequencing of all extant island populations of *Neospiza* finches should then identify the genes underpinning differences in bill size among populations, and measure selection on these genes compared to neutral alleles (especially at Inaccessible Island where there is localised hybridisation between birds with different bill sizes).

In addition to the work on the finches, the Inaccessible team also studied the sibling species of *Fregetta* storm petrels discovered following genetic analysis of samples collected by Rob Ronconi and Peter Ryan in 2009. With the knowledge that both White-bellied Storm Petrel



The two species of *Fregetta* storm petrels on Inaccessible Island are almost identical, even in the hand. This picture shows a Black-bellied Storm Petrel (left) next to a White-bellied Storm Petrel. (Photo: Peter Ryan)

F. grillaria and a white-bellied form of Black-bellied Storm Petrel *F. tropica* occur together on Inaccessible, we concentrated on catching as many birds as we could at both the coast (where to date all samples have been *F. tropica*) and on the plateau at Denstone Hill (where eight of 10 samples collected in 2009 were *F. grillaria*). We processed 24 birds on the plateau and 16 at Blenden Hall, and were soon able to distinguish



The Malawi Rift depicting geographical breaks detected from analyses of DNA sequence data collected by Potiphar Kaliba as part of his PhD dissertation. Left = Malawi Batis *Batis dimorpha* and Right = Stripe-cheeked Greenbul *Arizelocichla milanjensis*. The solid lines indicate geographical breaks and dotted lines indicate putative breaks, which require further sampling to confirm. Numbers in parentheses (1 and 2) correspond to alternative hypotheses of where a phylogeographic break may occur, based on our present sampling. (Image: Potiphar Kaliba)

the two species based on a combination of subtle plumage and mensural characters. Interestingly, *F. grallaria* were more abundant in Sept-Oct 2011 than in Oct-Nov 2009, with only four of 16 birds caught at Blenden Hall being *F. tropica*, suggesting that *F. grallaria* might breed earlier than *F. tropica*. Blood samples confirmed our identifications, and feather samples showed the same differences in stable isotope ratios between the two species as samples collected in 2009, suggesting that the two species differ ecologically. Unfortunately we were unable to find any calling *F. grallaria*, so it is not known whether the two species have different vocalisations. It remains puzzling why the two species appear so similar in the only place in the world where they are known to co-occur.

Phylogeography of Malawi's forest birds

Malawian student Potiphar Kaliba is in the final stages of analyzing the data for his PhD on the patterns of genetic structure in three forest birds and two small mammals across the Malawi Rift. Preliminary results suggest that among forest batises, the population on the Misuku Hills in far northern Malawi are allied to Dark Batis *Batis crypta*, not Malawi Batis *B. dimorpha*. Birds from Nyika and Ntchisi are

closely related, but do not share mitochondrial DNA haplotypes, suggesting that gene flow may be limited between the only two populations of *B. dimorpha sola*. Birds from Zomba and Namuli also did not share haplotypes, but because Mulanje has not been sampled, it is not possible to identify the phylogenetic break within *B. d. dimorpha*. This is a priority, because it may be prudent to recognise *B. d. sola* and *B. d. dimorpha* as full species. Were this to happen, it would make them among Africa's most range-restricted species.

Among Stripe-cheeked Greenbuls *Arizelocichla milanjensis*, mitochondrial DNA data suggest that *A. m. striifacies*, *A. m. olivaceiceps* and *A. m. milanjensis* are distinct taxa. However, Mt Mulanje appears to harbour *A. m. olivaceiceps* and not *A. m. milanjensis*, and the nuclear intron data do not provide any evidence for hybridisation. Further, within *olivaceiceps*, the Misuku Hills are clearly distinct from other sampled populations, and in contrast to the batis dataset, the Ntchisi population appears to be more closely allied with the southern rift populations of Zomba and Mulanje. Larger sample sizes from Zomba and Mulanje are required to understand fully the dynamics of observed patterns of structure in the in the central and southern Malawi Rift. In the northern rift, samples from



CB MSc student Vincent van der Merwe found that the fact that guineafowls, such as this Crested Guineafowl *Guttera pucherani*, are confined to Africa might relate to the breakup of Gondwanaland. (Photo: Peter Ryan)

Rungwe and the neighbouring Eastern Arc Mountains are needed to identify the break between *striifacies* and *olivaceiceps*.

Potiphar's findings have practical implications for conservation of Malawian forest birds. Nyika National Park is strategically located to encompass most of the evolutionary processes in northern Malawi, and is ideal because it encompasses both montane and woodland habitats. By comparison, most parks in southern and central Malawi are in lowland areas. Montane forests in this area have varying degrees of management and protection, compromising their long-term conservation value. Potiphar's study further bolsters calls for the need to conserve southern Malawi's remaining montane forests. The three mountain massifs of southern Malawi currently harbor the only bird species recognized as being endemic to Malawi – the Yellow-throated Apalis *Apalis flavigularis*. Happily, research just published by MSc CB student Tiwonge Mzumara has concluded that this Red Data species is more numerous than even BirdLife International's most optimistic estimate.

Systematics of higher taxa

Although Tim Crowe is still plagued by health problems, he continues to work on gamebird phylogenetics based on a much larger and up-to-date dataset than was available previously. This work, presented in plenary addresses at the Southern African Society for Systematic Biology (SASSB) conference in Grahamstown and at the Willi Hennig Society meeting in Brazil, largely confirms his research team's earlier conclusions. He found that there is no need to 'massage' molecular data with various model-based methods. He was presented with a life-time award for his contributions to systematics at the SASSB meeting.

MSc CB student Vincent van der Merwe worked with Tim and Salvador Arias from Argentina to investigate the biogeography of gamebirds. They found that gamebirds may have evolved as long as 80 million years ago. The early branches of the gamebird evolutionary tree probably were influenced by the break-up of Gondwanaland, with the megapodes evolving in Australasia, the cracids in South America and guineafowls in Africa. Thereafter, two out-of-

Africa dispersal events occurred: one to the west gave rise to the New World quails in North America, and the other to the east gave rise to all other gamebirds (quails, partridges, pheasants, peafowls and grouse). Vincent presented his results at the SASSB conference in Grahamstown, before graduating in June 2011. He was joined at the June graduation by long-standing PhD student Callan Cohen, who finally completed his thesis on the evolution of bustards, sandgrouse and coursers. In addition to providing support for generic revisions within all three groups, he confirmed the importance of the arid corridor between the south-west and north-east African arid zones in species-level radiations.

PhD student Owen Davies continued his research on cisticolas by using modern cladistic and statistical techniques to re-assess the seminal work of Rear-Admiral Lynes. He analysed morphometric data collected at the British Museum of Natural History to test Lynes's classification against a phylogenetic reconstruction based on mensural data, geometric morphometrics and a novel analysis of plumage colour. He has also started collecting plumage data from specimens for which we have DNA sequence data, so that he can compare and contrast this technique with previous plumage-score methods. He has further collected and collated many vocalisations for analysis and incorporation into the phylogenetic reconstruction. He presented his preliminary findings at the SASSB conference in Grahamstown and at the Willi Hennig Society



One of the cisticola species whose affinity was unclear to Rear-Admiral Lynes was Levaillant's Cisticola *Cisticola tinniens*. PhD student Owen Davies is attempting to resolve this and other mysteries about this speciose group. (Photo: Peter Ryan)

meeting in Brazil, where he also touched on the progress of his own morpho-cladistic analyses. Remarkably, many of Lynes's conclusions were confirmed, but previously unplaced cisticolas now have firm perches in a phylogenetic hypothesis.

Finally, moving to bird parasites, Rauri Bowie worked with a team of both American and French biologists to investigate diversity and specialisation among avian malaria species infecting African birds. In a recent paper led by Claire Loiseau published in *Molecular Ecology*, they contrast avian malaria communities in birds from Cameroon lowland rainforest with those in birds from East African highland forests and the Cape's Fynbos. They found the greatest diversity of malaria parasites, and an associated greater level of host specialisation, in lowland rainforest. There also was evidence that generalist parasites tend to become specialists much more often than specialists become generalists. They concluded that ongoing environmental changes are likely to change the distributions and degree of specialisation of avian malaria parasites, with as yet unknown impacts on bird communities.

Research team 2011

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Sociable Weavers *Philetairus socius*. (Photo: Augusto Faustino)

EVOLUTIONARY BIOLOGY

GENETICS CAN TELL US MUCH ABOUT WHEN SPECIES EVOLVED, AND ABOUT WHEN AND PERHAPS HOW SIMILAR SPECIES DIVERGED FROM ONE ANOTHER. BUT GENETIC TECHNIQUES HAVE BECOME SO ADVANCED THAT THEY ARE NOW INTEGRAL TO OUR UNDERSTANDING OF WHAT IS HAPPENING IN BIRD POPULATIONS TODAY AND IN PREDICTING HOW BIRDS MAY RESPOND TO FUTURE PLANETARY CHANGE. THESE ADVANCES HAVE OPENED UP NEW VISTAS IN THE FIELDS OF BEHAVIOURAL AND EVOLUTIONARY ECOLOGY, ALLOWING US TO ASK QUESTIONS ABOUT RELATEDNESS, DISPERSAL, PERSISTENCE AND THE RISE AND FALL OF POPULATIONS. THEY EVEN ALLOW US TO OBSERVE AND UNDERSTAND EVOLUTION IN ACTION. IMAGINE IF DARWIN HAD HAD THESE TOOLS IN HIS TOY BOX! EVEN 30 YEARS AGO, STUDENTS COULD ONLY DREAM OF WHAT THESE ADVANCES ALLOW US TO DO TODAY. THE FITZ HAS A LONG TRADITION OF RESEARCH IN BEHAVIOURAL AND EVOLUTIONARY ECOLOGY, AND THE PROJECTS RUNNING AT THE MOMENT ARE AT THE VERY CUTTING EDGE OF NEW ADVANCEMENTS.

Coevolutionary arms races in African brood-parasitic birds and their hosts

“A monstrous outrage on maternal affection ...”

Gilbert White, *A Natural History of Selborne* (1789)

COEVOLUTION IS THE PROCESS BY WHICH TWO OR MORE SPECIES RECIPROCALLY INFLUENCE ONE ANOTHER’S EVOLUTION, AND CAN ESCALATE TO PRODUCE BEAUTIFULLY REFINED ADAPTATIONS. A JOINT RESEARCH PROGRAMME BETWEEN THE FITZ AND THE UNIVERSITY OF CAMBRIDGE FOCUSES ON THE COEVOLUTIONARY INTERACTIONS BETWEEN AFRICAN BROOD-PARASITIC BIRDS SUCH AS CUCKOOS, CUCKOO FINCHES AND HONEYGUIDES, AND THE HOST SPECIES THEY EXPLOIT TO BEAR THE COSTS OF RAISING THEIR YOUNG. THE RESEARCH USES A COMBINATION OF APPROACHES INCLUDING EXPERIMENTS MADE AT HOST NESTS IN THE WILD IN ZAMBIA, SENSORY ANALYSES OF BIRD VISION, AND GENETIC TECHNIQUES.

Murder in the dark

Gilbert White famously deplored the Common Cuckoo *Cuculus canorus* for foisting its egg into the nests of other species, leaving foster parents to toil in service of the cuckoo chick’s prodigious appetite. We can only speculate what apoplexy White would have been driven to had he known of the parasitic adaptations of the honeyguide family (Indicatoridae) of Africa and Asia. Greater Honeyguides *Indicator indicator* are celebrated for their unique cooperation with humans, whereby they guide honey-hunters to bees’ nests and exploit their use of fire and tools to gain access to their favourite food, energy-rich bees’ wax. But new research from the Fitz has confirmed that honeyguides have a much darker side as unusually brutal brood parasites. Honeyguides hatch from the egg already equipped with a pair of needle-sharp hooks at the tips of their beaks, and it has long been inferred that they use these to kill the chicks of their hosts since maimed host young had been found alongside honeyguide chicks. However, this behaviour had never been observed under natural conditions in host nests. At our Zambian study site, Little Bee-eaters *Merops pusillus* are the honeyguides’ main hosts, and breed in burrows dug into the roofs of Aardvark holes. Infra-red footage from cameras buried in the darkness of the bee-eaters’ underground nests revealed how honeyguide chicks repeatedly grasp, bite and shake chicks of their newly

hatched foster siblings until they eventually die. (Videos are available on the *Biology Letters* website at <http://rsbl.royalsocietypublishing.org/content/early/2011/09/06/rsbl.2011.0739/suppl/DC2>). The killing behaviour is actually the culmination of a sequence of specialised adaptations that ensure that the young honeyguide has sole access to the food the host parents bring to the nest: the honeyguide mother ensures her chick hatches first by internally incubating the egg for an extra day before laying it, so it has a head start in development compared to the host, and she also punctures host eggs when she lays her own. But some host eggs are overlooked or survive puncturing, and it is these that precipitate chick killing by the young honeyguide as soon as they hatch. Because the honeyguide hatches first, it has grown to about three times the weight of a hatchling bee-eater by the time it sets about the ritual murder. Just one to five minutes of active biting time was enough to inflict sufficient injuries to cause host death. However, after maimed chicks stopped moving, honeyguides often ceased their attacks and, as a result, hosts sometimes took over seven hours to die. Host parents are apparently blithely unaware of what is happening and, in the darkness of their burrows, even attempted to feed a honeyguide chick busy attacking their own young. We also filmed one instance of the honeyguide biting its foster parent by accident.



TOP: Greater Honeyguide chick aged about 8 days, showing bill hooks used to kill host chicks.

MIDDLE: Greater Honeyguide chick with three recently killed Little Bee-eater hatchlings inside the bee-eater parents' underground nest chamber.

BELOW: Greater Honeyguide chick about to leave the host nest, aged about 30 days; no sign remains of its bill hooks.

(Photos: Claire Spottiswoode)

By the time the honeyguide emerges from the burrow after about a month of assiduous care by its foster parents, however, its bill hook has grown out and there is no trace of its siblicidal beginnings. This behaviour is exactly analogous to that of young cuckoos, which hoist

host eggs or chicks onto their backs and tip them over the rim of the nest. Because honeyguide hosts breed in tree holes or underground burrows, they cannot eject host chicks, and have instead evolved this highly effective killing behaviour to make sure that they alone monopolise the nest.

Fooling multiple hosts

A second focus of recent honeyguide research at the Fitz has been the long-standing conundrum of how a single parasitic species can simultaneously mimic multiple host species. In Greater Honeyguides, we have shown that females parasitising different host species show specialisation in egg size and shape rather than egg colour or pattern, because hosts breed in dark holes where visual appearance may be irrelevant. For example, while Greater Honeyguide eggs are invariably white, they are small and round in the nests of Little Bee-eaters, but large and tapered in the nests of Green Wood-Hoopoes *Phoeniculus purpureus*. Thus honeyguides appear to show specialised host-races just as do cuckoos and cuckoo finches (see below). However, the fact that a single species of brood-parasitic birds can closely mimic several host species is evolutionarily puzzling. How can such specialised adaptations be maintained in the face of interbreeding among parasitic males and females of the same species, but specialised on different hosts?

A possible solution is that the genes underpinning such egg adaptations are on the avian W-chromosome that is carried only by females, allowing them to be passed on intact from mother to daughter without detrimental genetic mixing from fathers raised by different hosts. For such a genetic mechanism to apply, however, lineages of parasitic females would need to remain highly host-faithful over evolutionary time. In collaboration with Prof. Michael Sorenson's lab at Boston University, we tested this idea in a study published in 2011 in *Proceedings of the National Academic of the Sciences of the USA*. We tracked lineages of Greater Honeyguide females using mitochondrial DNA as a genetic marker since, like the W-chromosome, the mitochondrial genome is inherited only from mothers. This revealed two highly distinct female lineages of honeyguides, each associated with separate groups of hosts: those nesting in terrestrial burrows (mostly bee-eaters) and those nesting in tree cavities

Tawny-flanked Prinia *Prinia subflava*



respective Cuckoo Finch gens



Red-faced Cisticola *Cisticola erythrops*



Rattling Cisticola *Cisticola chiniana*



Mimicry of host eggs by Cuckoo Finch eggs: in the left column are four host eggs, and in the right column are two Cuckoo Finch eggs. The top two rows come from Tawny-flanked Prinia nests and the third row from Red-faced Cisticola hosts. The photo shows how closely the parasite can mimic the host eggs, but also how variation in host egg appearance within species acts as a defence, by making it harder for a parasite to match any one female host's eggs accurately enough to be accepted. Relative to Tawny-flanked Prinia eggs, eggs of Red-faced Cisticolas vary little in colour. However, the Red-faced Cisticolas make up for this by being extremely discriminating about what eggs they will risk accepting as one of their own. The Rattling Cisticola (bottom row) both lays different-looking eggs *and* is highly discriminating about what it will accept. At the moment, this appears to be a winning strategy, because Rattling Cisticolas, even though they are common, are not parasitised by Cuckoo Finches. Photo: (Claire Spottiswoode)

(hoopoes, wood-hoopoes and others). The genetic divergence between the two strains was astonishingly deep, showing that each parasitic lineage has remained perfectly faithful to its specialist hosts for at least 3 million years. The depth of this divergence prompted us to question whether the Greater Honeyguide might in fact be in the process of splitting into two new species, each specialising on different hosts. We

investigated this by analysing nuclear DNA, which is inherited from both parents and should therefore show divergence if the two female lineages are speciating. What we found, however, is that Greater Honeyguides' nuclear DNA showed no host-specific association whatsoever, indicating that host-specialist females mate at random with any male, irrespective of what host raised that male. This

interbreeding keeps the Greater Honeyguide a single species comprising two remarkably ancient female host-races. We are moving forward to investigate whether the genes for host specialisation are indeed carried on the W-chromosome, and how genetic and environmental factors might interact to generate egg specialisation between and within genetic host-races.

Playing the game in the open

Cuckoo Finches *Anomalospiza imberbis* parasitise various species of prinia and cisticola, whose drab appearances betray the remarkably colourful arms races played out within their nests. Hosts are highly discriminating about what they will risk incubating, and this selection pressure has resulted in the evolution of superb egg forgeries by Cuckoo Finches, which closely mimic the colour and pattern of host eggs. But as the Cuckoo Finch has become more proficient at tricking its hosts with better mimicry, hosts seem to have evolved increasingly sophisticated ways to fight back. New research published in 2011 in *Proceedings of the Royal Society of London B*, based on field experiments in Zambia, show that this biological arms race has escalated in strikingly different ways in different species. One strategy is for every host female to lay a different type of egg, such that egg colour and pattern vary greatly among nests. This is the strategy taken by the Tawny-flanked Prinia *Prinia subflava*, resulting in the evolution of an amazing diversity of prinia egg colours and patterns. These variations seem to act like the complicated markings on a banknote: intricate colours and patterns act to make host eggs more difficult to forge by the parasite, just as watermarks act to make banknotes more difficult to forge by counterfeiters. Because the female Cuckoo Finch lays the same type of egg throughout her lifetime, she cannot change the appearance of her egg to match the eggs of different host individuals. Thus, her chances of laying a matching egg are exasperatingly small, and hosts have the Cuckoo Finch on the run. Other Cuckoo Finch hosts appear to use an alternative strategy: Red-faced Cisticolas *Cisticola erythrops* lay only moderately variable eggs but are instead extremely discriminating in deciding whether an egg is their one of their own. Thanks to their excellent discrimination, these hosts can spot even a sophisticated mimic. The experiments showed that these different

strategies are equally successful as defences against the Cuckoo Finch. Moreover, one species that has done a bit of both – the Rattling Cisticola *Cisticola chiniana* – appears to have beaten the Cuckoo Finch with this dual strategy, since it is no longer parasitised. The arms races between Cuckoo Finches, honeyguides and their hosts emphasise how interactions between species can be remarkably ancient and sophisticated especially in tropical regions such as Africa, giving us beautiful examples of evolution and adaptation.



Honey-hunters Lazaro Hamusikili and Collins Moya eating honeycombs that they have been guided to by an adult Greater Honeyguide. (Photo: Claire Spottiswoode)

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Research team 2011

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Sociable Weavers – searching to explain the evolution and maintenance of cooperation

DURING 2011 THE SOCIABLE WEAVER PROJECT HAS SIGNIFICANTLY BROADENED ITS ACTIVITIES. WE ARE NOW TAKING A WIDER APPROACH TO THE STUDY OF COOPERATION THROUGH A COLLABORATIVE TEAM EFFORT, WITH SIX PEOPLE NOW WORKING ON THE PROJECT, INCLUDING NEW FITZ PHD STUDENT MARGAUX RAT. THE BROADER SCOPE OF THE PROJECT ENCOMPASSES SEVERAL COOPERATIVE BEHAVIOURS AND WE ARE TESTING SOME INNOVATIVE HYPOTHESES TO EXPLAIN THE EVOLUTION AND MAINTENANCE OF COOPERATION. IN ADDITION, OUR LONG-TERM DATA SET (NOW SPANNING 18 YEARS) IS BEING PUT TO GOOD USE TO UNRAVEL THE FACTORS AFFECTING THE WEAVERS' POPULATION DYNAMICS.

Cooperative breeding – are there hidden benefits of having helpers at the nest?

Evolutionary biologists expect individuals to behave in ways that will maximise the chances of passing their genes to the next generation. It is therefore disconcerting to observe animals behaving in costly or risky ways that appear to have the single purpose of helping others. A striking example of altruism is cooperative breeding, where mature individuals forgo independent reproduction and assist others with their breeding efforts. W.D. Hamilton, however, showed that an individual may promote copies of its genes by improving the reproductive success of its kin. In cooperative breeders, helpers are often mature offspring of the breeders, suggesting that kin selection (i.e. favouring of offspring) should take place. However, in numerous species there is no detectable effect of the presence of helpers on reproduction, which currently presents an unresolved paradox.

One possible explanation for the weak effects of helpers on reproduction is that breeders decrease their reproductive effort when assisted by helpers. Under this hypothesis, the food provided by helpers compensates for the decrease in parental effort, resulting in similar reproductive success in the presence or absence of helpers. However, helper presence may still be beneficial for breeders because it could lead to improved survival (by reducing the workloads of the breeders while rearing chicks). Few studies have investigated this hypothesis because it requires long-term capture-recapture

data that are hard to obtain. Also currently debated are the mechanisms through which breeders might decrease their investment in reproduction. One possibility is that they reduce their chick-feeding rates. In addition, females may reduce egg size, but it is unknown if this strategy is common and whether additional mechanisms might exist.

PhD student Matthieu Paquet, under the supervision of Rita Covas and Claire Doutrelant, has been testing this hypothesis using Sociable Weavers *Philetarius socius*. After two field seasons of competition with Cape Cobras and



A Boomslang *Dysholidus typus* (centre) slides away frustrated, having failed to surmount the plastic wrapping that Matthieu Paquet has applied to some colony-holding trees in an attempt to get enough data to finish his PhD. The snakes feast on Sociable Weaver eggs and young, and can cause more than 70% of breeding attempts to fail. (Photo: Matthieu Paquet)

Boomslangs over who gets the eggs first (!), and with the help of an ingenious tree-wrapping system that prevents the snakes from climbing to some colonies, Matthieu finally managed to study enough Sociable Weaver eggs to test this hypothesis. In line with expectations, Matthieu was able to verify that eggs laid by females in groups are indeed smaller than eggs laid by females without helpers. Subsequently, however, the helpers compensate for the smaller egg size with increased food provisioning, with the result that there are no differences in the sizes of youngsters at fledging. These results strongly suggest that the presence of helpers allows females to save energy. This will be investigated in the future by analysing survival and condition of individuals breeding in pairs and groups. In addition, egg contents have been analysed and it was found, apparently for the first time, that the presence of helpers also influences some of the eggs' contents, in particular testosterone, corticosterone and proteins.

Matthieu is currently writing a paper to report these results while also trying to carry

out a brood-swapping experiment in the field to demonstrate that the findings are indeed a result of differential maternal allocation and not the environment. However, the rains at the end of 2011 were very poor and the breeding season has failed to get into full swing – thus we are likely to see Matthieu continuing these experiments next season.

Cooperation and conflict – the role of dominance and opportunities for sexual selection

Living in groups and cooperating always brings with it conflicts around sharing resources such as food, a territory or opportunities for reproduction. In 2011, a paper was published reporting the results of helper presence on juvenile survival. Contrary to expectations, it was found that young raised by groups had lower survival in their first year than those raised by unaided pairs. This intriguing result may arise from a true increase in mortality among these young or from an increase in their dispersal away from the study colonies. Either way, these results show a cost of cooperation that had not previously been described. The study of dispersal is continuing with the aims of distinguishing between dispersal and survival and of understanding the conflict between helpers and the young they help raise, as well as the behavioural mechanisms involved.

An important behaviour used to mediate conflicts between individuals that interact frequently is the establishment of dominance hierarchies. These help individuals negotiate over resources and decrease energy expenditure or risk of injuries. Understanding how dominance rankings are settled, and how they influence social organization and mate choice, is therefore important to understanding conflict resolution and cooperation.

But what do dominant individuals do when it comes to cooperation? For instance, dominance may be used to give kin privileged access to food, as a policing mechanism to punish 'cheaters', or simply to override competitors and obtain direct access to some resource. Dominance status may also affect mate choice, because dominant individuals might be of higher intrinsic quality or be in better condition. A new PhD student, Margaux Rat, was recruited. She will be investigating dominance hierarchies and their consequences for cooperation and reproduction in the weavers. Although only officially



Matthieu places an antenna at the entrance of a Sociable Weaver nest under the close supervision of Claire and Rita. This antenna will read the unique codes placed on the weavers breeding at this chamber to obtain data about food-provisioning rates. (Photo: Anne Delstrade)

starting her PhD in 2012 with CoE bursary support, Margaux's exploratory research in the 2011 breeding season seems to indicate that the Sociable Weaver society is not as egalitarian as it may seem. A minority of individuals seem to dominate over most others. These tend to be larger individuals with larger bibs (the dark plumage patch on the throat) and more 'scaly' feathers on the flanks. These plumage traits are therefore likely to be good indicators of social status.

Dominant individuals might 'reign' in a group, but they might also be the more cooperative individuals. Cooperation is usually costly and participating in cooperative behaviour may provide an ideal situation where individuals can 'show-off' their quality. For example, by helping feed other individuals' offspring, Sociable Weaver helpers may signal their own ability to raise young and hence increase their chances of finding a good mate. This link between cooperation and signalling has been supported by theoretical studies but has been poorly explored empirically. Some intriguing results suggest that the weavers' helping behaviour may have signalling characteristics. Claire and Rita had previously shown that Sociable Weaver helpers change their behaviour in relation to the number of birds in the 'audience'. In 2011, another paper was published showing that helpers that are more than one year old bring more food to the nestlings when they are less related to the breeders. This means that their main motivation is *not* to help raise their kin. On the contrary, they inject more effort into feeding non-kin, which indicates that their helping effort is not

related to kin selection, but rather to their quality as individuals. Alternative hypotheses suggest that the weavers may help in order to be accepted in a group or to increase their chances of mating.

Cooperative nest building – how is a 'tragedy of the commons' avoided?

Sociable Weavers build communally what is probably the largest nest structure of any bird. Although the individual nest chambers within each colony are built by the individuals that roost and breed in them, these colonies are communal structures that are built continuously by the colony members. The communal structure is therefore a 'common good' shared by all colony members – and hence susceptible to collapse under the 'tragedy of the commons'. A tragedy of the commons may occur because although it is in the group's interest that everyone cooperates to keep the structure in good shape, it is in each individual's interest to sit back and let the others do the work. A cooperative research project led by Prof. Ben Hatchwell from the University of Sheffield is now studying how the weavers avoid the tragedy of the commons and keep their nest structures for several decades. As a first step to understanding the characteristics of the nest structure, Post-doctoral Fellow René van Dijk described the thermoregulatory benefits of the Sociable Weaver nest structure. He found that the Sociable Weavers' communal nests buffer variation in ambient temperature, and reduce temperature variability within nest chambers. The extent of this buffering depends on both the position of nest chambers within the communal structure, and on the depth to which chambers are embedded within the nest mass. The volume of communal nests may also influence these thermoregulatory benefits, but nests are often much larger than that which would maximise these benefits. These results also indicate that there is competition for access to the thermal benefits of the nest mass: older birds tend to occupy the chambers with the highest thermoregulatory benefits, where breeding activity is also more concentrated. The work will now focus on describing who builds more and where; testing the assumption that nest building is costly; and testing alternative hypotheses for resolution of the tragedy of the commons. The latter will be achieved by determining whether the level of investment made by individuals in this cooperative task is a) related to kinship with



Rita is impressed by the oldest Sociable Weaver ever recorded. This bird was ringed as an adult by Mark Anderson in 1994, demonstrating the importance of long-term studies based on marked individuals. (Photo: Claire Doutrelant)

other colony members, (b) enforced by other colony members, or (c) a signal to other colony members of individual quality.

Sociality, demography and population dynamics

Costs and benefits of cooperation depend on the social environment, with local and regional population density being a central factor. Population density in relation to the availability of key resources determines how easily individuals can establish their own nest and raise their own offspring. At very low densities, finding suitable partners may become difficult and costs of nest defence/repair or finding food may increase. Understanding the dynamics of the colonies and the meta-population as a whole is therefore a critical aspect of the Sociable Weaver project. Our long-term, demographic data set (i.e. capture-mark-recapture) has been collected on the Sociable Weaver population at Benfontein since 1993 – it is one of the few long-term studies of an African passerine and provides unique access to individual histories and opportunities to understand the factors that affect population dynamics and determine population trends. Colony counts have revealed a slow but steady decrease in the population over this 18-year period, indicating that gains through reproduction and immigration are not matching losses due to mortality and emigration.

In a first study completed in 2011 in collaboration with Dr Res Altwegg (SANBI) we obtained some understanding of how these demographic parameters were affected by environmental, demographic and social factors. Survival strongly varied between years and colonies and was partly explained by variation in weather, being positively related to rainfall and negatively related to extreme temperatures. Another significant factor seemed to be disturbance, with survival being negatively linked to the intensity of field work conducted at a colony. Reproduction was positively related to rainfall (explaining 50% of the variation). Movement between colonies was related mainly to local density: individuals were more likely to emigrate from small colonies to large colonies and from colonies that were either well below or above their long-term average size. They were more likely to immigrate into colonies that were close to their natal colony and colonies that were below their average size. However,

we have not yet examined how population dynamics affects, and is affected by, individuals and their decisions to help or breed, or to stay or move. This will form part of our future research.

Into 2012

The team will grow further in 2012 with the addition of a new Post-doctoral Fellow (funded by the Portuguese Science and Technology Foundation, FCT) who will be investigating kin recognition and its role in cooperation. Margaux's PhD will begin officially and we are launching a new research project together with Res Altwegg and Dieter Oschadleus (SAFRING and ADU) that will be gathering data across the distributional range of the Sociable Weaver. This is an ambitious study that will rely on standardised data collected by citizen scientists (registered bird-ringers) and will monitor specific colonies over five years in order to study the factors driving population fluctuations.



Processing weavers: all individuals get a uniquely numbered metal ring and colour combination, are weighed and measured and individuals caught for the first time are also bled. Blood samples are used for sexing and genetic analyses. (Photo Anne Delstrade)

Key co-sponsors

French Research Agency (ANR); Portuguese Science and Technology Foundation (FCT); National Environmental Research Council (UK).

Research Team 2011

Dr Rita Covas (PFIAO Research Associate and Univ. Porto, Portugal)

Dr Claire Doutrelant (CEFE-CNRS, France)

Prof Ben Hatchwell (Univ. Sheffield, UK)

Dr René van Dijk (Univ. Sheffield, UK)

Students: Matthieu Paquet (PhD, Univ. Montpellier)

Research assistants: Chriszanne Burger, Colin de Kock, Graham Grieve, Cecille Houllé, Jennifer Kaden Margaux Rat, Ronele Visagie

Pied Babbler Research Project

LONG-TERM RESEARCH PROJECTS PROVIDE A WEALTH OF INVALUABLE INFORMATION ABOUT THE ECOLOGICAL, BEHAVIOURAL AND DEMOGRAPHIC PROCESSES THAT AFFECT POPULATIONS. SUCH PROJECTS REQUIRE A LARGE AMOUNT OF INVESTMENT AND FIELDWORK OVER MANY YEARS, BUT THE UNIQUE DETAIL, QUALITY AND QUANTITY OF INFORMATION THAT RESULTS FROM SUCH PROJECTS MAKES THE LONG-TERM INVESTMENT WELL WORTH IT.

The Pied Babbler Research Project has been running continuously since 2003. While nine years may not seem an especially long time, in terms of the average lifespan of medium-sized passerines, it does span several generations. The project is now reaching a point where the extremely detailed life-history data collected over several generations allow us to gain important insights into the demographic processes that determine group formation and extinction, and what ecological and social factors

promote the persistence of group-living in this species. This is a new direction for the research project – while short-term behavioural observations and experimentation remain an important and primary aspect of the field research, there is now a shift towards understanding long-term environmental and social influences on population dynamics. This has been catalysed by the recent award of a major research grant from the Australian Research Council to Mandy Ridley, principal investigator of the Project. This research will begin in 2012, and will combine information from the long-term database with short-term experimentation to determine what factors promote group cohesion versus conflict, and what makes groups vulnerable to extinction. Recent publications emanating from our pied babbler research include high-profile articles in *Evolution*, *Animal Behaviour*, *Behavioral Ecology*, *PLOS One* and *Journal of Animal Ecology*. In addition to exposure in journals, the research has been featured in several new editions of notable international textbooks.

Another beneficial aspect of long-term observations on the same population has recently come to fruition – the inter-specific interactions between pied babblers and other animals within their environment. We are currently researching several of these fascinating interactions in detail, and this has revealed amazing intricacies of communication and deception within the Kalahari ecosystem.

Scimitarbills – stealing information from the neighbours?

Common Scimitarbills *Rhinopomastus cyanomelas* are a common sight at our study site at the Kuruman River Reserve, and they often forage with and follow Southern Pied Babbler *Turdoides bicolor* groups between foraging sites.



Sentinels provide a predator-detection system, allowing other group members to forage in safety. (Photo: Alex Thompson)



Common Scimitarbills forage mostly in trees. However, they also join ground-foraging groups of Southern Pied Babblers, effectively parasitising the babblers' vigilance and their ability to detect predators. This allows them, at very little risk, to gain access to novel and rewarding food types. (Photo: Peter Ryan)

Common Scimitarbills have strongly curved bills and primarily probe for insects beneath the bark of trees. However, we soon came to notice that when scimitarbills were foraging with babblers they behaved very differently, often foraging on the ground, probing into the soft sand at the base of trees and shrubs. During these foraging associations with babblers the scimitarbills catch prey that they do not normally catch while foraging alone and on trees – subterranean arthropods and their larvae. Birds cannot probe deeply into the sand and be vigilant for predators simultaneously – so why do scimitarbills put themselves at such risk? We discovered that scimitarbills are displaying a cunning behavioural adaptation – they are parasitising the sentinel system of pied babblers. Previous research conducted by us and our colleagues (published in *Biology Letters*, *Evolution*, *Current Biology* and *Proceedings of the Royal Society (Lond)*) has revealed that pied babblers have a reliable sentinel system – one individual remains vigilant in an elevated position on the look-out for predators while the rest of the group forages. This sentinel system means that foraging individuals can spend less of their own time personally vigilant and instead rely on information given by sentinels. This organized 'sentry system' makes pied babblers a reliable information source regarding predator threat for other animals in the Kalahari ecosystem. Scimitarbills have effectively parasitised this sentinel system: when foraging with pied babblers they reduce their personal vigilance

rate by more than 70%, spend more than 80% of their foraging time on the ground, and exploit a novel food source. We conducted playback experiments to determine the dynamics of this inter-specific interaction and found that scimitarbills were 'information-takers' – when we played back a pied babbler alarm call, scimitarbills immediately fled to cover. In contrast, pied babblers (the 'information-givers' in this interaction) do not respond to scimitarbill alarm calls beyond raising their heads to scan the surrounding environment. The efficient sentinel system of pied babblers reduces the need to respond to all inter-specific alarm calls: rather, they rely on their own sentinels for such information. The scimitarbill, which is primarily a solitary forager, does not have a sentinel system and has instead used the sentinel system of pied babblers to its benefit. This is a unique example of unequal information exchange between species in terms of the differing benefits that each species gains from such interactions.



Jacobin Cuckoos (left) are raised peacefully alongside their Pied Babbler brood-mates (right), with no apparent ill effects on host young. (Photo: Martha Nelson-Flower)

Crafty cuckoos – are young babblers more easily fooled?

The pied babbler is not a regular host for any brood parasite. However, we have recently observed, for the first time, Jacobin Cuckoos *Oxylophus jacobinus* parasitizing pied babblers. The unique habituation of our birds has provided us with fantastic opportunities to investigate this host-parasite relationship. We have been able to monitor the weight change of pied babbler group members over the entire period of raising a cuckoo; we have been able to monitor the effects on brood mates raised



The arid Kalahari means good-quality Pied Babbler territories are at a premium: to defend their territory borders successfully, groups that fail to raise their own young need to try and kidnap young from other groups. (Photo: Alex Thompson)

alongside the cuckoo (in terms of survival and body mass); and, uniquely, we have been able to record the post-fledging interactions between the young Jacobin Cuckoos and their pied babblers hosts. Indeed, some of our juvenile cuckoos have become so habituated that they even jump onto our electronic balances! Over the last two seasons we have monitored seven cases of cuckoo parasitism and we have noticed something very interesting – young pied babblers are more likely to be fooled by the large and ever-begging cuckoos than are their older group-mates. By intensively monitoring feeding rates, we noticed that the older birds in the group tended to feed only the babbler nestlings and ignored the cuckoo. In contrast, the yearlings and juveniles seemed to find the begging of the cuckoo irresistible and fed them at relatively high rates (at a higher rate than they fed young babblers of the same age). This raises the interesting possibility that babblers need to have had experience of raising babbler young in order to be able to differentiate between babblers and cuckoos in the nest. This difference in response to a brood parasite is so marked that in several groups the older birds rejected the cuckoo altogether and the continued attention of young babblers was all that kept the cuckoo from starving. There are

many other interesting aspects of this brood parasite-host relationship that we plan to investigate over the next few seasons, including the cuckoos' ability to mimic the begging calls of babblers; the effect of group size on the babblers' ability to detect and reject brood parasites; and rejection behaviour by hosts according to their age and experience.

Kidnapping behaviour – a critical group size effect?

Kidnapping, whereby individuals actively remove young from their parents, is a rare but notable behaviour. At face value, kidnapping would appear maladaptive: why bear the risk of injury in trying to steal someone else's children rather than attempting to raise your own? Over nine years of research we have collected information on 13 kidnapping events. In all cases, these occurred under very predictable circumstances. Groups that fail to raise any young over the entire five-month breeding season are rare (less than 5% of groups in our population per year). However, these groups suffer high costs of failing to recruit young: they lose a significant proportion of their territory to neighbours who have bred successfully, and as a result they face a high risk of group extinction. This scenario provides a good motive for kidnapping and that is exactly what we observe: *only* groups that fail to raise their own young repeatedly over the breeding season attempt to kidnap young from their neighbours. Kidnapping therefore represents 'the best of a bad situation' scenario. Interestingly, kidnapping only occurs when fledglings are less than six weeks old as this is the period before young are able to recognize their kin (as recently determined by David Humphries through playback experiments): when kidnapped, they do not perceive their kidnappers to be anyone other than their parental group and do not try and return home.

Although this sounds as though kidnapping is a safe bet, it is a violent and prolonged endeavour and is successful only 60% of the time. Once kidnapped, however, the 'victims' continue to be fed and cared for by their kidnappers in the same way that care was previously provided by their parents. These kidnapped individuals then help to raise young produced in subsequent breeding seasons – providing a significant benefit for the kidnappers. In addition, groups that kidnap successfully are *less likely* to go extinct or lose territory than those groups that fail to raise

their own young but do not attempt to kidnap. Combined, this evidence suggests a significant benefit for this rare but enigmatic behaviour, primarily driven by critical group-size effects and the threat of group extinction.

Context-dependent alarm calling

Predation threats to any individual animal are likely to vary across its lifetime. Baby crocodiles, for example, are at risk from a variety of predators, but once they reach full size there are few animals that can harm them. From an evolutionary point of view, it would be beneficial to respond only to those predators that represent a threat at a specific life-history stage, saving individuals considerable energy in predator avoidance. We have been investigating this idea of context-dependent predator response in pied babblers. We have specifically explored how the responses of pied babblers to predators change depending on whether they are incubating, or have nestlings or fledglings because they have very different predators at each of these life-history stages. We elected to investigate two species that represent threats to pied babblers: the Southern Yellow-billed Hornbill *Tockus leucomelas* (a nest predator) and the Meerkat *Suricata suricatta* (a fledgling predator). We have been able to confirm that the response of pied babbler to these two predators differs according to the babblers' reproductive state. They treat hornbills as predators during the incubation and nestling phase and actively chase them away. In contrast, after young have fledged pied babblers tend to ignore hornbills completely. Similarly, during the incubation and nestling stage, pied babblers ignore the presence of meerkats because these terrestrial mammals represent no threat to the nest (which is high in a tree). In contrast, once fledglings have left the nest tree adult pied babblers will direct alarm calls at and mob meerkats from as much as 30 metres away. As offspring become increasingly mobile, the distance at which adults alarm at meerkats decreases. These findings show that pied babblers adaptively change their anti-predator behaviour in response to the level of threat that these different predators pose to their young. This is an efficient way of minimising the costs involved in predator defence and illustrates an ability to recognise the threat that different species pose to their young at different life-history stages. These results fit in neatly with our previous research

on the conflict between adults and fledglings over fledgling location, showing that adults actively change their behaviour in response to the changing risks faced by fledglings as they become older.

Looking forwards ...

In 2012, two new Fitz Post-doctoral Fellows will be joining the babbler research team. Martha Flower, a recent UCT PhD graduate, will be expanding her genetic studies of pied babblers to address the likely ability of these birds to shift their distribution in response to ongoing climate change. Her husband, Tom, who recently received a PhD from Cambridge University for a study of deception-calling by Fork-tailed Drongos *Dicrurus adsimilis* at the Kuruman River Reserve, will be further exploring the complexity of pied babbler-drongo interactions. Both Martha and Tom will also be affiliated to the 'Hot Birds' project.



Newly fledged pied babblers are unable to fly, move slowly, and are extremely vulnerable to terrestrial predators such as meerkats and other mongooses. (Photo: Alex Thompson)

Key co-sponsors

Macquarie University

Research team 2011

Amanda Ridley (PFIPO Honorary Research Associate and Macquarie University, Australia)
Dr Matthew Bell (Univ. Edinburgh)

Students: Krystyna Golabek (PhD, Univ. Bristol), Alex Thompson (PhD), David Humphries (PhD, Macquarie)

Research assistants: Fiona Finch, John Forecast, Elizabeth Wiley



African Penguins *Spheniscus demersus*. (Photo: Ben Dilley)

CONSERVING BIODIVERSITY – SPECIES

AS THE PLANET ENTERS THE ANTHROPOCENE – THE SIXTH MASS EXTINCTION OF GEOLOGICAL TIME – EVER-INCREASING NUMBERS OF SPECIES AROUND THE PLANET ARE FACING THE SPECTRE OF EXTINCTION. SEVERAL OF AFRICA’S ICONIC BIRDS, INCLUDING ITS ONLY PENGUIN, ARE IN THIS UNFORTUNATE POSITION. AFRICA HAS NOT EXPERIENCED A SINGLE MAINLAND BIRD EXTINCTION IN THE PAST 400 YEARS, BUT THIS IS ABOUT TO CHANGE. MANY SPECIES FACE A DIVERSITY OF THREATS, AND IT IS INCUMBENT ON CONSERVATIONISTS TO IDENTIFY WHICH OF THOSE THREATS CAN BE MITIGATED. ULTIMATELY, THIS BOILS DOWN TO UNDERSTANDING WHY RARE BIRDS ARE RARE – SOME ARE NATURALLY RARE, OTHERS HAVE BEEN DRIVEN THERE BY HUMAN ACTIONS. IF WE CAN IDENTIFY THE NATURE OF THESE THREATS – AND THAT IS NOT ALWAYS AS EASY AS IT MIGHT SOUND – THEN WE HAVE A CHANCE OF INTERVENING AND HALTING THE EXTINCTION PROCESS. WHEN THE FITZ’S ACTIVITIES WERE REVIEWED BY AN INTERNATIONAL PANEL IN 2009, IT WAS RECOMMENDED THAT WE DIVERT AN INCREASING PROPORTION OF OUR RESOURCES TO SOLVING THESE ISSUES, ESPECIALLY IN TERRESTRIAL ECOSYSTEMS. AS YOU WILL SEE FROM WHAT FOLLOWS, WE HAVE TAKEN THIS MESSAGE TO HEART.

Blue Swallows on the brink



The Blue Swallow is the bird most likely to go extinct in South Africa in the near future. (Photo: Warwick Tarboton)

THE BLUE SWALLOW *HIRUNDO ATROCAERULEA* HAS THE DUBIOUS DISTINCTION OF BEING THE BIRD MOST LIKELY TO GO EXTINCT IN SOUTH AFRICA IN THE NEAR FUTURE. HUMAN ACTIVITIES, MOST NOTABLY FORESTRY AND AGRICULTURE, HAVE DRAMATICALLY REDUCED THE HABITAT AVAILABLE TO THIS MID- AND HIGH-ALTITUDE GRASSLAND SPECIALIST. THE SWALLOWS' UNUSUAL BEHAVIOUR OF BREEDING UNDERGROUND IN AARDVARK BURROWS, SINKHOLES AND ABANDONED MINESHAFTS ALSO MAKES THEM VULNERABLE TO FACTORS SUCH AS FLOODING (DURING THE 2001/2002 BREEDING SEASON IN KZN, FOR INSTANCE, AT LEAST NINE BREEDING ATTEMPTS ARE KNOWN TO HAVE BEEN NEGATIVELY AFFECTED BY HEAVY RAIN). THEY ARE ALSO SUBJECT TO HUMAN DISTURBANCE, INCLUDING NESTLINGS BEING REMOVED FROM NESTS AND USED AS FISHING BAIT.

THE STATUS OF THE SOUTH AFRICAN POPULATION IS NOW SO TENUOUS THAT IT IS CURRENTLY THOUGHT TO NUMBER NO MORE THAN 50 BREEDING PAIRS, DOWN FROM AROUND 80 JUST TWO YEARS AGO AND MORE THAN JUSTIFYING ITS NATIONAL RED-LISTING OF *CRITICALLY ENDANGERED*.

Why so threatened?

Despite concerted efforts to pull the Blue Swallow back from the brink, its decline has continued unabated. The reasons for this are far from clear, and there are several distinctly puzzling aspects. In the summer of 2009/2010, for instance, the number of birds in Mpumalanga dropped precipitously, with no swallows breeding at traditional sites such as Kaapsehoop. A recent local extinction that is particularly difficult to explain involves the Blue Swallow population that formerly occurred in the Haenertsburg and Wolkberg region of Limpopo Province. Until the early 2000s small numbers of birds bred in this area, but they all but vanished in the space of a few years. Ironically, the Wolkberg Wilderness Area is the largest conserved area in South Africa that has until recently held breeding Blue Swallows. The birds have disappeared, but the grasslands in this area have not been directly affected by human activities in any obvious way.

The plan

An ongoing partnership between the Fitz's CoE, the Endangered Wildlife Trust and the CSIR is currently attempting to plug gaps in our knowledge of the Blue Swallow's biology. One key piece of information that we still lack concerns the extent to which individuals return to their natal areas after their first migration north to the wintering range. Although particular nest sites are repeatedly used in successive years, the absence of ringing recoveries has made it impossible to verify whether the same individual birds are involved, and whether young swallows return to their

natal areas to breed. During 2011, Dr Ian Little (a recent PFIAO PhD graduate now working for EWT) and Prof. Andrew McKechnie (University of Pretoria) began a project using Passive Integrated Transponder (PIT) tags to identify individual swallows. Late in 2011, swallow nestlings in several areas of KwaZulu-Natal were implanted with PIT tags (these are the same devices used to 'microchip' pets). This approach differs from ringing, the traditional approach to identifying individual birds, in one crucial way. Like a metal ring, each PIT tag contains a unique code that allows an individual swallow to be identified. Unlike a ring, however, a PIT tag can provide this information from a distance. A large square antenna, connected to a data logger, will be positioned over nest holes in 2012, and any swallow carrying a PIT tag will be detected as it flies into the hole, and its identity recorded automatically. This system should provide a much clearer picture as to whether individual Blue Swallows return to their natal breeding areas, information that is vital for conserving this highly threatened migrant.

Key co-sponsors

Endangered Wildlife Trust, Identipet

Research Team 2011

Prof Andrew McKechnie (CoE Core Team Member, Univ. Pretoria)

Dr Ian Little (EWT Threatened Grassland Species Programme)

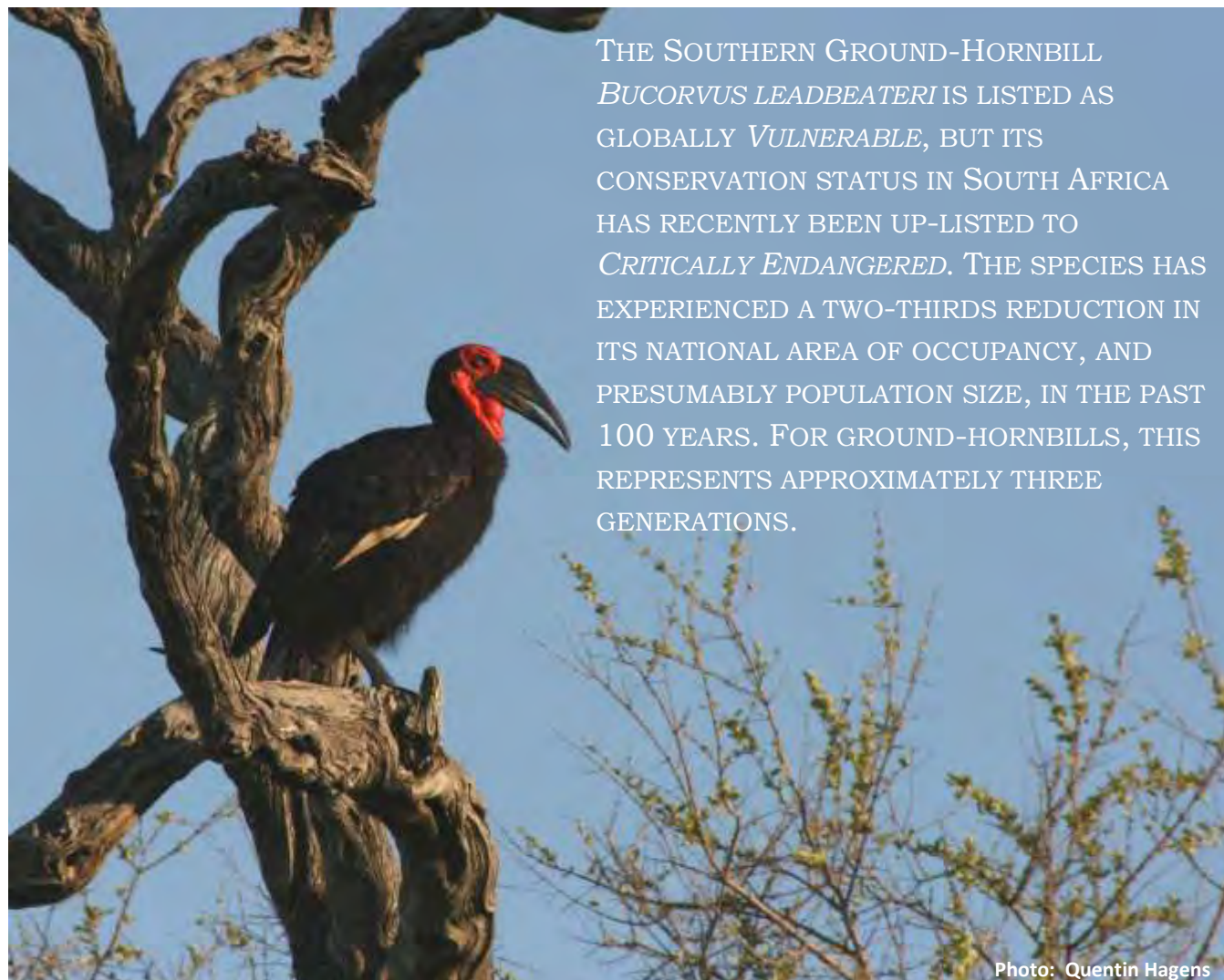
Dr Stephan Woodborne (CSIR)

Research assistant: Wendy Arnott



Miniature microchip transponders (PIT-tags) were attached to Blue Swallow nestlings in KwaZulu-Natal during the 2011/12 breeding season. During the 2012/13 season, nests will be monitored for returning PIT-tagged adults. (Photos: Brent Coverdale)

Southern Ground-Hornbill Conservation



THE SOUTHERN GROUND-HORNBILL *BUCORVUS LEADBEATERI* IS LISTED AS GLOBALLY *VULNERABLE*, BUT ITS CONSERVATION STATUS IN SOUTH AFRICA HAS RECENTLY BEEN UP-LISTED TO *CRITICALLY ENDANGERED*. THE SPECIES HAS EXPERIENCED A TWO-THIRDS REDUCTION IN ITS NATIONAL AREA OF OCCUPANCY, AND PRESUMABLY POPULATION SIZE, IN THE PAST 100 YEARS. FOR GROUND-HORNBILLS, THIS REPRESENTS APPROXIMATELY THREE GENERATIONS.

Photo: Quentin Hagens

Southern Ground-Hornbills *Bucorvus leadbeateri* have been on the South African research agenda for decades, mainly thanks to the efforts of Dr Alan Kemp, a past Honorary Research Associate of UCT and the Fitz. Since 2000, however, they have been the focus of a medium-term study at the Fitz. Our main study area is the Associated Private Nature Reserves (APNR) spanning Mpumalanga and Limpopo, and lying adjacent to the central Kruger National Park. The APNR is one of the largest privately owned conservation areas in the world, covering some 180 000 ha.

Co-operatively breeding ground-hornbill groups have large spatial requirements, and the entire APNR supports about 30 groups. We have reproductive histories spanning a decade for more than 20 of these groups. We have also been able to show that positive influences on

breeding success include group size, whether or not the group has access to an artificial nest, and the amount of open habitat within 3 km of the nest site.

A fair amount of information exists, in both South Africa and elsewhere, about the density of ground-hornbill groups – i.e. how many groups exist in a given area. The highest density recorded to date in southern Africa is one group per 25 km², at Mana Pools in Zimbabwe. In most places, including the APNR, densities are much lower.

There are, however, some important aspects of the species' biology about which we know very little. These include a) how big home ranges/territories really are – and do they stay constant; b) do they abut or overlap; and c) does seasonal use of home ranges change and is this

reflected in different seasonal patterns of habitat preference? Trying to answer these questions on the ground by following the birds would a) take forever; and b) yield less-than-ideal results because as soon as the birds see an observer, they change their behaviour. We discovered this fairly early on in the project while trying to track the birds ‘on the cheap’ using radio transmitters.

By 2009, we realised that we had to bite the bullet and invest in satellite tracking technology. The first satellite transmitter was deployed on a bird in the APNR in February 2010, and since then we have had up to five devices transmitting simultaneously. Each device sends a positional signal once an hour starting while it is still dark in the morning (before the birds have left their night-time roosts) until after they return to roost that evening. We now have in excess of 25 000 positional fixes, accurate to a few metres.

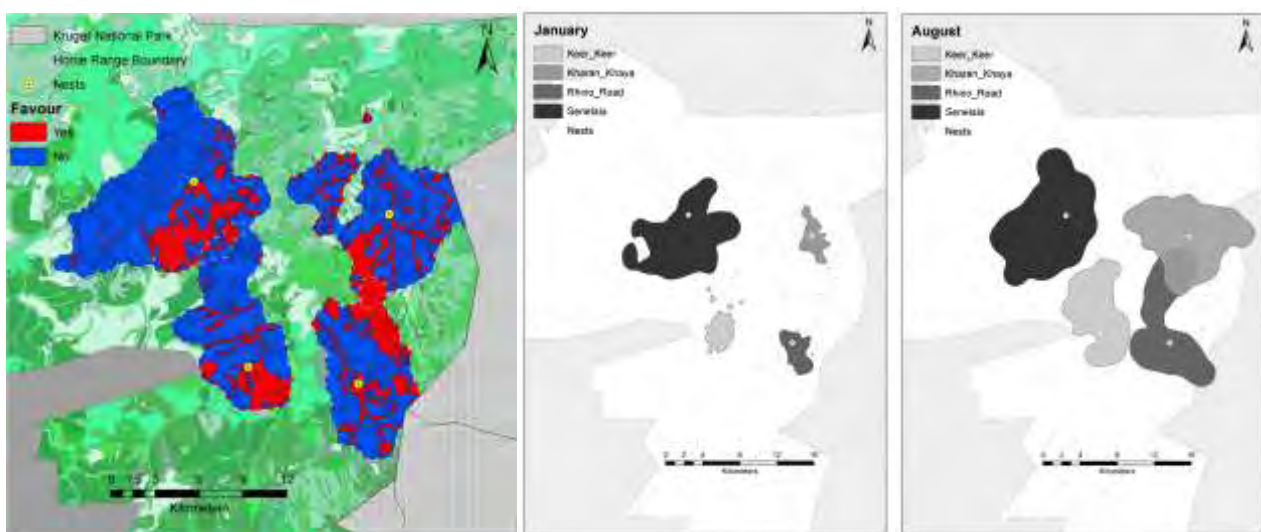
During 2011, Honours student William Wyness undertook a preliminary analysis of this data set (to be continued in more detail in 2012 by new MSc student Blair Zoghby). William’s project aimed to give us the first answers to the questions above. He worked with the satellite data from four ground-hornbill groups, each of which had been tracked for at least a year.

The areas used by different groups across the entire year ranged from 55.5 km² up to 103.2 km². In the summer breeding season, however, home ranges contracted dramatically. Three of the four groups bred successfully and, during the breeding season these groups used only 24-36% of the areas they used in winter. The fourth group attempted to breed, but failed at the chick stage, and ended up using 70% of

their winter range during the summer. In the summer there was no overlap between home ranges: indeed, groups never even got close to one another. In winter, however, when groups ranged over much larger areas, there was a small amount of home-range overlap.

We had hypothesised that the boundaries of home ranges may be set by patches of high resource density – as has been shown for foxes. However, this was not the case. Whilst there are some favoured areas that do lie on the edges of home ranges, such hot spots cannot explain the boundaries convincingly.

We are fortunate in that a detailed, geo-referenced vegetation map of the study area exists. This allowed William to analyse seasonal patterns of habitat preference in more detail. Despite the large home ranges, the proportions of these that were favoured at any time of year was fairly small – 0.5-22% (across four groups and four seasons). On average, more habitat types were avoided than preferred (2-55%), but most habitats were used in proportion to their availability (23-98%). The birds were apparently more ‘choosy’ about habitats in the breeding season, but this link may be spurious because at this time of year, group members regularly visit the nest to feed either the incubating female or the chick. This is termed central place foraging, and what we may have been seeing in summer is nothing more than an unwillingness of the birds to go too far from the nest. One of the habitats that was consistently favoured, however, was open ground (e.g. bush airstrips). Although open habitats are fairly rare, this may explain why those groups that do have



‘Hotspots’ (in red) used by four ground-hornbill groups across the year (left). The two black-and-white images compare home-range sizes in the middle of the breeding (centre) and non-breeding (right) seasons. (Images: William Wyness)

relatively large amounts of open ground close to their nests are the most successful. It also suggests that bush clearance could be used as a management tool.

William also undertook extensive vegetation surveys to see if we could explain *why* the birds avoided some habitats and favoured others. We designed a sampling protocol which we hoped would measure the habitat structure as seen by a ground-hornbill, and we also sampled different habitats in proportion to their areas. The results were inconclusive, quite possibly because the vegetation sampling was done in the mid to late dry season, when the landscape is at its least 'leafy', and when the birds wander over the largest area and are the least selective about which habitats they use. In 2012, we plan to take the analysis of the satellite data to the next level, zooming in to much more detailed spatial and temporal resolutions with the aim of using a combination of satellite tracking and satellite imagery to identify optimal sites elsewhere for

the reintroduction of ground-hornbills.

Reintroduction protocols, of course, depend on the availability of birds for reintroduction. One reintroduction initiative is already underway at Mabula in Limpopo and another at Madikwe in the North West Province. We work closely with the reintroduction initiatives implemented by the Mabula Ground-Hornbill Project and with the South African Southern Ground-Hornbill Recovery Plan Action Group. Ground-hornbills are captive-bred and reared at two sites in South Africa. Captive breeding is very slow, but the potential for captive-rearing and subsequent assimilation into groups for release is much greater. This is because ground-hornbills almost invariably lay two eggs, yet invariably rear only a single chick. Second chicks are therefore available for harvest and captive rearing (being destined to die in the wild). With permission from APNR management, we harvest second chicks annually at the APNR and hand these over for captive rearing by experts.



At first light, wild ground-hornbills (right) approach the walk-in trap containing the decoy models, one of which (Dorothy) is 'wired for sound'. Note that one of the wild birds is carrying a food offering in its bill - would that it was always that easy: many, many trapping mornings are spent watching nothing more than the decoys in the trap! (Photo: Sieglinde Rode)



The flash flood of 18 January 2012 swept away most of the project's equipment and badly damaged the research station.
(Photos: Kate Meares)



Postscript

All in all, 2011 was a good year for the ground-hornbill project. But 2012 did not start so well. In the third week of January, Tropical Storm Dando hit parts of the lowveld, cutting off some of Kruger's rest camps and forcing helicopter evacuations. Kruger escaped quite lightly! At our research station, on the banks of the Klaserie River, the river rose between four and five metres in a matter of half an hour. Six hundred millimetres of rain had fallen in 36 hours, three dams had burst upriver of the research station and, at 04h30 on Wednesday 18 January, project staff were given 20 minutes to evacuate. Floodwaters rose almost to ceiling level in the station, windows and doors were gone, and most of our research equipment, put together over more than 10 years, was swept away by the flood. The electronic data were mostly salvaged, but traps, laptops, binoculars, radio- and satellite-tracking equipment and much, much more were gone, essentially leaving us with an ageing vehicle, some hard drives, and no accommodation. Happily, no staff were injured, but Dorothy may be gone forever (and the project team has temporarily relocated to Mabula). Dorothy was a life-sized model of a ground-hornbill, specially designed to be wired for sound and used as a lure in our 30 m² ground-hornbill trap (also swept away by the flood). For the project, Dorothy's days are probably over, but I can see her remains causing confusion in the Kruger as she floats down the Olifants River en route to Mozambique ...



Dorothy – R.I.P. (Photo: Phil Hockey)

Key co-sponsors

Dow Southern Africa (Pty) Ltd; Associated Private Nature Reserves; Hans Hoheisen Charitable Trust; Senelala Estates.

Research team 2011

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Students: William Wyness (BSc Hons)

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Bearded Vulture population dynamics and conservation

THE DECLINE OF VULTURE POPULATIONS WORLDWIDE HAS EMERGED AS ONE OF THE MOST WORRYING EVENTS IN AVIAN CONSERVATION IN RECENT YEARS. THESE SCAVENGERS ARE VITAL TO THE PROPER FUNCTIONING OF ECOSYSTEMS AND ARE BEING LOST AT UNPRECEDENTED RATES FROM MANY PLACES THROUGHOUT THE WORLD. INDIA, NEPAL AND PAKISTAN, FOR EXAMPLE, HAVE LOST SOME 95% OF THEIR VULTURES IN THE LAST TWO DECADES.



Photo: Sonja Krüger

Declining trends are also evident in vulture numbers in South Africa, including for the Bearded Vulture *Gypaetus barbatus*. The species is listed as *Endangered* in a South African context. Although it is classified as being of *Least Concern* globally, its status is currently being reassessed for upgrading to *Near-threatened* or *Vulnerable* by BirdLife International due to concerns over declines in many parts of its range.

Limits on Bearded Vulture numbers

Sonja Krüger is currently undertaking PhD studies at the Fitz, her work is aimed at understanding the factors which are limiting population growth and reproductive success and to understand the foraging behaviour of the species. The research questions to be investigated include those dealing with the status and distribution of the species, the factors affecting survival and breeding success, the variables influencing the spatial and temporal use of home ranges, the future trajectory of the population and the conservation interventions that can effectively influence this trend.

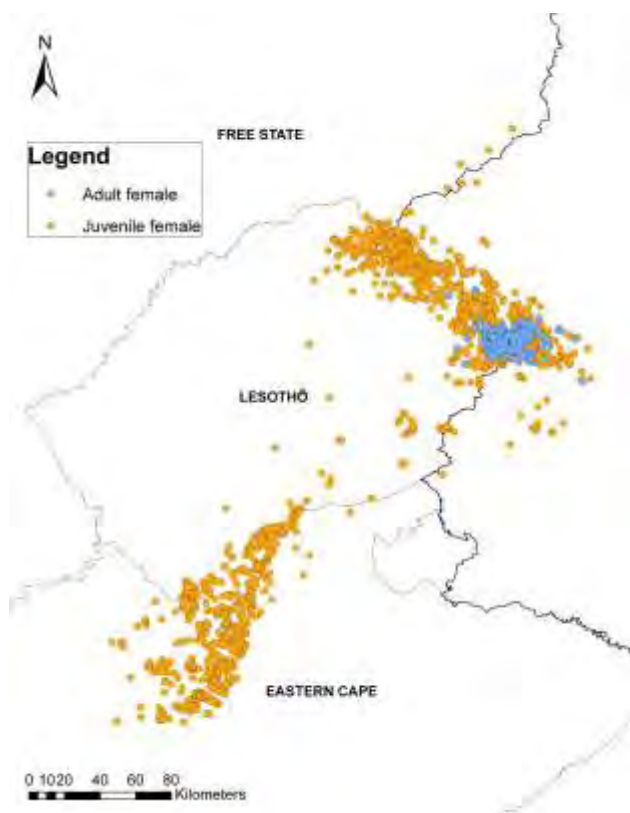
Recent analyses have explored the breeding status and distribution of the species in southern Africa. The results indicate that there has been a contraction of the species' breeding range as well as a continuing reduction in population numbers. The number of mature individuals in the population is estimated to be as few as 100 individuals, although some 200 historically used territories are known within the range of the species. It appears that the currently occupied territories are those within the core breeding areas and that territories in the peripheral areas have been abandoned. The variables influencing the abandonment of breeding territories will be investigated. In addition, nest sites have been monitored to provide an indication of breeding success.

Tracking the vultures' travels

In order to determine patterns of home-range use and the causes of mortality, four nestlings, eight juveniles, two immatures and four adult Bearded Vultures have carried satellite transmitters since 2007. Another six transmitters have been obtained which will be fitted

to adult and sub-adult birds during 2012 to increase the sample sizes for the older age categories. Of the 18 transmitters that have been fitted, two failed, two were dropped by the birds and four have been recovered from dead individuals. Three of the deaths were as a result of poisoning and one from a power line collision. Whether any particular age class is more prone to risk from poisoning or collisions as a result of their foraging behaviour is as yet uncertain. The primary causes of mortality are assumed to be related to increased human densities and associated infrastructure. Because conservation resources are limited and must be focused in priority areas, a modelling exercise will facilitate the targeting of appropriate areas for conservation action.

Molecular analyses will be undertaken in 2012 to determine the amount of genetic variability in the population and to determine whether the population in South Africa and Lesotho is genetically distinct from other populations. These results will also help guide conservation management decisions, especially any that may relate to reintroductions or translocations.



GPS satellite tags used in this study are providing unparalleled information on the locations of Bearded Vultures throughout the year in South Africa and Lesotho (Image: Sonja Krüger)



A Bearded Vulture fitted with a GPS satellite tag is readied for release. (Photo: Sonja Krüger)

Ultimately, current and future trends of the southern African Bearded Vulture population will be modelled using a population viability analysis. However, before that can be done with any confidence, better estimates of the key, baseline model parameters are required. Survival data will be obtained from tagged birds, and road counts will be undertaken to determine the population age structure. With current and more accurate information obtained during Sonja's study, the population trend can be determined and the relative effectiveness of management interventions can be evaluated. This information is critical for inclusion in the international Biodiversity Management Plan for the species, which is currently being developed.

Key co-sponsors

Ezemvelo KZN Wildlife; Wildlands Conservation Trust; Maluti-Drakensberg Transfrontier Project; Sasol through the Endangered Wildlife Trust; Aspen Pharmaceuticals; Marriott.

Research team 2011

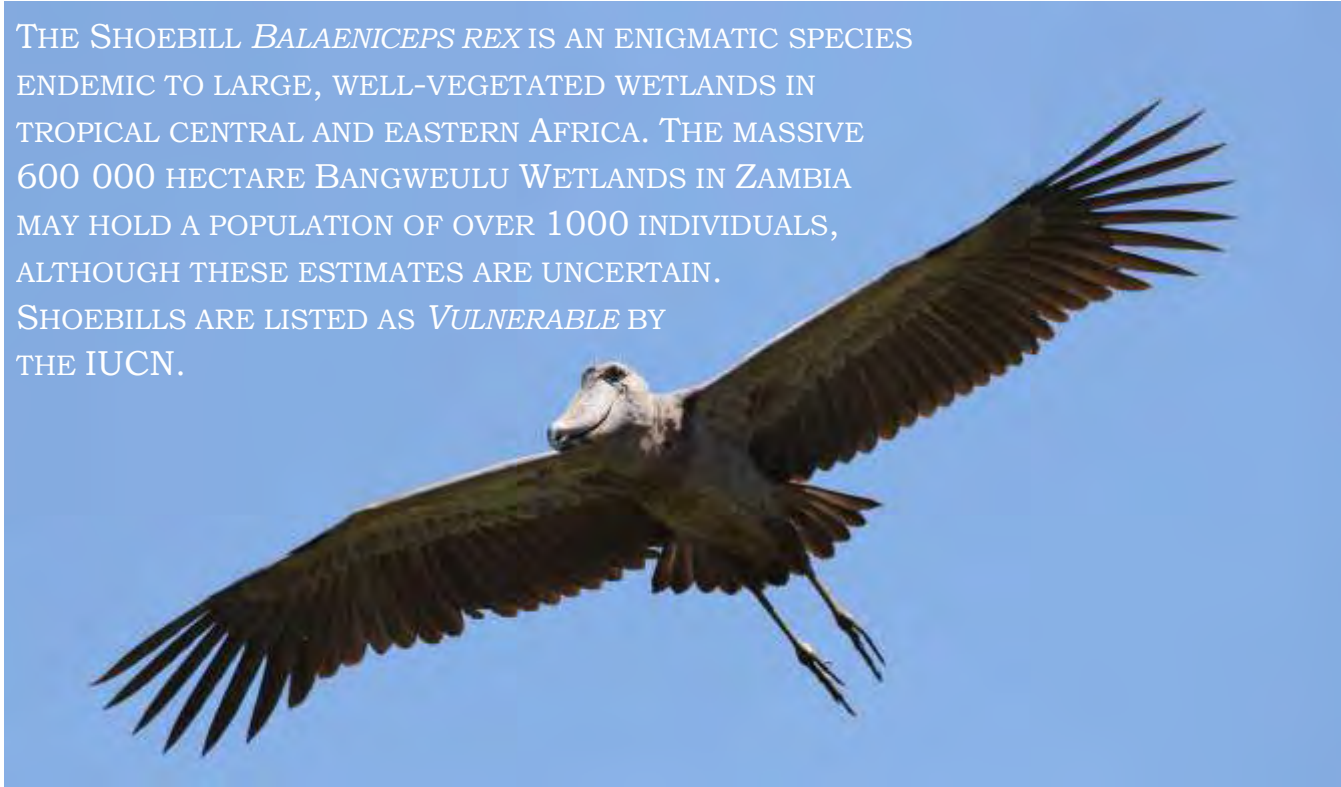
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Student: Sonja Krüger (PhD)

Research Assistants: Rickert van der Westhuizen (Ezemvelo KZN Wildlife), Carmen Calero (volunteer), Bearded Vulture Task Force members (Birds of Prey Programme of Endangered Wildlife Trust), Ezemvelo KZN Wildlife Conservation Managers in the uKhahlamba-Drakensberg Park World Heritage Site

Conservation of Shoebills in the Bangweulu Wetlands, Zambia

THE SHOEBILL *BALAENICEPS REX* IS AN ENIGMATIC SPECIES ENDEMIC TO LARGE, WELL-VEGETATED WETLANDS IN TROPICAL CENTRAL AND EASTERN AFRICA. THE MASSIVE 600 000 HECTARE BANGWEULU WETLANDS IN ZAMBIA MAY HOLD A POPULATION OF OVER 1000 INDIVIDUALS, ALTHOUGH THESE ESTIMATES ARE UNCERTAIN. SHOEBILLS ARE LISTED AS *VULNERABLE* BY THE IUCN.



Like their closest relatives, the pelicans, Shoebills are proficient soarers. (Photo: Peter Ryan)

Shoebills *Balaeniceps rex* are much sought after by birders, but are believed to face threats from habitat destruction, habitat degradation (decrease in fish prey stocks), the bird trade, disturbance and direct persecution. Knowledge of the population size and structure, and of suitable shoebill habitats, is vital for their effective conservation, yet this is lacking in most sites, including the Bangweulu Wetlands. This project aims to formulate strategies for the optimal protection of the Bangweulu population of Shoebills by gathering scientific data on their population size, distribution, ecology and threats, and to improve community perception of the species. This research project started in 2011 in collaboration with WWF-Netherlands, the African Parks Network and The Kasanka Trust. Dr Ralf Mullers is a Post-doctoral Fellow at the Fitz based at the Bangweulu Wetlands and is leading our research there.

Shoebill distribution

Data on shoebill distribution throughout the Bangweulu Wetlands have been collected

through aerial surveys. In April, an aerial survey (by plane) covering the whole Bangweulu Wetlands GMA was conducted and all wildlife and human activity were recorded. During this survey, at the end of the wet season, 27 shoebills were counted. These survey data will allow us to study the distribution of the shoebills in relation to human activity. A further survey (by micro-light) at the beginning of the breeding season focused on our core study area of 10 000 hectares to find nests that could be monitored during breeding. This survey located a total of 20 shoebills and five nests.

Nesting success

One of the main objectives of this project is to establish a reliable estimate of shoebill breeding success in our core study area. During the breeding season, active nest searches were conducted, either through aerial surveys, by actively searching from the ground or from interviewing local fishermen about possible nest locations.

It soon became clear that many nests are

under extreme pressure from the illegal trade in chicks and possibly eggs, direct human persecution and the ill effects of poacher's fires. Several chicks were found in fishing camps, waiting for transport to Zamfya, from where they would be sold to bird traders. The effects of illegal trading were much more serious than anticipated, and many chicks disappeared from our monitored nests. Additionally two chicks were found in fishing camps and these birds were confiscated and hand-reared by researcher David Ngwenyama. Breeding success was therefore extremely low and most likely not sufficient to keep the population at viable levels, considering the slow life-history of shoebills. Shoebills only start breeding when they are 3-4 years and typically rear only one chick per breeding season.

The two shoebills that were confiscated were hand-reared at a specially constructed enclosure at the Chikuni research base. Unfortunately, one chick had apparently been taken from the nest whilst still very young and was imprinted on humans. It showed strong signs of habituation, as it greeted humans with bill clapping displays and begging for food. The second chick was older when rescued and showed more natural behaviour. This second chick appeared to have had a positive influence on the imprinted bird and the birds were further stimulated to feed in a more natural way. They were no longer hand-fed, but fish were released in a small pond in the enclosure, so that the birds had to hunt for their own food. This strategy quickly became successful and both birds managed to fish for themselves.

The less imprinted chick has now been released after being fitted with a GPS-satellite transmitter and seems to be doing fine. It stayed in the area where it was released, about 5 km from Chikuni, and has a home range of about 3 km². We hope to release the other chick soon. A third chick that was also found at a fishing camp, but not brought to the rearing facility, was also fitted with a GPS device and released near its nest. After two weeks the device stopped transmitting data. After questioning the local fishermen, it appeared that the bird was still alive, but the fishermen had caught the bird and removed the GPS device. Once they realised the GPS device was of no use (and not a radio) they buried it.

GPS-transmitter deployments

We obtained 13 GPS-PTT devices which we hope to deploy on both juvenile and adult shoebills. These tags will provide accurate (within 10 m) positional fixes, data which would otherwise be impossible to gather. Because of the dramatic consequences of the illegal chick trading, only a few chicks were successfully reared in the wild and only two birds could be deployed with GPS devices, one of which is still transmitting data. In 2012 we hope to trap adult birds and attach these devices to understand their ranging behaviours and habitat use.

2011 was a challenging year, both in terms of setting up the research and dealing with the illegal trafficking of shoebill chicks. Nest protection plans will be installed for the next breeding season and hopefully this will allow us to both protect the chicks and collect some data on the breeding cycle of the shoebills.



Rob Little, Hanneke Hogerheijde (African Parks Network) and Frank Willems (The Kasanka Trust) with local field assistants at a Shoebill nest in the Bangweulu Swamps. (Photo: Ian Stevenson)

Key co-sponsors

African Parks Network, The Kasanka Trust, WWF Netherlands.

Research team 2011

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The impacts of power line collisions on bustards and cranes



A Ludwig's Bustard killed by low-voltage power lines near Calvinia. (Photo: Maurice Schutgens)

LARGE, OPEN-COUNTRY BIRDS SUCH AS BUSTARDS AND CRANES ARE RELATIVELY CUMBERSOME IN FLIGHT, AND ARE UNABLE TO REACT RAPIDLY WHEN THEY ENCOUNTER AERIAL OBSTRUCTIONS. HISTORICALLY, THEY HAVE HAD THE FREEDOM OF OPEN SKIES, BUT THE PROLIFERATION OF POWER LINES AND OTHER AERIAL HAZARDS POSES A SIGNIFICANT THREAT TO THESE BIRDS. SOUTHERN AFRICA HAS A RICH DIVERSITY OF BUSTARDS AND CRANES, WITH SEVERAL ENDEMIC SPECIES. THIS PROJECT INVESTIGATES THE CONSERVATION IMPLICATIONS OF POWER LINE COLLISIONS ON BUSTARDS AND CRANES IN THE KAROO AND OVERBERG REGIONS OF SOUTH AFRICA. THE MAIN FOCUS IS ON LUDWIG'S BUSTARDS *NEOTIS LUDWIGII* AND BLUE CRANES *ANTHROPOIDES PARADISEUS*, BUT SEVERAL OTHER SPECIES ALSO ARE OF CONCERN, PARTICULARLY KORI BUSTARDS *ARDEOTIS KORI*.

Estimating collision rates

PhD student Jess Shaw continues to be the mainstay of the project. She spent most of 2011 in the Karoo, looking for bustards live and dead. It was a wet year, which made driving under power lines tricky, and finding bustards to catch was pretty challenging. The 230 km sample of high-voltage transmission power lines across the Karoo was surveyed every quarter, adding to the seasonal collision data that have been collected over this large area for two years.

Collision rates remain high, but with considerable variation, probably because of the birds' seasonal movements around the Karoo.

An important factor in calculating collision rates is accounting for the birds we're not finding, because of scavenger removal, the relative experience of searchers and other biases. To get an idea of the accuracy of our mortality estimates, MSc CB student Maurice Schutgens joined the project in September 2011. He conducted an experiment with geese near

Calvinia over the summer, monitoring their removal and decay, and sending volunteers out to see how many geese they could find. The experiment showed that while scavengers located the majority of geese, most were consumed on site, leaving plenty of 'collision' evidence for us to find. Various searchers found 60-70% of geese in this open landscape, which overall suggests our mortality estimates are pretty good. Maurice also conducted the first Karoo surveys along low-voltage (22-66 kV) distribution power lines, finding that they are nearly as lethal for Ludwig's Bustards as are the larger transmission lines. Considering that the length of the distribution network is nearly four times that of the transmission grid, the results of this study are very worrying indeed, and these surveys need to be expanded to low-voltage lines in other areas of the Karoo.

In addition to the bustard collision estimates, Jess has continued long-term monitoring of a selection of power lines in the Overberg region of the Western Cape for a third year. This agricultural area supports approximately half of the global population of Blue Cranes. Most cranes are killed in late summer, perhaps representing mortality of inexperienced juvenile birds. The overall levels of mortality found corroborate collision rates estimated from Jess's 2008/9 CB project that suggested 12% mortality of the Overberg population annually. Small numbers of Denham's Bustards *Neotis denhami* also are killed on these lines, even though most of the monitored lines lie outside the main range of this bustard.

Population impacts and mitigation

To get an idea of the impacts of collision mortality on the Ludwig's Bustard population,



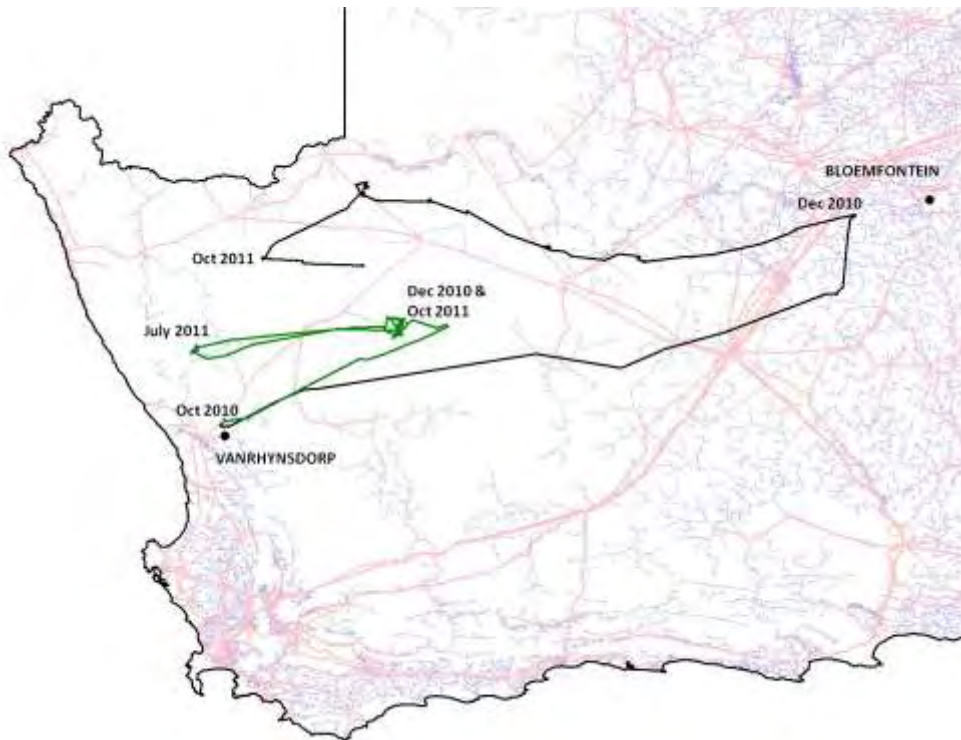
Ben Dilley releasing a newly tagged Ludwig's Bustard in the Free State. (Photo: Delia Davies)



Jess Shaw fitting a satellite transmitter to a Ludwig's Bustard near Brandvlei. (Photo: Ben Dilley)

Jess has repeated the extensive road counts conducted by David Allan in the 1980s. The fourth and final census was completed in April, and was very quiet, with far fewer bustards seen than on the autumn count 20 years ago. An aerial survey of the the eastern count route was conducted with the assistance of the Bateleurs in April, and low numbers were recorded using this method too. It is possible, however, that the high rainfall throughout the central and eastern Karoo this summer may have contributed to the small numbers of birds counted, with the birds more widely dispersed than usual.

The good rains across the Karoo in 2011 made trapping very difficult, as bustards didn't need to come to cultivated lands where we could trap them. Numerous trips were made to look for good trapping spots, and Jess was finally lucky in June when a new bustard was caught in a field north of Brandvlei used by one of our previously tagged birds. This trick worked again in December, when transmitters were successfully deployed on two more birds caught in the Free State where 'Ludwig', our first tagged bird, was spending his summer. Unfortunately, all birds tagged to date are males, and until December 2011, all were caught in the west of the range. It will be interesting to see if the two males caught towards the eastern edge of their range both move west in winter. Two of the first birds caught near Vanrhynsdorp in winter 2010 returned to the exact same areas two summers running, one near Brandvlei and the other near Petrusburg, perhaps to breed. The bustards clearly are most at risk when they undertake these extensive seasonal movements. Their risk during the rest of the year, when they only wander few kilometres each day, probably depends on where they choose to settle, and the



The movements of 'Ludwig' (black) and 'Boetie' (green), our first two tagged birds, over the first year of data transmission. (Image: Jess Shaw)

density of lines in that area.

In April, Jess joined Endangered Wildlife Trust staff and a live-line team from Eskom to put up a large-scale line-marking experiment over about 70 km of transmission lines near De Aar. This will test whether the marking devices commonly used in South Africa reduce bird collision mortality, particularly of Ludwig's Bustards and Blue Cranes. It was an exciting and stressful week, making last-minute calculations and design adjustments, counting markers, and watching the Eskom team attach them to live power lines from a helicopter. Weather delays meant the experiment was only fully in place by May, and standing water on the servitude prevented surveys on some of the lines for the next few months. Since then though, the data have been rolling in, with the EWT team conducting surveys every 6 weeks. We hope to have some answers on the efficacy of markers by the end of 2012.

And into 2012

And finally, towards the end of 2011, progress was made with extending the project into Namibia. After protracted talks between Nam-Power and the Namibian Nature Foundation, a bustard collision project was approved and John

Pallett was recruited as an MSc student. He will begin monitoring collision rates along Namibian power lines in 2012. However, perhaps the most important question is whether Ludwig's Bustards in Namibia move into South Africa. A key priority will be to try to catch some birds in Namibia and deploy satellite tags.

Key co-sponsors

Abax Foundation; Endangered Wildlife Trust-Eskom Strategic Partnership; Mazda Wildlife Fund; Mohamed bin Zayed Species Conservation Fund; University of Cape Town Research Committee and J.W. Jagger Post-graduate Scholarship. Francois van der Merwe provided invaluable assistance with field work around Calvinia.

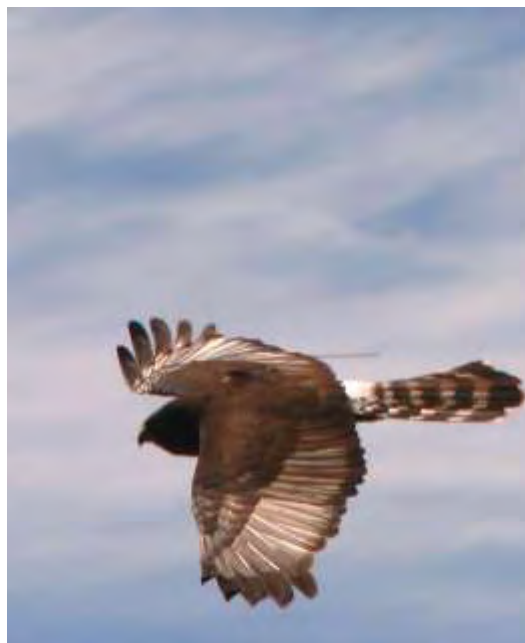
Research team 2011

Assoc. Prof. Peter Ryan (PFIAO)
Dr Andrew Jenkins (PFIAO Research Associate)
Megan Diamond (EWT)
Bradley Gibbons (EWT)
Jon Smallie (EWT)

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Research assistants: Delia Davies, Ben Dilley, Rosa Gleave, Chris Heward, Carol Smith, Paula Strauss

Life at the top of the food chain – raptor research projects



THERE ARE TWO CORE AIMS OF THE FITZ'S RAPTOR RESEARCH PROGRAMME. THE FIRST IS TO UNDERSTAND POPULATION PROCESSES OF RARE SPECIES (E.G. TAITA FALCON *FALCO FASCIINUCHA*) OR THOSE UNCOMMON SPECIES OF CONSERVATION CONCERN (E.G. BLACK HARRIER *CIRCUS MAURUS*, AND CAPE GYPS *COPROTHERES* AND BEARDED VULTURES *GYPAETUS BARBARTUS*) TO PROVIDE UP-TO-DATE INFORMATION FOR EFFECTIVE MANAGEMENT DECISIONS. IN THESE CASES WE LIAISE CLOSELY WITH REGIONAL AND NATIONAL CONSERVATION ORGANIZATIONS TO FACILITATE INFORMATION TRANSFER.

The satellite-tracked female Black Harrier – Moraea – photographed in Aberdeen where she bred successfully before heading back to Lesotho for the summer. (Photo: Rob Simmons)

The second aim of the programme is to provide long-term data on population ecology and dynamics of resident species (Peregrine Falcon *Falco peregrinus* and Black Sparrowhawk *Accipiter melanoleucus*) and migratory species whose world populations visit the subregion (kestrels). We have also been studying the effects of pesticides on African Fish-Eagle *Haliaeetus vocifer*, and responses to climate and other systemic environmental changes (using peregrines, sparrowhawks and vultures).

The arrival of new breeding species in South Africa is a rare occurrence, so the appearance of so-called "Mystery Buzzards" breeding in the Western Cape has caused quite a stir, not least because their identity remains embarrassingly unresolved! A new MSc study focusing on these birds started in 2011. Two raptor projects, Black Sparrowhawks and Bearded Vultures, are reported on elsewhere (pp 81-82, 39-40).

Black Harrier conservation and movements

Black Harriers are among southern Africa's rarest endemic birds, with the global population estimated at between 500 and 700 pairs. Preliminary DNA evidence suggests a lack of genetic diversity in this species, adding to its

intrinsic rarity and potential lack of adaptability to changing conditions. This species is classified as globally *Vulnerable* and the Fitz's long-term study of the species, now in its 12th year, investigates breeding ecology in relation to climate and habitat with a view to improving management strategies to meet their conservation needs. There are two major components to this project:

(1) An overview of the life history of the species in different regions of South Africa. Results from over 150 nests sites and more than 350 nesting attempts indicate that in the Northern and Western Cape Provinces clutches are smaller and fledging success lower in inland (mountains and Overberg habitats) relative to coastal sites, linked to fewer mice in the diet in the mountains; breeding in the Northern Cape and Free State Provinces is sporadic, occurring in approximately two out of every three years; polygyny (one male mated with two females) occurs at a low level (<8%) and only in the mountains; and Reversed Size Dimorphism (females larger than males) is pronounced.

(2) Understanding how the species uses the landscape at differing spatial scales. An exciting development here is the implementation of

satellite-tagging technology to follow harriers through a breeding season (when they move locally) and then determine where they spend the non-breeding season (when they may move extensively). Of the six birds followed to date, two have revealed remarkable and hitherto unsuspected journeys from the Cape west coast to Lesotho, moving rapidly across 1 200 km of Karoo and mountain habitats as the summer heated up in February. One bird – Moraea – finally showed that, unlike almost all other raptors, they do not invariably return to traditional breeding grounds. Instead, when she left Lesotho in April 2011 and headed west, she briefly re-visited her old west coast breeding grounds in July and then turned around and flew back east to the Camdeboo mountains near Aberdeen, where she bred. At the time of writing, she is currently back in Lesotho having travelled over 5 800 km since she was first tagged in November 2010. A film – *The Secret Life of the Circler* – has been made of her early travels by Home Brew Films in Cape Town.

An investigation will be initiated in 2012 to determine the influence of climate on migration



Cat Simmons holds Moraea shortly before release with her satellite tag in November 2010. This bird has covered over 5 800 km in a year since her release in the West Coast National Park and has visited Lesotho twice in the summer months. (Photo Rob Simmons)

strategies and breeding. Both the move to Lesotho in summer and the higher breeding success apparent at the coast could be a result of cooler, more equitable temperatures relative to hotter inland environments. As such, this species could be an ideal candidate as a barometer for climate change underway in southern Africa.

Black Harriers as indicators of biodiversity?

CB MSc student Julia Jenkins has recently seen the fruits of her study on Black Harriers as indicators of biodiversity published in *Bird Conservation International*. She questioned whether harriers breeding in severely degraded Renosterveld in the Overberg wheat-growing area were indicative of generally high biodiversity in the remnant patches in which they bred. She assessed the density of small mammals and passerine birds, and also recorded plant richness in those patches used by breeding harriers and compared these with controls of similar size from which harriers were absent. Results indicated (non-significant) trends showing passerine abundance was three-fold higher in harrier-occupied patches and small mammal species diversity was also higher in these patches. Surprisingly, plant diversity showed no trends (although this may reflect the manner in which we sampled the plants). Thus, as has been shown for some raptors in Europe, there is some evidence that Black Harriers could act as a rapid-assessment proxy for overall biodiversity.

Mystery buzzards breeding in the Western Cape

Traditionally, the only *Buteo* buzzards known to breed in South Africa are the endemic Forest Buzzard *B. trizonatus* and the near-endemic Jackal Buzzard *B. rufofuscus*. The former, which is nowhere common, is a recent coloniser of the extreme west of the Western Cape from its core range along the Garden Route. Palearctic-breeding Steppe Buzzards *Buteo b. vulpinus* are common during the austral summer, migrating through the Middle East from breeding grounds in the Russian steppes. A fourth buzzard species, European Honey Buzzard *Pernis apivorus*, occurs as a rare summer visitor in the north-east of the country, although over the past 20 years, this species has become increasingly common in the extreme south west of the Western Cape, where there is some indirect evidence that it may occasionally breed.

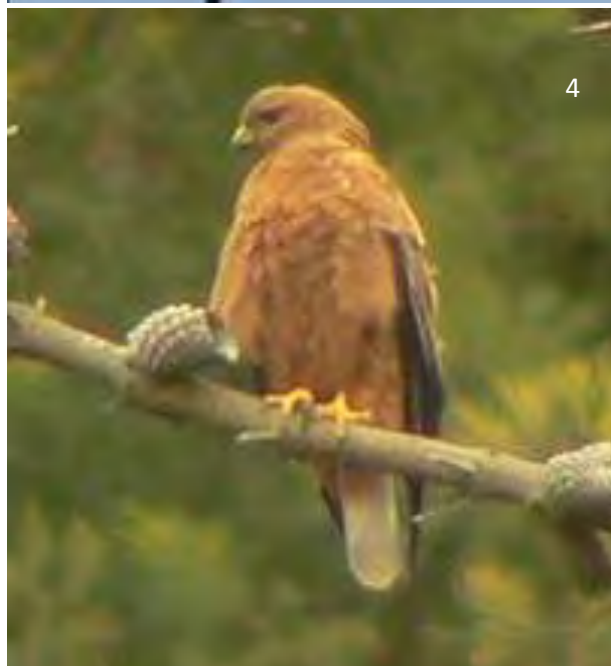
With reports of Steppe Buzzards breeding on the Cape Peninsula during the 1960s, and mysterious 'brown' buzzards breeding east of Swellendam in the 1980s, perhaps it should have come as no surprise when several pairs of 'Steppe' and 'brown' buzzards were found to be breeding in the Elgin Valley in the early 1990s, along with several, uniformly rufous buzzards.

Fast forward more than a decade to 2005 and the 'red buzzards' of Elgin are already well established, with several pairs of 'mystery' buzzards having also colonised the Cape Peninsula. 'Typical' Forest Buzzards are seen less often than in the past, and are apparently hybridising with the 'mystery' buzzards. This is where our investigation – spearheaded by MSc student Lisle Gwynn – began in earnest, with ecological data being collected, alongside blood samples wherever possible. Adult 'Mystery Buzzards' (unlike Steppe Buzzards) have proven notoriously difficult to trap. In order to obtain blood samples, therefore, we have been strongly reliant on sampling blood from chicks in accessible nests (some nests are unreachable without free-standing ladders of fire-engine proportions).

In 2006, a pair of 'brown' buzzards was found breeding on a cliff above Newlands Forest. Cliff nest sites have never been recorded as being used by Steppe Buzzards in their native breeding range, but are used frequently by both nominate Common Buzzards *Buteo b. buteo* and 'Ménétries's Buzzard' *B. b. menetriesi*, which breeds in the Caspian region. Closely related Long-legged Buzzards, of both the nominate



A selection of 'Mystery Buzzards' breeding in the south-western Cape that shows the range of phenotypes 'on offer' and thus the scale of the problem in trying to determine the identity of the coloniser(s). (Photos 1-3: Jessie Walton, 4: Ann Koeslag)



race *B. r. rufinus* and the smaller north African race *B. r. cirtensis*, also regularly use cliff nests. Curiouser and curiouser.

Although Steppe Buzzard does occur in 'foxy red' and 'blackish' morphs, it always shows some degree of barring on the underparts and has a variable, white crescent on the chest, forming a 'bib'. The underparts of some of the mystery buzzards of the Cape are entirely uniform, lacking any barring or a bib, with the darkest birds being brown or very deep rufous, never reaching the black extreme as occurs rarely in Steppe Buzzard (a morph very similar in appearance to the black morph of Wahlberg's Eagle *Aquila wahlbergi*). Furthermore, and relative to Steppe Buzzards, these uniform-morph buzzards are also longer winged, longer tailed, larger overall and have a different flight profile. They have an almost honey buzzard-like long neck, with an obvious broad, dark trailing edge to the secondaries. In many cases, the tail is almost unmarked, unlike the heavily barred tail of Steppe Buzzard and the broadly banded tail of honey buzzard. Still more curious (not least because unmarked tails are prevalent among Long-legged Buzzards)!

So what have we here? The birds could be Steppe Buzzards that have colonised the Cape unnoticed. This, however, does not account for the uniformly coloured 'mystery' buzzards, or the cliff-nesting behaviour, or the structural differences displayed by the uniform individuals.

They could be Ménétries's Buzzards. This subspecies is reportedly sedentary, or a short-distance migrant at best, but it fits the bill in many other ways. These include its shape, colour and cliff-nesting behaviour. In 1955, Mackworth-Praed and Grant claimed Ménétries's Buzzard to be a regular migrant to the Cape, "though not usually common". This claim had been made earlier by Rudebeck, so perhaps is not as unlikely as it seems. There are also a few specimens in South African museums that resemble Ménétries's Buzzard.

Or perhaps hybridisation with Forest Buzzard has occurred to such an extent that we are now seeing throw-backs to some earlier, ancestral form: in evolutionary terms, Forest Buzzard seems to be a fairly recent split on the family tree. As outlandish as this might sound, it may be possible. With the Old World *Buteo* buzzards ostensibly having diverged less than 400 000 years ago, there are likely no genetic barriers to hybridisation between species and

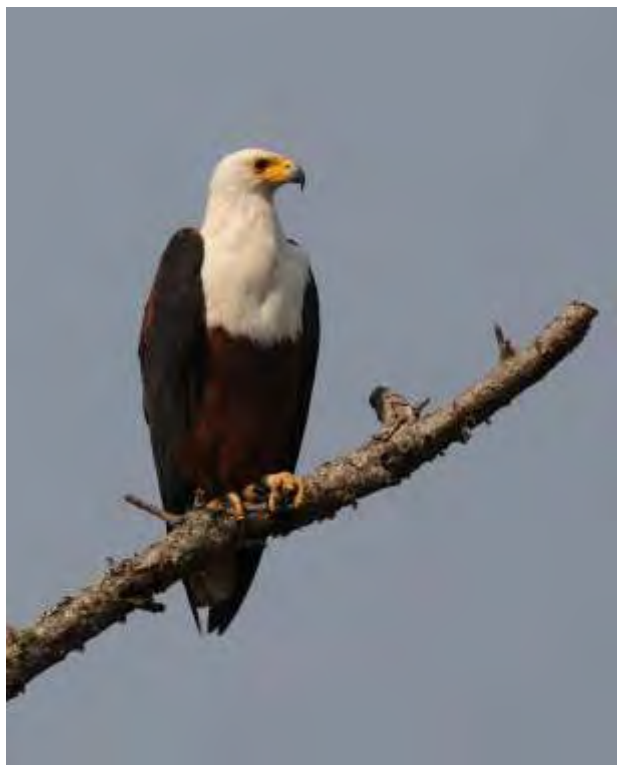
subspecies, and elsewhere hybridisation among buzzards is recorded frequently and widely.

Based on mathematical probability alone, it seems most likely that the colonists are Steppe Buzzards that have followed the example of Palearctic-breeding European Bee-eaters *Merops apiaster*, White Storks *Ciconia alba* and Leach's Storm-Petrels *Oceanodroma leucorhoa* that now breed in South Africa. It is also almost certain that a degree of hybridisation occurs between Forest Buzzard and these recent colonists.

In legal parlance, however, the evidence as to identity collected to date is circumstantial and contradictory. Phenotypically, some birds most closely resemble Steppe Buzzard, while others very closely resemble Ménétries's Buzzard or have the unbarred tail typical of Long-legged Buzzard. Occasional cliff-nesting fits with Common, Ménétries or Long-legged Buzzard, and the birds' hunting behaviour include harrier-like behaviour atypical of Steppe Buzzard. The question remains, then; what are these red and brown buzzards? If we are seeing colonisation by a single taxon, we may be able to get to the root of the problem, but if it is a two-taxon colonisation (e.g. by both Steppe Buzzard and Ménétries's Buzzard), the recent radiation of the entire *Buteo* genus is going to make this very difficult indeed. In collaboration with Centre of Excellence Core Team Member Rauri Bowie at UC Berkeley, and using a bank of blood collected since 2005, a micro-satellite investigation will be undertaken in 2012 to try and unravel the identity of these birds, and hopefully solve this long-running mystery.

Chemicals and flower farms – the Rift Valley Fish-Eagle Project

African Fish-Eagles are well known as indicators of chemical pollution of freshwater systems and, following on from a study on fish-eagles and pesticide uptake in South Africa, we initiated a second project on the same theme, this time on the fish-eagles at Kenya's Lake Naivasha in the Rift Valley. This collaboration between CB MSc student Masumi Gudka, Rob Simmons, Dr Munir Virani and Simon Thomsett of the Peregrine Fund, assessed the level of pesticides in fish-eagles, fish and water samples in two lakes in Kenya's Rift valley – Naivasha and Baringo. We wished to determine if the Lake Naivasha flower farms that export roses all over the world were adding significant amounts of pesticides to the lake and affecting the fish-eagles through their



Being top predators, African Fish-Eagles are appropriate monitors of pesticides and heavy metals in aquatic ecosystems (Photo: Peter Ryan)

prey. Blood samples taken from the eagles and their main fish prey, and both from water and their sediments, revealed a high incidence of Organochlorines (OCs) – persistent chemicals that can disrupt food chains.

Endrin and DDE were the most frequently detected chemical pollutants (in both lakes). As predicted, the levels found in fish-eagles were higher in territorial birds adjacent to the flower farms than those from elsewhere on Lake Naivasha and at Lake Baringo. Levels of several OCs were above Environmental Protection Agency guidelines and as such this source of contamination poses a threat not only to fish and fish-eagles in the lakes, but also to the customers of artisanal fishermen that eat contaminated fish. The main conclusion was that pesticide residues may not be high enough to affect the fish-eagles directly, but they could disrupt lower trophic levels and, with increased turbidity and increased alien weed infestation, the charismatic fish-eagles may be slowly edged out of Lake Naivasha.

Life and dinner: who wins the arms race?

Theory tells us that predators constantly exert selection pressure on their main prey, hunting them day after day, season after season. What

many naturalists fail to grasp is that the prey are also exerting pressure on their predators - by learning better and better ways of avoiding them. Thus, predators such as kites and harriers have to be finely tuned to the behaviour and activity of their small mammals prey or they will lose their dinner. However, because losing your life (as the one consumed) exerts a greater selection pressure than losing your dinner (as the consumer), mice should remain ahead in the arms race between predator and prey.

Honours student Kirsten Retief sought to determine if this was so in an ambitious project that simultaneously live-trapped mice and watched their predators attempting to capture them in the Jakkalsfontein Private Nature Reserve near Cape Town.

Kirsten trapped over 1 200 mice in three habitats in autumn, winter and spring and plotted their activity patterns throughout the day relative to the activity rhythms of hunting raptors. She found, as expected for the Life-Dinner Principle, that mice were more active in dense vegetation than in relatively open areas where they would have been more easily seen by the raptors. Small mammals also avoided peak periods of raptor foraging activity during winter at one site: the mouse activity was not linked to any climatic variables which could otherwise explain their behaviour. That they were indeed under strong selection pressure was illustrated by observations that most of the mice captured by hunting raptors fell prey when they were in the most open habitats.

Other studies have shown diurnal activity rhythms of Striped Mice *Rhabdomys pumilio*. By contrast, this study found no consistent rhythms and, unusually, the mice changed activity patterns between seasons. From this, we infer that the mice were deliberately randomising their activity patterns to prevent the raptors being able to predict when their prey would be most readily available. Thus, we suspect that the mice in this study area are winning the arms race on two fronts – where they are active and when they are active.

Wind farms and raptors

In 2010, energy-hungry South Africa embarked on developing its green energy sector and there are now applications (some already approved) for many wind- and solar-energy farms to be established across large tracts of the country, and also in Lesotho. An experimental wind farm



A Jackal Buzzard makes use of a lull in the wind to perch on one of the blades of the Darling Wind farm turbines (height: 81 m). Birds such as buzzards, eagles, bustards and cranes are thought to be very susceptible to wind farms, but few published data exist as to the extent of the problem in South Africa. (Photo: Rob Simmons)

at Darling, a short distance north of Cape Town, has just four working turbines, but literally thousands of other turbines are planned along the 'wind belt' which stretches all the way from northern Namaqualand south and east to Lesotho. While teams of consultants are collecting pre- and post-construction data on the potential effects of the wind farms on birds and bats, no published studies are available from any of them and thus the combined effects of turbines on South Africa's flying vertebrates is unknown. Honours students Kirsten Retief and Dave van Beuningen spent three days making some of the first observations of collision-prone bird species (most of which are large) at the Darling Wind farm and a control site close by. They recorded no fewer than 86 'at risk' birds flying in and over the wind farm and control site in 8.6 h (10 birds/h) of observation in September. These included red-listed species such as Martial Eagle *Polemaetus bellicosus*, Black Harrier *Circus maurus* and Great White Pelican *Pelecanus onocrotalus*. While these represent

high numbers of potentially collision-prone species at risk at this one tiny turbine array, the mortality rate of such species is as yet unknown (although we do know that bats are dying at the Darling facility). In both the United States and Europe, wind-energy farms have already resulted in several mass bird mortalities, especially of large, and sometimes threatened, raptors. Some of these have resulted in extremely expensive litigation going against the developers. Whilst wind-energy farms in South Africa are proceeding apace in response to the country's international commitment to reducing greenhouse gas emissions (which are high relative the human population size), the environmental friendliness of such farms is being increasingly questioned internationally. Not only are bird and bat collisions under the spotlight, but so too are the environmental costs of 'switching on' traditional energy-supply sources (such as gas-powered energy plants) at times when there is no wind. On top of this, the environmental costs of mining the element neodymium – the metal used in nacelle magnets – appear to be huge. The metal is mined mostly in China (where most of the nacelles are also built), and the collateral damage, especially in the form of wetland pollution, seems to be massive. South Africa's cavalier commitment to wind-energy power, and its fast-tracked implementation, thus sets us some very real challenges in trying to minimise the biodiversity consequences.

Long-term monitoring of raptors on the Cape Peninsula

Long-term banding studies of Peregrine Falcons and Rock Kestrels *Falco rupicolus* on the Cape Peninsula were extended into 2011. Now in its



Peregrines readily use elevated, man-made structures, such as these floodlights at a local sports stadium, to give them a height advantage when hunting. (Photo: Andrew Jenkins)

21st year, the Peregrine project has seen the Peregrine population of the Cape Peninsula grow at >5% per annum, from 8-10 pairs in 1989, to 47 pairs in 2009. For the last 12 years, Fitz Research Associate Dr Andrew Jenkins has focused on individually colour-ringing as many birds in the population as possible and following their fortunes, and the project is now starting to reap the benefits of this investment. With nearly 500 birds marked to date, some fascinating demographic secrets are starting to emerge as Res Altwegg, SANBI's biostatistics and modelling wizard, puts the data through their paces. We're hoping that 2012 will see some published results, with planned papers on basic demography, the relative influence of climate and urbanization/human subsidy on breeding success, and the source-sink relationship between rural and urban components of the population.



Cape Town's urban Peregrine population has been growing rapidly over the last quarter of a century. Today, the Cape Peninsula probably supports the highest breeding density of Peregrines in Africa, possibly in the world. (Photo: Andrew Jenkins)

... And further afield

Confined to Africa, and with a global population estimated at less than 500 pairs, the diminutive Taita Falcon is among the rarest and most elusive of the world's falcons. Although the population in Zimbabwe may be as large as 60 pairs, only fairly recently was a handful of pairs discovered to be breeding on the massive Drakensberg escarpment in South Africa. This population was surveyed in 2001 – shortly after its discovery - and again in 2011. A team led by Andrew Jenkins searched some 80 km of high cliff-lines looking for this spectacular little bird. The seven known nest sites were re-visited and six were still active in 2011. The seventh site had been usurped by a pair of Lanner Falcons *F. biarmicus*. No new pairs were discovered (although it is likely they exist), but the 2011 survey continues to highlight the importance of the escarpment as a global hot-spot for this hyper-rare species.

Key co-sponsors

BirdLife South Africa; Hawk Mountain Sanctuary (USA); Jakkalsfontein Private Nature Reserve; National Research Foundation; Natural Research Ltd (UK); The Peregrine Fund (USA); Steve Phelps and Peregrine Properties; Pick 'n Pay; Two Oceans Slope Soarers; University of Cape Town Research Committee.

Research team 2011

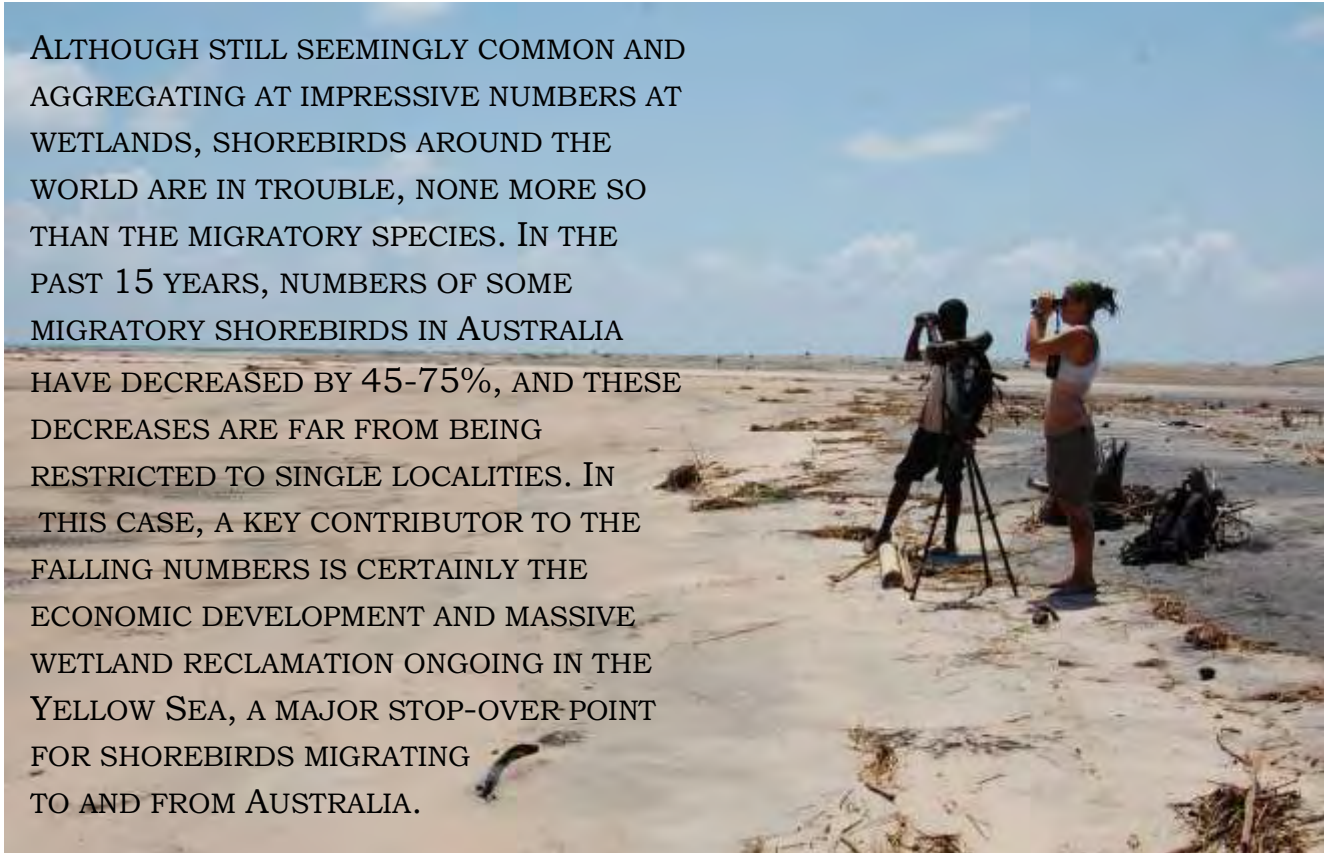
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Changing fortunes of Africa's shorebirds

ALTHOUGH STILL SEEMINGLY COMMON AND AGGREGATING AT IMPRESSIVE NUMBERS AT WETLANDS, SHOREBIRDS AROUND THE WORLD ARE IN TROUBLE, NONE MORE SO THAN THE MIGRATORY SPECIES. IN THE PAST 15 YEARS, NUMBERS OF SOME MIGRATORY SHOREBIRDS IN AUSTRALIA HAVE DECREASED BY 45-75%, AND THESE DECREASES ARE FAR FROM BEING RESTRICTED TO SINGLE LOCALITIES. IN THIS CASE, A KEY CONTRIBUTOR TO THE FALLING NUMBERS IS CERTAINLY THE ECONOMIC DEVELOPMENT AND MASSIVE WETLAND RECLAMATION ONGOING IN THE YELLOW SEA, A MAJOR STOP-OVER POINT FOR SHOREBIRDS MIGRATING TO AND FROM AUSTRALIA.



Kate England surveys shorebirds at Kenya's Sabaki estuary. (Photo: Beccy Johnson)

Most (but not all) of the shorebirds migrating into and out of southern Africa follow far less well-defined migration routes, moving in a more diffuse front once they cross the coast of north-east Africa. It seems that we are experiencing very much the same trends as Australia, but with a much less obvious door at which to lay the blame. We know about these trends because of monitoring effort, but more importantly it is incumbent upon us to try and explain these trends. South Africa is a signatory to many international conservation treaties and protocols, some of which specifically involve migratory species. We need to understand the source of the problem, in particular the degree to which we in Africa might be a contributing factor.

Migrant declines at Namibian hotspots – why?

Southern Africa's two premier wetlands – Walvis Bay and Sandwich Harbour – that together can hold 300 000 shorebirds – have now been monitored for more than 20 years. Given the parlous state of many of the world's shorebirds, the question arises as to the extent to which

environmental problems along the migration route might be contributing to population decreases.

In a collaboration between Holger Kolberg and Rod Braby (Ministry of Environment in Namibia), Rob Simmons (PFIAO), and Dr Birgit Erni (Statistical Sciences, UCT), long-term trends in numbers are being analysed using state-space models. Preliminary results confirm decreases in five of the 11 long-distance migrant shorebirds in the two wetlands (with Ruddy Turnstone *Arenaria interpres* and Little Stint *Calidris minuta* showing the largest decreases). However, in 20 years, overall numbers of shorebirds at Sandwich Harbour have almost tripled to over 100 000 birds. Numbers of resident shorebirds have all increased in number at Sandwich Harbour, and the same trends are apparent at Walvis Bay (the more polluted of the two wetlands). Both wetlands offer a fairly low diversity of prey for shorebirds, suggesting that environmental degradation is unlikely to explain falling numbers of long-distance migrants. We surmise that mortality factors elsewhere on migration or in the boreal breeding grounds,

possibly as a result of climate change, are a more likely cause of the global declines reported by Wetlands International.

Precious stones and endemic terns

Staying in Namibia, PhD student Justine Braby has completed her studies on Damara Terns *Sterna balaenarum*. This species breeds only on the coast of southern Africa, from southern Angola, through Namibia to the Eastern Cape, with by far the majority of the world's population breeding in Namibia. Justine was interested in whether the extensive diamond-mining activities on Namibia's coast were a cause of concern for this species, and concentrated her efforts in the desert coast's former 'forbidden area' the Sperrgebiet. This study, co-supervised with Les Underhill of the Animal Demography Unit, was initiated in 2007 at the request of the diamond mining company Namdeb to determine if initial research by Rob Simmons suggesting that diamond mining was detrimental to shorebird numbers was true for the *Near-threatened* Damara Tern.

Evidence from Justine's study of breeding and foraging success of terns at different localities in the Sperrgebiet suggests that Damara Tern numbers have increased in colonies at all four undisturbed sites. However, those at Elizabeth Bay, where mining has taken place since 1990, have dipped below the 1970s population estimates of 20 breeding pairs, to 4-13 breeding pairs. Sediment from the mining process is poured into the Bay, creating a murky foraging environment for the terns. As expected, foraging success in the sediment-filled bay was found to be significantly lower than at a nearby un-mined "control" site, and this could be responsible for the reduced breeding numbers at Elizabeth Bay. However, those pairs that did breed generally enjoyed good success and thus there was no clear link between breeding success and low foraging success. Thus it appeared that the Elizabeth Bay terns probably foraged elsewhere to compensate for the low visibility in the foraging grounds closest to their breeding sites.

Predation of eggs and chicks in the Sperrgebiet colonies was found to be the chief constraint on breeding success, and overall breeding success there was a mere 0.38 chicks per pair per year. Once fledged, chick survival improved and 59% of ringed chicks that fledged

from colonies on the central Namibian coast and the Sperrgebiet reached breeding age (3-4 years). Justine completed her study with a quick trip to West Africa where she not only found non-breeding Damara Terns in Nigeria, but remarkably photographed a bird that her mother had colour-ringed at Swakopmund in Namibia in 2003! This bird provides a link between Damara Terns in Namibia, where they are protected, to their non-breeding grounds in West Africa, where they are not.



Two ringed Damara Terns on a polluted beach on Nigeria's south coast in 2008. The yellow-ringed bird was ringed by Justine's mother, Sigi Braby, 4 000 km south in Namibia in 2003! (Photo: Justine Braby)

Changes among coastal shorebird communities in South Africa

In addition to those at major wetlands in Namibia, there are several initiatives underway in South Africa to monitor wetland bird communities, but the changes detected are confounded by alteration to the wetlands habitats themselves. Most wetlands are inherently variable systems, linked to inter-annual changes in rainfall, and they are subject to intense human drivers of change including development, water abstraction, etc. By comparison, the open coastline is a much more constant environment, subject mainly to changes in human disturbance. As a result, monitoring coastal bird communities offers a sensitive way to track changes in key bird groups such as migrant waders.

From the late 1970s to the early 1980s, the Western Cape Wader Study Group and the Fitz's John Cooper conducted synoptic counts of birds along most of the southern African coast. During the summer of 2010/11, 30 years after the original survey of this region, Peter Ryan



One of the few shorebird species whose numbers are on the up – African Black Oystercatchers. (Photo: Jessie Walton)

repeated counts along 275 km of coast in the Western Cape. Stretches of coast were selected to represent three regions (west coast, Cape Peninsula and south coast), and included both protected areas and open-access beaches. The aims of the survey were to determine whether changes in bird numbers had occurred and, if so, to try to understand the reason(s) for these changes (e.g. increased human disturbance). The 2010/11 surveys included counts of 58 km of coast that had been counted more than once in the 1970s/80s to confirm that any differences detected reflected medium-term changes rather than simply year-to-year variation.

The total number of coastal birds has not changed over the last three decades, but species richness has increased following invasion of the coast by Egyptian Geese *Alopochen aegyptiaca* and three species of ibises. Biomass increased due to greater numbers of large-bodied birds such as gulls. There were, however, dramatic decreases in migrant waders, with numbers of the four most abundant species falling by >50%, and the two common *Calidris* species (Sanderling *C. alba* and Curlew Sandpiper *C. ferruginea*) by >90%. Migrant wader populations decreased in all three regions, irrespective of whether surveys were in protected areas or not suggesting, as in Namibia, that factors outside the region are driving these trends. Some species may have decreased due to changes in their preferred wintering areas, but others probably

reflect population decreases, confirming the generally poor conservation status of migrant waterbirds worldwide. Further surveys of coastal birds around the southern African coast are needed to assess the spatial extent of the decreases in migrant shorebirds.

Among resident waders that breed along the coast, numbers of African Black Oystercatchers *Haematopus moquini* have doubled, linked to increased food availability following invasions by alien mussels, coupled with better overall coastal protection, including reduced dog activity on beaches during the breeding season and the off-road vehicle ban. By comparison, numbers of the much smaller White-fronted Plover *Charadrius marginatus* decreased by 37% (59% on the Cape Peninsula), at least in part as a result of increasing human disturbance. Their densities on the Cape Peninsula, where human disturbance is greatest, have decreased across the board, but more so on open-access beaches than in protected areas. On average, densities in protected areas have fallen by about 35%, and in open-access areas have fallen by 75%. Open-access areas now support barely one-third of the density of plovers found in protected sites.

Human – shorebird conflicts at a Kenyan wetland

Shorebirds face many obstacles on their migration from northern to southern hemisphere climes and one of those is increasing human use

of estuaries where they stop over to refuel.

MSc CB student Kate England focused on a well-monitored estuary on the Kenyan coast and asked (i) how much human disturbance do migrating shorebirds face on reaching the estuary; and (ii) how do humans make their living at the estuary and could the apparent conflicts be resolved. Kenya's Sabaki River estuary is an Important Bird Area where fishermen and cattle regularly disturb, but do not persecute, the migrants. The species most affected by these disturbances were flamingos and Terek Sandpipers *Xenus cinereus*. People from the nearby settlement use the estuary and surrounds as pasture, for fuel-wood and water collection: as many as 2 000 people are dependent on the estuary for their livelihood. Kate found that 96% of the foreign visitors to the estuary said they would be willing to pay to enter the area (and be guided), thereby providing a future means of income and protection for the resources that are presently heavily exploited.

Together with Phil Hockey, Kate used data from some disturbance experiments that she conducted to develop a novel technique for quantifying the relative susceptibility of different coastal birds to human disturbance.

This technique, based on one published recently by Phil Hockey and Odette Curtis in *Conservation Biology*, uses the concept of 'vulnerability space'. In the latter case, the technique was developed to assess extinction risk of species based on incomplete biological data. In the case of the Kenyan shorebirds, the technique was designed primarily as a rapid-assessment tool to be used on tropical wetlands where data are often few, as are the resources for making such vulnerability assessments.

Long-term study of African Black Oystercatchers

Movement patterns

The oystercatcher colour-ringing programme continues to document large-scale movements of young African Black Oystercatchers. However, the extent to which juvenile movements are genetically as opposed to environmentally determined remains unclear. The existence of age-based dominance hierarchies suggests that there may be an ecological component to the movement patterns of juvenile and non-breeding adult birds, with younger birds being forced further away from natal sites due to competitive exclusion by older birds. Because we have excellent data about the locations and sizes of



Counts along the Western Cape coast suggest that numbers of Sanderlings have decreased by more than 90% over the last three decades. (Photo Peter Ryan)

roosts on the southern African west coast, we are currently attempting to model this scenario and its consequences.

Understanding the extent to which movements of young oystercatchers are environmentally driven is not only of substantial scientific interest, but has important implications in assessing the impacts of future habitat change (including those precipitated by climate change) on the species' spatial population dynamics.

Although young birds do move over large distances (regularly >1500 km, with the record held by a bird that travelled from East London to Walvis Bay), natal site fidelity is very high. This can create problems for young birds trying to enter high-density populations, such as those at west coast islands, where we now know that some non-breeders are at least 10 years old, even though the birds are capable of breeding at 3-4 years. Recent ring-retrap data have indicated that a large proportion (>22%) of breeding birds on west coast islands are in excess of 20 years old, with the oldest known-age adult now at least 32 years old.

Island populations continue to remain stable. Theoretical models (based on the so-called Evolutionary Stable Strategy – ESS) suggest that this scenario is unlikely to change unless there is a significant change in habitat quality. Given the survival rates of juveniles and adults, for island-reared birds, models predict that they should continue to queue for high-quality territories on an island, rather than moving to the mainland to breed (even though they might be able to breed 4-5 years sooner on the mainland).

Oystercatcher conservation and a changing breeding syndrome

The African Black Oystercatcher's global population has increased by almost 50% over the past 25 years, from an estimated 4800 birds in the early 1980s to >6700 birds today. Given current trends it may well be possible in the near future to downgrade the species' IUCN status from *Near-threatened* to *Least Concern*. Both the presence of the alien mussel *Mytilus galloprovincialis* and improved protection have benefited the species. The primary way in which local breeding oystercatcher populations have increased (in response to improved habitat quality) is as a result of territory shrinkage of breeding pairs and a resultant influx of previously excluded, but sexually mature birds.

Ultimately, however, improved reproductive success must explain the overall increase. There are numerous reasons for this improvement in habitat quality. However, it appears that the response of oystercatchers may have gone beyond a simple increase in the number of young they are rearing successfully. In recent years, there has been a significant increase in the average clutch size of African Black Oystercatchers, driven primarily by an increase in the frequency of three-egg clutches (prior to the late 1970s, only two, three-egg clutches had ever been recorded).

Research into this changing breeding syndrome is ongoing. At this stage, we have not proven that a) the increase in three-egg clutches is due to increased reproductive effort and not to some other phenomena such as an increased frequency of egg-dumping or the emergence of polygynous trios (both phenomena have been recorded in other oystercatcher species, although rarely); and (b) if three-egg clutches do represent an increase in female reproductive effort, whether this translates into an increased production of young. The substantial increase in the proportion of three-egg clutches appears to be occurring largely in areas invaded by the alien mussel, *Mytilus galloprovincialis*, suggesting that larger clutches are linked to an improved food supply. The question of whether there has been a long-term, resource-driven change in the breeding syndrome of African Black Oystercatchers is of considerable scientific interest since it has apparently never been recorded for any shorebird species. During 2012/2013, these questions will be addressed by a new MSc student, Dane Paijmans.

Key co-sponsors

A Rocha (Kenya); Namdeb Diamond Mining Company (Namibia); Namibian Ministry of Environment and Tourism; National Research Foundation; University of Cape Town Research Committee.

Research team 2011

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Using seabirds and endemic landbirds as flagships to conserve oceanic islands

ISLANDS, ESPECIALLY THOSE THAT HAVE NEVER BEEN CONNECTED TO ONE OF THE CONTINENTAL LANDMASSES, HOLD A DISPROPORTIONATELY LARGE AMOUNT OF TERRESTRIAL BIO-DIVERSITY, YET ARE AMONG THE MOST SENSITIVE OF TERRESTRIAL ECOSYSTEMS. THE ARRIVAL OF MAN AND HIS COMMENSALS HAS HAD CATASTROPHIC IMPACTS ON ISLAND BIOTAS: MORE THAN 90% OF MODERN AVIAN EXTINCTIONS HAVE BEEN OF ISLAND BIRDS. WHERE ISLAND ECOSYSTEMS REMAIN REASONABLY INTACT, THEY ARE VULNERABLE TO NEW INTRODUCTIONS, REQUIRING STRICT CONTROL OF THE IMPORT OF PEOPLE AND MATERIALS. ISLANDS ARE KEY BREEDING SITES FOR SEABIRDS AND MANY ISLANDS SUPPORT ENDEMIC LANDBIRDS. THESE BIRDS CAN ACT AS FLAGSHIPS FOR THE CONSERVATION-MANAGEMENT AND RESTORATION OF ISLAND ECOSYSTEMS.

In the mid-Atlantic

The main focus of this research is at Tristan da Cunha and Gough Island, British Overseas Territories in the mid-Atlantic Ocean. The research is conducted in collaboration with Richard Cuthbert from the UK's Royal Society for the Protection of Birds. Two restoration projects are underway at Gough Island, one to control and, hopefully, eventually to eradicate the invasive plant, Procumbent Pearlwort *Sagina procumbens*, and one to eradicate introduced House Mice *Mus musculus*. *Sagina* has also greatly transformed habitats at South Africa's Prince Edward Islands, and every effort is being made to prevent it from spreading away from the base area on Gough Island. Mice are significant predators of seabird chicks on Gough Island, regularly killing large numbers of chicks up to 1 000 times their size. As a result, many seabird populations have decreased alarmingly in recent years.



TOP: Peter Ryan removing an a New Zealand Flax *Phormium tenax* plant found outside the species' known range on Inaccessible Island. (Photo: Martim Melo)

BELOW: A healthy Island Tree *Phyllica arborea* branch showing abundant fruits. Plants attacked by scale insects and associated fungal infestations support fewer fruit, potentially threatening the large-billed buntings that rely on these fruits for food. (Photo: Peter Ryan)

Progress on both projects at Gough was set back in 2011 when both field assistants sent to the island in September 2010 were forced to return to South Africa for medical reasons. Fortunately we were able to get Nic le Maitre to the island in their stead, but with only one person on the island, less work than anticipated was completed. The work force was returned to full strength in September 2011, when Karen Bourgeois and Sylvain Dromzee replaced Nic on the island. The takeover team was led by John Cooper and veteran field assistant Henk Louw, and ably assisted by rope-access technicians Jan Bradley and Rouberre Botha. Rope-access skills are needed to tackle *Sagina* growing on the island's sea cliffs, and Jan and Rouberre played a key role in training the new field team.

Attempts to rid Gough Island of mice have largely been put on hold, pending developments elsewhere. The attempted eradication of rabbits, rats and mice from Australia's Macquarie Island went ahead in 2011 (after an attempt in 2010 was abandoned due to poor weather). Initial reports suggest that the attempt has been extremely successful, but it will take some years before we can be confident that all introduced mammals were killed. If it is successful for mice, it will greatly increase our confidence that an eradication attempt on Gough should succeed, because Macquarie is even larger than Gough Island (to date, the largest island which has been successfully cleared of mice is an order of magnitude smaller than Gough). However, Richard Cuthbert was able to gain first-hand experience of a rodent eradication when he went to Henderson Island in the South Pacific from July-September 2011. His main task was to assist with capture of the island's endemic rails prior to a poison bait drop targeting introduced rats. A minimum of 80 rails had to be captured and held in cages to prevent them being poisoned during the exercise. A similar exercise would be necessary for the moorhens and buntings on Gough, so this proved invaluable experience.

Problems at Inaccessible Island

During September and October 2011, Peter Ryan visited Inaccessible Island in the Tristan group with Fitz Research Associate Martim Melo (CIBIO, Portugal) and PhD student Martin Stervander (Lund, Sweden). The main purpose of the visit was to study further the island's diverse bunting population (see *Evolution and Systematics* section), but several conservation actions also were undertaken. The upland areas were checked for invasive New Zealand Flax *Phormium tenax*. Only a few plants were found, including one outlier well outside the species' known range on the island. Fortunately this individual did not appear to have flowered (despite being very large). All plants were removed, and we are confident that the species is now almost entirely confined to the cliffs adjacent to the Waterfall. More good news is that the three large patches of Jointed Rush *Juncus effusus* near the hut at Blenden Hall had all died following spraying with herbicide in 2009. There was no evidence of regrowth or regeneration from seedlings. There was also no sign of any *Sporobolus africana* at the hut, but it is early in the season, and checks later in the summer are needed to confirm that eradication efforts targetting this species have been successful.

More worrying is the impact of an introduced scale insect *Coccus hesperidum*, a widespread

horticultural pest, and associated black mould infestations discovered on Island Trees *Phyllica arborea* at Wilkins' Copse, Blenden Hall, in 2009. These pathogens have been present at Tristan since at least 1999. Searches in 2011 found the scale insect and associated moulds on Berry Bush *Empetrum rubrum* and two ferns, the Bog Fern *Blechnum palmiforme* and the Seven Weeks Fern *Rumohra adiantiforme*. Currently, infestations are largely confined to the western scarp, up to 300 m elevation, but we also found two areas of infested Bog Fern, Berry Bush and a few affected Island Trees at 160 m on Harold's Plain on the other side of the island. These pathogens appear to impact Island Tree fruit production, with potentially worrying long-term implications for the large-billed Dunn's Buntings *Nesospiza acunhae dunnei* on Inaccessible Island. It was noticeable that Dunn's Buntings, which specialise on the fruits of the Island Tree, have become more scarce at Wilkins' Copse over the last decade. Strict quarantine measures are needed to prevent trees on Nightingale Island being infected, because that is the only place where the *Endangered*, large-billed Wilkins' Bunting *Nesospiza wilkinsi* occurs, with a total population of only a few hundred individuals.

Impact of the project

This is a largely applied project. If successful, the eradication of mice from Gough will have immense benefits for the long-term conservation status of the island and its biota, including two endemic landbirds and the once vast seabird populations. Our research over the last decade has been instrumental in changing the perception that mice are relatively innocuous to bird faunas on oceanic islands.

Key co-sponsors

Agreement on the Conservation of Albatrosses and Petrels; BirdLife International; Centre of Excellence for Invasion Biology (Stellenbosch); Royal Society for the Protection of Birds; South African National Antarctic Programme; UK Overseas Territories Environment Programme.

Research team 2011

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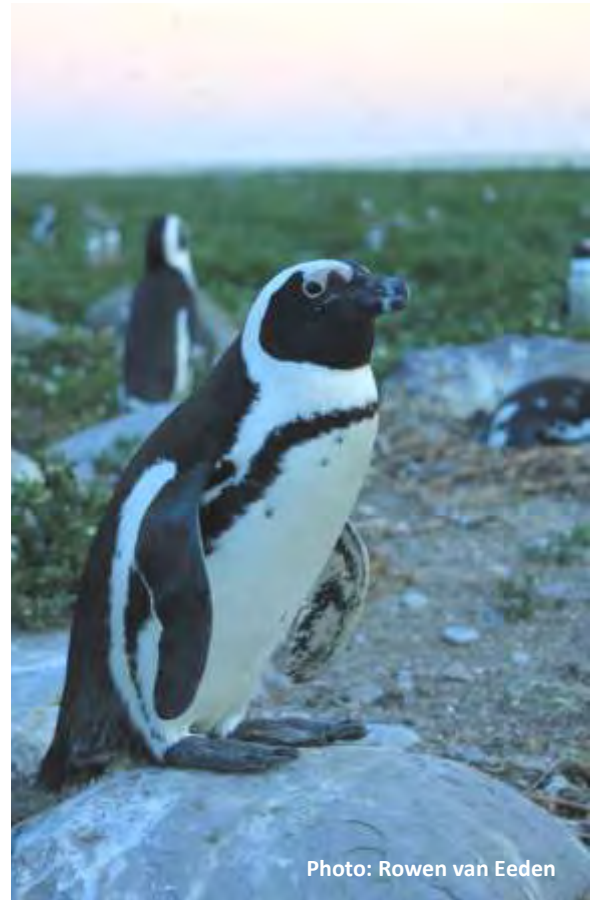
Seabird Conservation

SEABIRDS ARE AMONG THE MOST THREATENED GROUPS OF BIRDS. ALMOST ONE-THIRD OF ALL SEABIRDS ARE ON THE GLOBAL RED LIST, AND SEABIRDS DOMINATE THE LIST OF GLOBALLY THREATENED SPECIES IN SOUTHERN AFRICA. ONE OF THE REASONS WHY THEY ARE SO VULNERABLE TO HUMAN ACTIVITIES IS THAT THEY FACE THREATS BOTH AT THEIR BREEDING SITES AND AT SEA. THE FITZ'S SEABIRD RESEARCH PROGRAMME HAS A STRONG APPLIED FOCUS, ASSESSING THE SEVERITY OF THREATS FACED BY SEABIRDS, AND ATTEMPTING TO PROVIDE PRACTICAL MANAGEMENT SOLUTIONS TO REDUCE THESE THREATS. LAND-BASED THREATS ARE COVERED MAINLY IN THE SECTION ON ISLAND CONSERVATION (P. 58). AT SEA, THE MAIN THREATS COME FROM FISHERIES, WHICH EITHER COMPETE WITH SEABIRDS FOR FOOD OR KILL BIRDS DURING FISHING OPERATIONS.

Competition with fisheries

The Benguela ecosystem off the west coast of southern Africa is one of the world's major upwelling zones. Cold, nutrient-rich bottom water rises to the surface where it warms and its nutrients support blooms of large-celled phytoplankton. These tiny plants form the basis of a short, efficient food chain leading through zooplankton to small pelagic fish, dominated by Anchovies *Engraulis capensis* and Sardines *Sardinops sagax*. In turn, these small fish support a host of predators, including a wide diversity of seabirds and the largest fishery (by mass) in South Africa.

Of the seven seabirds endemic to the Benguela, three species rely heavily on anchovies and sardines: African Penguins *Spheniscus demersus* (*Endangered*), Cape Gannets *Morus capensis* (*Vulnerable*) and Cape Cormorants *Phalacrocorax capensis* (*Near-threatened*). African Penguins eat almost exclusively small pelagic fish, but Cape gannets also scavenge



discards and offal from fishing boats, and Cape Cormorants can forage inshore on a range of small, bottom-dwelling (benthic) fish species. Numbers of all three seabird species have decreased over the last few decades, linked in part to increased predation by Cape Fur Seals *Arctocephalus pusillus* and other predators. However, the greatest threat they face appears to be a reduction in the availability of their preferred prey. Namibia proves a salutary lesson; overfishing in the northern Benguela during the 1970s resulted in the collapse of pelagic fish stocks, and a regime shift to a system dominated by jellyfish and other gelatinous zooplankton. Seabird populations collapsed and, like the fish stocks on which they depend, show no signs of recovery.

South Africa's southern Benguela was more fortunate, with fish stocks recovering during the 1980s and 1990s following heavy fishing pressure in the 1960s and early 1970s. However, since the mid-1990s, pelagic fish have

shifted from the west coast to the south coast. This is bad news for seabirds and the purse-seine fishery alike, because they are tied to land-based breeding and processing plants, respectively. The fishery either has to ship fish hundreds of kilometres to west coast processing plants, or invest in new processing plants closer to the fishing grounds. The birds are even worse off, because there are no safe, predator-free breeding islands between Cape Agulhas and Port Elizabeth.

African Penguins

Given their relatively small foraging range when breeding and their almost total reliance on small pelagic fish, penguins have suffered most. The breeding population of African Penguins has more than halved since 2004. To assess the impacts of competition with the purse-seine fishery for food, experimental fishing closures took place within 20 km of key penguin colonies on Dassen Island (from 2008) and St Croix Island (from 2009). Post-doctoral Fellow Lorien Pichegru has been using GPS and depth loggers to compare the foraging effort of penguins breeding at St Croix and adjacent Bird Island each year since 2008, before fishing ceased around St Croix. The closure had an immediate impact on the birds from St Croix, but subsequent study has shown that 20 km is probably too small a radius to meet the penguins' needs. The situation at St Croix was exacerbated in the second year of the closure by fishing vessels concentrating their efforts right along the edge of the closed area. Despite this, penguins still fared better than prior to the closure. Honours student Ben Dilley investigated the link between adult foraging effort and chick growth rate on Bird Island over four years and discovered that despite increasing foraging effort over the years, chick growth was maintained. However, this came at the cost of reduced body condition; the weights of breeding adults have decreased consistently throughout the study.

The findings for African penguins are clear cut; their numbers are decreasing rapidly, and they are struggling to find enough food for themselves and their chicks. The real gap in our understanding centres around the behaviour and movement of pelagic fish. How mobile are these fish? If they move over large areas, then making small reserves around penguin colonies may have no benefit in the long run. And how do

fish movements change in response to fishing pressure by humans and other predators such as penguins? Lorien, together with Lloyd Edwards of Raggy Charters, has equipped a skiboat to map the distribution of fish schools and follow their movements using hydro-acoustics. The plan in 2011 was to track fish distributions in and around Nelson Mandela Bay while recording where penguins and the pelagic fishery operate, but several delays (including the tsunami in Japan, which delayed delivery of the sonar unit) forced the project to be postponed to 2012. Nevertheless, monthly surveys documenting the abundance and distribution of small pelagic fish around St Croix and Bird Island started at the end of 2011. In 2012, a new recruit to the seabird team, PhD student Alistair McInnes, will relate the at-sea distribution of penguins with the location of their prey, to determine how penguins respond to prey movement. He will also investigate if purse-seine fishing boats modify prey abundance and behaviour.



Lorien aboard the new research vessel in Nelson Mandela Bay, against the backdrop of a vivid bloom of phytoplankton forming a 'red tide' (Photo Lloyd Edwards)

In the interim, MSc student Rowen van Eeden has been examining where in the water column Bird Island penguins direct their foraging effort. The GPS-dive loggers he is using to do this also record water temperature. He first compared the temperature records from the penguins' deepest dives with data from three, fixed, temperature arrays in the area to demonstrate that penguins make good oceanographers. He then showed how the vertical structure of Nelson Mandela Bay varies over time, particularly with respect to the depth of the surface mixed layer, and assessed how penguins respond to these changes. Cold upwelling events stratify the water column, forming strong thermoclines. Under these

conditions, penguins concentrate their foraging dives below the thermocline. But when strong winds create deep mixed layers, penguins feed equally throughout the water column.

We have also analysed photographs of penguin feeding groups taken over the last decade by Lloyd Edwards. Rory Wilson, ex-Fitz PhD student and long-time affiliate, reported how adult penguins often hunt cooperatively, using their bold, black-and-white striped plumage to herd their fish prey into dense schools or 'bait balls'. However, he concluded that penguins hunted in fairly small groups, because groups larger than around 20 birds couldn't synchronise their dives. Lloyd's photographs clearly show that more than 100 penguins may encircle bait balls, and that synchronised diving was not a prerequisite for group foraging. If group foraging does enhance the rate of prey capture, the dwindling penguin populations may suffer from an Allee effect (a negative feed-back of rarity) as colonies become too small to support sufficient densities of birds for large-enough foraging groups to form.

Even though insufficient food is probably the main problem faced by penguins, predation by Kelp Gulls *Larus dominicanus* on penguin eggs and chicks exacerbates the problems they face. Gull numbers have increased due to human food subsidies, and their impact on the dwindling penguin populations is disproportionately large. In order to increase penguin productivity, rangers from SANParks culled most Kelp Gulls on Bird Island. Lorient compared the breeding success of penguins breeding in surface nests

and in artificial burrows before and after the gulls were removed. She found that adding artificial nests and removing gulls both improved penguin chick survival, but even after the gulls had been culled, chick survival was lower in surface nests than in artificial nests, suggesting a major impact of weather on chick mortality. The success of artificial nests varied depending on their design, but appropriately designed artificial nests can enhance African penguin breeding success by shielding them from predation and extreme weather events. Where artificial nests can't be deployed, controlling Kelp Gulls at penguin breeding colonies does enhance breeding success, and it is also likely to benefit non-burrowing seabirds, such as Cape Cormorants, Cape Gannets and Roseate Terns *Sterna dougallii*, which are also of conservation concern.

Cape Gannets

Gannet work continued at the two largest colonies: Malgas Island in the West Coast National Park, and Bird Island in the Greater Addo National Park. Post-doctoral Fellow Emilie Tew-Kai from the CNRS, France, tracked breeding gannets from Malgas Island in 2011 for the tenth successive year. Gannets were feeding mainly on large sardines, showing further evidence of some recovery in pelagic fish stocks off the west coast. By matching fine-scale gannet tracks with Vessel Monitoring System data from the hake trawler fleet, Emilie demonstrated when tracked birds were following fishing vessels. She showed that Cape Gannets depend on fishery wastes when their natural prey are scarce, but revert to feeding on their natural prey whenever they are available. This supports research by Christina Moseley for her CB MSc in 2010 that feeding on energy-poor fishery discards had no long-term effect on adult gannet body *condition*. However, evidence of decreased adult *survival* in areas with low availability of natural prey is worrying, and close monitoring of seabird populations trends and foraging behaviour as well as fish abundance and fishing effort is necessary to get to the root of understand the reasons for the decrease in west coast gannet numbers.

At Bird Island in Nelson Mandela Bay, NMMU Masters student Gavin Rishworth set up an automated VHF monitoring system to capture detailed information on nest attendance patterns in Cape Gannets. Small (<5 g) VHF transmitters attached to PVC leg bands signal when birds are



Lloyd Edwards's observations and photographs show that African Penguins sometimes feed in much larger co-operative groups than was thought to be the case, raising the spectre of an Allee effect reducing foraging efficiency as their populations continue to dwindle. (Photo: Lloyd Edwards)

present in the colony. Currently some 40 birds (20 pairs) are being tracked. The data are logged automatically by a solar powered receiver and are downloaded monthly. They will be used to assess temporal variations in visitation to the colony, including accurate measures of incubation shifts and provisioning rates, as well as to assess individual variation in time-activity budgets. Large seabirds such as gannets generally have flexible time-activity budgets, implying substantial variability in parameters associated with foraging that provide a rapid indication of how food availability is changing. The gannets also have large foraging ranges, so they effectively 'monitor' prey availability over large areas of ocean. The rate of food provisioning to chicks is thus a useful indicator of prey availability within a substantial area around the colony. A similar VHF monitoring system at Malgas Island would greatly strengthen conclusions reached and facilitate a better understanding of the behaviour and life-history variability of this species, given the divergent population trends of these two colonies.

Also at Bird Island, honours student David Green (NMMU) studied the effect of breeding location (colony edge or interior) on the breeding behaviour of Cape Gannets. During brooding, 'interior' birds spent longer at the nest and made shorter foraging trips than birds breeding on the colony edge. This has implications for current tracking studies, which primarily sample birds around the edges of colonies to reduce disturbance to the birds. Chick growth and breeding success was also lower at the colony edge than in the colony interior. During 2011, David also started collecting data for his MSc, starting in 2012, that will study long-term (decadal) changes in gannet diet at Bird Island, as well as tracking their current foraging distributions.

And cormorants...

Post-doctoral Fellow Tim Cook has been working on the foraging ecology of Cape Cormorants, continuing Maïke Hamann's pioneering study comparing the foraging ranges and diving behaviour of birds from colonies around Saldanha Bay on the west coast with those of birds from Dyer Island on the south coast. Tim has added three further years of data to Maïke's study and has shown that Cape Cormorants are proving to be versatile predators, foraging from close inshore to offshore waters up to 300 m

deep, diving 1-40 m deep. While provisioning small chicks, they travel up to 50 km from their colonies. Tim published a paper exploring the frequency, shape and purpose of benthic and pelagic dives in this species. Ultimately Tim wants to link differences in foraging effort of cormorants from different colonies to local oceanographic parameters and estimates of pelagic fish biomass, to better understand the key factors driving population changes in this species. Tim also has managed to obtain some additional diving information on the small, inshore-feeding Crowned Cormorant *Microcarbo coronatus*. During her PhD research on Malgas Island, Lorien Pichegru managed to deploy accelerometers on three birds at Malgas Island, but the sample size was too small to warrant analysing the data at that stage. By augmenting this data set, Tim will produce the first detailed description of the diving behaviour for a member of this, the smallest genus of cormorants. As expected, most dives are shallow and extend to the sea bed, but some dives reach 20 m. The results confirm that this species is dependent on shallow, inshore ecosystems.

Attempts to work on the foraging ecology of the *Endangered* Bank Cormorant *Phalacrocorax neglectus* at Robben Island have so far proved fruitless due to the sensitivity of this species to



The Bank Cormorant is the subject of a new research programme run jointly with the Animal Demography Unit. (Photo: Peter Ryan)



Honours student Kyran Wright and MSc student Rowen van Eeden adrift in Nelson Mandela Bay. Kyran's paper showing that African Penguins respond to the smell of dimethyl sulphide (DMS), a compound released when zooplankton and small fish graze on phytoplankton, was published in the *Journal of Experimental Biology* in 2011. (Photo: Lloyd Edwards)

disturbance. However, an application for an NRF Sea Change grant co-written by Tim and Dr Richard Sherley from the ADU at UCT has provided funding for the next three years for two MSc and/or PhD students. Each student will address one of the two main hypotheses proposed to explain recent decreases in Bank Cormorant numbers: heat-stress during breeding and changes in the prey base (especially reductions in Cape Rock Lobster *Jasus lalandii*).

Accidental fishing mortality

The other major impact that fisheries have on seabirds is through direct mortality, typically when birds get entangled by fishing gear. This problem occurs mainly in fisheries operating farther offshore than the purse-seine fishery, and is most serious for non-breeding migrants to southern African waters. Two main fisheries are involved. Long-line fisheries kill birds that either swallow baited hooks or get entangled in the lines, whereas the demersal trawl fisheries entangle seabirds on their warps or in their nets. Much of the work combating these problems is being conducted by NGOs, notably BirdLife International through its Albatross Task Force

and WWF-South Africa through its Sustainable Seafood Initiative.

For the long-line fishery, the main contribution of the Fitz during 2011 has been to continue to conduct autopsies on all dead birds returned to port. Together with Paul Scofield from Canterbury Museum in New Zealand, Peter Ryan has also been tasked by BirdLife International to assist the Japanese to identify seabirds killed by their high-seas, long-line fishery. In 2012, Dominic Rollinson will join the Fitz as a PhD student investigating the factors affecting seabird bycatch by joint-venture vessels targetting tunas and Swordfish *Xiphias gladius* in southern African waters. Thanks to the presence of fishery observers on all vessels, we have a huge data set spanning the last five years, with detailed information on all birds caught. Dominic will also be involved in field trials of a new device designed to expose baits and hooks only once they reach a pre-determined depth, beyond the reach of most seabirds.

In terms of trawlers, the fishery for hakes *Merluccius* spp. is the main concern. The fishery has a strong incentive to reduce its bird bycatch, as this is a threat to its Marine Stewardship Council (MSC) rating, which came up for review

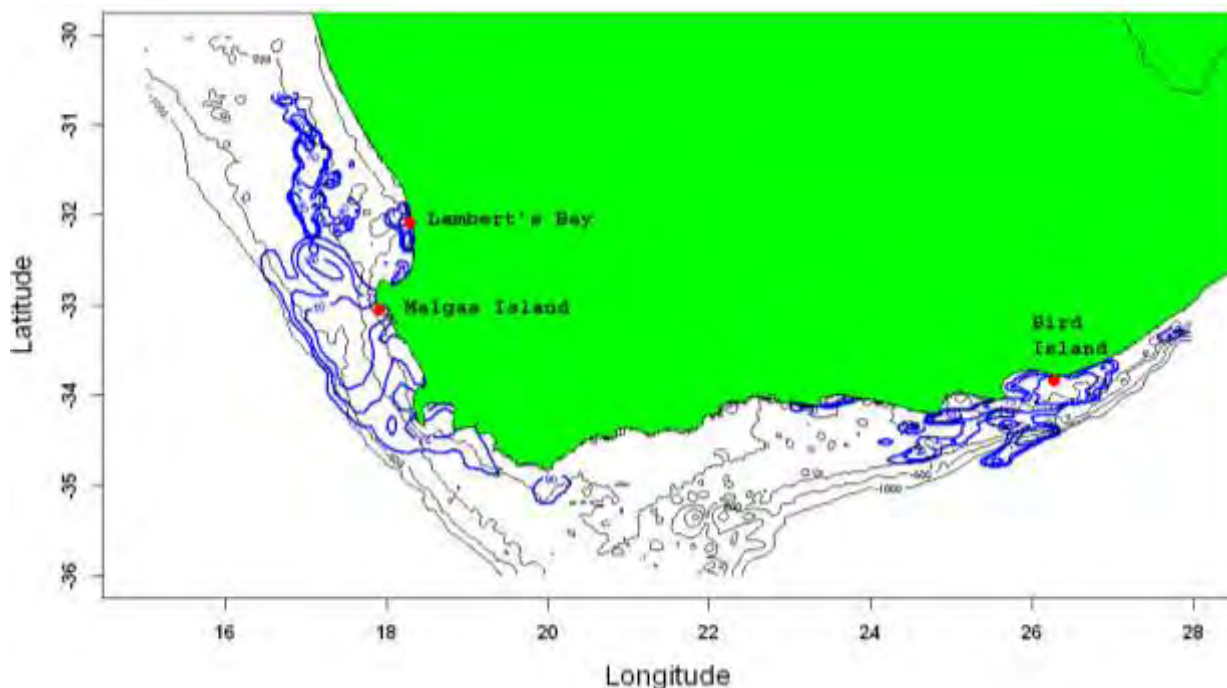
in 2011. The Fitz provided input to this process, and the rating was renewed, pending further efforts to reduce seabird bycatch. Barrie Rose was contracted to assess the feasibility of offal management as a mitigation measure (stopping discarding while fishing gear is in the water is the best long-term solution to the problem). Unfortunately, he concluded that most vessels cannot readily be converted to hold their discards, although this should be made a requirement for any new vessels entering the fishery. The 'sticky warp' problem, identified by Albatross Task Force observers in 2010, has been solved by asking warp suppliers to use a much less viscous lubricant on new cables, and the industry will try to schedule warp replacements in summer, when there are few Pintado Petrels *Daption capense* (the species most often affected by sticky warps) on the fishing grounds.

Finally, MSc CB student Ed Rice worked with the Albatross Task Force to test a device designed to augment bird-scaring lines in keeping birds away from the danger areas where trawl warps enter the water. Termed the Rory Line, it is a line of streamers attached to a solid boom off the side of the ship behind the scuppers where wastes are discarded. It appears to be particularly effective in reducing

mortalities of White-chinned Petrels *Procellaria aequinoctialis* and shearwaters, which is good news, as these were the species for which bird-scaring lines were least effective. Hopefully a combination of Rory Lines and bird-scaring lines will reduce seabird mortality to levels where they no longer threaten albatross and petrel populations.

Tracking birds at sea

Managing seabird-fishery interactions requires an understanding of the at-sea distributions of seabirds, resulting in numerous studies tracking seabird movements using satellite transmitters or archival geolocator (GLS) tags. Post-doctoral Fellow Tim Reid is working with a diversity of tracking data sets to identify important foraging areas for seabirds. He has summarised tracking data for Cape Gannets, African Penguins and Cape Cormorants in the Benguela region, and a draft proposal to recognise Marine IBAs (Important Bird Areas) for gannets is under review. He has also worked on tracking data for three species of albatrosses and petrels breeding at Tristan and Gough Island in the Atlantic. We intend to publish these individually, then put them together with data for two more species of albatross and petrel to identify key foraging areas around these important seabird breeding



Most regular areas used for foraging by breeding Cape Gannets tracked from the three colonies in South Africa, used in identifying marine Important Bird Areas. Blue lines are 50%, 75% and 90% utilization contours (i.e. 50% of foraging occurs within the 50% contour), black lines show depth contours. Data on gannets were collected by attaching GPS loggers to individual birds between 2002 and 2009. (Image: Tim Reid)



The survey of White-chinned Petrels breeding at South Africa's Prince Edward Islands was finally completed thanks to a follow-up visit to Prince Edward Island in March 2011. PhD student Genevieve Jones, who was part of the team that counted the population on Marion Island, led the count on Prince Edward. (Photo: Peter Ryan)

islands. At the same time, we continue to add to the suite of species that have been tracked, with data for Subantarctic Skuas *Catharacta antarctica* from both Marion and Gough Islands, as well as Atlantic Petrels *Pterodroma incerta*, Great Shearwaters *Puffinus gravis* and Broad-billed Prions *Pachyptila vittata* at Gough Island.

Another way to infer seabird movements relies on the ratios of naturally occurring stable isotopes (SIs) in seabird tissues. The SI ratios of carbon and nitrogen provide information on the diet and broad latitudinal position of marine organisms, integrated over varying temporal scales depending on the turnover rates of the tissue sampled. Feathers are particularly useful because they fix the SI ratios at the time the feather is grown during moult. We can infer where a bird breeding at a given site was when it moulted, and by sampling multiple feathers, whether it moved significantly during its moult period. PhD student Viviane Barquete Costa has used this approach to better understand the post-breeding dispersal of White-chinned Petrels. This is particularly important because White-chinned Petrels breed at islands around the Southern Ocean where they are the seabird killed most frequently by fishing gear. In order to assess the likely impacts of fishing mortality on different populations, we need to know which birds are affected by different regional fisheries.

Genetic work by former PhD student Mareile Techow has already shown that White-chinned Petrels from the New Zealand sub-Antarctic are quite distinct, and that they are rarely, if ever killed by fisheries in the Atlantic or Indian

Oceans. However, genetic markers couldn't discriminate between birds from the large colonies on South Georgia and those at islands in the south-west Indian Ocean. SI data can help here, because feathers of adults breeding in different ocean basins have different SI signals. Working with bycatch birds, Viviane was able to show that adult White-chinned Petrels undertake their moult on their wintering grounds. She used this finding to show that birds breeding at South Georgia winter in coastal waters around South America, while those breeding at islands in the south-west Indian Ocean spend the winter off southern Africa. Coupled with recent population estimates of all populations in the Atlantic and Indian Ocean sectors of the Southern Ocean, we can now estimate the impact of specific fisheries on these populations.

And seabird research on Marion Island

Long-term monitoring of various albatrosses and petrels continues on Marion Island, supported by year-round field assistants employed through the South African National Antarctic Programme. Genevieve Jones, who has spent a total of three years on the island, completed her PhD on the factors determining individual variation in Wandering Albatross *Diomedea exulans* breeding success, graduating in December 2011. She is currently writing up papers from her thesis for publication. Mia Cerfonteyn returned from a year on Marion Island in May 2011 and has been slaving away writing up her MSc on the factors underpinning the apparent decrease in the island's Subantarctic Skua population. She was replaced on Marion by Otto Whitehead, who has been collecting data for an MSc comparing the foraging ecologies of the two *Eudyptes* penguins that breed on the island - Macaroni Penguin *E. chrysolophus* and Southern Rockhopper Penguin *E. chrysocome*. He has found that although their foraging ranges are tiny while feeding small chicks, during the incubation and crèche stages, adults routinely range up to 450 km from the island, with Macaroni Penguins mainly heading south-south-west to forage over the Conrad Rise (an area where they are abundant after moulting in April-May). Otto was joined on Marion in 2011/12 by new Post-doctoral Fellow Maelle Connan. Maelle's PhD research in France used fatty acid analyses to investigate the foraging ecology of selected

Southern Ocean petrels. Ironically, she didn't actually visit the Southern Ocean until after she completed her degree and took up a post-doctoral position at Rhodes University, working with Prof. Christopher McQuaid. In 2011, she was funded jointly by the Fitz Centre of Excellence and an NRF post-doctoral grant to Prof. McQuaid. On Marion, Maelle is assisting with the long-term monitoring of albatrosses and giant petrels, while also continuing her research into the comparative foraging ecology of the two sooty albatrosses *Phoebastria* spp., as well as several species of burrowing petrels.

And finally, some encouraging news on the Marion front was that towards the end of 2011 the NRF finally put out a call for new research projects under the South African National Antarctic Programme. Both bird projects on the island (one led by Peter Ryan of the Fitz, and one by Dr Rob Crawford from Oceans and Coasts, Department of Environmental Affairs) lapsed in May 2010, and only basic monitoring was funded as an interim measure to prevent gaps in long-term data series. Two new projects have been submitted. One, led by Peter Ryan, asks why burrowing petrel numbers have failed to recover in the 20 years after the removal of cats from the island. The other, led by Rob Crawford and Dr Pierre Pistorius (Centre of Excellence-funded team member based at NMMU), focuses on the comparative foraging ecology of the two *Eudyptes* penguins, because the numbers of both species have decreased in recent years. We shall



MSc student Mia Cerfonteyn has confirmed that numbers of Subantarctic Skuas on Marion Island have declined over the last two decades. And despite the eradication of feral cats in 1990, burrowing petrels have not increased in abundance in their diets, suggesting that burrowing petrel numbers have not recovered since the cats were killed off. (Photo: Peter Ryan)

only hear whether these projects receive funding later in 2012, but Otto Whitehead has already made a start on the penguin project. And Ben Dilley will tackle the burrowing petrel project for his MSc when he returns to Marion in April 2012. We are fortunate to have arranged for Mike Schramm, a former Fitz student, to accompany Ben on the relief voyage to Marion. Mike conducted research for his MSc on the burrowing petrels of Marion Island in the late 1970s, and will be able to make sure that Ben repeats his burrow density transects as accurately as possible. It will be fascinating to hear Mike's impressions of how the island has changed, as he hasn't been there for more than 30 years.

Key co-sponsors

BirdLife International; BirdLife South Africa; Charl van der Merwe Foundation; CNRS; European Union; Plastics Federation of South Africa; Raggycharters Whale Watching; Royal Society for the Protection of Birds; South African National Antarctic Programme; UK Overseas Territory Environment Programme.

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Students: Viviane Barquete Costa (PhD), Genevieve Jones (PhD), Gavin Rishworth (MSc, NMMU), Mia Cerfonteyn (MSc), Rowen van Eeden (MSc), Edward Rice (MSc CB), Ben Dilley (BSc Hons), David Green (BSc Hons, NMMU)

Research assistants on Marion Island: Mia Cerfonteyn (2010/11), Otto Whitehead (2011/12)

Endangered species research in Angola and the Gulf of Guinea



Michael Mills assists in the planting of forest tree seedlings at Mount Moco in a last-ditch attempt to save this dwindling forest and its threatened birds. (Photo: Catherine MacMahon)

Conserving Angola's forest birds – more diplomacy than science?

During 2011, Angolan bird conservation and research moved into its third year and progressed well. Michael Mills made three, month-long visits to the country to carry out various field activities and to build further support for the work. He spent most of February in and around Luanda, focusing on building local support for the ongoing work. He delivered a talk entitled “Angolan bird conservation and research: working towards a secure future for Angola’s most threatened birds” to the Angola Field Group in Luanda. This was well attended, mostly by expats from the oil industry. He also delivered a short follow-up talk on the Mount Moco project to scholars of the Luanda International School, and thanked them for their fund-raising effort for the Vesto stoves. These fuel-efficient stoves will be distributed to the

community of Kanjonde during 2012, as a first step to alleviate their impacts on the forest habitats of the mountain. Finally, Michael led a field outing for the Angola Field Group during which he found the *Endangered* Braun’s Bushshrike *Laniarius brauni* at a new locality, which constitutes a range extension.

In April/May, Michael spent a week as part of a biodiversity survey team led by Brian Huntley to Lagoa Carumbo, a little-known Important Bird Area in the north-east of the country. This was carried out in collaboration with the Ministry of the Environment, and afforded Michael the opportunity to meet some of the ministry employees. During the field trip he made several significant finds, including the first South African Cliff-Swallow *Pterodelichon spilodera* for Angola, a previously unknown population of Black-chinned Weaver *Ploceus nigricornis*, and the second to seventh records of Long-toed Flufftail

Sarothrura lugens for Angola. After the Carumbo field trip Michael visited his two main conservation project sites at Mount Moco and Kumbira Forest. At Moco the tree seedlings planted in July 2010 were looking healthy, and plans for expanding the nursery were discussed with the local chief, who was happy to provide land for these purposes. At Kumbira, as the final activity of a Conservation Leadership Programme-funded project, Michael and co-workers distributed educational materials to schools and villages in the Kumbira valley, as a small initial step to promoting awareness of forest conservation in the area. They visited two communities in the valley with schools. At each village they addressed the soba (chief) about their project. Angolan botanist and project leader Francisco Gonçalves addressed adults of the community about the importance of forest conservation and taking care of the environment, while a local teacher spoke to the children. The team distributed pamphlets to adults and children, those for the latter to be used in school classes. Finally, back in Luanda, Michael delivered a talk on various Angolan ornithological activities to the United States Embassy.

During the final month of field work (in October), Michael spent a week conducting surveys in the northern scarp forests, as part of an ongoing project to understand bird distributions in this region, especially the distribution of Braun's Bush-shrike. A second aim was to follow up on the population of olivebacks *Nesocharis* sp. Michael had discovered while leading a bird tour in August. Although he managed to relocate them, he failed to capture any, so there is still some uncertainty as to their identity. Then a return visit to Mount Moco enabled further maintenance work on the nursery, including the control of a spider infestation that was causing leaf curl, and most significantly, the experimental planting of the first ten trees from the nursery back onto the mountain. This concluded in-country activities for 2011.

Other out-of-country activities included Michael attending an AEWA workshop in Maun, Botswana, as the Angolan expert, to produce a Slaty Egret *Egretta vinaceigula* conservation plan; and attending the annual BirdLife South Africa staff meeting where he delivered a short presentation on his Angolan work; he also gave a 45-minute talk "Bird Conservation and Research

in Angola" to the Cape Bird Club in Cape Town.

In 2012 the work will continue with the support of APLORI and under the auspices of BirdLife South Africa. Main aims for the year are to procure a project vehicle to be stationed in Luanda; to construct a new nursery facility at Kanjonde/Mount Moco; to maintain the current nursery at Kanjonde; to assess the success of initial tree planting done in October 2011; to plant 30 new trees at the commencement of the next rainy season; to secure funding for 2013 field work; to conduct further field surveys in the northern scarp forests, specifically on Braun's Bush-shrike; to deliver a shipment of 80 Vesto fuel efficient stoves to Kanjonde; to organise and run a week-long bird training workshop at Kissama National Park for a select group of Angolan students and field rangers of Kissama National Park; and to continue to engage various Angolan individuals and organization in our work.

Rare Gulf of Guinea endemics – conservation and hard science

The São Tomé Grosbeak *Neospiza concolor* is one of the rarest birds in the world. Three were collected between 1888 and 1890, then no more were seen and the species was thought to be extinct until it was rediscovered in a remote forest in south west São Tomé Island in 1991. Almost nothing is known about its ecology, distribution or population size. Intriguingly, the grosbeak also offers an unparalleled case study into evolutionary processes as it represents the best-documented case of sympatric speciation in birds – the emergence of two new species without geographic separation. The opportunity to understand this process may be running out however, as the grosbeak is *Critically Endangered* and is threatened by ongoing habitat loss.

During six weeks in July and August 2011, a team led by Martim Melo carried out systematic field surveys of the known and likely range of the São Tomé Grosbeak. The team included researchers from CIBIO in Portugal, the Fitz and Lund University, Sweden, as well as members of the local conservation group. The primary objectives of the survey was to assess the distribution, population size and conservation status of the São Tomé Grosbeak in order to formulate conservation recommendations relevant to the local NGO charged with protecting this species. However, we also

wanted to gain insights into the ecological processes underpinning its sympatric speciation from the Príncipe Seed eater *Serinus rufo-brunneus* by determining differences in their habitat preferences and ecology. There are three populations of seed eaters: one on São Tomé, one on Príncipe, and one on Boné, a small islet off the coast of Príncipe. Genetic evidence indicates that the São Tomé Grosbeak evolved from the São Tomé population of seed eaters, possibly after they split from the other island populations.

We concentrated our efforts in the less-visited island interior. Although we walked more than 100 km of transects through the forests, only one new locality was found for the species (three individuals observed probably in the area where the first individual was collected in 1888). We did confirm a new locality (the first and only in the highlands, discovered by members of the Monte Pico Association in 2010), and capture one individual (in the same place where two others were captured in 2005). This capture allowed us to collect an extremely valuable sample for genetic analyses (bringing the total number of samples to four). The transects also provided important data about the other least-known São Tomé endemics, including the *Critically Endangered* Dwarf Olive

Ibis *Bostrychia bocagei* and São Tomé Fiscal *Lanius newtoni*, and the *Vulnerable* São Tomé Short-tail *Amaurocichla bocagei*.

During the trip we also visited Príncipe Island and the associated, small Boné Islet where the two other populations of Príncipe Seed eater occur. We were successful in collecting blood samples necessary for next-generation sequencing techniques from all three seed eater populations. During 2012, genomic analyses will hopefully reveal more about the speciation of these range-restricted species (together with the parallel case of the Tristan buntings, p.13).

Key co-sponsors

A. P. Leventis Ornithological Research Institute; The Conservation Leadership Programme; CGG Veritas; Julian Francis; The Rufford Foundation (Angola); National Geographic Society (São Tomé).

Research team 2011

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Dr Martim Melo (CIBIO, Portugal)
Dr Bengt Hansson (Lund, Sweden)
Assoc. Prof. Peter Ryan (PFIAO)
Francisco Gonçalves (Instituto Superior da Ciências e Educação, Lubango, Angola)

Student: Martin Stervander (PhD, Lund)

Research assistants: Sendi Baptista, Aimy Cáceres, August Hansson, Michael Rogerson, Alexandre Vaz



Martin Stervander, Martim Melo and Peter Ryan process birds mist-netted on Boné, a small islet off the coast of Príncipe. (Photo: Alexandre Vaz)



Large birds, such as cranes, are thought to be particularly at risk from collisions with wind turbines. (Photo: Peter Ryan)

CONSERVING BIODIVERSITY – GLOBAL CHANGE

WHILST THE CONSERVATION OF RARE SPECIES IS TO SOME DEGREE REACTIVE, STUDIES OF THE CONSERVATION ISSUES RELATED TO GLOBAL CHANGE, ESPECIALLY CLIMATE CHANGE, ARE MORE PROACTIVE IN NATURE. WE KNOW THAT THE WORLD'S CLIMATE IS CHANGING: WE ALSO KNOW THAT MANY SPECIES, BIRDS INCLUDED, ARE ALREADY RESPONDING TO THESE CHANGES. THE KEY CHALLENGE IS PREDICTING HOW THESE NASCENT BIOLOGICAL CHANGES WILL MANIFEST THEMSELVES IN THE FUTURE IN TERMS OF CHANGING BIOLOGICAL COMMUNITIES AND WHAT THE BIGGER RAMIFICATIONS OF THESE CHANGES MIGHT BE. MUCH CLIMATE-CHANGE RESEARCH HAS REMAINED THE DOMAIN OF MODELLERS, BUT THERE HAS ALSO BEEN MUCH BIOLOGICAL DOCUMENTATION OF CHANGE, ESPECIALLY RANGE CHANGES OF SPECIES. HOWEVER, WHAT IS LACKING IS A GOOD UNDERSTANDING OF THE MECHANISMS THAT LEAD TO SUCH CHANGES. THE FITZ IS CONTRIBUTING TO FILLING THIS NICHE AND BUILDING THE BRIDGE BETWEEN MODELLING AND EMPIRICISM.

Ducks, dispersal and disease

Understanding the movement ecology and epidemiology of southern Africa's waterfowl and their pathogens

Movement is fundamental to many ecological questions and theories. It is a dominant theme in evolution and biogeography, in community ecology, and in conservation and management. With support from recent advances in tracking and computing technologies, movement ecology has now come into its own as an independent field of study. Our rapidly improving understanding of movement ecology has not, however, fully bridged the many gaps to other related areas of enquiry. For example, the interactions between internal elements of movement (e.g. navigation capacity or site fidelity) and biogeographic patterns are largely unexplored; the ways in which individual movements translate to population- and species-level distribution patterns at different scales remain unclear; and the links between animal movement and the spread of pathogens and parasites are poorly understood.

Southern African waterfowl, with their high movement capabilities and semi-nomadic lifestyles, provide an intriguing test case for understanding poorly known elements of movement ecology and their relationships to other bodies of ecological theory. Waterfowl movements are enigmatic. Despite decades of often intensive ringing and counting efforts, relatively little is known about the causes and consequences of the long-distance movements of most southern African ducks. Movement patterns are diverse and extensive; for instance, Red-billed Teals *Anas erythrorhynchos* ringed at Barberspan, in the North West Province (roughly mid-way between Kimberley and Mahikeng), have been recaptured as far north as Tanzania and as far south as Cape Town. Equally intriguingly, anecdotal accounts from bird hunters and amateur ornithologists suggest that huge influxes of some of our most mobile ducks, including Knob-billed Ducks *Sarkidiornis melanotos* and teals, may occur in certain places and at certain times of year. However, it has been difficult to pin down these movements with any certainty and their transient nature means that they are often not captured by monitoring efforts such as the biannual Africa Waterfowl Census.



White-breasted Cormorants nesting at Paarl Wastewater Treatment Works. The Fitz is currently undertaking an extensive review of breeding records for water birds, including data capture from nest cards from seven other African countries. (Photo: Graeme Cumming)

Uncertainties over the exact nature and frequency of waterbird movements create difficulties for waterfowl conservation and management, human health care, and veterinary scientists with an interest in the health of South Africa's poultry stocks. Many seemingly simple questions are currently unanswerable. For example: if populations of some of our ducks were declining (as has been proposed for African Pygmy Geese *Nettapus auritus* and Maccoa Ducks *Oxyura maccoa*), would we know, and would we be able to prove it? How strong a regional decline can we currently detect? What would be the impact on aquatic and riparian ecosystems if duck abundance greatly increased or decreased, or particular kinds of species were lost? And if a virulent pathogen such as highly pathogenic avian influenza (H5N1) were to enter southern Africa, how far and how fast could wild birds carry it? Were the recent outbreaks of the fatal H5N2 avian influenza in ostrich farms in the Cape caused by inadequate precautions

relating to the movements of domestic poultry, or by strains of the virus that were transported by wild Egyptian Geese *Alopochen aegyptiaca*? And just how worried should people be that H5N1 has made its way south as far as Kenya?

Since 2007 the Fitz has been working on improving our fundamental understanding of the movement ecology of waterfowl and the epidemiology of their pathogens. Our approach has been to pursue several different lines of enquiry in the hopes of finding complementary strands of evidence that together will create a solid understanding of both waterfowl and pathogen dynamics. The primary strands of empirical evidence at our disposal include ringing recoveries, count and atlas data, satellite telemetry data, data on dietary composition from feather isotope ratios, population genetics, and information on avian parasite and pathogen composition and phylogenetics. It should in theory be possible to use these kinds of data, individually and together, to provide rigorous tests of competing hypotheses that explain when, where, and why ducks move.

History of the research programme

The Fitz, in partnership with the Onderstepoort Veterinary Institute (OVI), Cirad (the French Centre de Coopération Internationale en Recherche Agronomique pour le Développement) and the Wildlife Conservation Society, led the implementation of the southern African component of the USAID-funded GAINS (Global Avian Influenza Network for Surveillance) initiative. The field component of this intensive two-year project ran from 2007 to 2009. It included regional data collection on the distributions and movements of ducks and the prevalence of avian influenza viruses in wild duck populations in five sites spread across South Africa (Strandfontein in the Cape and Barberspan), Botswana (Lake Ngami), Mozambique (Lake Chuali and a single mission to Massingir Dam) and Zimbabwe (Lakes Chivero and Manyame, both in the Manyame River catchment, near Harare). The primary aims of the project were twofold: first, to document the prevalence of influenza viruses (including but not limited to H5 strains) and malaria parasites in wild duck populations in southern Africa; and second, to obtain a better understanding of the regional movement patterns of wild waterbirds.

During the two years of the project we conducted over 2 500 standardized point counts

and collected samples from nearly 5 000 water-associated birds. Samples included blood, feathers, photographs, cloacal and tracheal swabs, and a full range of morphological data. We also measured water quality at each point count site during each mission and attached a total of 44 satellite GPS transmitters to Red-Billed Teal and Egyptian Geese at our three core sites (Strandfontein, Barberspan and Manyame).

From the original 44 transmitters, two are still working and returning good data and two more have been recovered and are ready to redeploy. Several Egyptian Geese have now been tracked for over three years, with GPS fixes every four hours during the day yielding a rich and accurate account of their movements.



Graeme Cumming holds a satellite-tagged Red-billed Teal at Strandfontein. Our tracking data suggest that most of the teal that moult at Strandfontein remain in the Cape throughout the year. (Photo: Dominic Henry)

Student projects

The GAINS funding provided support for several Fitz students, and the data and equipment obtained through the GAINS funds have provided a nucleus of resources that have contributed usefully to ongoing projects supported mainly by the Centre of Excellence. Student involvement has proceeded in several complementary directions.

Zimbabwean students Gregory Mutumi and Mduduzi Ndlovu were both heavily involved in the field component of the GAINS project. Greg submitted his MSc thesis in 2010 and graduated in June 2011. His project focused on trying to understand and interpret the isotope signatures of feather samples from ducks collected at each of our five sites. Because ducks undergo a complete and synchronous moult of their wing feathers, Greg was able to compare freshly grown feathers (which we could be sure were

grown on site) with body feathers, which would have been grown at feeding and breeding sites. We were interested in learning (1) whether different study sites, each over a thousand kilometres apart, had different isotopic signatures; (2) what the level of variation in feather isotopes was between different seasons from the same site; and (3) whether we could detect any consistent evidence for dietary convergence or dietary differences from feather isotopes. In theory, grazing ducks such as Egyptian Geese should have different carbon and nitrogen signatures from dabbling ducks because of differences in the ratio of C3:C4 plants in their diets; and ducks which feed primarily on benthic invertebrates, and hence occur higher in the food chain, should have enhanced levels of heavy nitrogen. Greg's results suggest that although consistent inferences about movement may be drawn from isotope ratios for some species, there is a considerable amount of variability by site, season and population within freshly grown wing feathers. The technique thus appears less useful for movement analysis than we had hoped, although Greg's results do suggest that it may be possible to use nitrogen signatures to distinguish birds that forage in coastal areas (e.g. Strandfontein and Rietvlei) from birds that forage purely in freshwater systems.

Mduduzi upgraded his project at the start of 2010 to a doctoral study and is due to submit his thesis in 2012. His first thesis paper, on the timing of moult in Egyptian Geese, has already been published in the *Journal of Avian Biology*. The results suggest that Egyptian Geese show an unexpectedly high level of phenotypic plasticity, redistributing body mass between organs and flight muscles in a way that differs from the standard northern hemisphere model. Our best guess as to why they should do this is that it probably permits them to fly earlier after wing-feather moult, allowing them to escape drying wetlands, return to foraging sooner, and avoid predation more effectively. Mduduzi has found different moult patterns in some other species (including the other local tadornid, the South African Shelduck *Tadorna cana*) and is currently working on a follow-up paper in which he relates foraging style to the physiology of moult. He has also been exploring the influence of seasonality and rainfall on the timing of moult; and more recently, moult and daily movement patterns from our satellite-tagged ducks.



Mduduzi Ndlovu prepares to measure the wing length of an Egyptian Goose. Mduduzi is close to completing his PhD thesis on movement and moult in Egyptian Geese. (Photo: Graeme Cumming)

While Greg and Mduduzi have both undertaken projects on the fundamentals of waterbird ecology, Sharon Okanga and Felix Nchu have been working directly on pathogens. Sharon's doctoral project is focusing on avian malaria in the Western Cape, exploring the influence of landscape location (and particularly, in relation to an urban-rural gradient) on levels of avian influenza in passerines living near small wetlands. She sampled and counted birds at 25 different sites in 2010 and 2011 and has collected over 900 blood samples from passerines. These are currently being tested for malaria using PCR and will provide the backbone of her PhD thesis. Sharon won the PARSA award for the best student presentation at the joint ZSSA/PARSA meeting in Stellenbosch. She should complete her thesis in 2012 and we look forward to being able to report next year on what look to be some exciting results.

Felix left us in late 2011 to move to a full-time position at the Cape Peninsula University of Technology. His post-doctoral project focused on avian malaria. He will continue some of his research by writing a paper on the prevalence of avian malaria parasites and the relationship between environmental variables and parasite abundance in the Western Cape.

Two new additions to the research group in 2011 were Dominic Henry and Christine Moore.



Farmed ostriches share feeding troughs with passerines in Oudtshoorn. The ostrich industry in Oudtshoorn is still recovering from a major outbreak of highly pathogenic H5N2 avian influenza that resulted in the culling of thousands of ostriches and costs of millions of rand to the government and ostrich farmers. Research has demonstrated that passerines (such as those pictured here) may act as vectors of avian influenza. The Fitz has been working with state vet Dr. John Grewar and the Ostrich Business Chamber to explore how ostrich translocations between farms may be relevant to the spread of avian influenza. In collaboration with Dr Celia Abolnik of OVI, we plan to launch a project in 2012 that will explore the movements and potential involvement of wild birds in avian influenza epidemics. (Photo: Graeme Cumming)

Dominic is working in close collaboration with Ezemvelo-KZN Parks on an MSc thesis on the habitat choices and movements of waterfowl in Kwazulu-Natal, focusing in particular on the area between Richards Bay and Kosi Bay. This region remains a significant 'unknown' in our understanding of waterfowl movements and we hope that Dominic's project will help us to understand how it fits in to waterfowl movements across the rest of the subregion. Christine is a CB MSc student who is working on ostrich translocation data from Oudtshoorn, with a view to understanding how the movements of ostriches may affect the potential spread of avian influenza viruses and their transmission to (and receipt from) communities of wild birds.

Main findings

We are gradually making progress in converting our rich data sets into peer-reviewed publications. Our main findings to date include the following:

- The prevalence of avian influenza in southern African waterbirds is relatively low, at around 2.5%. From our stock of 5 000 samples we found just 125 birds with avian influenza. There is however considerable spatial and temporal variation in influenza prevalence, with highest levels

in Zimbabwe, where prevalence reached as high as 24% during one sampling mission.

- There is no detectable influence of the annual influx of Palearctic-breeding migrants on avian influenza prevalence in southern Africa. Influenza viruses appear to be in circulation within local waterbird populations in the subregion throughout the year.
- The prevalence of avian influenza among passerines is considerably higher than in European birds, and we obtained unexpected positives from longclaws and sparrowlarks. Interestingly, recent results from passerines tested in the USA show a similar trend.
- Egyptian Geese may not be the lazy suburbanites that we often picture them as, with many of our satellite-tracked birds from Barberspan travelling around 1000 km, to and from their moulting site. One bird flew from Barberspan to a wetland near East London in two days. By contrast, birds in the Cape tended to stay in the winter-rainfall region and Zimbabwean birds mainly moved from the Manyame catchment north to the Zambezi Valley and back.
- Egyptian Geese show substantial flexibility in moulting behaviours and physiology, but this flexibility is not mirrored in the closely related South African Shelduck.
- Many Egyptian Geese appear to be highly faithful to their moulting site and very precise in the timing of their flightless moult. For instance, we recaptured one satellite-tagged bird at the same location in Strandfontein, 364 days after first tagging it.
- The prevalence of avian malaria in typical southern African populations of water-associated birds appears to be close to 12% in passerines and possibly higher in waterfowl (nearer to 16%, based on preliminary results). We currently have little idea whether or how avian malaria may influence bird behaviours and survivorship, nor whether synergies exist between malaria and infectious zoonoses such as influenza, Newcastle Disease, or West Nile.
- The movements of Egyptian Geese appear to have a strong internal component. In other words, they may be moving in ways that are dictated more by long-term selective pressures and evolved behaviours than by current environmental variation.

Collaborations and future directions

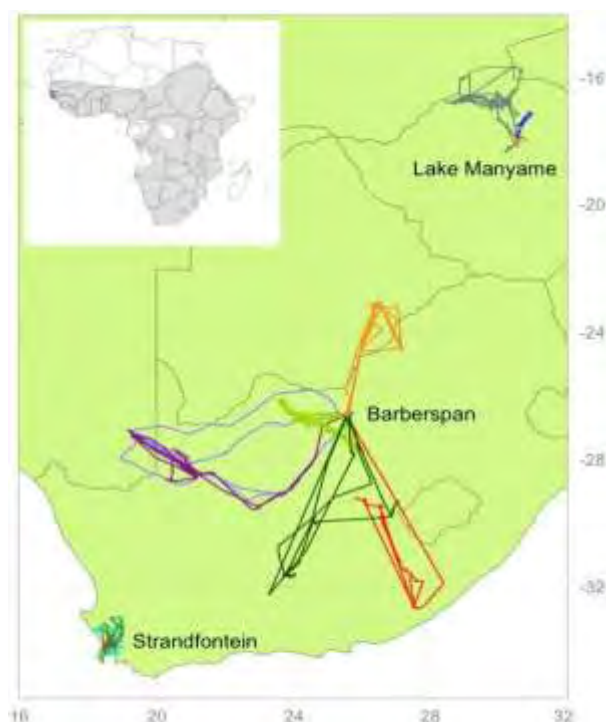
As the scope and depth of our research on waterbirds and their pathogens has expanded, the programme has developed several active and interesting collaborations. We have worked actively with OVI since the inception of the programme and Celia Abolnik at OVI has tested many of our samples for pathogens, as well as leading a paper on the phylogenetics of avian influenza viruses in southern Africa.

Graeme continues to work intensively with the animal health and disease group (AGIR) of Cirad, the French Agricultural Development Agency, particularly Alexandre Caron, Nicolas Gaidet, Daniel Corn  lis, and Julien Cappelle. Alex oversaw sampling efforts at the Zimbabwean site and has already either led or contributed to three co-authored papers on avian influenza. Nicolas has been coordinating Cirad's bird sampling programme for avian influenza in other areas of Africa and has included our data in a larger, synthetic analysis of environmental influences on avian influenza. Graeme worked with Daniel on developing and testing a new approach to comparing home range metrics and acted as an external examiner for Julien Cappelle's PhD thesis. We have also been interacting over a publication that will use shared data sets to explore environmental influences on the prevalence of Newcastle Disease. These collaborations have yielded several published papers and another two that are (hopefully) almost through the review process following revisions.

In the USA, Jeff Peters (Wright State University, Ohio) has been analysing the genetics of our avian blood samples as well as testing for malaria, typing different strains, and developing phylogenies of malaria parasites in the same samples. Preliminary results are interesting, suggesting a) that several species of southern African ducks may have passed through a genetic bottleneck in relatively recent times; and b) that the prevalence of avian malaria in our samples will be high enough for us to explore some interesting hypotheses that will link our point-count data to the richness and abundance of malaria strains.

Looking forward, we envisage that the waterbird work will continue to produce high quality outputs and tackle interesting questions. As we gradually explore the importance of movement and waterbird community composition for pathogens and parasites, we hope to

move beyond the initial descriptive stages of research and more deeply into testing fundamental ecological hypotheses in this fascinating area of research.



The movement paths of Egyptian Geese, tracked by satellite telemetry from three moulting sites over the period 2007-2011, show clear evidence of differences in movement patterns between different sites. This analysis is currently in press with the *Journal of Biogeography*. The inset shows the African range of the Egyptian Goose. (Image: Graeme Cumming)

Key co-sponsors

National Research Foundation; University of Cape Town Research Committee.

Research team 2011

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Asst. Prof. Jeffrey Peters (Wright State University, Ohio, USA)

Dr Celia Abolnik (Onderstepoort Veterinary Institute)

Dr Alexandre Caron (Cirad, Harare)

Dr Nicolas Gaidet (Cirad, Montpellier)

Dr Daniel Corn  lis (Cirad, Montpellier)

Dr Ricky Taylor (Ezemvelo-KZN Parks)

Dr Felix Nchu (PFIAO Post-doctoral Fellow)

Students: Mduduzi Ndlovu (PhD), Sharon Okanga (PhD), Dominic Henry (MSc), Gregory Mutumi (MSc), Christine Moore (MSc CB)

Research assistant: David Nkosi

Social-ecological resilience and landscape dynamics



The ecology of Chizarira is heavily influenced by elephants, who have replaced closed-canopy Miombo woodland with more open, shrubby vegetation and grassland. Elephants feed preferentially on plants on termite mounds and may gouge mounds for salt; but higher, steeper termitaria in particular appear to offer refuges to woody vegetation from fire and elephant herbivory. (Photo: Graeme Cumming)

Exploring the relevance of scale and spatial pattern for the long-term sustainability of ecosystems and human wellbeing

One of the more important intellectual developments in ecology over the last two decades has been the realization that ecosystems and ecological processes have a location. Differences between locations are described generically as landscape heterogeneity, or spatial variation. Spatial variation can have some interesting effects on ecological processes; the predictions of just about any ecological theory must be reconsidered when spatial variation is included in the analysis. For example, spatial variation in reproductive success and resource availability can create sources (areas that are net exporters of individuals) and sinks (areas that are net

importers of individuals) within the same management area. These effects may modify the predictions derived from classical models that assume homogeneity and random mixing within populations, and can be vitally important for understanding the dynamics of populations of threatened species.

Human impacts on ecosystems are hugely variable in both space and time. Processes within human societies also have some strong parallels to processes that occur within ecosystems. For example, urban sprawl can create a situation in which a city council must continually channel funds towards providing basic infrastructure to outlying suburbs, reducing their ability to maintain the tax-paying and more profitable central suburbs at an acceptable level. This kind of dynamic, with its spatial structuring and continual flow of resources from one location to another, has much in common with the source-sink dynamics discussed earlier.

Human society is strongly dependent on ecosystems for a range of goods and services; and the influence of humans now touches every corner of the world. We thus live in a linked system of people and nature, a social-ecological system, in which many of the supposedly internal dynamics of human society have strong relevance for ecosystems and for conservation. For example, the changes to our climate that will influence all of the earth's organisms can partly be blamed on the failure of social collective action processes to reduce CO₂ emissions.

Many of the most pressing problems of our time have both social and ecological elements, and exhibit a strong form of spatial structuring – whether by biomes and nation states, regional connections, or finer-scale processes of land use and land-cover change. For ecologists and conservation biologists, understanding the role of space and spatial variation in system processes (and in particular, the contributions of spatial variation at different scales to the overall sustainability and resilience of the system) is a deep and fundamental problem.

We have been exploring the influence of spatial variation on ecosystems and social-

ecological systems in several distinct project areas. Although this programmatic theme is not as clearly bounded as our research on waterbirds, it overlaps with it and is gradually converging on a subset of questions relating to broad-scale variation in land use and avian communities. In particular, we are interested in understanding how spatial variation in land-use and management decisions affects avian communities; whether protected areas offer a genuine long-term conservation solution for bird communities, particularly where birds are far-ranging; whether, and how, birds perform important ecological functions and/or influence ecosystem processes; and how spatial variation in social-ecological systems affects the resilience of bird communities.

Ongoing research

There have been several significant developments in this research theme in 2011. Graeme used part of his sabbatical year (2010) to write a monograph, *'Spatial Resilience in Social-Ecological Systems'*, which was published by Springer in February 2011. The new book builds on an earlier edited volume, *'Complexity Theory for a Sustainable Future'* (Norberg & Cumming 2008, Columbia University Press) and explores the role and relevance of spatial variation for the resilience of social-ecological systems. It puts forward a theoretical framework for the analysis of spatial resilience, explores the development of spatial models and related concepts in ecology, economics and sociology, and concludes with a set of case study analyses that illustrate some of the principles discussed through the book.

Former Post-doctoral Fellow Xanic Rondon, PhD student Grant Joseph and CB MSc student Jeremy Goss have contributed actively to this theme in 2011. Xanic has been modelling deforestation processes in the Amazon using a set of predator-prey equations adapted from ecology. The focus of her research has been on understanding how different spatial patterns of forest harvesting (largely contingent on the trade-offs between the prices of high- and low-value timber) may impact forest regeneration times. Papers from this research are currently under review at *Biotropica* and *Ecological Complexity*. Both Graeme and Xanic worked with Jane Southworth of the University of Florida on an additional paper on land-use and land-cover change in our Amazonian study site.

Grant has nearly completed his doctoral



Zaccheus Mahlangu and Grant Joseph in the field at Chizarira National Park. Zaccheus, a skilled botanist, helped Grant with his field work while also acting, on occasion, as interpreter, safari guide, and rescuer-from-lions. (Photo: Colleen Seymour)

research on the ecological role of large termite mounds in miombo woodlands in Chizarira National Park, Zimbabwe. Chizarira has been through a number of changes in recent years, with rapidly increasing African Elephant *Loxodonta Africana* populations now coming under increasing threats from poachers and fire. Grant's doctoral thesis will focus on the influence of spatial heterogeneity on species and functional diversity in disturbed landscapes. Some of his main findings to date are as follows:

- Vegetation on termite mounds follows a species-area curve, with differences in the plant assemblage (relative to the matrix) occurring even on very small mounds.
- A number of distinct woody plant communities exist, related to mound surface area (which in turn relates to soil composition, but only to a point).
- Matrix indicator species drop out from the mound community at surface-area and soil-related intervals, and mound indicator species emerge in similar fashion.
- Woody plants on mounds experience less fire, but more fire damage, while matrix species get burned more frequently and more intensely but re-sprout with greater vigour. The implication is not only that the matrix is fire adapted and that mounds act as refugia for fire-sensitive species, but that at the landscape level, the movement of savanna fires is influenced by the presence of termitaria.
- Mound vegetation has a distinct set of functional characteristics and diversity

relative to the matrix, implying that mound vegetation may play a functionally different role in ecosystem dynamics.

- Mounds support greater numbers of tall trees, with associated deadwood, and hence offer an important refuge for cavity-making and cavity-nesting birds. The paper that presents these results is now published in *Landscape Ecology*.

Grant's work on termite mounds has also involved collaboration with botanists Zaccheus Mahlangu (formerly with the Zimbabwe Parks Authority) and Colleen Seymour (SANBI, Cape Town). Colleen has contributed to soil and vegetation analyses and remains an active participant in the research programme.

David Cumming, Honorary Professor at the Fitz, has been deeply involved in Grant's research and has been doing some additional analyses on erosion of termite mounds, as evidenced by the white rings of soil that form around damaged and abandoned mounds. These rings are frequently detectable from aerial photographs. David's analysis of these photographs dating back to the 1960s suggests that rates of mound erosion have increased significantly and in tandem with increases in the elephant population of Chizarira, suggesting in turn that elephant overstocking has been negatively impacting not only the matrix of Chizarira (which has been transformed from closed-canopy woodland to scrub), but also the additional biodiversity of the mounds. It thus remains to be seen whether, and how successfully, the additional resilience that mounds appear to offer bird communities (through the maintenance of cavity-nesting birds in the system) can buffer elephant impacts on the broader ecosystem.

Lastly, Jeremy Goss has been working on assembling and analysing the translocation permits that detail the movements of wildlife within the Western Cape and between the Cape and other provinces. These data show that surprisingly large numbers of animals are being moved around the Cape on a regular basis. Jeremy will focus on understanding the movement network as well as determining the number and nature of exchanges of two quite different groups of species – potentially invasive species, and rare and threatened species. These movements may be important elements of local ecological resilience and their

relationships to the booming wildlife and tourism industry in South Africa are largely unstudied and poorly known.

Future directions

This programme has so far been highly productive in terms of concrete and useful results, student training, and peer-reviewed publications. In 2012 we will be starting to move with a new programme of research on the social-ecological resilience of private protected areas in South Africa, focusing initially on the Cape. Key questions here are (1) whether private protected areas can be relied on into the future to contribute to national biodiversity conservation goals; and (2) whether, and how, different (human) community engagement strategies adopted by private protected areas influence their long-term viability. Two new students, John Heydinger (MSc) and Julia Baum (PhD) will be exploring different aspects of the problem.



CB MSc student Jeremy Goss's project has mapped out the shape of the network of wildlife translocations occurring within the Western Cape. Many translocations involve introductions of animals beyond their original species' ranges. Over the last decade, more than 17 000 wildlife translocation permits were issued in the Western Cape alone. (Photo: Peter Ryan)

Key co-sponsors

The National Research Foundation; University of Cape Town Research Committee.

Research team 2011

Prof. Graeme Cumming (PFIAO)
 Prof. David Cumming (PFIAO)
 Prof. Jane Southworth (Univ. Florida)
 Dr Colleen Seymour (SANBI)
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Students: Grant Joseph (PhD), Jeremy Goss (MSc CB)

Research assistant: Zaccheus Mahlangu

Urban adaptors – the Cape Peninsula’s Black Sparrowhawks

THE FUTURE RANGES OF MANY BIRD SPECIES ARE PREDICTED TO SHIFT AS THE REGION’S CLIMATE ALTERS DUE TO THE EFFECTS OF GLOBAL CLIMATE CHANGE. UNDERSTANDING HOW SPECIES MOVE INTO AND ADAPT TO NOVEL ENVIRONMENTS CAN HELP US TO UNDERSTAND THE CHALLENGES SOME OF THESE BIRDS WILL FACE. IN SOUTH AFRICA THERE HAVE ALREADY BEEN MAJOR CHANGES IN THE DISTRIBUTION OF SOME SPECIES, AND THE NEW SOUTH AFRICAN BIRD ATLAS IS REVEALING THE TRUE EXTENT OF SOME OF THESE RANGE SHIFTS. THE BLACK SPARROWHAWK *ACCIPITER MELANOLEUCUS* IS ONE SPECIES WHICH HAS SHOWN A DRAMATIC AND RAPID CHANGE IN ITS RANGE. DURING THE LAST TWO DECADES, THE SPECIES’ RANGE HAS EXPANDED GREATLY, MOVING INTO THE WESTERN CAPE AND COLONISING THE CAPE PENINSULA, WITH THE FIRST BREEDING ATTEMPT RECORDED HERE IN 1994. THIS IS NOT A PATTERN THAT COULD HAVE BEEN PREDICTED BY THE CURRENT GENERATION OF BIO-CLIMATIC ENVELOPE MODELS (FAVOURED TOOLS FOR PREDICTING RANGE SHIFTS).

Monitoring the colonisation

Since 2000, we have monitored the population which nests around the Table Mountain chain and in the southern suburbs of Cape Town. This monitoring was started by Odette Curtis for her MSc thesis at the Fitz, and was subsequently continued by a team of dedicated volunteers, led by Ann Koeslag. Along with monitoring the territories, Ann’s team has been colour ringing the population. More than 180 chicks have now been ringed as well as over 100 adults, and about 75% of the adult breeding population is currently marked with unique colour rings. The population has grown dramatically, from around five pairs at the start of the 2000s to over 50 pairs in 2011. Data generated from this project therefore provide a unique opportunity to study several aspects related to population ecology and evolutionary ecology.

Adaptation accompanying the expansion

Using the monitoring data, together with historical nest record cards from the rest of their South African range, MSc CB student Lovelater Sebele has been exploring how the timing of breeding varies across the species’ range and how the species has coped as it has expanded out from its traditional areas. Over its historical

range in southern Africa (Zimbabwe, and the north and south-east of South Africa) the species breeds during the winter dry season. However, the newly colonised south west of South Africa experiences a winter-rainfall regime. Two interesting patterns have emerged from this analysis. Firstly, laying tends to occur several months prior to the rainfall peak in regions with summer rainfall, whereas in the winter rainfall region laying occurs either immediately after the peak in rainfall, or, in the case of the Cape Peninsula population, in two peaks (i.e. a bimodal distribution) either side of the rainfall peak. Secondly, the populations in the summer-rainfall regions have a far shorter laying period, lasting around 4-5 months, whereas the population experiencing winter rains has an extended breeding period, lasting almost eight months.

Coats of many colours

The Black Sparrowhawk is a polymorphic species, with a white morph which has largely white underparts, and a dark morph which can have wholly black underparts. Over most of the species’ range, the white morph is markedly the more common of the two, but on the Cape Peninsula the morph frequencies are reversed, with dark birds being most common. The



Black Sparrowhawks occur in two colour morphs, called dark (left) and white (right). Over most of the species' range, the white morph dominates, but on the Cape Peninsula the reverse is true, with the dark, recessive morph being by far the most abundant. (Photos: Ann Koeslag)

phenomenon of polymorphism has long fascinated evolutionary ecologists, because the occurrence of two morphs of the same species runs counter to the principle of natural selection, which predicts that the fittest morph should be selected and that morphs with lower fitness should be eliminated from the population. Because of the long-running nature of this project and because many of the chicks have been ringed, we have been able to establish the pattern of inheritance of plumage morphs. We have been able to follow the offspring produced by birds of known morphs to see how colour is inherited. We have found that coloration is inherited in a classical Mendelian pattern, with alleles coding for the white morph being dominant over black morph alleles. Thus, two light morphs birds in a pair, or a mixed pair, can produce either dark or light offspring, but two dark morphs breeding together will always produce dark offspring. We are very interested to explore why the Cape Peninsula population shows a reversal in the frequency of the two morphs (with the morph carrying recessive genes being the most common). We have been working with other researchers who have also recorded the frequencies of the two morphs

across South Africa to explore how the pattern in morph ratio changes across the landscape.

A PhD student will be joining the project in 2012, this student will seek to understand the origin, adaptive function and maintenance of plumage colour polymorphism in this species using two key lines of evidence. An ecological study will test whether the different colour morphs have a selective advantage in different habitats or under different climatic conditions. A molecular study will a) establish the role of the melanocortin-1 receptor (MC1R) in the evolution of plumage morphs in Black Sparrowhawks, and b) test the alternative hypothesis that plumage polymorphisms are maintained through limited dispersal and genetic drift.

Key co-sponsors

University of Cape Town Research Committee.

Research Team 2011

Dr Arjun Amar (PFIAO)
Ann Koeslag (PFIAO-funded volunteer)
Gerrie Meihuizen (Volunteer monitor)
Sharon Yodaiken (Volunteer monitor)

Student: Lovelater Sebele (MSc CB)

Climate change and vulnerability of Fynbos birds

SOUTH AFRICA'S RENOWNED BIODIVERSITY HOTSPOT, THE CAPE FLORAL KINGDOM OR 'FYNBOS BIOME,' IS A CAPTIVATINGLY DIVERSE SHRUBLAND WITH FOLDED MOUNTAIN RANGES, MEDITERRANEAN-TYPE WINTER RAINFALL, POOR SOIL NUTRIENTS AND SUBTLE SPECIES MUTUALISMS. THE COUNTRY'S REMARKABLE BIODIVERSITY IS ONE OF ITS STRATEGIC ADVANTAGES FOR TOURISM, RURAL ECONOMIC DEVELOPMENT AND HUMAN WELL-BEING. SO ALTERATIONS TO THE FYNBOS BIOME STEMMING FROM CLIMATE AND LAND-USE CHANGE ARE OF IMPORTANCE NOT JUST FOR CONSERVATION BIOLOGISTS AND ACADEMICS, BUT FOR SOCIETY AT LARGE.

The Fitz's first climate-change field project, 'Fynbos Endemic Birds: Vulnerability and Adaptation to Land Use and Climate Change' started in early 2008. It forms part of the Fitz's Climate Vulnerability and Adaptation Programme, run in conjunction with the Climate Change and BioAdaptation Division of the South African National Biodiversity Institute (SANBI). The Fynbos project explores how species on the edge of the continent and along urban edges are being squeezed by climate change, rampant urbanization, and associated ecological changes such as biological invasions and novel predators. For example, Fynbos-endemic birds are potentially threatened by the unravelling of evolved plant-pollinator mutualisms, invasion by woody plants, predation by domestic cats, and novel diseases associated with urban encroachment.

To understand the vulnerability of species to the rapid environmental changes of the past century, and to the additive effects of environmental change drivers, it is necessary to look through different lenses. The Fynbos endemics research team is increasingly integrating the use of population and community ecology, behavioural ecology, phenology (timing of the life cycle), conservation genetics, stress ecology and landscape ecology to predict the likely impacts of rapid change on Fynbos endemic birds. The project works at sites in the Cape Peninsula, Kogelberg Biosphere Reserve, Hottentots Holland Mountains and Langeberg Mountains, with most effort to date concentrated at Elsie's Peak in the Table Mountain National Park.

Cape Sugarbirds *Promerops cafer*, Orange-breasted Sunbirds *Anthobaphes violacea*, Cape



Phoebe Barnard and Chris Johnson swab a Malachite Sunbird *Nectarinia famosa* for pollen. (Photo: Martine Maron)

Rock-jumpers *Chaetops frenatus* and other endemics are focal species, with the first step to colour-mark accessible populations which can be tracked over time. The team includes ornithologists, a small network of volunteer observers and amateur bird-ringers, and the initial effort in establishing marked populations is already bearing considerable fruit in terms of resightings and recaptures. Once we know how long birds of different age classes and sexes survive, when they breed, moult and disperse, and where they disperse, we can start to build a detailed picture of their population ecology, behaviour and phenology.

Detailed information like this is one of the key gaps in current scientific understanding of species' vulnerabilities. Improving the spatial models of range changes built by global change biologists using climate envelope concepts requires integrating demographic and spatial data in second-generation models, such as those now being developed in a collaboration between

the Universities of Durham and Cambridge, SANBI, the Fitz and the Animal Demography Unit at UCT. The Fynbos endemics project is focusing on gathering survivorship, dispersal, clutch size and other reproductive data to generate parameters for, and validate, these integrated models. This will enable conservation biologists to identify populations in trouble *before* range changes and local extinctions occur.

In 2011, the project was run by Phoebe Barnard and Rob Simmons at sites in the Cape Peninsula (Table Mountain National Park), Kogelberg Biosphere Reserve buffer zone, and in the Langeberg and Baviaanskloof mountains, with the collaboration of bird ringers Margaret McCall, Mike Ford, and Robyn Kadis. The availability of Fitz CoE funds and students from 2011 allowed the start of fruitful collaborations with Anton Pauw of Stellenbosch University, Jeremy Midgley of UCT's Botany Department, Frank Schurr of Potsdam University and Katrin Böhning-Gäse and Matthias Schleuning of the Senckenburg Biodiversity and Climate Research Institute in Frankfurt. This has allowed an acceleration of the project around several of its core research questions (see below), as well as around some important protea- and erica-focused evolutionary and ecological questions.

The third year of fieldwork at the Elsie's Peak site on the Cape Peninsula focused on the establishment of colour-marked populations and

gathering of behavioural, phenological, stress-related and genetic data to answer questions 2 through 8, but these (and questions 1 and 9) will involve more intense work in 2012-14. The work in 2011 by students Anina Heystek (BSc Hons) and Zingfa Wala and Ross Turner (both PhD) will involve experimentation, morphometric measurement, stress analysis and behavioural/evolutionary ecology observation.

Pollinators and pollinated

Anina Heystek and Lara Croxford, Univ. Stellenbosch BSc Hons students in Anton Pauw's team, explored sunbird and sugarbird pollination as a driving force in the radiation of the genus *Erica* and the biology of *Protea lepidocarpodendron* respectively, while UCT BSc Hons student William Wyness explored sugarbird pollination as a driver of plant architecture in *Protea compacta*. Anina will continue with Phoebe in 2012 as a MSc student. Ross Turner's work on sunbird pollination of *Erica halicacaba* was published this year, bringing to 69 the known number of *Erica* species dependent on Orange-breasted Sunbirds.

Hunters and hunted

Following the ground-breaking project on domestic cats, their home ranges and levels of predation in 2010 (by CB MSc student Sharon George), the question arose "are cats in winter (when our endemic birds begin breeding) showing the same levels of predation and home ranges as in the summer months"? UCT BSc Hons student Koebräa Peters answered this question in 2011 by GPS-tracking nine domestic cats in the Glencairn wetland conservation area and calculating predation rates of another 27 cats in the areas. Her research found that despite the 'winter' cats travelling less often and less far than the 'summer' ones they had average predation rates (3.7 prey brought to the house/cat/six weeks) not much lower than those recorded in summer (4.2 prey brought to the house/cat/six weeks). The Glencairn suburb is home to *ca* 670 cats and, based on our minimum estimates of winter predation rates, these cats would account for 7 358 prey annually. Surprisingly, reptiles made up 62% of winter kills, with birds contributing only 3% (meaning that extrapolating from winter diet and predation rates, cats at Glencairn kill at least 220 birds annually). In Sharon's summer study, birds made up 13% of cat prey, so this value of

The key questions of the Fynbos endemics project are:

1. Do individuals at range edges have lower fitness/survival than in range cores?
2. Are inland populations more heat-stressed than those at the coast?
3. Is there significant current gene flow between sites, and what are the inferred past levels?
4. Are nectarivores especially vulnerable to frequent fire?
5. How does urbanization influence adaptation options for birds?
6. Is survivorship (disease, predation, energetics) a function of urbanization?
7. What phenotypic variables (if any) reliably indicate physiological stress?
8. Are any range shifts and phenotypic changes consistent with predictions?
9. How can conservation planning, policy and management respond?

220 is almost certainly an underestimate. While this may seem good for native birds, the kill rate of birds in Greater Cape Town, estimated from Sharon's study, was *ca* 728 000 individuals per year, with the majority being endemic species such as Cape Grassbirds *Sphenoeacus afer* and Cape Bulbuls *Pycnonotus capensis*, and sunbirds.

Diseases affecting Fynbos birds may also be facilitated by urbanization, with the incidence of avian pox, a contagious, lesion-forming virus potentially facilitated by warm temperatures, birdbaths and bird feeders, now being monitored in Cape Sugarbirds.

Stress indicators

Contending with multiple and simultaneous environmental changes such as climate, biotic invasion and urbanization, may pose both threats and opportunities for endemic Fynbos birds. Is urbanization a net cost or a net benefit for birds, in terms of the balance between risks and opportunities? Do birds seek refuge in urban areas in times of fire, hot, dry winds, or rainstorms, and do the resources they acquire there help them cope? In the search for answers to these questions, the project is quantifying morphological and disease indicators of stress, including the incidence of feather stress-barring, incidences of asymmetry in body size and feather growth, and diseases such as avian pox.

Impact of the project

While the Fynbos endemics, climate and land-use change project is well grounded in population, community, spatial, behavioural and evolutionary ecology, it will increasingly cast light on conservation planning, policy and land

management, and even the seemingly prosaic matters of gardening and wildlife feeding. As so much national and global attention is paid to the future security of biodiversity (mainly plant diversity) in the Fynbos hotspot, this project will help guide landowners on both sides of the urban edge as well as those concerned with the future of biodiversity on the southern tip of Africa. Just as importantly, it will help make fine-scale, climate-driven, range-shift modelling, on which conservation planning will be increasingly based, more accurate, more robust and more reliable for the species of this very special biodiversity hotspot.

Key co-sponsors

South African National Biodiversity Institute (SANBI); University of Cape Town Research Committee; National Research Foundation.

Research team 2011

Dr Phoebe Barnard (PFIAO Honorary Research Associate and SANBI Birds and Environmental Change Partnership)
 Dr Rob Simmons (PFIAO Honorary Research Associate)
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 Dr Katrin Böhning-Gäse (Senckenburg Research Institute, Germany)
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 Prof. Phil Hockey (PFIAO)
 Dr Brian Hole (Conservation International and Univ. Durham, UK)
 Prof. Brian Huntley (Univ. Durham, UK)
 Mr Chris Johnson (Univ. Stellenbosch)
 Dr Alan Lee (SANBI/PFIAO Post-doctoral Fellow)
 Dr Martine Maron (Univ. Queensland)
 Prof. Guy Midgley (SANBI)
 Prof. Jeremy Midgley (UCT Botany)
 Dr Anton Pauw (Univ. Stellenbosch)
 Dr Frank Schurr (Univ. Potsdam, Germany)
 Dr Clélia Sirami (SANBI Post-doctoral Fellow)
 Ross Turner (Univ. KwaZulu-Natal)
 Prof. Les Underhill (Animal Demography Unit, UCT)
 Dr Steve Willis (Univ. Durham, UK)

Students: Zingfa Wala (PhD), Lara Croxford (BSc Hons, Univ. Stellenbosch), Anina Heystek (BSc Hons, Univ. Stellenbosch), William Wyness (BSc Hons Botany), Koebraa Peters (BSc Hons)

Research assistants: Gavin Bell, Rene Delport, Mike Ford, Lorraine and Peter Holloway, John Johansson, Chris Johnson, Robyn Kadis, Margaret McCall



Martine Maron gets to grips with a male Orange-Breasted Sunbird. (Photo: Phoebe Barnard)

Hot Birds – climate change and desert birds



Sociable Weavers exploit the thermally buffered microsites provided by a Camelthorn *Acacia erioloba*. (Photo: Rowan Martin)

Body size effects

Body size influences the way birds experience the thermal environment. As a result, birds of different sizes may be affected to varying degrees by rising global temperatures. Larger birds have a smaller surface area in relation to their volume which means that as body size increases, the rate at which birds exchange heat with their environment (through radiation, convection and evaporation) decreases. This principle underpins Bergmann's Rule that states that the body size of animals generally increases towards the poles because, relative to body mass, larger animals lose heat to the environment more slowly. As a corollary, smaller animals are expected to be better suited to areas where temperatures are high, as they are able to dissipate metabolic heat more quickly.

Being small, however, also has its disadvantages. Small birds heat up more quickly when exposed to high levels of solar radiation and so may be restricted to being active for short periods of time before having to retreat to cooler microsites. Rates of energy and evaporative

SINCE 2009, THE 'HOT BIRDS' PROJECT HAS GONE FROM STRENGTH TO STRENGTH AND HAS INCLUDED THREE GRADUATED MSCS, ONE SOON-TO-GRADUATE PhD AND TWO POST-DOCS. IN 2011, HOT BIRDS CONCENTRATED ON A) HOW BODY SIZE AND ECOLOGICAL GUILD INFLUENCE RESPONSES TO RISING TEMPERATURES; B) HOW PHYSIOLOGICAL PROCESSES MEDIATE THE INTERACTIONS BETWEEN A BIRD AND ITS ENVIRONMENT; AND C) HOW RISING TEMPERATURES AFFECT SURVIVAL AND REPRODUCTION (I.E. FITNESS). THE WORK CONTINUES TO BE CENTRED IN THE KALAHARI, AN AREA THAT HAS EXPERIENCED RISING TEMPERATURES SINCE THE 1960S AND IS PREDICTED TO EXPERIENCE EVEN HOTTER CONDITIONS IN THE FUTURE.

water loss are also relatively high in small birds. Walking the tight-rope of obtaining sufficient water and energy while minimising rates of loss can be a substantial challenge for these small birds.

Anyone who has visited the hot deserts of southern Africa will be aware that some very large birds, such as Common Ostriches *Struthio camelus* and some species of bustard survive in searingly hot temperatures alongside their smaller counterparts, such as Sociable Weavers *Philetairus socius*. A key aim of the Hot Birds research team is to understand how birds of such different sizes cope with the demands of desert living, and to identify the thresholds beyond which they are no longer able to cope. This information will assist in making empirically based predictions for the impacts of global climate change, not only for southern Africa's deserts but for hot, arid environments worldwide.

Over the last three summers, PhD student Ben Smit, Post-doctoral Fellow Rowan Martin and CB MSc students Gina Louw and Justine



The availability of surface water - such as the waterhole this Burchell's Sandgrouse *Pterocles burchellii* is using to quench its thirst - is likely to be an important determinant of the ability of desert birds to cope with the hotter climates of the future. (Photo: Ben Smit)

Cordingley have amassed over 14 000 records of the heat-related behaviour of a diversity of Kalahari bird species. Each time a bird was seen, key aspects of its behaviour were recorded; these included whether or not it was exhibiting heat-dissipation behaviours, such as panting or wing-spreading, whether it was foraging and whether or not it was sitting in the shade. By relating the behaviour of a variety of different species to the weather conditions, the Hot Birds team have been building a picture of how different species cope with increasing temperatures. Preliminary analyses indicate that larger birds pant and wing-spread at lower temperatures than small birds and are the first to seek shade. Just as it does for humans, humidity also plays an important role: when humidity levels are high, birds begin panting, wing-spreading and curtailing activity at much lower temperatures.

To assess whether these patterns are universal, the Hot Birds project is expanding its horizons to the deserts of Western Australia, where summer temperatures regularly exceed those of even the hottest Kalahari days. Spearheaded by the Hot Birds project, a team at the University of Western Australia is conducting an identical study. In late 2011, the Hot Birds team hosted an Australian student, Grace Russell, who came to learn the field and analytical methodologies we have developed over the last three years.

Post-doctoral Fellow Rowan Martin has been exploring in greater detail how birds use the

thermal landscape. By using biophysical models based on heat transfer theory it is possible to develop predictions for how birds of different sizes should use the landscape from a thermal perspective. For example, Figure 1 below shows how the suitable 'climate space', defined by wind speed and air temperature, varies for birds of different sizes. Smaller birds are expected to be more responsive than larger birds to convective environments (wind). Due to the greater challenge of dissipating heat through convection, larger birds may be more sensitive to variation in the radiant environment (direct radiation from the sun and long-wave infra-red radiation from the surroundings). This means when it gets hot, larger birds should be the first to move down from the trees and into the shade – a

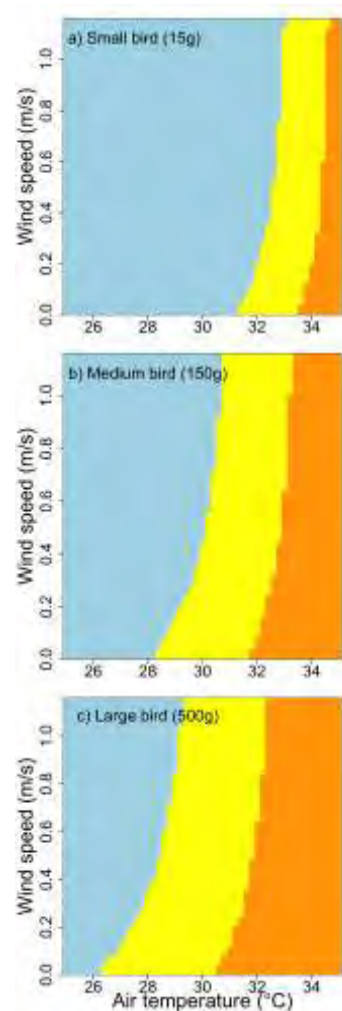


Fig 1: The thermal landscape as experienced by birds of three different sizes. Different coloured areas indicate the range of climatic conditions within which birds must either elevate metabolic rates (pale blue), make no adjustment (yellow), or elevate rates of evaporative water loss (orange) to maintain body temperatures within tolerable bounds. (Image: Rowan Martin)

prediction borne out by data collected to date. By comparing patterns of landscape use between a variety of species, Rowan is testing the extent to which the thermal landscape determines movement patterns of birds and how rising temperatures may affect foraging behaviour. This research combines both field observations of wild birds and experimental studies using copper-cored models of different bird species and determining how core body temperatures respond to a range of environmental conditions.



A White-browed Sparrow-Weaver panting in the heat. Panting is one of the key ways in which birds dissipate heat, but it brings an increased risk of dehydration through excessive water loss. (Photo: Ben Smit)

Linking physiology and environment

Physiological processes mediate many of the interactions between a bird and its physical environment. Understanding the temperature dependence of a bird's physiology is therefore vital for predicting how it will respond to higher temperatures and more frequent heat waves. Ben Smit, a CoE-funded student completing his PhD at the University of Pretoria, is examining how physiological variables such as body temperature and water requirements change with increasing temperatures. During 2011, much of Ben's work focused on the White-browed Sparrow-Weaver *Plocepasser mahali*.

This species is both tractable to work with and represents a suitable model species for many of the questions being addressed by the Hot Birds team. Ben's work on the sparrow-weavers has several different facets.

First, Ben used miniature temperature loggers to record the sparrow-weavers' body temperatures while the birds were going about their daily lives. The loggers, which weigh a mere 2 g, were surgically implanted into the birds' body cavities by a veterinarian, providing insight into even small changes in body temperature associated with activity and periods of very hot weather. These body-temperature data, which represent some of the very first for small, free-living birds in hot environments, reveal that the sparrow-weavers do not maintain a steady body temperature during the day. Rather, they show short-term 'spikes', during which temperature may rapidly increase by 2-3°C above average daytime levels. The magnitude of these spikes depends to some extent on maximum air temperature, and is significantly greater on very hot days. These findings are important, because they provide insight into temperature fluctuations that may take the sparrow-weavers close to lethal body temperatures. This body temperature study provides a key link in the chain of information required to predict with accuracy the responses of sparrow-weavers and other species to rising temperatures.

A second component of Ben's research focuses on daily water turnover, in other words the amount of water the sparrow-weavers lose – and thus need to replenish – on a daily basis. The technique used to address this question makes use of a stable isotope tracer: by injecting the birds with a small dose of isotopically labelled water, and then measuring the rate at which the label is lost from the body water pool, we can accurately measure the amount of water a bird turns over in a 24-hour period. Ben found that as daily maximum temperature increases from the upper 20s to the upper 30s, daily water demands rise dramatically: some of his birds lost and replaced quantities of water corresponding to more than 50% of their body mass on a daily basis – that's equivalent to a 70 kg person drinking and sweating out 35 litres of water a day! Most of this water represents evaporation across the skin and respiratory tract, whereby the bird offloads heat and maintains body temperature at sub-lethal levels. Daily water requirements were strongly dependent on

maximum air temperature as well as humidity, and showed significant positive relationships with both these variables.

Ben has collected an impressive data set over the last three summers that sheds new light on a number of aspects of the biology of desert birds and will be submitting his PhD in mid-2012. His findings also provide key pieces of information needed to model avian survival and reproduction under predicted future climate scenarios.

Fitness – the ultimate leveller?

Behaviour, microsite use, and physiological functions of birds change with increasing temperature in ways which vary between species of different body sizes and ecological guilds. In order to predict how these changes may affect population persistence, we need to understand how they translate into fitness effects, i.e. how they affect survival and reproduction. The 'fitness' of an individual is a function of its lifetime reproductive success, but this correlates with a number of proxies that can be measured over shorter time-scales in studies of focal species. To date, the Hot Birds team has investigated how temperature affects two of these proxies for fitness: body mass in Southern Pied Babblers *Turdoides bicolor* and breeding success in Common Fiscals *Lanius collaris subcoronatus*, both studies being carried out in the Kalahari. A major focus of this part of the research programme has been investigating the

mechanisms via which temperature affects fitness, including potential trade-offs between foraging and the need to thermoregulate.

CB MSc student Kate du Plessis studied the mechanistic links between temperature and body mass change of habituated Southern Pied Babblers at Kuruman River Reserve in the summer of 2010-2011. Kate was able to entice these birds to weigh themselves on a portable scale in the morning and evening. She conducted focal observations of the birds throughout the day and linked temperature-related changes in behaviour with changes in body mass. Kate found that the proportion of time focal individuals spent engaged in heat-dissipation behaviour (panting and wing-spreading) increased with temperature such that by 36°C babblers were spending 50% of their time heat dissipating (Fig. 2). Despite this increase in heat-dissipation behaviour, babblers did not decrease time spent foraging as temperature increased: i.e. there was no immediately obvious trade-off between foraging and thermoregulation in these birds. Closer examination of the data showed however, that despite spending an equal amount of time foraging, the rate of food acquisition decreased by an order of magnitude when it was hot, resulting in an overall reduction in food intake on hotter days. The consequence of this was that babblers gained less weight between dawn and dusk on hotter days than on cooler days. Babblers failed to recover overnight weight loss on days above 37°C, with some birds

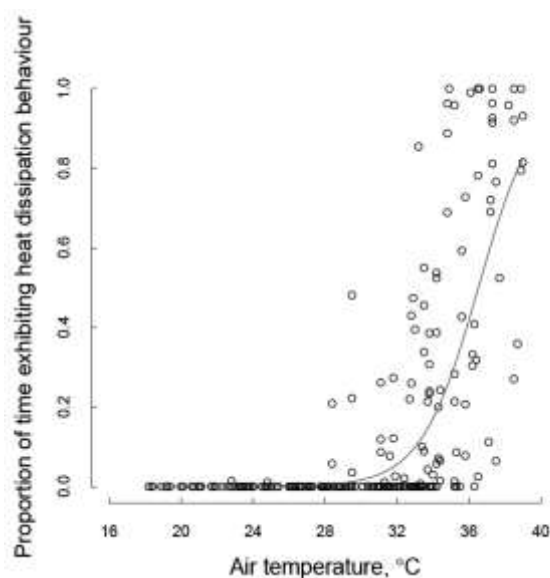


Fig 2: Relationship between air temperature and proportion of time Southern Pied Babblers spend heat dissipating (panting and wing-spreading). (Image: Rowan Martin)

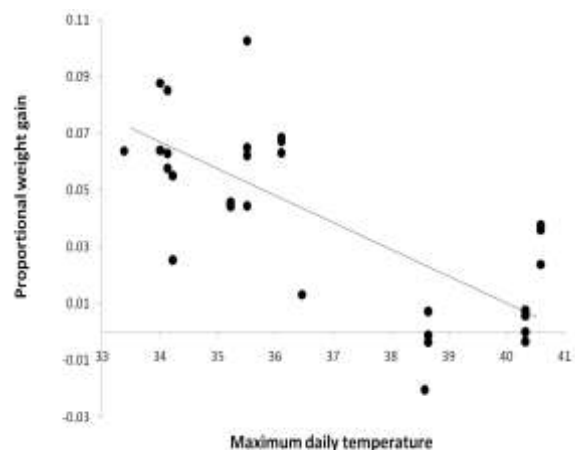


Fig 3: Proportional mass gain of Southern Pied Babblers between dawn and dusk reduces as maximum daily temperatures increase. Long-term data indicate that babblers lose approximately 4% of their body mass overnight, so they must gain at least as much during the day (i.e. 0.04 on the y-axis of Fig 3) in order to 'break even'. (Image: Rowan Martin)

even losing weight during the day as temperatures approached 40°C (Fig. 3). This has serious implications for maintenance of body condition, and even survival, during heat waves. The Southern Pied Babbler is a 'desert specialist' with a global distribution centred on the Kalahari. Kate's findings show that even ostensibly desert-adapted birds such as this may be vulnerable to increasing average temperatures and frequencies of heat waves under climate change.

At Tswalu Kalahari Reserve, Post-doctoral Fellow Susie Cunningham is conducting a study into the links between temperature and breeding success in Common Fiscals. She is focusing on how temperature affects thermoregulation, foraging behaviour and parental investment choices of breeding birds – and what the consequences of these effects are for nestling growth and fledging success. This study was piloted in summer 2010-2011 and at the time of writing data collection is underway on a second field season.

Susie's work involves observation of adult birds at regular intervals throughout the day, weighing and measuring nestlings of focal birds at dawn and dusk, and placing video cameras at nests to record provisioning rates. A major finding of the study to date is that provisioning rates to nestlings by adult Common Fiscals decrease once maximum daily temperatures exceed 33°C. Concurrently, nestling growth rates drop dramatically. For example, six-day-old shrike nestlings gain an average of 40% body mass per day on days when maximum tempera-

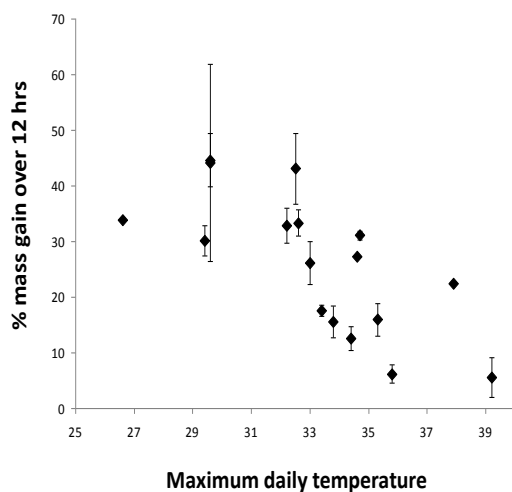


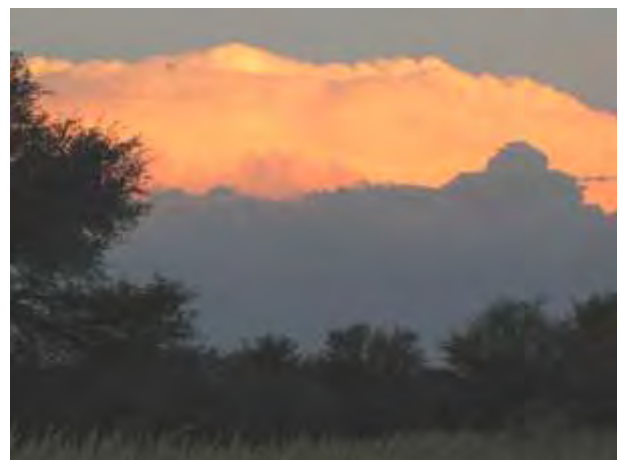
Fig 4: Six-day-old Common Fiscal nestlings gain on average 40% body mass per 12-hour period when maximum daily temperatures are below 33°C. Above this however, nestling growth drops off dramatically. (Image: Susie Cunningham)



Susie Cunningham seeks out a shady microsite from which to observe foraging Common Fiscals. (Photo: Rowan Martin)

tures are below 33°C. However, there is a steep drop in the body mass gain of six-day-old nestlings on days when the maximum daily temperature exceeds 33°C. By the time maximum daily temperatures reach 39°C, nestlings are gaining less than 10% body weight between dawn and dusk (Fig. 4).

Several things change with temperature which could be responsible for the reduction in both provisioning rate and chick growth. For example, preliminary results from focal observations suggest that, like babblers, Common Fiscals increase the proportion of time spent heat dissipating as temperatures rise. Like other shrikes, Common Fiscals are perch-and-pounce foragers. Birds in this study spend much of their time (82%) sitting on high, exposed perches where they are vulnerable to high solar radiative heat loads. Black-bulb thermometers placed throughout the study site record



Climate change has the potential to affect the fitness of desert birds not only through increases in temperature, but also through the timing and amount of summer rain. (Photo: Phil Hockey)

maximum (in the sun) and minimum (in the shade) temperatures available to the shrikes depending on the perches they chose to use. Using black bulb data plus data on microsite choices of birds from focal observations, Susie is able to calculate the “heat load” each bird experiences as it moves around the landscape. Current data show that on cool days (<30°C), the heat load of Common Fiscals tracks that of the warmest, sunniest sites in the landscape. On warmer days, however, Common Fiscals adjust their perch use to spend more time in the shade, thus reducing their heat load below the maximum measured in the environment. Because shrikes use exposed, sunny perches for hunting, this change in behaviour may represent a foraging/thermoregulation trade-off – which could result in reduced food intake and drive the observed reduction in provisioning to chicks in the nest. Data currently being collected should allow analysis of the magnitude of this trade-off and whether panting and wing-spreading behaviour compromise foraging efficiency in shrikes as they do in babblers.

In addition to recording the behaviour of the shrikes, Susie also monitors the activity levels of the animals they use as food – insects and other invertebrates as well as small mammals and reptiles. Data to date suggest these species also change their behaviour as temperatures increase. On cool days, the activity levels of Common Fiscal prey species remain relatively constant throughout the day, whereas as maximum daily temperatures rise, there is a distinct drop in prey activity in the afternoon. Nest-provisioning patterns track these changes in prey availability closely, meaning we cannot be sure whether reductions in provisioning on hot days are due to the shrike itself suffering from the heat, or due to the difficulty it may be experiencing finding and catching prey that are also taking shelter from the elements.

In summary, hot days result in reduced growth of Common Fiscal nestlings, a pattern which correlates with reduced nest provisioning by shrike parents. It seems likely that both reduced provisioning rates and direct physiological effects of temperature on the chicks are responsible for these reductions in growth. However, we do not yet know which of these processes is most important. Furthermore, the long-term effects of reduced nestling growth rates due to high temperatures are also unknown for Common Fiscals. In other birds,

reduced nestling growth rates can prolong the nestling period, increasing the risk that the nest will be found by a predator (many of Susie’s broods were depredated). Reduced nestling growth can also result in chicks attaining a smaller adult size, with knock-on effects for the chicks’ own survival and lifetime reproductive success. The ‘Hot Birds’ team plans to continue work into the links between temperature and fitness, expanding studies into other species, e.g. the Southern Yellow-billed Hornbill *Tockus leucomelas*, and combining physiological and behavioural data in order to understand better how temperature influences adult body mass, nestling growth, and breeding success.

The ‘Blair Wolf’ project

The Hot Birds project received a significant boost in 2011 with the news that Dr Blair Wolf of the University of New Mexico, USA, was successful in a grant application to the National Science Foundation. The \$650 000 grant, which involves CoE Core Team Member Prof. Andrew McKechnie (Univ. Pretoria) and Dr Todd McWhorter (Univ. Adelaide, Australia) as co-investigators, will provide funding for a project examining body temperature and dehydration tolerance limits in desert avifaunas on three continents – North America, Africa and Australia. Understanding the limits to body temperature and dehydration that can be tolerated by birds is critical for predicting the impacts of extreme weather events under future climate scenarios.



The Hot Birds Australian axis – at work in the Simpson Desert. (Photo: Grace Russell)

The latest predictions from the UN's Intergovernmental Panel on Climate Change reiterate the higher maximum temperatures and increased frequency of heat waves predicted to result from global warming, highlighting the need to develop models for the impacts of extreme weather events on avian survival and reproduction.

And into 2012

The Hot Birds team will grow significantly in 2012. Fitz- and CoE-funded Maxine Whitfield (Univ. Pretoria) will begin her MSc examining thermal and dehydration tolerances in Kalahari Desert birds. Other new additions to the Kalahari-based Hot Birds team in 2012 will include Tom and Martha Flower (PFIAO Post-doctoral Fellows), and Tanja van de Ven (PhD, PFIAO). Our wings will also spread geographically, with the addition of Grace Russell (BSc Hons, Univ. West Australia) who will be replicating some of our work in Australia's Simpson Desert. By mid-2012, we also hope to

have an American student on board under Blair Wolf's supervision in the Sonoran Desert, southwestern USA, allowing us to make the first-ever, multi-continental comparison of the effects of high temperatures on desert birds.

Key co-sponsors

Tswalu Foundation; University of Cape Town Research Committee.

Research Team 2011

Prof. Phil Hockey (PFIAO)

Prof. Andrew McKechnie (CoE Team Member, Univ. Pretoria)

Dr Blair Wolf (Univ. New Mexico)

Dr Nicola Mitchell (Univ. West Australia)

Dr Susie Cunningham (PFIAO Post-doctoral Fellow)

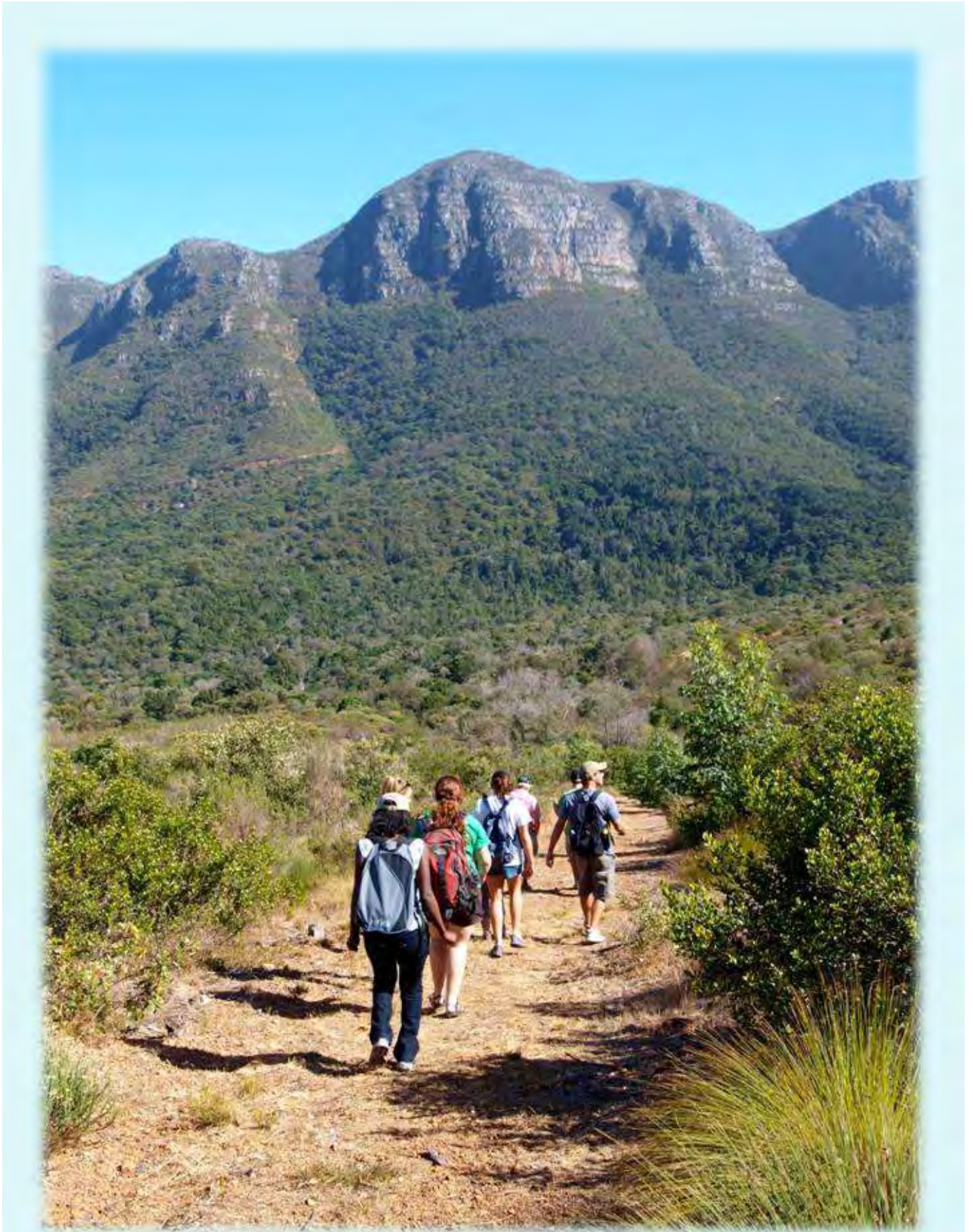
Dr Rowan Martin (PFIAO Post-doctoral Fellow)

Students: Kate du Plessis (MSc CB), Gina Louw (MSc CB), Ben Smit (PhD, Pretoria)

Research assistants: Laura Barclay, Jessie Berndt, Craig Harding, Carryn Hojem, David Nkosi, Sue-Joy Schultz, Robert Sutcliffe



In 2012, PhD student Tanja van de Ven will start a study of the effects of high ambient temperatures on breeding Southern Yellow-billed Hornbills in the Kalahari. These birds' unusual breeding system means that for much of the breeding cycle the potential for success is driven entirely by decisions made by the males. The high work-loads demanded of males suggest that high temperatures could take considerable tolls. (Photo: Phil Hockey)



Although the seven-month taught component of the CB course is gruelling, students nonetheless get to spend time in the field, coming to grips with practical aspects of conservation biology. (Photo: Christine Moore)

TEACHING, OUTREACH, AND RESEARCH SUPPORT AND OUTPUT

ALL THE WONDERFUL RESEARCH IN THE WORLD IS OF LITTLE USE IF OTHER PEOPLE DON'T LEARN ABOUT IT, USE IT AND BENEFIT FROM IT. ALTHOUGH FITZ STAFF DO TEACH ON UNDERGRADUATE COURSES IN ZOOLOGY AND BOTANY, MOST OF OUR TEACHING EFFORT IS DIRECTED AT OUR IN-HOUSE CONSERVATION BIOLOGY MSc PROGRAMME. WITH THE 20TH COHORT OF STUDENTS ARRIVING IN 2011, THIS IS A HIGHLY SUCCESSFUL INITIATIVE THAT HAS STOOD THE TEST OF TIME AND HAS PLACED UPWARDS OF 170 GRADUATES IN CONSERVATION-RELATED JOBS. OUR RESEARCH CONTINUES TO BE PUBLISHED IN BETTER AND BETTER JOURNALS; WE MAINTAIN AN ACTIVE PRESENCE IN THE POPULAR, WRITTEN MEDIA; AND ALL OUR ACTIVITIES ARE BOLSTERED BY OUR WORLD-CLASS, INSTITUTE LIBRARY. THE FINDINGS OF OUR RESEARCH ARE USED AT LEVELS FROM GOVERNMENTAL TO NGOS AND PUBLISHERS. WE ALSO HAVE AN EVER-INCREASING OUTREACH AND SOCIAL REDRESS FOOTPRINT. IN 2011, DIRECT EMPLOYMENT SPIN-OFFS FROM FITZ RESEARCH PROJECTS INCLUDED 29 FULL-TIME JOBS AND 93 PART-TIME JOBS. THESE WERE SPLIT BETWEEN PREVIOUSLY DISADVANTAGED SOUTH AFRICANS AND IMPOVERISHED RURAL COMMUNITIES IN COUNTRIES TO THE NORTH.

Conservation Biology Masters Programme 2011

The Fitztute was once again privileged to host a fantastic group of MSc students in 2011. The 19th cohort of Conservation Biology students completed their projects early in 2011, with 11 of the 12 students graduating in June 2011. Masumi Gudka did not complete her project due to a family tragedy: she finally submitted her project in early 2012. Special congratulations go to the four students who obtained their degrees with distinction, and to Sarah Lewis who won the inaugural Patrick Niven Award for the best student (see below). The 2011 graduation brings the total number of students who have completed the course successfully to 213 – not too shabby!

The 20th cohort of students started their studies in January 2011, with participants from seven countries including our first Liberian student, Darlington Tuagben. At the start of the year, 13 students were registered, but one student had to leave the course. The remaining 12 students will hand in their research projects during February 2012. The 2012 intake of CB students, our 21st cohort, includes 15 students from seven countries: South Africa, Australia, Canada, Germany, Mauritius, the UK and the USA.

The course continues to be supported by a wide variety of people both inside and outside UCT. We owe particular thanks to module leaders from outside UCT for their willingness to teach on the course and the consistently high academic standards that they have maintained. 2011 saw us bid a sad farewell to Norman Myers, our opening lecturer and class inspiration for most of the last two decades. Norman's role will be taken on by Dr John Hanks, former director of the Peace Parks Foundation. John has a long history with the CB programme, having been the first external examiner for the course back in the early 1990s. We welcome John's expertise, experience and enthusiasm. Other current module leaders from outside UCT include Phoebe Barnard (climate change), Peter Carrick (restoration ecology), Georgina Cundill (conservation and society) and Jackie King (freshwater ecology). Non-Fitz teachers from within UCT come from a diverse



The 2011/12 CB class celebrates measuring 650 *Mimetes fimbriifolius* plants as part of their demography module. CB classes have been monitoring the survival and growth of a marked population of these plants since 1994. (Photo: Peter Ryan)

range of departments, including Economics (Jane Turpie), Philosophy (Jack Ritchie), Geological Sciences (Woody Cotterill) and Zoology (Colin Attwood, Jacqueline Bishop).

In addition to the module leaders, many other people have contributed through guest lectures, field trips and discussions. The programme is also strengthened by the dedication of the Fitztute support staff, especially Hilary Buchanan who administers the CB applications and generally assists with the settling-in process for the newly arrived foreign students.

Last but not least, the 2011 CB class was able to spend some time with one of those legendary characters, Sir David Attenborough, who visited the Fitztute to honour a promise made many years before to the late Patrick Niven. Sir David gave a fascinating seminar on birds-of-paradise as part of the Vice-Chancellor's Open Lecture Series. He also participated in a lively three-hour discussion at Kirstenbosch with the CB students



The Bateleurs (<http://www.bateleurs.org/>) provide an aviation service to environmentalists throughout southern Africa. As a field trip for the Landscape Ecology course module, they very kindly took our 2011 class on a flight up the West Coast to count waterbirds, think about aerial survey techniques, and obtain a first-hand landscape-ecologist's-eye view. Pictured here are pilots Harold Blocher (left) and Craig Strang (right) of the Bateleurs, with CB students Ed Rice, Emily Cressey, Lovelater Sebele, Nikki Best, Jeremy Goss (back) and Christine Moore and Maurice Schutgens (front). (Photo: Graeme Cumming)

as well as staff and students from the Fitzitute, Zoology, and SANBI.

Key co-sponsors

The CB programme again received support in 2011 from the Umhlanga Rotary Club, who provided a R50 000 per annum bursary in 2010 and 2011. Gina Louw was the Rotary Bursary holder for 2010 and Edward Rice for 2011. The DST/NRF Centre of Excellence at the Fitzitute also contributes two R50 000 bursaries annually and, from 2012, will contribute directly to CB student project running costs. The Nature Conservation Corporation donated the funds to upgrade the CB lab computer facilities for the 2010 cohort – our CB students benefit hugely from this generous gift.

The first R12 000 Patrick Niven Award for the top CB student in the 2010/11 class was awarded to Sarah Lewis at a special cocktail party in August. The award was sponsored by Peter Johnson's family in celebration of both the Fitzitute's 50th Anniversary and the significant support for the Institute given the Niven Family over five decades. It was with deep shock that we learned of Peter's untimely death only two

months after the award was given. We remain deeply grateful for the Johnson family's generosity and their ongoing interest in the Fitzitute.

Looking Ahead

As we look to the future, the CB course currently seems well placed to deal with potential contingencies. We have managed to upgrade and update the course so that it keeps pace with recent developments within the conservation biology field. The fact that we continue to attract top students from all over the world indicates that the course remains highly rated, both nationally and internationally. Some of our key concerns will nonetheless be to continue to keep the curriculum aligned with contemporary trends in conservation biology; to attempt to secure a greater amount of funding for student bursaries, particularly for students from Africa; and to ensure that the quality of teaching and project work remains high. The fact that some 85% of our graduates are currently employed in the conservation arena in South Africa and further afield emphasises the local and global need for skilled conservation biologists – a need we are helping to satisfy on an ongoing basis.

Course co-ordinators

Prof. Graeme Cumming
Assoc. Prof. Peter Ryan

External/Contractual lecturers

Assoc. Prof. Colin Attwood (Zoology, UCT)
Dr Phoebe Barnard (SANBI)
Dr Jacqueline Bishop (Zoology, UCT)
Dr Peter Carrick, (Botany, UCT)
Dr Woody Cotterill (Geological Sciences, UCT)
Dr Georgina Cundill (Rhodes University)
Assoc. Prof. John Hoffmann (Zoology, UCT)
Prof. Astrid Jarre (Zoology, UCT)
Dr Jackie King (Water Matters)
Prof. Norman Myers (Oxford University)
Dr Jack Ritchie (Philosophy, UCT)
Dr Jane Turpie (Anchor Consultants)



Delighted 2011 CB students interact with one of the world's natural history media icons at Kirstenbosch (Photo: Cheryl-Samantha Owen)

Conservation Biology projects 2011/2012

Best, Nikki: The historical exploitation of chondrichthyans in False Bay, South Africa and assessment of their conservation status. Supervisor: Colin Attwood.

Cressey, Emily: The conservation genetics of a newly recognised Cape Peninsula endemic: Rose's Mountain Toad (*Capensibufo rosei*). Supervisors: Krystal Tolley, John Measey and Peter Ryan.

De Vos, Lauren: Baited remote underwater video survey of reef fish in the Stilbaai marine protected area, with an assessment of monitoring requirements. Supervisors: Colin Attwood, Albrecht Götz.

Goss, Jeremy: Human networks of vertebrate translocations in the Western Cape, South Africa: trends and potential impacts on biodiversity. Supervisor: Graeme Cumming.

Mbatha, Hlengiwe: Understanding tradeoffs between biodiversity and ecosystem services: Exploring the biodiversity and ecosystem service tradeoffs associated with different livestock practices in the Enkangala grasslands, South Africa. Supervisors: Jeanne Nel, Belinda Reyers and William Bond.

McCarter, Jenneca: Major histocompatibility complex diversity in an urban Chacma Baboon (*Papio ursinus*) population: implications for conservation. Supervisor: Jacqueline Bishop.

Moore, Christine: Understanding highly pathogenic avian influenza outbreaks in the Western Cape ostrich industry: did network dynamics enhance vulnerability. Supervisors: Graeme Cumming, Jasper Slingsby.

Rice, Edward: Rory Lines: a silver lining for seabirds in South Africa's demersal trawl fisheries. Supervisor: Peter Ryan.

Schutgens, Maurice: Collisions and biases: estimating the impact of low-voltage distribution lines on the Ludwig's Bustard (*Neotis ludwigii*). Supervisor: Peter Ryan.

Sebele, Lovelater: Factors influencing the timing of breeding a range-expanding raptor at two spatial scales. Supervisor: Arjun Amar.

Tuagben, Darlington: The vulnerability of the coast of Liberia to marine oil spills: implications for biodiversity and renewable natural resource utilization. Supervisors: Patrick Morant, Jane Turpie and Peter Ryan.

Wright, Dan: Significant population structure and little connectivity in South African rocky shore species: implications for the conservation of regional marine biodiversity. Supervisor: Jacqueline Bishop.

Service, Profiling and Outreach during 2011

IN RECENT YEARS, IT HAS BECOME INCREASINGLY EXPECTED THAT ACADEMICS AND ACADEMIC RESEARCH SHOULD BENEFIT SOCIETIES AND COMMUNITIES OUTSIDE THE NARROW AND IMMEDIATE CONFINES OF ACADEMIA ITSELF. THE FITZ HAS A LONG-STANDING TRADITION OF PUBLISHING ITS RESEARCH IN POPULAR MAGAZINES AND AS POPULAR BOOKS, AND HAS DEVELOPED GOOD RELATIONS WITH OTHER MEDIA, INCLUDING RADIO AND TELEVISION. YOU MIGHT WELL ASK, AS MANY OF US DID FOR YEARS – ‘HOW CAN BIRD RESEARCH PROGRESS BEYOND THAT POINT IN THE BENEFICIATION STAKES?’. WELL, THE ANSWER IS SIMPLE – WITH SOME IMAGINATION AND COMMITMENT, QUITE A LONG WAY. IN 2011, DIRECT EMPLOYMENT SPIN-OFFS FROM FITZ RESEARCH PROJECTS BENEFITTED BOTH PREVIOUSLY DISADVANTAGED SOUTH AFRICANS (19 FULL-TIME JOBS AND 59 PART-TIME JOBS) AND RURAL AFRICANS IN ANGOLA AND ZAMBIA (10 FULL-TIME JOBS AND 44 PART-TIME JOBS)

Community and equity outreach

The Cape Parrot Project in the Amatole Mountains of the Eastern Cape aims to plant 25 000 indigenous tree saplings (predominantly yellowwoods) each year for the next two years and erect 600 artificial nest boxes for parrots in suitable trees throughout the Hogsback area. We have injected much-needed investment into a poorly managed, community-run indigenous tree nursery by purchasing their entire stock of 5 000 indigenous tree saplings. We are teaching local women to use “worm farms” to produce fertilizer and grow the yellowwood saplings. Teams of five local women are supervised by our Community Liaison Officer (jointly employed by the Fitz and BirdLife South Africa) planting up to 1 000 saplings in individual forest patches. They will be trained how to take care of these saplings and, following an audit by the Community Liaison Officer, will be paid up to R50 000 each year. The project has also taken over the management of a pecan nut orchard at the University of Fort Hare, where over 280 Cape Parrots feed daily for more than four months each year. We have contracted local women to gather the pecan nuts, de-shuck and package them. Revenue from this will be shared between the women and the management of the orchard. The Cape Parrot project has also initiated the Green Campus Initiative at Fort Hare by planting 750 indigenous trees (wild olives and wild plums) with the Student Representative Council and the International Leadership Council hosted by Fort Hare.



Members of the Oceanview community bird-scaring line manufacturing team at work. (Photo: Meidad Goren)

The Fitz’s seabird and fishing industry programme has initiated the use of bird-scaring lines (BSLs) to minimize the incidence of seabird bycatch by industry. This created the opportunity for 10 disadvantaged coloured people in the Oceanview community, Kommetjie (5 males and 5 females ranging from 22 to 71 years old) to form a micro-industry making BSLs. Older people involved are able to pass on their skills and knowledge to the younger members of the team. They are able to build a long-line BSL in two

hours and a deep-sea trawl line in one hour. They sell the lines for R150 each and are thus able to bring money back into the community. Some of the team are ex-fishermen and now regard this as an alternative livelihood.

The brood parasite project in Zambia run by Claire Spottiswoode has provided a source of income to over 40 local people, mostly unemployed farm labourers, as well as full-time employment to 10 people. During 2011, few of these were women, but we are actively trying to recruit more women to take part in the project. Claire is also a Mentor for the British Ecological Society's Mentorship Scheme for Women in Ecology and gave a talk on academic careers in science for the Women in Science, Engineering and Technology Initiative in Cambridge, UK, during 2011.

The project at Mount Moco in Angola has employed, on a part-time basis, four young men from the Kanjonde community to run a nursery for forest tree species that will be used to expand the remaining forest fragments. The project is also promoting Mount Moco as an avitourism destination, increasing work opportunities for the local guides.

Kate England completed her MSc CB project on the disturbance to shorebirds by local resource users and tourists at the Sabaki River Estuary, Kenya during 2011. The study included a livelihood and resource-use survey of 190 households. Although 70% of income was from natural resources, and restricting resource use would therefore impact local livelihoods and thus undermine conservation, over 90% of households responded positively to both increased tourism and regulation of resource use. Recommendations from her project included the provision of a piped water supply

which would increase agricultural protein output and income, thus reducing fishing activities. It would also increase women's time for more constructive activities than that of fetching water from the estuary. In the same vein, research into avian malaria and avian influenza, diseases which affect chickens and other poultry, is providing information that can be used to educate African women about the risks of handling poultry as well as the causes of the spread of these diseases.

The 5th Biodiversity Conservation Academy, a joint venture between the Fitz CoE and the CoE for Invasion Biology (CIB), was held at Potberg Environmental Education Centre in De Hoop Nature Reserve during January 2011. The Academy was attended by 11 students from seven South African universities, and three interns from the South African National Biodiversity Institute and SANParks. All of the 14 students were black and nine were women. The five-day programme immersed students in an intensive series of theoretical, practical and philosophical discussions and field-work sessions on biodiversity conservation. The aim of these sessions was to enhance student appreciation for the complexity of biodiversity, sharpen their knowledge and skills required to assess it, and broaden their knowledge of the theory and practice of conservation in a South African context. The Academy received high commendation from the participating students. Of the 95% of previous attendees whose future has been tracked, 75% have pursued post-graduate studies or internships in the conservation biology sector.

Service rendering and commercial partners

Whilst the upliftment of disadvantaged communities is an important and worthwhile cause, we must never lose sight of the fact that we also have a responsibility to make the results of our research available to those agencies who have pressing and immediate needs for such information. These activities fall under the broad ambit of service rendering. 'Clients' for such services include governments (home and abroad), provincial conservation agencies, NGOs and the corporate world. The Fitz has been involved in such service rendering for decades: indeed, many research projects have been initiated because of such demand. We continue to fulfil such needs today and some examples follow.



Women will hopefully play a more constructive role in their community following the Sabaki Estuary project. (Photo: Kate England)



Participants in the 5th Biodiversity Conservation Academy, January 2011. (Photo: Sarah Davies)

During 2011, the International Commission for the Conservation of Atlantic Tunas (ICCAT) entered a new era in cooperation and willingness to embrace the measures that have been designed and shown to be effective at reducing seabird by-catch in long-line fishing. Fishing nations, led by Japan, agreed to simplify the current requirements for fishing vessels operating in areas of highest risk to albatrosses. The Commissioners accepted that the best available science supports the use of a combination of only three measures, and moved to eliminate all other measures which do not have scientific support. The three measures are: only setting lines at night when few seabirds can forage effectively, mandatory use of 'bird-scaring streamer lines' (also called Tori lines), and the addition of weights to ensure that baited hooks sink quickly. These measures are currently required in South Africa's domestic and joint-venture tuna long-line fisheries, and South Africa was one of the supporting nations for the successful amendments to the ICCAT resolution. The Fitz and BirdLife have been working towards this since 2004, and the new ICCAT measures have been enforced in South Africa since 2008. Monitoring of mortality on long-lines in the ICCAT area has shown that these simple techniques can reduce seabird deaths by 80% or more, without impacting fishing operations' profitability. This resolution finally brings the rest of the Atlantic tuna fleets in line with South Africa's domestic policy, and we applaud the proactive role of the South African delegation to the 2011 ICCAT commission in working with the other nations to achieve this.

Staying with seabirds, members of the Fitz's Nelson Mandela Bay penguin research team

have been comparing two management strategies to increase African Penguin breeding success. This has resulted in the continued culling of Kelp Gulls *Larus dominicanus* by SANParks on Bird Island, Eastern Cape, as well as changing the design of artificial burrows. The latter have been changed from fibreglass to cement pipes cut in half, resulting in an increased survival of penguin chicks. The Fitz's Nelson Mandela Bay research team has also been training formerly disadvantaged rangers from SANParks to collect data on the penguins at Bird Island, Eastern Cape. Peter Ryan has also been advising the Robben Island Museum on various strategies to protect cormorant breeding colonies from human disturbance.

The Ludwig's Bustard project, which amongst other things aims to explore mitigation options through experimentation of power-line marking devices and visual assessment of bustards and other collision-prone species, has rendered a close relationship between the Fitz and ESKOM. Following our successful application, Ludwig's Bustard was upgraded to globally *Endangered* on the 2010 IUCN Red List (based on preliminary power line mortality survey data and population modelling). We also recently assisted the Endangered Wildlife Trust and the Eskom live-line team as they put up a large-scale bird-deterrent experiment on transmission lines near De Aar. This will test whether marking devices are effective in lowering bird collision mortality.

Research on the Afromontane forests of Angola is being used to support and guide Angola's Ministry of the Environment to develop a conservation strategy for this endangered habitat, including choosing and designing appropriate protected areas.

The 'Hot Birds' team assisted BirdLife South Africa with the development of lobbying materials as part of the United Nations Convention Framework on Climate Change (NFCCC) for use at the 17th International Climate Change Conference of Parties (CoP 17) held in Durban during December 2011.

The waterbird spatial ecology and diseases team led by Graeme Cumming are working with Ezemvelo-KZN Wildlife to understand anthropogenic impacts on waterbirds on the Pongola floodplain which will lead to refinement of management policy for the area.

We are also involved in ongoing research with Dr John Grewar of SA Veterinary Services,

Dr Celia Abolnik of Onderstepoort Veterinary Institute, and the Ostrich Producers' Association (Oudtshoorn) to try to better understand and manage the causes of avian influenza outbreaks among farmed ostriches. Christine Moore investigated the ramifications and intricacies of the avian flu (N2H5) in the ostrich industry in South Africa with the intention of advising the industry on vulnerability to avian flu. This followed the 2004 and 2011 outbreaks which lead to the culling of 32 000 birds in 2011 and subsequent compensation by the Government to the tune of R23 million. The project has offered recommendations on the alterations of the design of the production system and a new pathogen-testing strategy.

In addition to project-linked services, during 2011 Fitz members served on the editorial boards of 16 scientific journals, and on 35 membership and advisory services, as well as reviewing 97 papers for 50 international and local journals. Fitz staff members also contributed to an NRF SARCHI Review Panel, conducted four NRF personal rating evaluations and one NRF Post-doctoral Fellowship evaluation.

While service rendering is an important component of our activities, it is also important for us to keep our activities in the public eye –

there is no point doing great work if only a select handful of academics are aware of it ...

Putting ourselves out there

Fitz staff and students attended 11 international and seven local conferences during 2011. This year, Tim Crowe received the Southern African Society for Systematic Biology's Lifetime Achievement Award for Extraordinary Contributions to Systematic Biology and Sharon Okanga was awarded the best student presentation at the Parasitological Society of Southern Africa Conference.

The Fitz presented a stand at the NRF/DST 2010/2011 CoE Annual Day held at UCT Medical School during February 2011, at which Phil Hockey gave an overview of the alignment and delivery of the Fitz CoE to the South African Government's Outcomes Approach, specifically for research and development. The Fitz also presented a stand at the NRF's National Post-doctoral Research Forum at the Lord Charles Hotel, Somerset West, during December 2011. This was a valuable opportunity to network with the other CoEs and to expose the activities of the Fitz to numerous Post-doctoral Fellows from across the country.

The Fitz also presented a stand at the Biodiversity Expo hosted by Kirstenbosch



The newly launched research boat 'Winkle' with a state-of-the-art, multi-scan sonar system which can estimate the abundance and movements of the fish prey of the *Endangered* African Penguin. (Photo: Gary Davis)

National Botanical Gardens, SANBI, during May 2011. The Biodiversity Expo is an annual conservation community event where conservation organizations gather to exhibit their current work to Western Cape schools and the general public. While the primary focus is on exhibiting conservation work, a diverse range of other value offerings have spun off from the event such as career guidance, job opportunities, sustainable living, business opportunities and corporate social investment opportunities. The four-day event also initiated a blog site with the objective of maintaining an online presence so that participants can interact with the conservation community from year to year.

UCT celebrates Africa Day on 25 May each year, which is an opportunity to highlight our role in, and contribution to, higher education and development in South Africa and the rest of Africa. The week-long Africa Exhibition during May 2011 highlights academic research, capacity-building endeavours, collaborations and links that UCT staff members have forged with continental universities, and the contribution made to the generation of African knowledge. The Fitz presented a stand with a banner and posters which reflected our activities and impact in Africa.

..... and in the media

A significant collaborative event this year was the launch of the Penguin Research Vessel, "Winkle", at the Algoa Bay Yacht Club in Port Elizabeth in June 2011. More than 130 people, including many sponsors and conservation partners, attended the event. Equipped with a hi-tech, multi-scan sonar, the Winkle will allow the research team to gain an accurate picture of sardine and anchovy movement. We know where the penguins are going through GPS deployments, and where the fishermen are catching their prey, but we don't know how many fish are actually available to the penguins and the fishermen. The extent to which fish move is critical to designing the appropriate size and configuration of no-take zones where fish can escape heavy fishing pressure and be more available to the penguins close to home. The event was covered by the *Algoa Sun*, *The Herald* and *Die Burger*, and also screened on the SABC news that Sunday evening. Information on the project and photographs can be viewed at www.algoafm.co.za/blog or the project's Blog, The Penguin Patrol: AlgoaFM.

Following the launch of the Cape Parrot Project *Facebook* page during 2010, which became the largest parrot conservation group online anywhere in the world, with over 5 000 subscribers and hundreds of photos, videos, links and posts, the project has this year produced a DVD which has been screened in the USA on PBS and local networks. "Endangered" has now brought it to South Africa where it will be screened after "Shoreline 2" during 2012.

Another 'parrot highlight' during 2011 was that one of our project collaborators (Natalie Rowles), who supplied over 600 *Podocarpus latifolius* saplings for the tree-planting scheme, won a "Special Commendation" in the *Mail & Guardian's* "Greening The Future Awards for 2011" for her "Free Trees for Schools" programme. Most of her saplings were planted at the University of Fort Hare by the project's planting team under Nic Armstrong, the project horticulturalist trained at Kirstenbosch gardens. These trees will improve the local food supply for Cape Parrots which, at some times of year, are really struggling to find enough high-quality food.

The 'arms race and co-evolution' research by Claire Spottiswoode appeared in a full-page interview published in *The Observer* (the Sunday UK edition of *The Guardian*; June 2011); a video podcast interview published by The Royal Society; media coverage published in *The New York Times* (twice); BBC News website (twice); *The Times*; *USA Today*; *New Scientist*; *Discover Magazine*, and other international newspapers and magazines (e.g. *De Volkskrant*, *NRC Handelsblad* and *Kijk* in The Netherlands; *Science et Vie* in France; *Infox* in Russia, and *Il Venerdì di Repubblica* in Italy), as well as a commentary published in the *Proceedings of the National Academy of Sciences*, USA.

Findings of the Ground-Hornbill Project in the Associated Private Nature Reserves (APNR) adjacent to the Kruger National Park have been produced as a DVD titled "Hornbill in Crisis", which has been well received by funders and potential supporters. A full-length documentary of the project was also completed in 2011 and is currently being updated. The project was also featured on 50/50.

We have also launched two *Facebook* pages for the Fitz itself, rather than projects: more details in the Director's report. Have a look there, too, for some details about the visit of Sir David Attenborough to the Fitz in 2011.

Niven Library

DURING 2011 THE LIBRARY OF THE ANIMAL DEMOGRAPHY UNIT WAS TRANSFERRED TO THE NIVEN LIBRARY FOR INCORPORATION. THE DIGITISING OF PFIAO STAFF PAPERS BACK TO 1960 AND THE DIGITISING OF CONSERVATION BIOLOGY PROJECTS BACK TO 1996 WERE COMPLETED. THE LIBRARIAN INITIATED CLOSER TIES WITH SANBI LIBRARIES AND THE BIODIVERSITY HERITAGE LIBRARY IN ORDER TO DIGITISE HERITAGE AFRICAN ORNITHOLOGICAL INFORMATION AND MAKE THIS AVAILABLE IN THE OPEN DOMAIN TO SUPPORT AFRICAN BIODIVERSITY CONSERVATION. AN ONLINE LIBRARY GUIDE WAS DEVELOPED TO ALERT USERS TO THE LATEST MATERIAL AND GIVE ONGOING ASSISTANCE IN THE USE OF RESEARCH RESOURCES. THE REMAINING UCT LIBRARY BOOKS AND JOURNALS IN THE NIVEN LIBRARY WERE PERMANENTLY DONATED TO THE NIVEN LIBRARY.

Staff and staff development

Margaret Koopman

New initiatives included the development of integrated library software (ILS) and an intensification of the digitising effort. Both are time-consuming tasks and, in the case of the ILS, each component has to be customised to suit the library before the current database can be imported. The Librarian is dependent on manuals and a user group for trouble shooting as there are no other libraries in South Africa using this Free and Open Source Software, the closest user group being in Zimbabwe and one test site being in Namibia.

Launching the digitised collection remains a problem as there is nobody within the Fitz who has the requisite skills to develop an online repository. Where archival literature is concerned, the Librarian is seeking collaboration to achieve this, including from the Biodiversity Heritage Library.

Since July 2010, the Librarian has engaged with the University's Human Resources department regarding the lapsed professional status of the Niven Librarian post: this had not been resolved by the end of 2011.

The Librarian continued to support the research initiatives of Fitz staff and students, BirdLife South Africa, the Zoology Department and researchers around the world.

Phelisa Hans

A new task for Phelisa for 2011 was inputting the publication count for the Fitz, under the guidance of the Librarian. Phelisa also shelves books, journals, newsletters and reprints; assists with

annual shelf-reading; inter-library loans and responds to requests for information if the Librarian is away. She manages the recording and statistics of new journal and newsletter acquisitions, and continues to digitise student theses, including Zoology Honours projects. A complete set of MSc Conservation Biology theses will be launched through links to the Fitz Website, as well as a complete set of staff papers back to 1960 once the relevant copyright clearance has been achieved.

Workshops given

The Librarian conducted the annual MSc CB information skills workshop. This involves a tour of the UCT Main and Niven Libraries: the students are introduced to various databases and shown how to compile a bibliography for a specific journal, using two bibliographic tools, RefWorks (a proprietary tool offered by UCT Libraries) and Mendeley (an open-access tool freely available from the Web). They are encouraged to use one of these tools to organise their readings for their thesis and publications emanating from their project.

The Niven Library hosted a workshop in August 2011 for Zoology staff and postgraduate students on the use of Web of Science. The workshop was a combined initiative of UCT Library and the Niven Library. Eight people attended the workshop. This workshop may be repeated in 2012.

Workshops attended

The librarian attended the annual EBSCOhost meeting, where the main product being pro-

moted was a one-stop-shop for academic researchers, somewhat like the Primo interface introduced by UCT Libraries during 2011.

The librarian attended two copyright and open access workshops hosted by the OpenUCT initiative. This was useful since UCT now employs a specialist copyright lawyer who was helpful in establishing the copyright status of articles published in *The Ostrich* between 1930 and 2002. Many Fitz papers have been published in this journal and it was established that during these years copyright remained with the authors. To make these articles Open Access on the Fitz website will require permission of the authors and the establishment of a Creative Commons licence for each paper.

In November 2011 the Librarian attended the Life and Literature Conference in Chicago and contributed to the workshop on digitising African heritage literature. This invitation was made by the Biodiversity Heritage Library, the Field Museum in Chicago and the JRS Foundation with a view to setting up a Biodiversity Heritage Library presence in Southern Africa. Digitised books and journals will be made available via Open Access on the Biodiversity Heritage Library, a digital library initiative. The Librarian initiated collaboration with the SANBI Library to submit a proposal in February 2012 for funding to set this up.

Whilst in the US the Librarian visited The Peregrine Fund library in Boise, Idaho. Books and journals from the Niven Library book sale were exchanged for books from The Peregrine Fund library with a savings value to the Niven Library of over R15 000.

Library liaison

The Librarian was invited to be a member of the British Ornithological Librarians' interest group, demonstrating that the Niven Library is a recognised international ornithological facility.

BirdLife South Africa's increasing focus on research has meant more use of the library and the services of the Librarian by the staff of BirdLife. Ordinary members of BLSA visit the library from time to time to consult our resources.

Library development

Research support

The Librarian continues to send alerts about the latest journal articles to Fitz staff and students, the Zoology Department and past students; a

popular service offered since 2007. In July 2011, the Librarian was granted access to the UCT Library proprietary software LibGuides. An interface has been developed for the Niven Library which allows users to see which new books have been added to the collection, gives ongoing support in the use of databases, off-campus access to resources, bibliographic tools and other useful applications. The guide can be found at the URL: <http://libguides.lib.uct.ac.za/content.php?pid-242411>.

Space management

During the year the Animal Demography Unit moved from premises in the PD Hahn building to the John Day building. The Niven Library took over the entire library of the ADU, the maps and the extensive set of nest record cards.

Collection management

Journals: The exchanges generously donated by Africa Geographic continue to benefit the Niven Library collection. The exchange agreements represented a savings of subscriptions in 2011 of R18 130.

The Estate of the Late Roelf Attwell contributed to filling gaps in runs of Zimbabwean nature conservation journals, such as *Rhodesia Science News* and *Wild Rhodesia*, as well as making hard-to-come-by African journals available for the exchange programme. Interesting reprints from the Attwell Estate will contribute to the MSc CB programme as they deal with relevant topics from southern Africa.

Books: Prof. Timm Hoffman of the Plant Conservation Unit donated a set of the useful publication *Biodiversity in Southern Africa* volumes 1-3. André Boshoff donated a copy of the second edition of Skead's *Historical Incidence of the Larger Land Mammals*. A copy of *Priority! The Dating of Scientific Names in Ornithology* was received from Edward Dickinson as the Librarian had contributed information about *The Ostrich* for the publication. Peter Steyn donated books from his personal collection to the library, 11 of which were taken into stock and duplicate titles included, with his agreement, in the book sale. Jenny Day donated her personal collection of books on evolutionary history to the library including the two volume set of *Life and Letters of Thomas Henry Huxley* published in 1900.

During November, the UCT Libraries donated the remaining UCT Library books which have

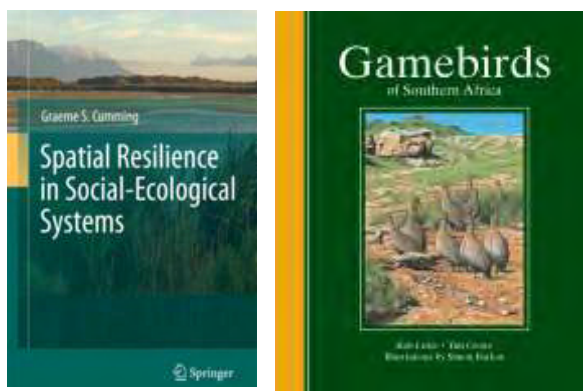
been housed on a semi-permanent loan basis in the Niven Library as far back as 1973. These books had been purchased against an Ornithology departmental book grant during the years 1973-1996. During the intervening years many books had been recalled to the UCT Main Library. All books which were returned appear on the Niven Library catalogue with their UCT Library location number.

The Niven Library purchased 15 books during the year, some of which increased the collection of books on the Free and Open Source Software (FOSS) programme "R", which is used for statistical analysis by the Fitz staff and students. Eleven books were received from publishing houses for review. The value of books received through review copies and donations during 2011 amounted to over R30 500.

During 2011 the Niven Library was the beneficiary of the Estate Late E.O. Pike which includes information on CD about birds nesting.

Book Sale: During 2011 an amount of R18 151 was raised for the library through the sale of ornithological books. The sale will continue in 2012.

Staff Books published during 2011



Cumming, G.S. 2011. *Spatial Resilience in Social-Ecological Systems*. Dordrecht, Springer.

Little, R.M., Crowe, T.M. 2011. *Gamebirds of Southern Africa*, 2nd ed. Cape Town, Struik Nature.

Databases: The University Library launched its long-awaited Primo interface to the UCT Library catalogue as a beta version during 2011. This has been described as "Google for undergrads" by a librarian from UKZN Libraries where it was launched in 2010. There is a search function which enables alerts to material in the UCT

Library collection to be e-mailed to a registered user (see the Niven Library guide), but by the end of 2011 there were still problems which had not yet been ironed out.

Electronic Journals: Towards the beginning of 2011 UCT Libraries enabled access to the titles *The Ostrich* (volume 68, 1997+) and *Bird Study* (44, 1997+), both Taylor & Francis titles.

Use of the Library

Table 1. Niven Library stock circulation

	2011	2010	2009	2008
Monograph	280	281	228	300
Reprints	9	14	52	27
Theses	15	16	26	24
Journals	55	153	181	141
Audio-visual	1	6	3	5
Total	360	470	490	497

Document Delivery

Table 2. Niven Library inter-library loans

	2011	2010	2009	2008
Items requested (by staff/students)	56	134	61	96
Items supplied	117	121	78	189
Requests not satisfied	0	13	14	15

Reprint requests

Table 3. Requests for PFILO Reprints

	2011	2010	2009
Number of reprint requests	123	177	238
Number of countries	22	33	23

The breakdown of requests (2010 statistics in brackets) by countries was: Argentina 1 (10), Australia 2 (9), Brazil 4 (2), Canada 1 (12), Chile 7, Columbia (1), Czech Republic 2 (8), Denmark 1, Falkland Islands 1, France 2 (11), Germany 8 (7), Guatemala (2), Hawaii (1), India (3), Ireland (1), Israel (2), Italy (9), Japan 1 (1), Malawi (2), Mexico 1 (2), Netherlands (1), Poland 1 (1), Portugal 3 (5), Prince Edward Islands (4), Romania 3, Russia 3 (1), South Africa 41 (36), South Korea (1), Spain 3 (3), Tasmania, 1, Tristan da Cunha (2), Ukraine 1, United Kingdom 8 (13), United States of America 12 (21),

Uruguay (1), Venezuela (1), Vietnam (1), Zambia (1).

The drop-off in reprint requests is directly linked to the high-visibility journals in which CoE authors publish their work which are readily available electronically to international researchers.

Research requests

A total of 2 030 requests for information were received during 2011, 43% of these from Fitz staff and students. Pdf or jpg files were supplied by e-mail to users locally, nationally and internationally. The number of hard copy articles supplied 43 [48] remains constant. In addition 85 literature searches were compiled and sent by e-mail to users. Other usage of the library was for verification of information, journal impact factors, calculation of H-indices, the supply of URLs and e-mail addresses. The Library received 881 research requests from Fitz staff and students, 234 from Zoology staff and students, and 73 from the ADU: 221 requests for information were also received from elsewhere at UCT, and 596 requests both nationally and internationally.

Requests for information

Requests for information were received from the following national and international organisations and individuals:

Ornithological NGOs

BirdLife Namibia; BirdLife South Africa; BirdLife Zimbabwe.

Conservation NGOs

Helderberg Nature Reserve; Macassar Nature Reserve; Okavango Research Institute Library.

Government affiliations

Craig Whittington-Jones, Gauteng Department of Agriculture & Rural Development; Institute for Maritime Technology; Greg Davies, Ditsong National Museum of Natural History.

Publishers

EarthTouch; The Birder e-magazine; Pearson Publishers; Howard and Moore *Checklist of the Birds of the World*.

Private Companies

Anchor Environmental; One World Group.

South African Universities

CPUT, BTech Nature Conservation

International Universities

Swedish University of Agricultural Sciences; Brown University, USA; Lund University, Sweden.

Acquisitions and collection building

By December 2011 the bibliographic records in the Niven Library database totalled 59676 [52627 in 2010]. The numbers of items received in the Niven Library are shown below:

Table 4. Niven Library acquisitions

	2011	2010	2009	2008
Monographs	137	185	155	113
Journals	392	443	530	351
Newsletters	215	165	328	296
Reprints	70	49	10	121
PDFs	1338	1764	1332	1300

Books added to the collection comprised books ordered by members of the Fitz, books donated and review books for *The Ostrich*. The Zoology Department, SAFRING, ADU and the African Seabird Group continued to donate their exchange journals.

Donations

We acknowledge with thanks donations from the following: Per Alstrom; Animal Demography Unit; E.J.M. Baumbach; Pamela Beresford; John Voelcker Bird Book Fund; A&C Black; André Boschoff; Adams Chaskda; Callan Cohen; John Cooper; Tim Crowe; Graeme Cumming; Jenny Day; Edward Dickinson; Kate du Plessis; Morné du Plessis; Mike and Liz Fraser; Christopher Helm; Timm Hoffman; Santiago Imberti; Paul Isenmann; Genevieve Jones; Lloyd Kiff, The Peregrine Fund; KNNV Publishers; Ian Little; Sampath Lokugalappatti; Lynx Edicions; Andre Mader; Dane Marx; Michael Mills; Patrick Morant; Ineke and Greg Modeley; Norman Myers; NISC; Dieter Oschadleus; Pippa Parker, Random Struik; Estate Late E.O. Pike; Peter Ryan; SAEON; Ute Schmiedel; Peter Steyn; Roy Siegfried; H.P. Silbernagl; Les Underhill; D.J. van Niekerk; Anthony van Zyl; Walker & Co.; Wiley- Blackwell.

Scientific publications 2011

Names in **bold** are members of the Fitztstitute or the Centre of Excellence.

IF = Impact Factor.

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Mike Fraser graduated from the Fitz in 1990 with an MSc on the topic of birds associated with fynbos in the Western Cape. Although Mike and his artist wife Liz returned to their native Scotland, they continue to associate with the Fitz and with fynbos. Their latest, beautifully illustrated book, *The Smallest Kingdom*, was donated to the Niven Library by the authors. From left, MSc student Mia Cerfonteyn, Phil Hockey, Arjun Amar and Peter Ryan.

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