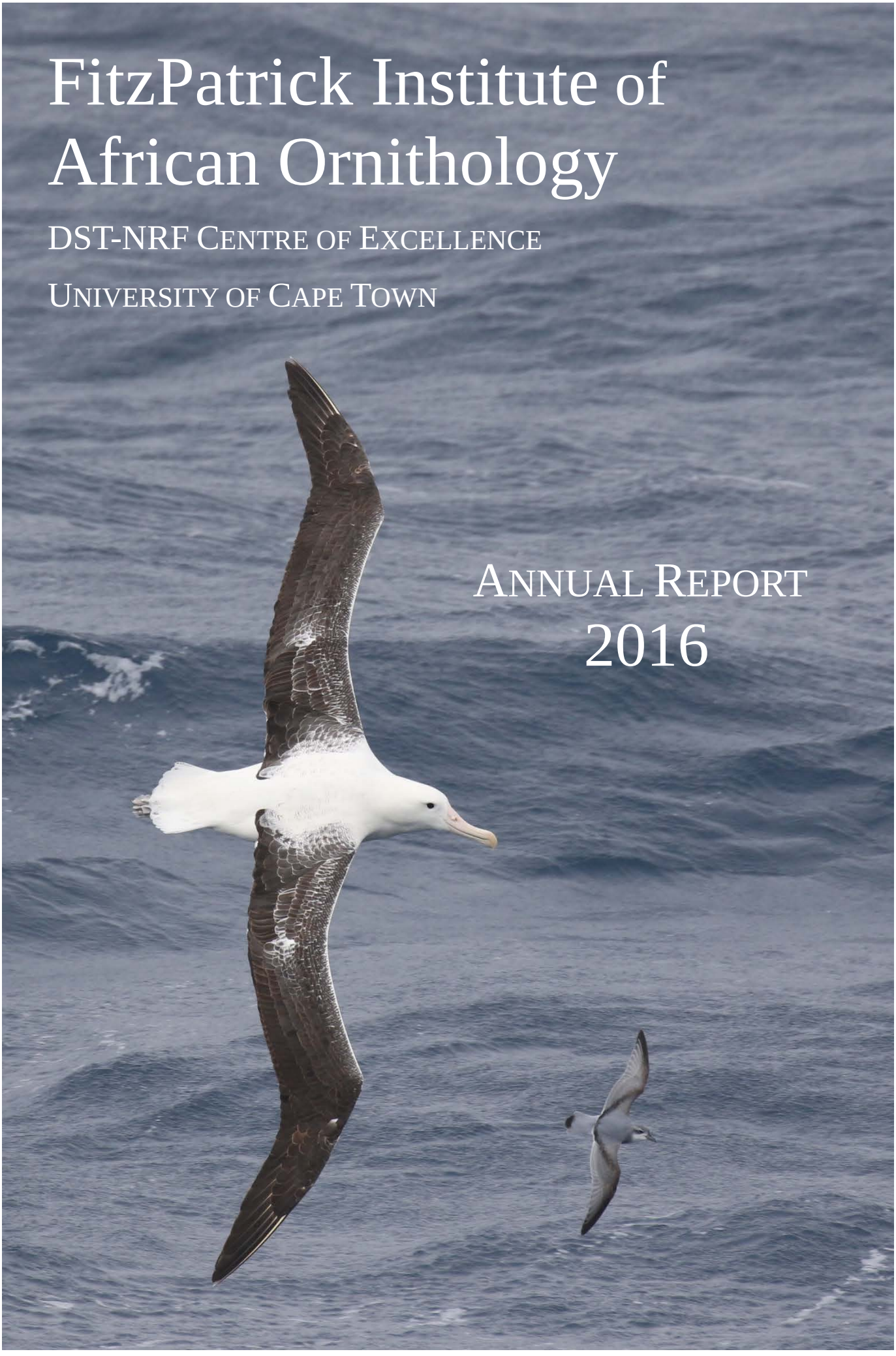
FitzPatrick Institute of African Ornithology

DST-NRF Centre of Excellence

University of Cape Town



Annual Report 2016

FitzPatrick Institute Advisory Board 2016

Mark Anderson (BirdLife South Africa)
Dr Graham Avery (WESSA)
Michael Buckham (co-opted)
Dean Ferreira (co-opted)
Vernon Head (co-opted)
Prof. Anton le Roex (Dean of Science, UCT, Chairperson)
Prof. Michael Meadows (ENGEO, UCT)
A/Prof. Muthama Muasya (HoD, Biological Sciences, UCT)
Clyde Niven (FitzPatrick Memorial Trust)
Rory Niven (FitzPatrick Memorial Trust)
Prof. Peter Ryan (PFIAO)
Francois van der Merwe (co-opted)
Prof. Danie Visser (Research, UCT)

Centre of Excellence Board 2016

Prof. Mike Cherry (Botany & Zoology, Stellenbosch)
Prof. John Donaldson (SANBI)
Prof. Anton le Roex (Dean of Science, UCT)
Dr Thandi Mgwebi (NRF)
A/Prof. Muthama Muasya (HoD, Biological Sciences, UCT)
Prof. Peter Ryan (PFIAO)
Dr Marilet Sienaert (Research Office, UCT)
Dr Hanneline Smit-Robinson (BirdLife South Africa)
Prof. Danie Visser (Research, UCT, Chairperson)

FRONT COVER: **A Southern Royal Albatross *Diomedia epomophora* dwarfs a Salvin's Prion *Pachyptila salvinini* off Marion Island (Photo: Peter Ryan).**

REPORT LAYOUT: HILARY BUCHANAN

Contents

Director's Report

Peter Ryan on Scott Island during the ACE cruise, with the *Akademik Tryoshnikov* in the background (Photo: Ben Bernard).

2016 was another productive year for the Fitz. Despite ongoing disruptions on university campuses around the country, the Fitz Centre of Excellence (CoE) set a new record with 151 peer-reviewed publications appearing in 2016. There was no shortage of 'quality' papers either; 42 were published in journals with impact factors greater than 3.5, with the highlight being Claire Spottiswoode's paper "Reciprocal signaling in honeyguide-human mutualism" that appeared in *Science*. This impressive output was largely instrumental in the University of Cape Town recently being ranked as joint third in the world for ornithology studies by the Centre for World University Rankings.

Fitz staff and students also made a great effort to ensure that their findings reached the broadest possible audience. Almost 100 popular articles were published in 2016, and many research projects were featured on radio and TV programmes. There is also increasing use of a diverse array of social media platforms.

2016 was equally productive in terms of postgraduate students. No fewer than seven PhDs were capped: Julia Baum, Hayley Clements, Dominic Henry, Alistair McInnes, Megan Murgatroyd, Chevonne Reynolds and Gareth Tate. Jenni Roberts was awarded an MSc by dissertation, and 11 conservation biology MSc students graduated: Jennifer Angoh, Christiaan Brink, Angela Ferguson, Gabi Fleury, Kyle Lloyd, Hermenegildo Matimele, Penny Pistorius, Jessleena Suri, Wataru Tokura, Julia van Velden and Elke Visser. Congratulations to them all, as well as two Fitz CoE-supported students based at other institutions: Mathew Noakes was awarded his PhD from the University of Pretoria, and Tegan Carpenter-Kling her MSc from NMMU.

Fitz students continued to excel. Dr Margaux Rat's PhD thesis won the Purcell Memorial Prize for the best zoological dissertation awarded at UCT in 2015. PhD student Alistair McInnes (best oral presentation on conservation-based research) and MSc student Noelle Tubbs (best poster on conservation-based research) were among five students who won seabird conservation prizes from the Royal Society for the Protection of Birds at the 9th International Penguin Congress held in Cape Town in September 2016. Post-doc Petra Sumasgutner received the top oral presentation award as an early career scientist at the British Ornithologists' Union conference on urban birds held in Leicester in April, post-doc Anina Coetzee won the prize for the best young scientist presentation at the International Association of Vegetation Science conference in Brazil in June, and post-doc Alan Lee received the best poster award at the Fynbos Forum held in Port Elizabeth in July 2016.

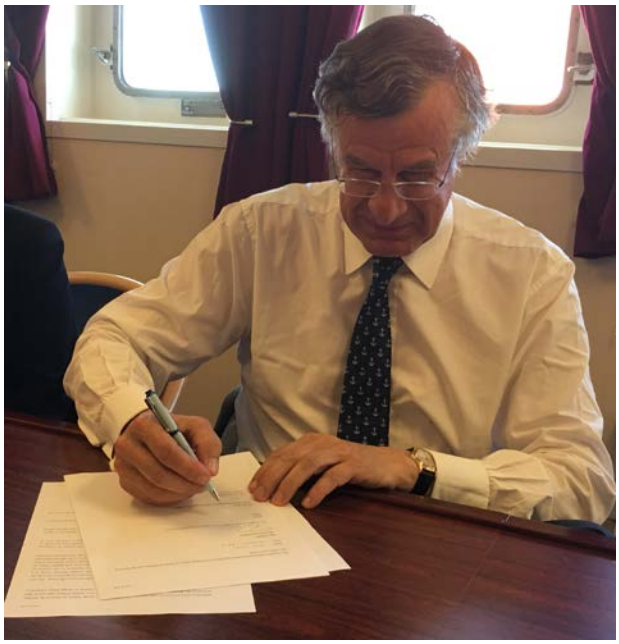
The Fitz and BirdLife South Africa (BLSA) co-hosted the third LAB (Learn About Birds) conference – a stimulating meeting of academic and amateur birders held in conjunction with BLSA's annual general meeting or 'Flock' every second year. The meeting in 2016 was held in Skukuza, which no doubt boosted its appeal, but there has been a steady growth in attendance since the first LAB was held at Port Elizabeth in 2012. This success brings its own difficulties, because there are not too many venues close to good birding areas that can hold a meeting for around 500 delegates. LAB 2018 will be hosted in the Western Cape for the first time, at a venue just outside Langebaan.

The fact that the Fitz CoE not only exceeds its performance targets, but continues to grow despite a decrease in real CoE funding, highlights the success of the centre of excellence model. The Fitz CoE is midway through its third 5-year funding cycle, and there is still uncertainty as to what will happen when the current cycle ends in 2019. The CoE Directors' meeting, held in Durban in August 2016, was designed to address this question. Senior officials from the Department of Science and Technology (DST) and the National Research Foundation (NRF) enthused about the success of the six original CoEs, and agreed that they should continue to be supported, but that "there must be a change in the funding model". This

apparently means that other beneficiaries of the CoEs must shoulder some of the costs. Officials from the DST offered to facilitate negotiations with other government departments, and looked to industry and the universities to increase their investment in CoEs, but neither avenue seems particularly fruitful for the Fitz. The research we do is largely for the public good, with little direct commercial relevance, and university budgets continue to be squeezed by income cuts and increased expenditure on non-academic activities (necessitated in part by the Fees Must Fall protests).

I'm writing this report on the high seas, at the end of three months spent on the Antarctic Circumnavigation Expedition (ACE). Having spent more than 30 years travelling to islands in the African sector of the Southern Ocean, ACE offered the chance to gain a broader perspective of Antarctica. The cruise started and ended in Cape Town, calling at a mouth-watering selection of sub-Antarctic and Antarctic islands en route. I was fully occupied conducting surveys of breeding seabirds at seldom visited islands, as well as recording the distribution and abundance of seabirds, marine mammals and drifting debris while the *Akademik Tryoshnikov* steamed between islands. During the 90 day cruise I recorded more than 30 000 seabirds (88 species), 2 600 marine mammals (27 species), 1 000 drifting kelp plants and 22 litter items in more than 15 000 km of transects. I also ran a project to assess the prevalence of microplastics in the Southern Ocean. Given the scarcity of large plastic debris, I wasn't expecting to find much evidence of microplastics, although we have known since the 1980s that many Southern Ocean seabirds ingest small plastic particles. As expected, our net samples contained little if any plastic, but biological oceanographers filtering water coming in through the ship's underway water supply (collected 4.5 m below the sea surface) reported finding a few synthetic-looking fibres in their samples. Subsequent bucket samples of surface waters confirmed the almost ubiquitous presence of fibres throughout the Southern Ocean. We still need to confirm that they are synthetic in origin, but the finding indicates the worrying extent to which very small plastic items have dispersed to even the most remote parts of our oceans.

ACE was the first research activity of the Swiss Polar Institute, brain-child of philanthropist Frederik Paulsen. Frederik, who accompanied the Expedition, has a strong pedigree of polar exploration, being the first person to visit all eight 'poles' (geographic, magnetic, geo-magnetic and the poles of inaccessibility in both hemispheres). During ACE, he was shocked by the plight of seabird chicks on Marion Island being attacked by introduced house mice. The ability of the South Georgia Heritage Trust to tackle rats and mice on South Georgia was in large part due to Frederik's support. Excitingly, he offered to leave the expedition's three helicopters in South Africa for use in mouse eradications on Gough and Marion Island. This generous offer stimulated discussions with the South African Department of Environmental Affairs, and led to the government committing to mount an eradication attempt to remove mice from Marion Island. Such public-private partnerships offer a viable model to fund conservation, research and academic initiatives in a time of shrinking government budgets for these activities.



Frederik Paulsen signs the donation agreement giving three helicopters and $100,000 to the Department of Environmental Affairs for use in mouse eradication programmes (Photo: Guy Preston).

Sadly, I have to end this report on a sombre note. The winter student intern programme once again brought students from Limpopo University to UCT for three weeks in June 2016. Honours student William Madumane returned for a second year, accompanied by under-graduates Abigail Ramudzuli and Samuel Tebogo. William had an NRF internship to study Red-winged Starlings at the Fitz in 2017, but tragically was killed in a home invasion at the end of 2016.

Peter Ryan, March 2017

Staff, Students and Associates

UCT GRADUATES

PhD
Dominic Henry, Megan Murgatroyd, Chevonne Reynolds (June); Julia Baum, Hayley Clements, Alistair McInnes, Gareth Tate (Dec)

MSc
Jenny Roberts (June)

Conservation Biology MSc
Jennifer Angoh, Christiaan Brink, Angela Ferguson, Gabriela Fleury, Kyle Lloyd, Hermenegildo Matimele, Penny Pistorius, Jessleena Suri, Wataru Tokura, Julia van Velden, Elke Visser (June)

NEW UCT POST-DOCS AND STUDENTS

Post-doctoral fellows
Diana Bolopo (Robert Thomson); Anina Coetzee (Claire Spottiswoode); Megan Murgatroyd (Arjun Amar); Chevonne Reynolds (Claire Spottiswoode)

PhD
Amanda Bourne (Susie Cunningham); Jordan Calder (Robert Thomson)

MSc
Campbell Fleming (Peter Ryan); Laurie Johnson (Peter Ryan); Luke McClean (Claire Spottiswoode); Ditiro Moloto (Peter Ryan)

Upgrade from MSc to PhD: Ben Dilley, Rebecca Garbett, Kim Stevens

Conservation Biology MSc
Fourteen students began the CB MSc in January 2016.

BSc Hons
Carla duToit, Alexis Osborne, Kervin Prayag, Sanjo Rose

Staff
*** Denotes permanent member of the UCT staff establishment**

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

Academic and Research Staff:
Dr Arjun Amar, PhD (Aberdeen)*
Dr Susan Cunningham, PhD (Massey)
Prof. Claire Spottiswoode, PhD (Cambridge)* (July-Dec)
Dr Robert Thomson, PhD (Oulu)*

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

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

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

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

Support Staff

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

Principal Technical Officer: Gonzalo Aguilar*

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

Senior Secretary, DST-NRF CoE:
Denise Scheepers

Departmental/Accounts Assistant:
Anthea Links*

Niven Librarian:
Susan Mvungi MSc (Cape Town)*

Niven Library Assistant:
Phelisa Hans

Ad Hoc Research Assistants:
Cassie Carstens, Mark Cowen, Isabelle Giddy, Dominic Henry, Carrie Hickman, Sello Matjee, Kyle Middleton, Lisa Nupen, Nola Parsons, Vonica Perold, Kervin Prayag, Stefan Schoombie, Lucy Smythe, Miqkayla Stofberg, Jessleena Suri, Gareth Tate, Chris Tobler, Julia van Velden, Eleanor Weideman, Kim Zoeller

Post-docs and Students

Post-doctoral fellows
Dr Diana Bolopo, PhD (Valladolid)
Dr Anina Coetzee, PhD (Stellenbosch)
Dr Sophie Lardy, PhD (Lyon)
Dr Alan Lee, PhD (Manchester)
Dr Megan Murgatroyd, PhD (Cape Town)
Dr Dayo Osinubi, PhD (Christchurch)
Dr Margaux Rat, PhD (Cape Town)
Dr Chevonne Reynolds, PhD (Cape Town)
Dr Petra Sumasgutner, PhD (Vienna)

Doctoral
Julia Baum, MSc (KIT, Germany)
Amanda Bourne, MSc (Cape Town)
Jordan Calder, MSc (Cape Town)
Kate Carstens, MSc (KwaZulu-Natal)
Hayley Clements, MSc (NMMU)
Daniël Cloete, MSc (Cape Town)
Rebecca Garbett, BSc (Hons) (Kent)
Dominic Henry, BSc (Hons) (Cape Town)
Marie-Sophie Garcia Heras, MSc (Aix-Marseilles)
Davide Gaglio, MSc (Bologna)
Anthony Lowney, MSc (Manchester)
Alistair McInnes, MSc (KwaZulu-Natal)
Chevonne Reynolds, MSc (Wits)
Dominic Rollinson, MSc (KwaZulu-Natal)
Kim Stevens, BSc (Hons) (Cape Town)
Gareth Tate, BSc (Hons) (Cape Town)
Tanja van de Ven, MSc (NMMU)
Rowen van Eeden, MSc (Cape Town)
Otto Whitehead, BSc (Hons) (Cape Town)

MSc by dissertation
Andrew de Blocq, BSc (Hons) (Cape Town)
Campbell Fleming, BSc (Hons) (Cape Town)
Selena Flores, BSc (San Diego)
Laurie Johnson, BSc (Hons) (Cape Town)
Amanda Kyne, BSc (Wesleyan)
Luke McClean, BSc (Queens)
Ditiro Moloto, BSc (Hons) (Limpopo)
Jenni Roberts, BSc (Hons) (Cape Town)
Noelle Tubbs, BSc (Rhode Island)

Masters in Conservation Biology 2016/17
Huyam Abbas, BSc (Hons) (Khartoum)
Michelle Blanckenberg, BSc (Hons) (Rhodes)
Sarah Casola, BSc (Ithaca)
Tendai Chinho, BSc (Hons) (NUST, Zimbabwe)
Christie Craig, BSc (Hons) (Cape Town)
Belinda Day, BSc (Hons) (Cape Town)
Carles Durà, BSc (U. Vic, Catalonia)
Wesley Gush, BSc (Hons) (Rhodes)
Corey Jeal, BSc (Deakin)
Alicia Ly, BSc (Hons) (Oregon)
Matthew Macray, BSc (Hons) (Cape Town)
Elelwani Nenzhelele, BSc (Hons) (Venda)
Ryan Olinger, BSc (Arizona)
Margaret Parrish, BA (Colby)

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

BSc Honours
Carla du Toit, Alexis Osborne, Kervin Prayag, Sanjo Rose

Externally registered students

Doctoral
Cambridge – Gabriel Jamie
Edinburgh – James Westrip
Montpellier – Aloïs Robert
NMMU –Krista Oswald, Rabi'a Rijklief, Gwendoline Traisnel
Oulu – Jere Tolvanen
Palacky – Michal Kysučan
Porto – André Ferreira
Pretoria – Matthew Noakes, Ryan O'Connor, Darren Pietersen, Michelle Thompson
Western Australia – Elizabeth Wiley
Zurich – Sabrina Engesser

MSc by dissertation
Porto – Lara Broom, Rita Fortuna, Liliana Silva
NMMU – Jonathan Botha, Jerry Molepo, Nick Pattinson, Danielle van de Heever
Lisbon – Sofia Santos
Sheffield – Rebecca Goldberg
UCT (Molecular Biology – Edmund Rodseth
UWC – Janine Greuel

BSc Honours
Pretoria – Ryno Kemp, Mpho Malematja

Coevolutionary arms races in brood parasites and their hosts

Coevolution is the process by which two or more species reciprocally influence one another's evolution, and can escalate to produce beautifully refined adaptations. Brood-parasitic birds, the cheats of the bird world, give us an ideal opportunity to study coevolution in the wild. Coevolutionary "arms races" can arise as hosts evolve defences such as rejecting parasitic eggs, which imposes natural selection for parasitic counter-adaptations such as mimicry of host eggs, and in turn for ever more sophisticated defences from hosts. Two long-term projects address different aspects of this fascinating model system for coevolution: Claire Spottiswoode's and her team study a range of African brood parasites (including cuckoos, honeyguides and parasitic finches such as Cuckoo Finches, indigobirds and whydahs) in Zambia; and Robert Thomson and his team study the Common Cuckoo *Cuculus canorus* and its host the Common Redstart *Phoenicurus phoenicurus* in Finland.

Claire Spottiswoode's team in Zambia focusses on three general questions: first, how do interactions between species generate diversity among individuals? We are interested in how biological arms races between hosts and parasites shape phenotypic diversity in both parties. For example, parasites diversify to mimic multiple hosts, and in response hosts sometimes diversify with defensive adaptations to foil mimicry, such as visual 'signatures' of identity. Second, how is specialisation to different coevolutionary partners genetically maintained? The genetic basis of signature-forgery arms races played out by brood parasitic birds is currently almost entirely unknown. In collaboration with Prof. Michael Sorenson and his lab at Boston University, we are using genomic approaches to ask how specialised adaptations to different host species (mimicry of host eggs) are maintained within a single parasitic species (Cuckoo Finches and greater honeyguides) in the absence of parasite speciation. We are also investigating the mechanistic basis of host-specific adaptation in specialist brood parasites that have speciated to parasitise one species each (the *Vidua* finches: whydahs and indigobirds). We are also interested in the genetic basis of host defences, and whether convergent genetic mechanisms have evolved in their corresponding parasitic mimics. Third, what is the role of phenotypic plasticity in the coevolutionary process? We are interested in how phenotypic plasticity might facilitate parasitic exploitation of new host species in the initial absence of appropriate genetic adaptations. Such a role for plasticity in facilitating novel adaptations would imply that, contrary to the long-established paradigm, environmentally-induced variation might sometimes shape the course of subsequent genetic evolution. We are addressing these questions both within and between species of parasitic finch.

Robert Thomson's team in Finland focusses on the evolution of front-line defences in hosts: how can host pairs stop a cuckoo laying an egg in their nest? Much work on brood parasitism has focussed on host adaptations and parasite counter-adaptations during the egg-laying phase, but recently the emphasis has been extended to cover all stages of the host breeding cycle. Hosts that are able to avoid parasites decrease the fitness costs of parasitism; these costs would be further reduced the earlier

Claire Spottiswoode holding cuckoo finch eggs from nests found by her amazing team of field assistants from the local community (Photo: Callan Cohen).

during the breeding cycle that avoidance occurs. Therefore, adaptations occurring prior to egg laying would be especially beneficial for hosts. The Finnish project investigates defences used by hosts and counter-adaptations by parasites, especially during nest site and territory location decisions, which have received almost no attention to date. Common Redstarts are the only regular cuckoo hosts that breed in cavities, which challenges adult cuckoos during egg laying and makes it harder for cuckoo chicks to evict host eggs/chicks. This project further investigates habitat selection decisions that allow hosts to associate with heterospecifics in the bird community as an adaptation to decrease parasitism rates.

Activities in 2016

- Two 3-month field seasons were performed by the Zambian team: PhD student Gabriel Jamie working on indigobirds and whydahs and Claire Spottiswoode working on Cuckoo Finches during the rainy season, and MSc student Luke McClean working on honey-guides during the dry season.
- Gabriel Jamie presented his finding on *Vidua*-host interactions in a very well-received talk at the International Society for Behavioral Ecology congress in Exeter, UK, in July 2016.
- PhD student Michal Kysučan visited the Fitz for 3 months to work on a key paper in the project. Prof Tomáš Grim also visited for 3 weeks.
- A 3-month northern summer field season was performed by the Finland team.

Highlights:

- Paper published on range changes in South African brood parasites and their hosts, in collaboration with the Statistics in Ecology, Environment and Conservation group at UCT (Péron *et al*. 2016. *J.Anim. Ecol*.)
- Paper published describing the uniqueness of the redstart-cuckoo system (Thomson *et al*. 2016. *J. Avian Biol.*)
- Paper published on migration of young Common Cuckoos to Africa, using cuckoo chicks followed in the Finnish study system (Vega *et al*. 2016. *PLoS One*)
- Luke McClean received a MSc Study Abroad Studentship from The Leverhulme Trust to study honeyguide-host interactions in Zambia, supervised by Claire Spottiswoode and Nick Horrocks.

Gabriel Jamie bleeding a *Vidua* chick (Photo: Claire Spottiswoode).

- A film crew making a documentary for German national television successfully filmed honeyguide-host interactions at our study site in Zambia.
- Our honeyguide-host research was featured in the prime-time BBC program 'World's sneakiest animals' with presenter Chris Packham, and is available internationally on the Discovery Channel.
- Dr Chiara Morosinotto received a Post-doc fellowship from the Finnish Cultural Foundation to work in the project for 12 months in 2017.

Key co-sponsors

DST-NRF CoE grant; Academy of Finland; Finnish Cultural Foundation, University of Oulu graduate School; Biotechnology and Biological Sciences Research Council (BBSRC); The Leverhulme Trust.

Research team

Prof. Claire Spottiswoode (FIAO, UCT and U. Cambridge)
Dr Nicholas Horrocks (U. Cambridge)
Prof. Michael Sorenson (U. Boston)
Dr Robert Thomson (FIAO, UCT)
Dr Jukka Forsman (U. Oulu, Finland)
Prof Tomáš Grim (Palacky University, Czech Republic)

Students: Gabriel Jamie (PhD, U. Cambridge), Jere Tolvanen (PhD, Oulu); Michal Kysučan (PhD, Palacky) Luke McClean (MSc, UCT)

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

The evolution, ecology and conservation of honeyguide-human mutualism

This project focusses on a unique mutualism: the foraging partnership between an African bird species, the Greater Honeyguide *Indicator indicator*, and the human honey-hunters whom it guides to bees' nests. Honeyguides know where bees' nests are located and like to eat beeswax; humans know how to subdue the bees using fire, and open the nest using axes. By working together, the two species can overcome the bees' defences, providing beeswax for honeyguides and honey for people. Remarkably, this relationship has evolved through natural selection, rather than through training or domestication which underpins cooperation by other human foraging partners such as dogs or falcons. The honeyguide-human system gives us a wonderful opportunity to study the ecology and evolution of mutualisms in nature, because local human and honeyguide populations vary strikingly in whether and how they interact, and because we can readily manipulate these interactions experimentally.

Since 2013 Claire Spottiswoode has been studying human-honeyguide interactions in the Niassa National Reserve of northern Mozambique in collaboration with the honey-hunting community of Mbamba village, and with the support of Keith and Colleen Begg of the Niassa Carnivore Project. A key focus has been investigating reciprocal communication between the two parties. Not only do honeyguides signal to humans, but in many different cultures humans signal back to honeyguides, giving special calls to attract honeyguides and maintain their attention while following them. Among the Yao honey-hunters of northern Mozambique, this call is a loud trill followed by a grunt: "brrrr-hm!". In a paper published in the journal *Science* in 2016, we showed using a field experiment that honeyguides were twice as likely to initiate a cooperative interaction with humans who made this sound compared to humans giving control human and animal sounds, and three times as likely to successfully lead such humans to honey. These results provide experimental evidence that a wild animal in a natural setting correctly attaches meaning and responds appropriately to a human signal.

Honey-hunter and project assistant, Orlando Yassene, holding a honeycomb from a nest shown to him by a Greater honeyguide (Photo: Claire Spottiswoode).

Next, supported by a newly-awarded Consolidator Grant from the European Research Council, we plan to ask whether learning is involved in maintaining a geographical mosaic of honeyguide adaptation to local human cultures; how reciprocal communication between humans and honeyguides mediate their interactions; what the effects are of cultural co-extinctions on each partner and their ecosystems; and how quickly such cultures can be re-ignited following their loss. This will involve fieldwork in Mozambique, Tanzania, South Africa and

Lazaro Hamusikili and Avedy Munkombwe holding a female honeyguide captured for research in Zambia: Lazaro and Avedy have been a key part of our research team in Zambia for over 10 years (Photo: Claire Spottiswoode).

Zimbabwe by a team starting work in 2017. In so doing we hope to test for the first time the hypothesis that reciprocal learning can give rise to matching cultural traits between interacting species. Understanding the role of such phenotypic plasticity is crucial to explain how and why the outcome of species interactions vary in space and time, and to predict how such interactions will respond to a rapidly changing world.

Activities in 2016

- In collaboration with Brian Wood from Yale University, Claire carried out fieldwork on the honeyguide-human relationship among the Hadza people of northern Tanzania.
- Claire Spottiswoode conducted a further field experiment for four weeks in northern Mozambique, testing how honeyguides respond to honey-hunting calls from different human cultures in different parts of Africa.

Highlights:

- Paper published demonstrating reciprocal communication between honeyguides and people; it received worldwide attention in the popular press, even briefly displacing Donald Trump from the front page of *The New York Times* (Spottiswoode *et al.* 2016. *Science* 353: 387-389). The research was also featured in *The New Yorker, The Times, The Guardian, Nature, National Geographic*, the BBC World Service, and many others.
- European Research Council Consolidator Grant to the value of € 2 million awarded to support Claire Spottiswoode's honeyguide research for the next five years; the grant is held jointly between UCT and the University of Cambridge.
- Claire Spottiswoode and Brian Wood discussed their honeyguide research in depth in a half-hour programme on honeyguides on BBC Radio 4, as part of the "Natural Histories" series.

Key co-sponsors

DST-NRF CoE grant; Biotechnology and Biological Sciences Research Council (BBSRC), UK; from 2017: European Research Council (ERC).

Research team

Prof. Claire Spottiswoode (FIAO, UCT and, U. Cambridge)
Dr Brian Wood (Yale University)
Keith Begg (Niassa Carnivore Project)
Dr Colleen Begg (Niassa Carnivore Project)

Cooperation and population dynamics in the Sociable Weaver

The elaborate social structure and cooperative behaviour of Sociable Weavers *Philetairus socius* in their large nesting colonies make them an ideal model to study the effects of environmental and social factors on population dynamics and the benefits and costs of cooperation. We have been gathering detailed data on cooperative breeding for seven years, and our long-term demographic data spans over 20 years.

The long-term nature of this project affords unique data and insights to understand the evolution of cooperation and the mechanisms that allow Sociable Weavers to persist. Simultaneously, the demographic data allows examination of the factors affecting population dynamics in relation to environmental change.

Activities in 2016

- Post-doc Sophie Lardy concluded a demanding experiment where the cost of helping was artificially manipulated. Sophie also collected blood and plasma samples for over 300 individuals. Her Claude Leon Post-doctoral fellowship at the Fitz ended in August 2016, and she is analysing her data through a Post-doctoral fellowship based at the CNRS in Montpellier, France.
- Analyses of oxidative stress and telomere length were conducted in collaboration with François Criscuolo from CNRS Strasbourg, France.
- PhD student André Ferreira and Post-doc Arnaud Tognetti conducted field trials for experiments to be conducted in the 2017 breeding season. André will investigate the reliability of cooperative behaviour and the social benefits of cooperating. To measure social benefits we will use social networks in collaboration with Damien Farine (Max Planck, Germany). Arnaud will investigate whether helping behaviour may be used as a signal to attract mates. He will test whether helpers change their behaviour in relation to changes in the 'audience', i.e. the individuals that witness cooperative behaviours. The change in audience will be mimicked by broadcasting calls from males and females. We started collaboration with acoustics expert Fanny Rybak (U. Orsay, France) to assist with this project.
- Janine Greuel started an MSc project working with Bryan Maritz (UWC) to study the ecology of Boomslangs *Dyspholidus typus* and Cape Cobras *Naja niv*ea and how they interact with Sociable Weaver colonies.
- The collaboration with Ben Hatchwell and René van Dijk (University of Sheffield, UK) has found inbreeding avoidance in Sociable Weavers. An ongoing experimental study aims to understand the mechanisms of kin recognition underpinning this inbreeding avoidance.
- To improve data collection and storage, we are creating a standardized database that will integrate capture-recapture, reproduction and cooperation data. Franck Theron was hired to develop and run the database, and Jerémy Tornos was appointed a short-term contract to develop a tablet interface for data collection in the field.

A Sociable Weaver fledgling (Photo: Franck Theron).

Highlights

- Two major grants were obtained in 2016 from the Portuguese (FCT) and French (ANR) national research agencies to investigate whether cooperation provides direct benefits to individuals, in addition to those obtained through helping close kin. A new PhD student, and two Post-docs have joined the project under these grants.
- CB MSc student Kyle Lloyd used a 5-year experimental exclusion of snakes from specific colonies to confirm the negative role of nest predation on reproductive output and population trends (snakes take ca 70% of eggs and chicks). Warm winters also benefit the weavers. For example, in 2016 a relatively warm winter and late rains allowed the weavers to breed continuously through winter into the following summer. Surprisingly though, Kyle found that under the increased aridity predicted by the climate models, this population would decline, even if under continuous predator exclusion and warmer winters. To further understand the role of snakes in this ecosystem we have initiated a collaboration with herpetologist Bryan Maritz (UWC).
- MSc student Rita Fortuna (U. Porto) graduated in 2016 with a study on begging behaviour. Previously we had shown experimentally that chicks produced by females with helpers begged less than those from females without helpers, probably because females put less hormones in their eggs when they have helpers. Rita demonstrated that males, females and helpers all respond similarly to begging, but parents receive higher-frequency begging calls than helpers.
- MSc student Liliana Silva (U. Porto) graduated in 2016 with a study on the physiological costs of helping. Previous work revealed fitness benefits of dominance in terms of access to resources and higher numbers of helpers. Liliana tested whether dominance also has costs, using oxidative stress as a proxy. Interestingly, she found costs for females but not males, revealing an unexpected pattern, which might arise because of the reduced access to resources experienced by females coupled with a higher cost of reproduction.
- MSc student Rebecca Goldberg (U. Sheffield) graduated in 2016 with a thesis on kin recognition and inbreeding avoidance.
- A paper by former Fitz Post-doc, Matthieu Paquet, illustrating the thermoregulatory benefits of communal roosting was published in *Journal of Avian Biology*, and was picked as the Editor's choice.
- The Sociable Weaver was chosen as BirdLife SA bird of the year.
- Four new collaborations were initiated: Bryan Maritz (snake ecology); Damien Farine (social networks), Fanny Rybak (acoustics), François Criusculo (telomeres).

Impact of the project

The long-term nature of this project affords unique data and insights to understand the evolution of cooperation and the mechanisms that allow Sociable Weavers to persist. Simultaneously, the demographic data allows examination of the factors affecting population dynamics in relation to environmental change.

The 2015/16 Sociable Weaver team (Photo: Rita Covas).

Key co-sponsors

FCT, Portugal; French Research Agency; ANR, France; DST-NRF Centre of Excellence grant; Marie Curie-IRSES, EU.

Research team

Dr Rita Covas (FIAO, UCT and CIBIO, U. Porto)
Dr Claire Doutrelant (FIAO, UCT and CNRS, France)
Dr Sophie Lardy (FIAO, UCT and CNRS)
Dr Arnaud Tognetti (U. Toulouse)

Students: André Ferreira (PhD, U. Porto); Rita Fortuna (MSc, U. Porto); Rebecca Goldberg (MSc, U. Sheffield); Janine Greuel (MSc, UWC), Liliana Silva (MSc, U. Porto); Kyle Lloyd (CB MSc, UCT);

Research Assistants: Rita Leal, Thomas Pagnon, Maxime Passerault, Hugo Pereira, Franck Theron.

Pied Babblers and Fork-tailed Drongos

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

The causes of conflict and cooperation in group-living societies

The Pied Babbler Research Project investigates the benefits of cooperation and the causes of conflict in this highly cooperative, group-living species. The population of 12-19 groups has been monitored continuously for 14 years. Group size and number varies considerably according to weather conditions in the Kalahari, with the population suffering a considerable decline following breeding seasons with poor rainfall and high temperatures. The population also declines during very cold winters, with juveniles experiencing high mortality. Long-term life history data, along with short-term observations and experimentation, have helped the team understand the causes and consequences of cooperative breeding behaviour. These findings help to reveal the benefits of cooperation not just in babblers, but from a broader evolutionary perspective.

How interactions between species shape animal behaviour

The Fork-tailed Drongo project initiated in 2006 explores how interactions with other species in an animal's environment can shape the evolution of behaviour. The project focuses on a population of over 40 pairs of habituated and colour-banded drongos that are individually recognisable. Research has primarily focussed on the drongos deceptive use of false alarm calls, including mimicked alarms, to scare other species and steal their food. We have also explored the drongos role as a sentinel species within mixed species groups. They even sing a special 'watchman's song' for other species, attracting them and allowing other species to spend more time foraging, and less keeping a lookout. Most recently, research has focussed on brood parasitism. Ironically drongos are themselves deceived by the African Cuckoo *Cuculus gularis*, and less frequently the Jacobin Cuckoo *Clamator jacobinus*, which lay their eggs in drongo nests. This affords an opportunity to explore competition over hosts between brood parasites. Furthermore, drongos and African Cuckoos appear to be locked in a tight co-evolutionary arms race as both show amazing matching variation in their egg pattern and coloration. In collaboration with Claire Spottiswoode, we have conducted experiments to explore whether such variation results from selection on drongos to reject dissimilar eggs. In addition, detailed knowledge of drongo life histories will enable investigation of the development of individual variation in drongo's parasite defences.

A young fledgling learns how to forage under the watchful eye of an adult group member (Photo: Amanda Ridley).

Activities in 2016

- PhD student Amanda Bourne successfully trialled passive measurement of metabolism in Pied Babblers by feeding individuals prey items injected with doubly labelled water without having to directly handle individuals.
- PhD student Elizabeth Wiley collected her final season of data on the benefits of the monogamous pair bond at the start of 2016. The monogamous pair bond has rarely been investigated in a cooperative breeder, due to the traditional view that the importance of the group supersedes the importance of the pair bond. Lizzie's work, using both playbacks and observation, has revealed this is not the case.
- A new collaboration was forged between Susie Cunningham, Amanda Ridley, Claire Spottiswoode and Andrew McKechnie to understand the physiological effects of extreme weather events on Pied Babbler behaviour.
- A comprehensive long-term population analysis for Pied Babblers conducted by Elizabeth Wiley, revealed considerable sensitivities of the population to predicted future climate change.

Highlights:

- Amanda Ridley's TEDx talk on cooperation and conflict, featuring Pied Babbler research, was released online.
- PhD students Sabrina Engesser (U. Zurich) and James Westrip (U. Edinburgh) were awarded PhD degrees for their Pied Babbler research.
- An NRF grant application was successful for the collaboration of Susie Cunningham, Mandy Ridley, Claire Spottiswoode and Andrew McKechnie.
- New PhD student Amanda Bourne started conducting the physiological research on Pied Babblers.
- Pied babbler research was featured in the prime-time BBC program 'World's sneakiest animals' with presenter Chris Packham, and is available internationally on the Discovery Channel.
- Several papers on Pied Babblers were published, including on meaningful call combinations (Engesser *et al.* 2016. *Proc. Natl Acad. Sci. USA*) and nepotism (Nelson-Flower and Ridley, in press *Biol. Lett.*).

Research assistant Sello Matjee maintaining the weather station on Kuruman River Reserve (Photo: Amanda Bourne).

- A new *Cooperative Breeding in Vertebrates* was released by Cambridge University Press, featuring a chapter specifically on Pied Babbler research.
- Our research was presented at several international conferences.
- Ryan Olinger undertook a successful CB MSc project exploring the consequences of increasing temperatures for drongos. He showed that when it was hot, drongos foraged and provisioned their chicks less because of thermoregulatory constraints on their activity (see p.47).
- Rita Leal completed field data collection experimentally exploring coevolution between drongos and African Cuckoos.

Key co-sponsors
DST-NRF CoE grant; Australian Research Council.

Research team
Assoc. Prof. Amanda Ridley (FIAO, UCT and UWA)
Dr Thomas Flower (FIAO, UCT and Simon Fraser University)
Dr Matt Bell (U. Edinburgh)
Dr Martha Nelson-Flower (U. British Colombia)
Dr Susie Cunningham (FIAO, UCT)
Prof. Claire Spottiswoode (FIAO, UCT and U. Cambridge)
Prof. Andrew McKechnie (U. Pretoria)
Dr Simon Townsend (U. Zurich)

Students: Sabrina Engesser (PhD Zurich); James Westrip (PhD Edinburgh), Elizabeth Wiley (PhD UWA); Amanda Bourne (PhD, UCT); Ryan Olinger (CB MSc, UCT)

Research assistants: Rita Leal, Sello Matjee

Sociable Weaver nests as a resource

This project examines the importance of Sociable Weaver *Philetairus socius* nests to Kalahari animal and plant communities. The objectives are to investigate the diversity of animals associated with the nests, the interactions between these species, and to gain insights into the life histories of associated species. We also aim to understand how the 'ecological engineer' potential of these nests may have community-wide impacts on structure and function, and how this impact may change across environmental gradients.

Evidence of the importance of facilitation in communities has accumulated, which challenges traditional emphasis of negative interactions in ecology. In particular, facilitative interactions are predicted to increase in importance in stressful environments and may become a crucial component of the adaptive responses of communities under stress. Ecological engineers, species that modify habitats and ameliorate abiotic stress for other species, are a key research focus. Identifying and understanding the impact of ecological engineers is vital, especially in arid environments that are expected to become harsher with global climate change.

Activities in 2016

- PhD student Anthony Lowney quantified the diversity of animals using Sociable Weaver nests at monthly intervals throughout 2016. Camera traps showed frequent use by mammals for shade (Kudu *Tragelaphus strepsiceros*, Impala *Aepyceros melampus*), foraging (Chacma Baboon *Papio ursinus*, Slender Mongoose *Galerella sanguinea*), refuge (Leopard *Panthera pardus*, African Wild Cat *Felis silvestris*), and as a vantage point (Cheetah *Acinonyx jubatus*). Night visits revealed that 87% of nests host multiple species, such as African Pygmy Falcons *Polihierax semitorqutus*, Acacia Pied Barbets *Tricholaema leucomelas*, Ashy Tits *Parus cinerascens* and Scaly-feathered Finches *Sporopipes squamifrons*. Furthermore, the number of species and their abundance changes across the year.
- Anthony also counted Kalahari Tree Skinks *Trachylepis spilogaster* and assessed their behaviour in contexts when Sociable Weavers were present at nest colonies and when they were not. This investigation will continue with an experimental test in 2017.

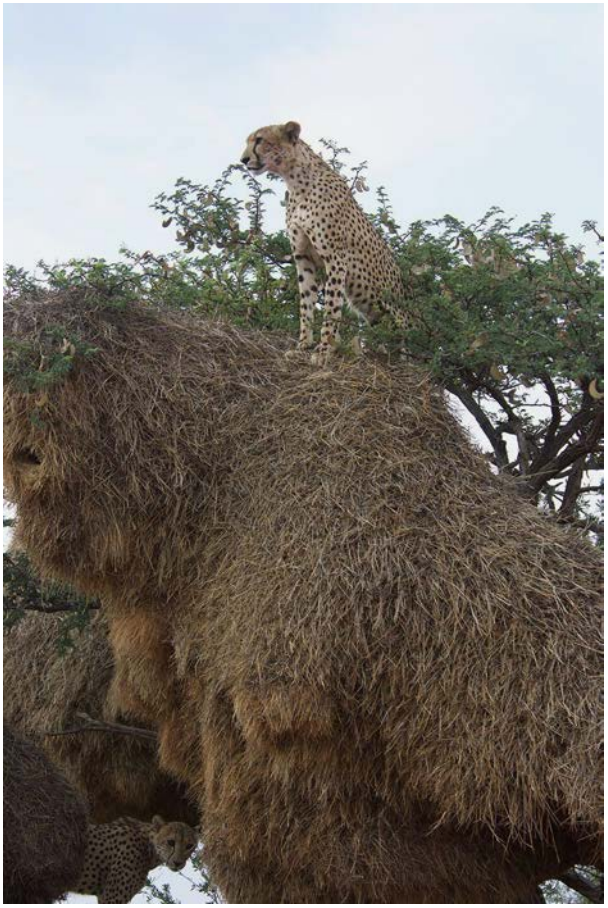
A male Boomslang forages in a Sociable Weaver nest (Photo: Anthony Lowney).

- The African Pygmy Falcon population breeding in the study area was monitored for the sixth season. In 2016, all individuals received colour rings to facilitate with the long-term demographic study of this species.
- Led by Post-doc Diana Bolopo, GPS loggers were sourced for attachment to African Pygmy Falcons. These devices will be used to study territoriality of this species in addition to habitat use and dispersal of individuals.
- UCT BSc Hons students Kervin Prayag and Carla du Toit investigated the impacts of Sociable Weaver nests on landscape soil nutrient concentrations and the impacts on the host Camelthorn *Vachellia erilooba* trees. They found that the soils below Sociable Weaver nests had highly enriched soil nutrient concentrations due to the accumulated faecal droppings. These nutrients were used by the trees, and trees with Sociable Weaver nests had 27% more leaves per branch than trees without nests. But the costs of hosting weaver

nests were also measured in terms of a reduced canopy volume and increased likelihood of branch fall and lost biomass.

Highlights:

- Diana Bolopo joined the project as a Post-doc and subsequently received a Claude Leon Postdoctoral Fellowship to continue her work on this project.
- BSc Hons students Kervin Prayag and Carla du Toit presented their findings at the Arid Zone Ecology Forum meeting and the Diamond Route Conference respectively, and both are currently preparing a manuscript for submission in early 2017.
- Robert Thomson presented a talk on Sociable Weaver nests as a resource to Kalahari animals at the Pan-African Ornithological conference in Dakar, Senegal.
- A collaboration was initiated with Bryan Maritz (UWC), a herpetologist, to study the importance of Sociable Weaver nests to Cape Cobras and Boomslangs. The collaboration will also investigate the interactions of snakes with other nest associates.



A cheetah using a Sociable Weaver nest as a look-out (Photo: Liam Charlton).

A BBC film crew filming the project work for a new series (Photo: Tara Yvette Naeser).

- The project activities were filmed twice by the BBC. The first piece featured Anthony Lowney working with African Pygmy Falcons, and was aired on BBC's "*Naomi's Nightmares of Nature*" in 2016. The second film crew came in December 2016 specifically to film falcon-weaver interactions at nests for a new series called "*Animals Behaving Badly*" that will be aired in 2017.
- Anthony Lowney's paper about territorial fights among Pygmy Falcons was accepted by *Journal of Raptor Research*.
- Anthony published a short note about the Cheetah's use of Sociable Weaver nests as look-out points in *Biodiversity Observations*.

Impact of the project

This project will provide unique insights about the community ecology and between-species interactions in the Kalahari. It will also explore the potential ecological engineering role of the Sociable Weaver, as well as contribute to available eco-tourism information that enhances the experience of visitors to landscapes within the distribution of the Sociable Weaver.

Key co-sponsors
Academy of Finland; University of Cape Town launching grant; DST-NRF CoE grant; Tswalu Foundation.

Research team
Dr Robert Thomson (FIAO, UCT)
Dr Diana Bolopo (FIAO, UCT)
Associate Prof. Michael Cramer (UCT)
Dr Dieter Oschadleus (ADU, UCT)
Dr Bryan Maritz (UWC)

Students: Anthony Lowney (PhD, UCT); Carla du Toit (BSc Hons, UCT); Kervin Prayag (BSc Hons, UCT)

Understanding colour polymorphism in birds

Many species show a variety of different phenotypes. How this diversity is maintained is one of the main questions in evolutionary biology. Researchers have long been fascinated by this phenomenon because the occurrence of two or more phenotypes in the same population runs counter to the notion that selective pressure should favour the optimal form for an environment, and any lesser quality individuals should be quickly eliminated through natural selection. Colour polymorphism occurs where a population of animals displays different colour morphs that are unrelated to age or sex and occur too frequently to be due to recurrent mutation. Colour polymorphism is rare in birds, occurring in around 3.5% of species. However, it is more common in raptors and particularly within *Accipiter* hawks where about 25% of species are polymorphic.

Our research in this field focuses primarily on the Black Sparrowhawk *Accipiter melanoleucus*. We use this model species to test various hypotheses for the occurrence and maintenance of colour polymorphism in bird species. Our study population breeds on the Cape Peninsula and is unusual in that most adults consist are the rarer dark morph. The main focus of our research has been attempting to explore the occurrence and persistent of this unusual morph ratio in this area.

In addition, we have been investigating the use of images sourced through internet search engines to document the distribution of visual phenotypes such as colour morphs in animal species.

Activities in 2016

- Gareth Tate submitted his PhD 'Exploring the maintenance of plumage polymorphism in the Black Sparrowhawk'.
- Sanjo Rose's BSc Hons dissertation explored whether the morphs of Black Sparrowhawks are distributed differently according to the degree of urbanisation.
- Edmund Rodseth (MSc candidate in Molecular and Cell Biology, UCT) continued to make good progress on his study to identify the genetic pathway for colour polymorphism in Black Sparrowhawks.
- In collaboration with Dr Christopher Briggs in the United States, we are using MORPHIC to describe the distribution of morphs of Swainson's Hawks *Buteo swainsoni* across North America.
- In another collaboration led by Dr Chiara Morosinotto, University of Turku, including the research group of Prof. Jon Brommer and Dr Patrik Karell in Finland, Dr Rui Lourenço in Portugal and Dr Anita Gamauf in Austria, we are using MORPHIC to describe spatial distribution of Tawny Owls *Strix aluco* across Europe in relation to climate, habitat, anthropogenic impact and diet.
- We presented our research at the Pan-African Ornithological Congress (PAOC), Dakar, Senegal; and the North American Ornithological Conference (NAOC), Washington DC, United States.
- We ran a workshop at the British Ornithologist Union (BOU) conference held in Leicester, UK, to demonstrate the use of the MORPHIC web app.

Dr Gareth Tate graduated at the end of 2016 and is now employed by the Endangered Wildlife Trust as Manager of their Birds of Prey Programme (Photo: Ann Koeslag).

Dark and light morph black sparrowhawks. Pairs that consist of contrasting morphs were found to produce more young than pairs consisting of the same morphs (Photos: Ann Koeslag).

Highlights:

- Gareth Tate was awarded his PhD and has since been appointed as Manager of the Endangered Wildlife Trust's Birds of Prey Programme.
- Gareth published a paper which examined differential hunting success between the two morphs in relation to ambient light levels in the leading ecology journal *Ecology Letters*. This paper was highlighted as a recommended paper by Faculty 1000.
- Gareth published a paper from his thesis which explored the breeding performance of pairs consisting of either different or like morphs in the *Journal of Avian Biology*.
- Gareth submitted a paper to *Scientific Reports* which is currently in review. This paper uses information on GPS tracked male Black Sparrowhawks to explore whether the two morphs spend different amounts of time foraging in different habitats or in varying light levels.
- Petra Sumasgutner published a paper examining recruitment and survival rates of offspring of different morph parents in the *Journal of Animal Ecology*.
- Gabriella Leighton published her BSc Hons dissertation in *Methods in Ecology and Evolution* This research demonstrated the successful use of Google images to describe the spatial distribution of colour morphs, and included the development of the freely available web app MORPHIC which facilitates the capture of this information from the web. This paper was awarded the prize for the best paper by an Early Career Researcher published in this journal in 2016.

Impact of the project

This project will add to our understanding and theory about the maintenance of genetic diversity in populations. It provided the first empirical evidence for the light level hypothesis for the maintenance of colour polymorphism in birds. Our demonstration that Google Images can provide robust unbiased information on the spatial distribution of visible phenotypes, and the development of the MORPHIC web app, has opened up a whole new approach for research in this field.

Key co-sponsors
DST-NRF CoE grant; Claude Leon Foundation; UCT URC grant.

Research team
Dr Arjun Amar (FIAO, UCT)
Dr Jacqui Bishop (Biological Sciences, UCT)
Dr Rob Ingle (MCB, UCT)
Dr Petra Sumasgutner (FIAO, UCT)
Ann Koeslag (Volunteer)
Pierre Hugo (Comp Sci, UCT)
Prof. Alex Roulin (UNIL, Switzerland)

Students: Gareth Tate (PhD, UCT); Edmund Rodseth (MSc, MCB, UCT), Gabriella Leighton (BSc Hons, UCT); Sanjo Rose (BSc Hons, UCT)

Bird pollination in the Cape Floristic Region

Why do flowers come in so many different colours, both within and between species? This deceptively simple question is still surprisingly difficult to answer. The Cape Floristic Region's bird pollination systems provide an ideal opportunity to address it in the context of natural communities of co-flowering species. Fitz Post-doc Anina Coetzee is tackling this question in collaboration with Claire Spottiswoode and Colleen Seymour. Specifically, she is testing the hypothesis that flower colour variation within species arises from selection for convergence in flower colour with other species in the local community, to benefit from shared signalling to pollinators. Such ecological processes may now be threatened by habitat fragmentation in many parts of the Cape Floristic Region, and understanding these effects is the goal of PhD student Daniël Cloete's research.

The genus *Erica* is one of the most diverse in the fynbos biome, and its many bird-pollinated species are striking for the high levels of colour polymorphism in their flowers. Some *Erica* species have up to five different colour morphs both within and between populations. These species are pollinated predominantly by just one bird species, the Orange-breasted Sunbird *Anthobaphes violacea*, so the prevalence of these polymorphisms is a mystery. This project is investigating the origin and maintenance of these flower colour polymorphisms: what role does plant community context and sunbird foraging behaviour play in generating the intra-specific colour diversity of this group of plants, and how might habitat transformation influence these ecological and evolutionary processes?

Flower colour polymorphisms may evolve for two opposing reasons. Firstly, if co-existing species experience competition for the attention of pollinators, then colour divergence may promote assortative foraging by pollinators. Secondly, when a plant species receives low pollinator visitation rates, it may benefit from mimicking the signals of co-existing species in order to attract more pollinators. Evidence of such honest signal mimicry, as opposed to deceptive mimicry, is very rare in nature. A cause for concern is that habitat fragmentation may change sunbird behaviour in such a way that the evolutionary process maintaining this diversity in ericas is changed completely

The effect of habitat fragmentation on the fitness of bird-pollinated plants is being directly addressed by Fitz PhD student Daniël Cloete,

Three bird-pollinated Erica species in the Kogelberg Biosphere Reserve and Cape Point – from the top *Erica massoni, Erica plukeneti* and *Erica thomae* (Photos: Claire Spottiswoode).

working in the Tsitsikamma section of the Garden Route National Park. Daniël's research aims to investigate how bird pollination relationships are affected by habitat fragmentation, and to test whether certain thresholds of patch size and isolation exist where pollination services by birds start to break down. To do so, he is measuring pollination by sunbirds and sugarbirds of *Protea* and *Erica* species across 17 fynbos patches, natural and fragmented, around Nature's Valley. This is a good area to address this question because it naturally comprises of a matrix of forest, fynbos, thicket and grasslands, now further fragmented by agriculture, plantations, farmland and urban areas. Insights from Daniël's research will hopefully shed light on how threats including land-use change, alien invasive vegetation and climate change are affecting, and will further affect, ecosystem function and services in the Cape Floristic Region.

Activities in 2016

- Anina Coetzee surveyed nine communities of bird-pollinated Erica species in the south-western Cape, collecting data on sunbird visitation rates, pollinator-attracting traits and reproductive morphology.
- Three of these communities were sampled monthly to establish what the flowering phenology patterns are of co-existing species.
- Anina is currently analysing the data and preliminary results suggest that flower colour convergence between co-existing species occur when species differ in their reproductive morphology.
- Hybrid pollination experiments were conducted on three Erica species at two different sites.
- Daniël carried out a year of focused fieldwork in the Nature's Valley area, collecting data on pollination rates, flowering phenology, nectar traits and seed set.

Highlights:

- Anina won the prize for the best oral presentation by a young scientist at the annual symposium of the International Association for Vegetation Science in Pirenópolis, Brazil.
- Anina received a research grant from The Botanical Education Trust.

An Orange-breasted Sunbird feeding on Erica coccinea (Photo: Callan Cohen).

Impact of the project:

The unique sunbird-*Erica* mutualism will allow us to gain key insights into the mechanisms by which individual bird behaviour affects community ecology. It provides an opportunity to address knowledge gaps, particularly because human disturbance may directly interact with evolutionary processes in this system. Insights into the effects of habitat transformation on pollination systems such as this will inform the development of guidelines for maintaining biodiversity and ecosystem functioning.

Key co-sponsors
DST-NRF CoE grant; The Botanical Education Trust; Biotechnology and Biological Sciences Research Council; South African National Botanical Institute; Harry Crossley Green Matter Scholarship.

Research team

Dr Anina Coetzee (FIAO, UCT)
Prof. Claire Spottiswoode (FIAO, UCT and U. Cambridge)
Dr Phoebe Barnard (FIAO, UCT and SANBI)
Dr Mark Brown (Nature's Valley Trust)
Prof. Peter Ryan (FIAO, UCT)
Dr Colleen Seymour (SANBI)

Student: Daniël Cloete (PhD, UCT)

Intra-African bird migration

Globally, migrant birds are at greater risk of extinction than are resident species. To date, the emphasis has been on long-distance, inter-continental migrants. We are employing a broad-scale spatial approach to address questions of connectivity, movement, variation and speciation in focal intra-African migrant birds that breed across western, eastern and southern Africa. Since mid-2015, we have established study sites in Nigeria and Ghana for western, Uganda for eastern and South Africa for southern Africa.

Little is known about the migratory routes, timings, drivers, connectivity and environmental prescriptions of intra-continental migrant birds compared to inter-continental migrants. This project aims to investigate migratory patterns of focal intra-African migrant birds. Fieldwork is conducted during the sub-regional breeding seasons of target species, which include Woodland Kingfisher *Halcyon senegalensis*, African Pygmy Kingfisher *Ispidina picta*, Diederik Cuckoo *Chrysococcyx caprius* and Klaas' Cuckoo *Chrysoccyx klaas*.

An array of methods is being used to better understand these migrants. To address connectivity, we are using single nucleotide polymorphisms (SNPs) and mitochondrial DNA sequence analysis to explore genetic differentiation across each species' range. To investigate movement patterns, we are relying on ringing data, stable isotope analysis of the oldest primary feather and telemetry data from geolocators deployed on suitable species. Phenotypic variation in vocalisations are being explored across the range and between genetically distinct populations. Analyses of these datasets with environmental data will facilitate statistical models to more accurately direct conservation action and possibly indicate anthropogenic-drivers of speciation.

A Woodland Kingfisher carrying a geolocator (Photo: Samuel Temidayo Osinubi).

Activities in 2016

- The first southern African field season was completed (Nov 2015-Jan 2016). Three study areas were visited in the Limpopo Province, where samples were collected from 15 Woodland Kingfishers, five African Pygmy Kingfishers, 16 Diederik Cuckoos and three Red-chested Cuckoos *Cuculus solitarius*.
- The first western African field season was completed (Jun-Jul 2016). One study area in Nigeria and two in Ghana were visited, collecting samples from three Woodland Kingfishers and seven Diederik Cuckoos. During an earlier site reconnaissance, samples were collected from three African Pygmy Kingfishers. The small number of samples collected was attributed to commencing the field season late due to logistical constraints.
- The first eastern African field season was completed (Aug 2016). One study area in Uganda was visited, collecting samples from three Woodland Kingfishers and two African Pygmy Kingfishers. Again, the low number of samples collected was attributed to a late and short field season due to logistical constraints.
- Ten light archival geolocators were donated by the Swiss Ornithological Society for use on Woodland Kingfishers during the 2016-2017 southern African field season.
- Sound data for all target species archived in the Macaulay Library of the Cornell

Examining a Woodland Kingfisher for wing moult (Photo: David Green).

Laboratory of Ornithology were donated to aid the vocalisation analysis.

Highlights:

- A story publicising the project was published in *The Conversation Africa* in May 2016 - (http://theconversation.com/sights-are-set-on-understanding-bird-movements-across-africa-58943).
- Fitz MSc student Ditiro Moloto was able to join the expedition to Uganda for the eastern African field season. Ditiro contributed immensely to the field work and gained valuable field techniques from the experience.
- Preliminary analysis of differences in frequency- and time-based vocalisation parameters in Woodland Kingfisher calls recorded in Ghana, Uganda and South Africa was presented as part of a talk by Dr Samuel Temidayo Osinubi at the 14th Pan-African Ornithological Congress in Dakar, Senegal.
- During the just-concluded 2016-2017 southern African field season, samples were collected from 12 Woodland Kingfishers, with seven geolocators successfully deployed. Samples also were collected from three African Pygmy Kingfishers, six Diederik Cuckoos, two Klaas' Cuckoos and one Red-chested Cuckoo.

Impact of the project

This project addresses the research, conservation and policy gaps concerning intra-African migrant birds. We are facilitating a research network that links institutions across Africa, providing a near-regional operating base for other students and researchers to utilise in answering diverse questions about intra-African migrant birds. This network serves to support the objectives of the UNEP/CMS African-Eurasian Migratory Landbirds Action Plan (AEMLAP) and the Migrant Landbird Study Group (MLSG).

Key co-sponsors

DST-NRF CoE grant; National Zoological Gardens of South Africa (NZG); International Foundation for Science; BirdLife West Africa Sub-Regional office; A.P. Leventis Ornithological Research Institute.

Research team

Dr Samuel Temidayo Osinubi (FIAO, UCT)
Prof. Desire Dalton (NZG)
Dr Phoebe Barnard (FIAO, UCT)
Prof. Peter Ryan (FIAO, UCT)

Evolution in island birds and the 'insularity' syndrome

The shared characteristics of island environments, such as impoverished biotas and less-seasonal climates, are thought to trigger specific adaptations by organisms. Birds are good island colonisers, and are among the best studied groups. However, few broad-scale systematic analyses have examined patterns of evolution in island birds and as a result our understanding of which traits are affected by the 'insularity syndrome' remains weak. We have been studying patterns of adaptation in reproductive life histories, morphology and sexual ornaments in island birds worldwide. Our previous results show that insularity favours a slower pace of life in birds, with reduced fecundity, extended developmental periods, and an increase in the frequency of cooperative breeding.

A poorly understood topic was whether insularity affected other important traits such as animal signals. We tested whether birds' plumage colouration and songs are part of the island syndrome. For coloration, we used museum specimens and analysed, with spectrophotometry, the colouration of 116 species endemic to islands and their 116 closest mainland relatives. We found a pattern of reduced brightness and colour intensity for both sexes on islands. In addition, we found a decrease in the number of colour patches on island bids that, in males, was associated with a decrease in the number of same-family sympatric species. These results, which were published in *Ecology Letters,* demonstrate a worldwide pattern of parallel colour changes on islands and suggest that a relaxation of selection on species recognition may be one of the mechanisms involved.

However, other mechanisms may influence the reduced colouration of island birds. For example, it has been suggested that sexual selection would be higher in species facing higher parasite pressure and would thus select more for elaborate ornaments that signal their resistance to parasites. Therefore, on islands, lower parasite pressures are expected to lead to a reduced pressure to maintain elaborate ornaments. To investigate this hypothesis, we conducted detailed field-based work on avian malaria immunity and plumage colouration in the Gulf of Guinea islands and the nearby mainland (Gabon and Cameroon). As expected, we found an overall decrease in parasite pressure on islands (manuscript in review). However, this was not followed by reduced immune capacity. Instead the results, published in *Ecology and Evolution*, showed that different immune parameters responded differently to the island environment. On the other hand, reduced parasite pressure appears to influence the decrease in coloration found on islands and a manuscript is currently in preparation.

Additionally, in October 2016 we initiated a field-based project to test the role of reduced interspecific competition in the evolution of bird song on islands. We used SM3 passive recorders to record the acoustic space of island and mainland bird communities. Simultaneously, we focused on seven pairs of island-mainland species, quantified the number of species co-singing with these focal species, and measured the acoustic niche occupied by them. The analyses are currently underway.

Activities in 2016

- Elisa Lobato concluded a Post-doc at CIBIO, U. Porto, investigating parasite pressure, immunity and the links with bird colouration on the islands of São Tomé and Principe compared with Gabon. Elisa worked under the supervision of Rita Covas and Claire Doutrelant. Two manuscripts were published in 2016, one is in review and a fourth one is in preparation.
- Martim Melo and Claire Loiseau (CIBIO) finalised a manuscript on the prevalence and diversity of avian malaria in birds from the four Gulf of Guinea islands and nearby mainland (Gabon and Cameroon), which is currently in review in *Journal of Biogeography*.

- Claire Loiseau initiated a global-scale comparative study in collaboration with Rita Covas and Claire Doutrelant on whether there are consistent differences in parasite prevalence and diversity on islands versus the mainland and whether avian malaria parasites follow the island biogeography rules described for macrofauna.
- Claire Doutrelant, Martim Melo, Thierry Lengagne and PhD student Alois Robert conducted one month of fieldwork in São Tomé and Cameroon. They recorded the songs of 14 species of birds, as well as the dawn chorus of the bird communities in three different locations each morning using SM3 passive recorders.

Highlights:

- A paper in *Ecology Letters* described how island birds worldwide generally have reduced plumage brightness and colour intensity.
- Two additional papers comparing immunity parameters and gut bacteria in island and mainland populations were published in *Ecology and Evolution* and *Symbiosis*, respectively.
- A book chapter on 'Life-history evolution on islands' by Rita Covas was published in the *Encyclopedia of Evolutionary Biology* (Springer).
- Rita Covas and Claire Doutrelant convened the Symposium 'Patterns of adaptation on islands and the insularity syndrome' at the II International Conference of Island Evolution, Ecology and Conservation, Angra do Heroísmo, Azores, Portugal.
- Martim Melo convened a Symposium on 'Biodiversity in the Gulf of Guinea Islands' at the same conference. This will form the basis for a reference book on this system.
- A presentation at the 16th congress of the International Society for Behavioural Ecology by Rita Covas reported that island birds are more likely to live in family groups and breed co-operatively than their mainland relatives. She identified the life-history and climatic factors associated with these traits.

Impact of the project

This project is uncovering novel patterns of adaptation in island birds and investigating for the first time some of the mechanisms underlying these adaptations. The results are making a significant contribution for our understanding of the ecology and evolution of island environments. Given the large number of species endemic to islands worldwide and the role of islands as 'natural laboratories', our results make a significant contribution to understanding and conserving island environments.

The largest weaver in its family, the Giant Weaver *Ploceus grandis* is endemic to São Tomé Island (Photo: Anne Delestrade).

Principe Starling *Lamprotornis ornatus* endemic to Principe Island (Photo: Anne Delestrade).

Key co-sponsors

FCT (Portugal); National Geographic; British Ecological Society; CNRS (PEPS); DST-NRF CoE grant; University of Montpellier (PhD grant to Alois Robert).

Research team

Dr Rita Covas (FIAO, UCT and CIBIO, U. Porto)
Dr Claire Doutrelant (CNRS and FIAO, UCT)
Dr Martim Melo (FIAO, UCT and CIBIO, U. Porto)
Dr Elisa Lobato (CIBIO, U. Porto)
Dr Claire Loiseau (CIBIO, U. Porto)
Dr Thierry Lengagne (CNRS)

Students: Aloïs Robert (PhD, U. Montpellier)

Impacts of power infrastructure

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

This programme, which is run in close collaboration with BirdLife South Africa's Birds and Renewable Energy programme, received a considerable boost in 2016 with the awarding of a grant from the Hans Hoheisen Charitable Trust to fund a full-time research assistant for three years. Vonica Perold, a former field assistant on Marion Island, was appointed to this position from August 2016. A presentation to the ABAX Foundation in December 2016 also resulted in further funding to model the impacts of wind farms on Verreaux's Eagles *Aquila verreauxii.*

Activities in 2016

- The large-scale experiment to test the efficacy of transmission line marking (using flappers or static flight diverters) to reduce collision mortality continued in the De Aar region of the eastern Nama Karoo thanks to ongoing monitoring by staff from the Endangered Wildlife Trust (EWT). Jess Shaw, now based in the UK, updated preliminary analyses showing a benefit to marking lines for Blue Cranes *Anthropoides paradiseus*, but not for Ludwig's Bustards *Neotis ludwigii*.
- Wind and solar power generation have much less broad-scale environmental impact than the coal-fired power stations on which South Africa relies for most of its power generation, but both technologies can have significant impacts at a local scale. A review of the first year of bird mortality monitoring at eight wind turbine facilities led by Samantha Ralston found that a wide variety of birds were killed; the 340 bird carcasses found represented 80 species from 38 families, including 16 families of passerines. Raptors are the species of greatest conservation concern, with significant numbers of both Accipitriformes (60 birds from 11 species) and Falconiformes (50 birds from 5 species) killed. However, flufftails were surprisingly frequent victims given their general rarity, with 5 individuals from 3 species killed.
- Building on the success of Tim Reid's model to predict the impact of wind farm developments on Bearded Vultures *Gypaetus barbatus* (Reid et al. 2015, *J. Appl. Ecol.*), similar data are now being used to manage impacts of wind farms on Verreaux's Eagles. Megan Murgatroyd was awarded her PhD in June 2016 for her study of these iconic eagles. She continues as a post-doc at the Fitz studying how this eagle's movement patterns renders it susceptible to colliding with wind turbines. At least five Verreaux's Eagles have already been killed by windfarms in South Africa, with three killed at a single facility. By understanding where and when eagles are vulnerable to collisions, we can advise developers on plant design, and potentially stop problematic turbines during periods of high risk to eagles.
- Accurate movement data also are being collected for Blue Cranes in the Overberg to better understand how cranes move in this region, which is home to the world's largest population of this species. Cost-effective solar-powered GSM-linked GPS loggers have been deployed on the cranes using harnesses, so they should provide long-term data on their movements. The EWT's Tanya Smith is leading this project, but the plan is to recruit a CB MSc student to analyse the data in 2017.
- Industrial-scale solar power generation also is growing rapidly in South Africa, with little information on the impacts on biodiversity. CB MSc student Elke Visser was awarded her degree in 2016 for her study of the impacts of the Jasper 96 MW photo-voltaic plant near Postmasburg in the Northern Cape. She found very few mortalities, and even accounting for a fairly high scavenger removal rate of small birds, it is unlikely that significant numbers of

CB MSc student Corey Jeal at the concentrated solar power 'trough' facility, Bokpoort (Photo: Peter Ryan).

any bird species are being killed by the facility.

- CB MSc student Corey Jeal conducted a similar study of a concentrated solar power (CSP) 'trough' facility, Bokpoort, near Groblershoop. This plant uses parabolic mirrors to heat a synthetic oil to almost 400°C. Corey found few direct impacts on birds, and limited evidence of attraction of macro-invertebrates to the facility. The main concern surrounded animals drowning in the plant's evaporation ponds. Like Elke, Corey found that the bird community in the plant area differed significantly from adjacent untransformed land mainly as a result of open-country species being favoured following the removal of bush cover. However, some species benefited from the installation, notably Barn Owls *Tyto alba*, which use the mirror support tubes as roost sites.

Highlights:

- Megan Murgatroyd was awarded her PhD in June 2016 for a comparison of the Verreaux's Eagles breeding in the natural area of the Cederberg and those breeding in the transformed Sandveld. Megan's first paper on the fine-scale movement patterns in these two areas was published in *PLoS ONE*.
- Julia van Velden had two papers from her CB MSc project on Blue Cranes published: one reported estimates of adult survival based on *Kevin* Shaw's long-term ringing study (*Ostrich*) and the other examined the basis of potential conflicts with farmers in the Swartland and Overberg regions of the Western Cape (*Environmental Management*).
- Elke Visser obtained her MSc after studying the impacts of a large photovoltaic solar plant.
- GSM-GPS trackers were deployed on Blue Cranes in the Overberg region to track their long-term movements in collaboration with the EWT and CapeNature.

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

Research team
Prof. Peter Ryan (FIAO, UCT)
Dr Arjun Amar (FIAO, UCT)
Samantha Ralston-Paton (BLSA)
Dr Andrew Jenkins (ADU, UCT)
Dr Megan Murgatroyd (FIAO, UCT)
Vonica Perold (FIAO, UCT)
Dr Jess Shaw (FIAO, UCT)
Dr Rob Simmons (FIAO, UCT)
Tanya Smith (EWT)

Students: Corey Jeal (CB MSc, UCT), Julia van Velden (CB MSc, UCT), Elke Visser (CB MSc, UCT)

Conserving Martial Eagles

This project aims to understand the factors driving a decrease in the population of Martial Eagles *Polemaetus bellicosus* in South Africa, with a particular focus on the declines that have been observed within the largest protected area in the country, the Kruger National Park. This research is important in understanding the role that protected areas have in species conservation and understanding specific threats and habitat requirements for the conservation of Martial Eagles.

The Martial Eagle research project was initiated following an analysis which showed that the species had declined by up to 60% across South Africa, including large declines within protected areas. Our original hypothesis for these declines was that Martial Eagles may be subject to increased mortality outside of protected areas, particularly during immature life stages when inexperienced eagles are likely to range away from the nest and into areas with increased human pressures. Contrary to this hypothesis, data collected since 2013 did not find evidence for low survival during these early life stages despite ranging widely beyond non-protected area boundaries. However, through GPS tracking of adult birds and nest monitoring, two potential factors that may be contributing to the observed population declines have been detected: low adult survival and poor breeding productivity. Adult mortalities, including persecution and electrocution, during unexpected wide ranging movements outside of the Kruger National Park may be contributing to declines. These unexpected adult movements and the drivers of poor breeding productivity will now form the main focus of ongoing research on Martial Eagles in the Park.

Martial Eagle Project research team in the field: Rowen van Eeden, Arjun Amar, Megan Murgatroyd (Photo: Gareth Tate).

A Martial Eagle photographed in the Kruger National Park (Photo: Gareth Tate).

Activities in 2016

- Rowen van Eeden, Gareth Tate and Megan Murgatroyd undertook fieldwork in the Kruger National Park to collect data on breeding productivity. This is our fourth consecutive year of Martial Eagle breeding monitoring in the Kruger National Park.
- British TV presenter, Steve Backshall, joined Rowen in the Kruger National Park to film the GPS tagging of two Martial Eagles for the series "Fierce", which airs on primetime UK TV. One of these tagged eagles was subsequently found dead, caught in a hunting snare 60 days later in Mozambique.
- We continued to monitor the movements of our GPS tagged Martial Eagles.
- We signed another three year contract with South African National Parks, which will allow us to continue the research on Martial Eagles.

Rowen van Eeden with the remains of the GPS tagged Martial Eagle caught in a snare in Mozambique (Photo: Gareth Tate).

Highlights:

- Rowen van Eeden submitted his PhD entitled "Understanding population declines of Martial Eagles *Polemaetus bellicosus* in the Kruger National Park, South Africa" for examination.
- Rowen had the first paper from his PhD research accepted for publication in the open access journal *PLoS ONE*.
- We published a paper in *Ostrich* based on Daniël Cloete's CB MSc dissertation, which used nest survey data to validate changes in reporting rates of Martial Eagles between the Southern African Bird Atlas Project 1 and 2.
- We submitted another paper from Daniël Cloete's CB MSc to *Bird Conservation International*. This paper quantifies the population changes throughout South Africa using SABAP1 and SABAP2 data.
- Considerable publicity was generated around the discovery of our GPS tagged female caught in a snare in Mozambique. This included local and international newspaper articles (e.g. *Daily Mail* in the UK).

Impact of the project

Our research indicates that protected areas alone are unlikely to conserve this species and that additional conservation measures, such as education programs, or trans-boundary policy should be put in place to ensure the successful conservation of this species.

Key co-sponsors

ABAX Foundation; African Bird Club; Bataleurs; Columbus Zoo and Aquarium; DST-NRF CoE grant; Endangered Wildlife Trust; Natural Research Ltd; Raptor Research Foundation; Riverbanks Zoo and Garden; South African National Parks; University of Cape Town Research Committee.

Research team

Dr Arjun Amar (FIAO, UCT)
Dr Phil Whitfield (Natural Research Ltd, UK)
Dr Megan Murgatroyd (FIAO, UCT)
Dr Gareth Tate (FIAO, UCT, Endangered Wildlife Trust)
Andre Botha (Endangered Wildlife Trust)
Dr Andrew Jenkins (ADU, UCT)

Students: Rowen van Eeden (PhD)

Conserving Verreaux's Eagles

Verreaux's Eagle *Aquila verreauxii* has recently been upgraded to "Vulnerable" in South Africa due to decreases in range and abundance recorded by the Southern African Bird Atlas Project. Land use change, habitat loss and more recently, the development of the wind energy industry, all pose threats to this species. Initially, this project explored the ecology of Verreaux's Eagles in natural and agriculturally transformed habitats. Generally regarded as a highly specialised raptor, habitat transformation was predicted to reduce availability of preferred prey species (Rock Hyrax *Procavia capensis*), resulting in reduced breeding productivity or increased foraging efforts. Contrary to this prediction, our research in the Cederberg and Sandveld regions of the Western Cape found that Verreaux's Eagles are in fact diversifying their diet in agriculturally developed areas and their breeding productivity does not appear to be negatively impacted.

High-resolution GPS tracking technology proved to be important to understand the ranging behaviour of Verreaux's Eagles in contrasting habitats. This technology is now being used to understand flight behaviour and the associated risk of wind turbine collisions. Like many other large soaring raptors, Verreaux's Eagles are particularly prone to wind turbine collision risk. During 2015, at least five Verreaux's Eagle fatalities were recorded at wind farms in South Africa. Although wind energy in Africa is still in its infancy in comparison to many other countries, the sector is developing at a rapid rate. The GPS data will be used to build habitat use models that explore how territory holding eagles use the landscape. In particular, we need to understand how factors such as distance from the nest, topographical features and collision risks influence their movements.

The aim is to incorporate these models within a user-friendly, web based interface for use by the wind energy industry to obtain a relative collision risk map of potential development areas, thereby ensuring that wind turbines can be placed in locations that will minimise risk to flying eagles.

Megan Murgatroyd with a Verreaux's Eagle, trapped for GPS tagging (Photo: Gareth Tate).

Activities in 2016

- A collaboration was started with Andrew Jenkins of AVISENSE Consulting to GPS tag Verreaux's Eagles at a wind farm development site in the Karoo. Six Verreaux's Eagles were equipped with high-resolution GPS tags from the University of Amsterdam Bird Tracking System. These tags have already yielded huge amounts of high resolution tracking data, which will be used for the Environmental Impact Assessment and for our proposed collision risk model.
- Megan Murgatroyd presented her key PhD results at the Pan African Ornithological Congress in Dakar, Senegal.
- Megan presented her Post-doctoral research proposal at the Birds and Renewable Energy Forum hosted by BirdLife South Africa and the Endangered Wildlife Trust (EWT) at Kirstenbosch.

A Verreaux's Eagle soaring in the Sandveld region (Photo: Megan Murgatroyd).

Highlights:

- Megan submitted and received her PhD entitled "Ecology of the Verreaux's Eagle in natural and agriculturally transformed habitats" supervised by Les Underhill (ADU, UCT) and Arjun Amar.
- The first paper from Megan's PhD research was published on the influence of agricultural transformation on the breeding performance of Verreaux's Eagles (Murgatroyd *et al.* 2016. *Condor*).

Verreaux's Eagles with their two-week old chick on a nest in the Cedarberg (Photo: Megan Murgatroyd).

- Research on the diet of Verreaux's Eagles was also published (Murgatroyd *et al*. 2016. *J. Avian Biol.*).
- Research using high resolution GPS tracking to investigate ranging behaviour and habitat preferences was published and is available open access. (Murgatroyd *et al*. 2016. *PLoS ONE*).

Impact of the project

This project has added to our understanding of the ecology and habitat requirements of Verreaux's Eagles. The primary aim of the ongoing work is to contribute to reducing future injuries and mortalities of Verreaux's Eagles via wind turbine collisions throughout their range. This will contribute to the long-term sustainability of wind development within Sub-Saharan Africa and minimise the impact on one of the most widespread and vulnerable eagle species on the continent.

Key co-sponsors
ABAX Foundation; DST-NRF CoE grant.

Research team
Dr Arjun Amar (FIAO, UCT)
Prof. Les Underhill (ADU, UCT)
Dr Andrew Jenkins (ADU, UCT)

Student: Megan Murgatroyd (FIAO and ADU, UCT)

Vulture conservation

We are currently experiencing what some have termed an "African Vulture Crisis". Several populations of vultures have declined by up to 95% over the last few decades resulting in four species being listed as Critically Endangered and three as Endangered. Unlike the Asian Vulture Crisis, where the collapse of vulture populations had a single cause (the veterinary drug – diclofenac), there appears to be multiple drivers for the situation in Africa, with the importance of each varying between species and regions.

The FitzPatrick Institute recognises that vultures provide important eco-system services and that their declines or disappearances will have a dramatic effect on people and wildlife in Africa. We are therefore committed to help conserve vultures in Africa by engaging in a number of research projects on multiple species in several countries in southern Africa.

Working with Raptors Botswana, we are involved in a research programme to conserve Botswana's significant populations of five species of vultures, all of which are endangered or critically endangered, despite Botswana having one of the highest percentages of protected areas coverage for wildlife conservation on the continent. Central to this research is an attempt to quantify changes in vulture populations in Botswana over the last 20 years by repeating road transects undertaken in the early 1990s. Another focus of this research has been on lead levels in vulture blood and how these vary inside and outside of hunting areas and hunting seasons. Finally, this research has a special focus on understanding the movement patterns and the current rates of productivity of Lappet–faced Vultures *Torgos tracheliotos*.

We remain a key partner in the conservation of the Bearded Vulture *Gypaetus barbatus* in southern Africa. Dr Sonja Krüger completed her PhD research on the conservation of this population with the Fitz in 2014 and we continue to collaborate with her (Ezemvelo KZN Wildlife) and others on the conservation of this important population. More recently, research has focused on the feasibility of captive breeding and of establishing an 'insurance' population away from the main Maloti-Drakensberg Mountains' population.

With key collaborators VulPro, we are investigating the role that vulture restaurants can play in vulture conservation in South Africa.

A Lappet-faced Vulture released after tagging (Photo: Beckie Garbett).

We aim to get a baseline understanding of the spatial and temporal availability of food for vultures at vulture restaurants, and to examine the benefits and the costs that these may entail. We are working with farmers, particularly from the pig industry, to gain insights into their role in providing carrion for vulture restaurants that can serve as a win-win strategy for farmers and vultures.

In Namibia, we are investigating poison use as a threat to vultures. We aim to map poison hotspots to understand the factors and conflicts that impact poison use in order to find solutions for the farmers, which will indirectly benefit vultures. With Vultures Namibia and the University of Helsinki we also aim to understand the movements of vultures within and outside of protected areas. We link movement data from across the region to investigate the overlap with areas that represent threat hotspots.

Activities in 2016

- PhD student Beckie Garbett completed the repeat raptor road transect surveys initially carried out during 1991-1995 in northern

Botswana. These data will be used to quantify the population trends of vultures in Botswana.

- Beckie also completed breeding surveys of Lappet-faced Vultures in the Makgadkgadi Pans, and continued to collect data from GPS tagged Lappet-faced Vultures.
- Christiaan Brink (CB MSc) investigated the feasibility of establishing a reintroduced population of Bearded Vultures in South Africa.
- Christie Craig (CB MSc) surveyed over 350 communal farmers in Namibia to understand poison use during predator control.
- The vulture restaurant database of South Africa was updated for analysis during 2017.
- Four team members presented at the Pan African Ornithological Congress in Dakar, Senegal, and the second Pan African Vulture Summit (PAVS). PAVS was used to draft the Migratory Species Action Plan for African-Eurasian vultures.
- Seven Lappet-faced Vultures in the Namib-Naukluft National park in Namibia were fitted with GSM trackers by collaborators Vultures Namibia.
- Following the PAVS meeting, we initiated a project to synthesise the priorities for research on African Vultures from the opinions of vulture experts. This will be completed in 2017.

Highlights:

- Over 21 000 km of repeat road transects were completed across Northern Botswana.
- A paper examining the dispersal behaviour of GPS-tagged fledgling Bearded Vultures was published in *Bird Study* in March 2017.
- A paper examining the breeding performance of the Southern African population of Bearded Vultures was submitted to *Ostrich*.
- Christie Craig presented her preliminary results at the annual Namibian Association of CBNRM Support Organisations (NASCO) Working Group meeting.

Impact of the project

Our research aims to understand important ecological issues affecting vultures, quantify population trends of multiple species, and identify key drivers of their population declines. Using our research on vulture restaurants, poisons use, blood lead levels and hunting, and more recently with our research on reintroductions, we hope to deliver solutions to help reverse the declines in these species in Africa. The outcomes of these projects will help better understand the why, what, where and how of vulture threats, with implications for targeting cost-effective conservation actions.

Christie Craig interviewing a cattle farmer in the Omaheke region, Namibia (Photo: Ndapanda Kasaona).

Key co-sponsors
DST-NRF CoE grant; NRF Innovation Scholarship; JW Jagger Grant; Denver Zoo; Raptors Botswana; Rufford Grant; Wilderness Wildlife Trust; Mohammed bin Zayed Species Conservation Fund; Colombus Zoo; Leslie Brown Memorial Grant; Peregrine Fund; IDEA Wild; British Ecological Society; Ezemvelo KZN Wildlife; Endangered Wildlife Trust; N3TC through Wildlands.

Research team
Dr Arjun Amar (FIAO, UCT)
Dr Robert Thomson (FIAO, UCT)
Dr Sonja Krüger (EKZN Wildlife)
Dr Andrea Santangeli (U. Helsinki, Finland)
Ms Kerri Wolter (VulPro)
Dr Glyn Maude (Raptors Botswana)
Dr Richard Reading (Raptors Botswana)
Dr Ara Monadjem (U. Swaziland)
Dr Andrew Tucker (CSVet, Pretoria)
Vultures Namibia

Students: Beckie Garbett (PhD, UCT), Christiaan Brink (CB MSc, UCT); Christie Craig (CB MSc, UCT)

Black Harriers – Ecology and Fitness

The Black Harrier *Circus maurus* is a rare southern African endemic raptor, which breeds within Fynbos and Karoo biomes. It is estimated that there are less than 1 000 breeding individuals, and the species is considered Endangered in South Africa, Namibia and Lesotho.

Carrying on the research initiated by Rob Simmons in 2000, PhD student Marie-Sophie Garcia-Heras's main goal was to investigate how various environmental factors may affect the breeding and health of this endangered species, at both the population and individual levels. Her research focused on factors influencing Black Harrier breeding performance, in particular diet composition, prey abundance and availability, habitat quality and weather conditions (temperatures and rainfall). She also explored the effects of persistent organic pollutants such as polychlorinated biphenyls (ΣPCB) and dichlorodiphenyltrichloroethane (ΣDDT) which are suspected to be a major threat to the population. The potential sub-lethal effects of these contaminants on diverse health indicators were also investigated. Studies on movements between breeding and non-breeding areas, and levels of connectivity between subpopulations, which may influence the level of genetic mixing were also assessed. Marie-Sophie submitted her PhD thesis in January 2017.

Highlights:

- Field work in coastal areas along the Western Cape was contrasted with inland areas in the Northern Cape to identify differences between breeding populations. Breeding parameters were collected at 490 nests during 2000-2015.
- Data were collected on physical and physiological condition (i.e. measurements, blood samples for contaminants and carotenoid analyses, stress hormone level) and photographs to assess skin colouration (cere and tarsi) from 90 chicks and 32 adults at 46 nests.
- PCBs and DDTs in the blood of nestlings and adults apparently induce sub-lethal effects on indicators of health and disrupt skin colouration of nestlings.
- We collected 954 pellets at breeding sites during 2006-2015 containing 1679 prey items. Black Harriers fed primarily on small mammals (64.4%), birds (19.2%) and lizards (16.3%). However, inland breeders consumed twice as many birds as small mammals as a result of a marked seasonal decline in the occurrence of small mammal prey.
- Automated cameras placed at 18 nests in 2014 showed a marked reduction in small mammal provisioning rates during midday in the hotter inland regions, which did not occur in the cooler coastal regions.
- Three satellite transmitters and six GPS/GSM transmitters fitted to adult birds during 2013-2015 provided accurate data on the foraging habitats of breeding Black Harriers, confirming the west-east-west migration routes and identifying non-breeding areas in Lesotho and the Eastern Cape.

Health status:

Laboratory analyses on organochlorine (OC) pesticides showed that both Black Harrier adults and chicks carry contaminants in their blood. PCB and DDT were detected in 79% of adult and 84% of chicks. Nestlings had significantly higher ΣPCB and p,p'-DDT concentrations than adults; adults presented higher levels of p,p'-DDE than nestlings. Levels of ΣPCB significantly increased with an index of "electric transformer density", (a measure combining the number and power of electric transformers around nests – PCBs were used in transformers). This could be used as a useful tool for assessing this potential source of ΣPCB exposure in wildlife. Levels of p,p'-DDE significantly increased with the proportion of wetlands in the breeding territory and with the percentage of bird biomass in the diet, confirming intra-specifically the association between diet and DDT contamination. No association was found between OC levels and the protected area status of nesting sites; some of the highest levels occurred in nestlings in protected areas north of Koeberg.

We also show associations between OC levels and indicators of physiological condition. White blood cell count increased with higher p,p'-DDT levels, while the heterophil to lymphocyte ratio

An adult Black Harrier moulting in late December (Photo: Peter Ryan).

increased with higher ΣPCB levels, suggesting increased physiological stress and reduced immunity in contaminated individuals. Analyses on the carotenoid-based colouration of the cere and tarsi in nestlings revealed that the a disruption of yellow-orange colouration was correlated with a decrease in circulating carotenoid levels at high levels of blood p,p'-DDT. This may have implications for nestlings given the importance of the expression of carotenoid-traits for social communication. Our results suggest that OC contaminants are a threat to Black Harriers, and probably affect other predators breeding in the same area.

Impact of the project

Overall, the results of Marie-Sophie's thesis highlight the importance of multifaceted and long-term studies, when attempting to understand a species´ limiting factors. She showed the importance of the coastal region (fynbos biome) for the stability and sustainability of the overall Black Harrier population. Fynbos habitat seems to provide better conditions for breeding in terms of food availability and weather conditions, but suitable habitat is severely fragmented. Neither provincial nor private reserves offered protection against persistent chemical pollutants affecting this rare harrier. Hence the scarcity of Black Harriers may be related to a lack of optimal, i.e. un-urbanised, un-polluted, un-fragmented and food-rich areas for breeding. The preservation and protection of the fynbos should, therefore, be prioritized to insure optimal and sustainable conservation of Black Harriers in the long term, but also for the conservation of many other terrestrial species that face similar threats.

Key co-sponsors
National Research Foundation; Golden Fleece Merinos; BirdLife South Africa

Research team
Dr Rob Simmons (FIAO, UCT)
Dr Beatriz Arroyo (CSIC, Spain)
Dr Francis Mougeot (CSIC, Spain)
Dr Raphael Mateo (CSIC, Spain)
Pablo E. Camarero (CSIC, Spain)
Dr Graham Avery (Iziko Musuems)
Dr Margaret Avery (Iziko Museums)

Student: Marie-Sophie Garcia-Heras (PhD, UCT)

Southern Ground-Hornbill conservation

Southern Ground-Hornbills *Bucorvus leadbeateri* are globally Vulnerable, and have been up-listed to Endangered in South Africa. They have experienced a two-thirds reduction in their national range, and presumably population size, in the past 100 years. Since 2000, they have been studied at the Fitz, investigating their habitat use, reproductive success as well as natal and breeding dispersal, largely to inform activities of the Mabula Ground-Hornbill Project (MGHP) and the national Ground-Hornbill Action Group, who are our partners in implementing the national Species Recovery Plan. The main study area is the Associated Private Nature Reserves (APNR), covering some 180 000 ha adjacent to the central Kruger National Park, that supports about 30 ground-hornbill groups. We have reproductive histories spanning a decade for more than 20 groups. Breeding success increases with group size and the amount of open habitat within 3 km of the nest site.

PhD student Kate Carstens completed her field research during 2016 and will submit her thesis on the effectiveness of artificial nests as a conservation tool in early 2017. Kate has expanded the data from the long-term study monitoring breeding biology and her thesis will provide valuable insights into the impact that the installation of artificial nests has had on groups in the APNR.

As a unique cooperative breeding species, Southern Ground-Hornbills offer a significant opportunity to investigate behavioural aspects of their life history and thus Dr Rita Covas, Research Associate at the Fitz, has started a new phase focussing on the social structure and cooperative behaviour of the APNR groups. Several aspects of their life history such as high longevity, low fecundity, large body size and large territory size, a social system comprising both family members and immigrants, and their phylogenetic position make them an interesting species in which to study the factors promoting sociality and cooperation and the associated conflicts. Furthermore, the long-term data available allows investigation of how social factors interact with environmental factors to determine population trends. This is interesting in itself and is highly relevant in this species, given the substantial population decline that the species has experienced.

Maxime Loubon recording Southern Ground-Hornbill vocalisations (Photo: Carrie Hickman).

Activities in 2016

- The new behavioural component of the research was initiated at the start of the 2016/17 breeding season.
- Kyle Middleton and Carrie Hickman were appointed as field assistants to help with the start of the behavioural research and to continue the monitoring of breeding activity and foraging habits of the groups in the APNR.
- Field assistant Maxime Loubon, received training on how to record bird vocalisations with an acoustics specialist working on the Sociable Weaver project at Benfontein. Maxime will also train Kyle Middleton.
- Camera traps were placed close to nest entrances, starting with a single camera-trap in 2016, but 2-3 cameras could be used rotating

among nests, if the system works. The cameras take short videos of ca 30 seconds of the birds when they enter the nest to feed.

- Increased efforts were made to identify individuals by non-invasive techniques such as the use of photographs of their face to obtain distinctive individual features of their bill or cask shape, red throat pouch, 'side-burns', etc.
- Vocalisation recording has been started to determine whether calls have group and individual bird 'signatures'.
- The collection of genetic samples from known individuals is continuing through non-invasive methods, such as from moulted feathers, fresh faeces, and by swabbing eggs. Genetic finger printing will allow us to determine parameters such as investment in cooperative behaviour and associations between individuals.

Highlights:

- Blair Zoghby's second MSc thesis paper on the roost site selection by Southern Ground-Hornbills was published in *Ostrich* during 2016.
- Kate Carstens published an article in the *Klaserie Chronicle,* which is distributed to the greater Hoedspruit community and surrounding private nature reserves.
- The 2015/16 breeding season saw 11 active nests with six chicks successfully fledged, and four second-hatch chicks were harvested for the reintroduction programme. One week before fledging, we colour-ringed, measured and took blood samples from the nestlings.
- The 2015/16 season also saw a confirmed case where the first egg failed to hatch for unknown reasons, resulting in the chance for the second chick to hatch and thrive.
- Since 2010, the APNR has contributed 33 second-hatched chicks for the species action group, of which 13 are intended for reintroduction releases.
- Ongoing repairs to and replacement of artificial nest boxes ensure that ground-hornbills can continue to thrive in an area which has a limited number of natural nest cavities.
- Two new artificial nests installed during 2015 were used by hornbills during the 2015/16 breeding season.

A spectacular adult female Southern Ground-Hornbill showing characteristic cask shape, red facial and throat-pouch features (Photo: Kate Carstens).

Impact of the project

This project has contributed to the basic science for the national SGH Species Action Plan and to the SGH Reintroduction Plan, and has substantial applied components assisting with the implementation of these plans. Rob Little and Kate Carstens represent the Fitz on the national SGH Action Group while Rob is also Vice Chairman of the MGHP management board.

Key co-sponsors

Associated Private Nature Reserves; Dow Southern Africa (Pty) Ltd; The Foundation for Science and Technology FCT, Portugal; Senelala Estates.

Research team

Prof. Peter Ryan (FIAO, UCT)
Dr Rita Covas (FIAO, UCT and CIBIO, U.Porto)
Dr Rob Little (FIAO, UCT)

Students: Kate Carstens (PhD, UCT)

Research Assistants: Cassie Carstens, Carrie Hickman, Maxime Loubon, Kyle Middleton.

Threatened species of South Africa's Moist Highland Grasslands

South Africa's grasslands comprise around 16.5% of the country's land surface and are one of the most threatened ecosystems, with more than 33% irreversibly transformed and only 2.7% formally protected. This threatened biome hosts a multitude of rare, threatened and/or range-restricted species, with two such species being the Yellow-breasted Pipit *Anthus chloris* and Rudd's Lark *Heteromirafra ruddi*. Each species is the focus of studies based at the Fitz.

Yellow-breasted Pipits

Yellow-breasted Pipits are restricted to well-managed grasslands along the eastern escarpment of South Africa marginally entering eastern Lesotho and western Swaziland. Concerns that this species' total population size and range are decreasing resulted in a study to investigate the drivers of any decline. Darren Pietersen, a PhD student at the University of Pretoria supervised by Andrew McKechnie, Ray Jansen and Ian Little, is employing a multi-faceted approach to determine the current distribution and status of Yellow-breasted Pipits in southern Africa, as well as investigating potential sources of decline. Darren and the team conducted bird- and plant community surveys, together with veld condition assessments, at 46 sites spanning the known and potential distribution of this species. These data are being used to assess the habitat preference of this species across its range, as well as assessing the feasibility of using bird community assemblages (and Yellow-breasted Pipits in particular) as a rapid-assessment indicator of Moist Highland Grassland ecological integrity. To determine the distribution of Yellow-breasted Pipits, verified sightings were combined with our records. The resultant database was combined with appropriate climatic variables and analysed in Ecological Niche Modelling software to predict the species' potential range. The results suggest that the species is occupying most of its potential range, at least at the macro-scale, and that the main drivers of this species' occupied range are occurring at the local scale (specifically grazing and burning regimes, confirming the results of previous studies).

The jewel of the grassland. A Yellow-breasted Pipit captured near Dullstroom, Mpumalanga (Photo: Darren Pietersen).

Is this where mist-nets get their name from? Trying to catch Yellow-breasted Pipits in grasslands near Dullstroom to get samples for the molecular aspects of this study (Photo: Darren Pietersen).

The patchy occurrence of Yellow-breasted Pipits has raised concerns about the genetic diversity of this species and whether there is still gene flow between its fragmented populations. To address these questions, we sequenced DNA from the three main populations and will soon be subjecting these data to population genetics analyses. Lastly, to investigate the possibility

that Yellow-breasted Pipits are a taxonomically ancient (basal) lineage that may have adapted to a climate and habitat that are receding due to a changing environment (both naturally- and anthropogenically induced), we are also elucidating the taxonomic placement of Yellow-breasted Pipits within the Motacillidae. As a spin-off of this study, we are also hoping to present a robust phylogeny of the sub-Saharan Motacillidae. Although this aspect is still ongoing, initial analyses suggest that some taxonomic changes may be required.

Rudd's Lark

Rudd's Lark was the focus of Wesley Gush's CB MSc project, supervised by Claire Spottiswoode, David Maphisa and Paul Donald. Wesley's research aimed to test whether the species has declined in one of its population strongholds, the Wakkerstroom area, and if so why. Wesley found both lower numbers of Rudd's Larks and a lower probability of encountering Rudd's Larks, compared to an identical survey conducted by David Maphisa in 2002–2004. Some previously suitable grassland habitat has been lost through conversion to crops, although the species has also declined within the remaining area of grassland habitat. The specific drivers of this decline remain unclear given that changes in grassland structure detected between 2002 and 2016 did not correspond with the Rudd's Lark's observed habitat selection. Taken together, these findings are concerning given that the Wakkerstroom area is considered to be one of the last remaining strongholds for the species, and may call its IUCN threat status of globally Vulnerable into question. A priority for future research will be to understand what limits Rudd's Larks to its current pockets of occupancy within its remaining apparently suitable grassland habitat, and so to better inform rangeland management.

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

Research team
Prof. Andrew McKechnie (U. Pretoria)
Prof. Ray Jansen (Tshwane University of Technology)
Dr Ian Little (Endangered Wildlife Trust)
Prof. Claire Spottiswoode (FIAO, UCT and U. Cambridge)
Dr David Maphisa (SANBI)
Dr Paul Donald (BirdLife International)

Students: Darren Pietersen (PhD, Pretoria), Wesley Gush (CB MSc, UCT)

Wesley Gush and David Maphisa surveying vegetation in the expansive highland grasslands (Photo: Claire Spottiswoode).

Saving Cape Parrots and their forests

The Cape Parrot *Poicephalus robustus* has been confirmed to be a separate species, and as such is endangered and endemic to a few Afromontane forest patches in South Africa. With less than 1 500 individuals remaining in the wild, it is threatened by a diversity of impacts ranging from habitat loss to illegal trade and disease. Tackling this array of threats makes it a useful model for developing and testing different conservation strategies, and it is a valuable flagship species for conserving its habitat.

The Cape Parrot Project, initiated in 2009, is a long-term project which aims to conserve the Cape Parrot through research, education, and reforestation efforts in partnership with government, local communities, conservation partners, and research collaborators.

Activities in 2016:

- Appointed Cassie Carstens as a research manager to focus on reforestation and community partnerships. Employed six people from the local community to work in the reforestation programme.
- The project base has moved to a large property in Hogsback (Boscobel), where the nursery, germination rooms, storage facilities, and accommodation for two managers is available.
- Artificial nest boxes erected in 2010/2011 were repaired and were inspected for use by parrots or other cavity-nesting species.
- Recorded large amounts of sightings data to start understanding their use of the landscape at different times of the day and in different seasons, where they forage and breed in indigenous forest patches.
- Successfully developed a technique of attaching a tracking transmitter onto a parrot, using a captive Grey-headed Parrot *P. fuscicollis*, enabling us to apply for ethics clearance to track wild parrot movements.
- Hosted three students from UCT, who helped with the capture and sampling of Cape Parrots, and two international students from Otterbein University, who helped with collecting data on parrot vocalizations for a collaborative project with their supervisor, Prof Anna Young.
- BSc Hons student Sanjo Rose worked as a research assistant for three months helping to collect data on parrots.

Radiotelemetry backpack prototype successfully tested on a captive Grey-headed Parrot (Photo: Cassie Carstens).

- Promoted Cape Parrots with educational posters, marketing material (logos on pencils, banners, etc.), attending festivals (BirdLife Bird Fair), and visiting schools.
- Continued working with the Department of Forestry and Fisheries (DAFF) and Eastern Cape Tourism and Parks to demarcate and proclaim new protected areas.
- Built a large nursery in Hogsback and a germination room to grow tree seedlings.
- Seed collection teams gathered ~ 230,000 seeds from *Afrocarpus falcatus*, *Harpephylium caffrum*, *Podocarpus latifolius*, *Olea africana africana*, and *Vepris* sp. for germination.
- Continued working with 20 micro-nurseries in Sompondo village to grow seedlings. Busy building them a large communal nursery to help with water supply.
- Continued preparation of planting sites, tree-planting, and alien invasive removal.

Highlights:

- Published a short note describing the rarely witnessed mating behaviour of Cape Parrots.
- Located and monitored several new natural nests being used by Cape Parrots, including one with chicks.
- Uncovered a possible Cape Parrot capture and trafficking hub in Alice. Information from investigation given to the provincial Department of Economic Development and Environmental Affairs (DEDEA) legal compliance division, who are investigating.

Looking forward: Research plan for 2017 and long-term goals

- Have hired new staff, including a project manager, and project assistant. Will be hiring a research assistant.
- Will employ community members to run the communal nursery and help the micro-nursery owners to grow stock for re-sale; look at establishing in other villages.
- Will be investigating the seasonal movement of parrots in the Amathole mountain range through radio-telemetry, while continuing behavioural ecological observations of parrots in and around Hogsback.
- Will continue to increase the capacity of nurseries to produce indigenous trees that can be planted in reforestation and feed lot sites, and sold to other organisations for their reforestation efforts.

Research manager, Cassie Carstens, fixing an artificial nest box (Photo: Justice Vusani).

Cape Parrot eating *Protea caffra flowers* (Photo: Cassie Carstens).

- Will secure several reforestation and rehabilitation sites for planting of indigenous trees and clearing of alien invasive plants, such as working on riparian zones on pine plantation land.
- Will work with local pecan orchard farmers to develop a "parrot friendly pecan nut" initiative.
- Will fund a Skills Development Course for teachers in the Amathole Region, where they will incorporate information on Cape Parrots and forest conservation into the curriculum to teach Grade 10, 11 and 12 learners.

Impact of the project

By learning more about Cape Parrots, we are able to better conserve the species. For instance, by understanding the characteristics of natural nest cavities (e.g. position, type of tree) we can improve the use of artificial nest boxes. Finding where they travel in different seasons and the indigenous tree species they rely on for fruit gives us a better idea of areas that need to be protected and incorporated into reserves. Increased capacity to grow trees allows us to populate degraded habitat with indigenous trees for use by forest species, particularly Cape Parrots.

Key co-sponsors

Abax Foundation; Ford Wildlife Foundation; Roland and Dawn Amall Foundation.

Research team

Dr Steve Boyes (FIAO, UCT)
Dr Kirsten Wimberger (Wild Bird Trust, Cape Parrot project director)
Dr Helen Fox (Wild Bird Trust)
Cassie Carstens (Wild Bird Trust)
Nikki Steyn (Wild Bird Trust)

Disturbing the peace

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

This programme had two active projects in 2016: MSc student Andrew de Blocq is advising CapeNature on the sustainability of boat-based tourism on De Hoop Vlei, a Ramsar wetland which is a key component of their of flagship De Hoop Nature Reserve. And in the Garden Route area, MSc student Selena Flores is studying the factors causing population decreases in coastal populations of White-fronted Plovers *Charadrius marginatus*.

The Great Crested Grebe *Podiceps cristatus* is the species of conservation concern that is perhaps most impacted by boat tours at De Hoop Vlei (Photo: Peter Ryan).

Activities in 2016

Andrew de Blocq continued to monitor the impact of tourist boat trips on waterbirds at De Hoop Vlei throughout the first half of 2016. By comparing the numbers of birds affected by boat trips with the total population on the vlei he showed that the two routes currently used for boat tours impact at most 10-20% of the vlei's bird populations. Few species of conservation concern were affected by the current tour routes.

Flight initiation distances varied greatly among species, but most species were surprisingly intolerant of boats, reacting when the boat was around 80-100 m away. Added to this, most species failed to return to an area within one hour after being displaced by a boat. By comparing bird responses to the tour boat with their responses to a kayak, Andrew showed that most birds were disturbed more by the kayak. Kayak tours also are harder to control in terms of routes, and can penetrate into shallower water (which support high bird concentrations), and are not practical at De Hoop Vlei given the frequent strong winds, and thus were not recommended as a tourist activity.

Andrew conducted similar approaches by kayak at Rietvlei, a coastal wetland in Cape Town with a long history of boat use. Surprisingly, there was little difference in flight initiation distances between the two wetlands, suggesting that there is little habituation to the passage of small boats. However, his comparison was complicated by the need to sample both in the open access and reserve areas at Rietvlei. Habituation of waterbirds at De Hoop Vlei is unlikely for most species because it requires repeated exposure of the same individuals, yet regular counts at De Hoop show regular changes in bird populations, suggesting frequent movement in and out of the system. Accordingly, Andrew advised caution in the implementation of boat tours at De Hoop Vlei.

Selena Flores monitored White-fronted Plovers on the coast around Plettenberg Bay for the third breeding season in succession. She is testing how plover breeding behaviour differs over a disturbance gradient. Overall breeding success is low (<10%), especially during the busy holiday season. Incubating plovers respond to an approaching person from up to 50 m away, and typically leave their nests when the person is 30 m away, remaining away from the nest until the person has moved at least this distance

past the nest. Her trials with dummy eggs show that unattended eggs can reach a potentially lethal 45°C in under 15 minutes during summer midday temperatures.

In 2016 the project initiated an intervention and awareness programme to help mitigate human disturbance on the plovers, planned and implemented in conjunction with the Nature's Valley Trust. Information boards highlighting conservation concerns and responsible beach usage have been installed at beach entrances, and signage placed around White-fronted Plover nests to encourage visitors to be aware of ground-nesting shorebirds and avoid of active breeding areas. Awareness campaigns also are being conducted using public talks and workshops, social media and directly with beach visitors. The research team also is conducting a questionnaire survey to gather public opinion and general rates of compliance with and enforcement of beach regulations. The findings will be presented to municipal government and nature conservation agencies.

***Highlights*:**

- MSc student Andrew de Blocq completed his field studies at De Hoop Nature Reserve and will submit his thesis in early 2017.
- The project final report was given to CapeNature in December 2016. The report recommended that at current water levels it is acceptable to allow boat tours to continue on the current two routes at De Hoop Vlei, provided specific conditions are met. Kayak tours should not be permitted.
- Selena Flores upgraded her MSc to a PhD in December 2016.
- A documentary featuring White-fronted Plover research was filmed by Cape Town's Homebrew Studios in February 2016. The segment is part of upcoming Smithsonian Earth series Wildlife Odyssey, with final production for airing in North America and online planned for 2017.
- White-fronted Plover samples were contributed to Josie Jackson's PhD study with the University of Bath and Cardiff University, on genetic diversity and gene flow within populations of southern African shorebirds.

Natures's Valley Trust research assistant Christina Marques undertaking surveys to assess beach goers' opinions and awareness of beach regulations (Photo: Selena Flores).

A sign warning beach goers to avoid a White-fronted Plover nesting area (Photo: Selena Flores).

Key co-sponsors
BirdLife Plettenberg Bay; Cape Nature; DST-NRF CoE grant; Keurboomstrand Property Owners' Association; Knysna Toyota; Table Mountain Fund; Wader Quest.

Research team
Prof. Peter Ryan (FIAO, UCT)
Dr Mark Brown (Nature's Valley Trust)
Dr Robert Thomson (FIAO, UCT)

Students: Andrew de Blocq (MSc, UCT), Selena Flores (MSc, UCT)

Research assistants: Jesse Beck, Taylor Frerichs, Andrea Gress, Amber Hatch, Aurora Hood, Christina Marques; Carissa Wasyliw.

Conserving Benguela endemic seabirds

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

However, not all seabirds in the region are decreasing. Numbers of Greater Crested Terns *Thalasseus bergii* (known locally as Swift Terns) have increased over the last few decades, despite feeding on the same small pelagic fish prey as the African Penguin *Sphensicus demersus*, Cape Cormorant *Phalacrocorax capensis* and Cape Gannet *Morus capensis*. And it is not only species that depend on small pelagic fish that are in trouble. Populations of Bank Cormorants *Phalacrocorax neglectus*, which feed on a diverse array of demersal prey, also have decreased along the South African west coast, but increased locally along the south coast. Understanding the drivers behind these population changes is the crucial first step necessary to mitigating population declines. This is a large, multi-faceted programme, with key participants including Lorien Pichegru and Pierre Pistorius (NMMU), David Grémillet (CNRS Montpellier), former post-docs Tim Cook (Paris) and Richard Sherley (Bristol), and collaborators at BLSA (Ross Wanless, Christina Hagen, Taryn Morris) and DEA (Azwianewi Makhado and Rob Crawford).

Activities in 2016

- Alistair McInnes completed his PhD on the fine-scale drivers of African Penguin prey dynamics and their impacts on penguin foraging ecology. His paper in *Marine Ecology Progress Series* identified the oceanographic processes affect prey availability in Algoa Bay, which now supports about half the world population of African Penguins. Lorien Pichegru is extending Alistair's findings with the help of NMMU post-doc Dr Giannina Passuni, to investigate how climate change is likely to influence fish availability in Algoa Bay.
- Together with Pierre Pistorius (CoE team member at NMMU), Maëlle Connan investigated the diet of African Penguins using stable isotope analyses. She found that although small pelagic fish are critically important during chick rearing, squid also are important for adult self-provisioning during certain times of the year.
- The experimental closure of commercial fishing for small pelagic fish around key penguin breeding islands continued in its eighth year. The Island Closure Task Team presented its findings to the International Stock Assessment Review Panel in December 2016, which differed from those presented by the fishery consultant. The panel recommended that the experiment be continued in 2017 to strengthen the statistical power of the findings.
- Lorien Pichegru published a paper in *Ibis* showing that two-thirds of African Penguin chicks fledged from Bird Island were male. Male chicks grow faster and fledge heavier than females, likely enhancing their first year survival. This discrepancy in sex production and survival may eventually lead to a male-biased sex ratio, further exacerbating the species' conservation status.

Post-doc Alistair McInnes recovers a tiny video camera from an African Penguin at Stony Point, assisted by CapeNature's Cuan McGeorge (Photo: Peter Ryan).

- PhD student Gwendoline Traisnel assessed how African Penguin responses to a human intruder vary among individuals. Personalities influence breeding success; shyer individuals tend to be better parents than bolder, more aggressive individuals, especially when food is scarce. Aggressive individuals may spend more energy defending their nests, limiting their investment in foraging effort.
- Lorien Pichegru and David Grémillet continued their long-term study of the foraging ecology of Cape Gannets breeding on Malgas Island. Innovative data from a range of data loggers showed that in recent years most adult gannets provisioning chicks spend more energy than they gain through foraging, with long-term fitness cost in terms of adult body condition and reproductive performance. Based on this evidence, we advocated a revision of regional fishing quotas for small pelagic fish including an experimental cessation of purse-seine fishing activities off the west coast.
- CB MSc student Tendai Chinho explored the Information Centre Hypothesis in Cape Gannets, i.e. whether individuals returning from a foraging trip communicate information about their foraging environment to their partners and neighbours during their ritual displays. Her preliminary analyses revealed that some components of the display, such as head-shakes, were correlated to indices of foraging effort.
- Pierre Pistorius also continued his studies on Cape Gannets. Jonathan Botha completed his MSc on resource partitioning (how individuals spread their foraging effort between sexes and over time). PhD student Rabi'a Rijklief showed that foraging effort, nutritional stress and hormonal stress was greater in gannets from the massive colony at Bird Island compared to birds from Malgas Island, when controlling for diet differences. She concluded that intra-specific competition forces gannets breeding on Bird Island to travel long distances to provision their chicks.
- Andrea Thiebault and Pierre Pistorius published a paper on acoustic communication in gannets. Bird-borne video cameras with built in microphones showed that gannet calls are context specific, with collision avoidance while foraging in groups being one of the key functions.
- PhD student Davide Gaglio completed a third year of diet monitoring in Greater Crested Terns breeding on Robben Island. His use of digital photography to record prey brought to the colony allows unprecedented insights into this species' diet, and revealed some fascinating insights (e.g. although anchovy dominate their diet, the proportion of anchovy drops by 20% on foggy days, indicating the importance of social facilitation for finding anchovy schools). He will complete his PhD in early 2017.
- PhD student Ana Payo Payo from Spain visited the Fitz for two months to work with Peter Ryan and Res Altweg (SEEC). She analysed mark-recapture data for Greater Crested and Roseate Terns *Sterna dougallii* to estimate annual survival rates.

Highlights:

- Jenni Roberts completed her MSc on the non-breeding movements of adult African Penguins, and Alistair McInnes completed his PhD.
- David Grémillet's paper on starving Cape Gannets, published in *Marine Biology*, resulted in a legal challenge from the fishing industry.
- Davide Gaglio published a paper in *Methods in Ecology and Evolution* on the use of photographs to quantify the diet of birds that carry prey to their nests, such as terns.
- Richard Sherley consolidated findings from two MSc theses on Bank Cormorants for a paper that has just been accepted in *Conservation Biology.*
- Several students presented papers or posters at the 9th International Penguin Congress that took place in September 2016 in Cape Town. Alistair McInnes and Noelle Tubbs received awards for the best student presentations.

Key co-sponsors

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

Research team

Prof. Peter Ryan (FIAO, UCT)
Prof. Res Altwegg (SEEC, UCT)
Dr Maëlle Connan (NMMU)
Dr Timotheé Cook (FIAO, UCT)
Dr Rob Crawford (Oceans & Coasts, DEA)
Dr Jon Green (U. Liverpool)
Dr David Grémillet (FIAO, UCT and CNRS)
Dr Azwianewi Makhado (Oceans & Coasts, DEA)
Dr Lorien Pichegru (NMMU)
Dr Pierre Pistorius (NMMU)
Dr Richard Sherley (U. Bristol)
Dr Ross Wanless (FIAO, UCT and BLSA)

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

Conserving Southern Ocean seabirds

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

Fitztitute seabird research on Marion Island, conducted through the South African National Antarctic Programme (SANAP), has continued unbroken since the early 1980s, when a series of long-term study colonies were established by John Cooper. The current three-year research project is focused on understanding the threats facing sooty albatrosses *Phoebetria* spp., and investigating how large, long-lived seabirds tradeoff the costs of moult and breeding. However, an array of other topics also are studied. Most field work takes place at the Prince Edward Islands, Tristan da Cunha and Gough Islands, with some students spending protracted periods on islands as field assistants, whereas others are based in South Africa. This project overlaps with the island conservation project (see p. 39).

Activities in 2016

- PhD student Dom Rollinson had two papers accepted for publication; one summarising the impacts of the South African large pelagic longline fishery on seabirds over the last decade, reporting changes since Samantha Petersen's study published in 2008, and one on the diving ecology of Grey Petrels *Procellaria cinerea*, a bycatch species that might facilitate the killing of albatrosses by bringing bait to the surface. He completed his thesis in early 2017.
- Dom also drafted a paper on the dispersal of White-chinned Petrels *Procellaria aequinoctialis* from Marion Island, based on 3-years of GLS tracking and GPS tracking of breeding adults. He found that this species, which is by far the most commonly killed species on longlines off South Africa, does not wander widely when not breeding. All birds from sub-Antarctic islands in the southwest Indian Ocean winter off southern Africa.
- Former PhD student Mareile Techow's work on the genetic structure of White-chinned Petrels showed that all age classes remain in the same ocean basins, and a final paper from her thesis reflecting this finding was published in *Polar Research* in 2016. A paper on genetic structure of Black-browed Albatrosses *Thalassarche melanophris* led by Theresa Burg was accepted for publication.
- Former MSc student Stefan Schoombie published a paper from his dissertation showing that numbers of Sooty Albatrosses *Phoebetria fusca* breeding on Marion Island have increased since 2008, whereas Light-mantled Albatrosses *P. palpebrata* have decreased. This result accords with predictions of regional warming, and contrasts with the trends in these species observed from the late 1990s to mid 2000s. Stefan also has a paper in press reporting the at-sea dispersal of both sooty albatross species, which reports the dispersal of breeding adults for roughly 80% of the global population (Prince Edwards, Gough and Tristan da Cunha).
- Stefan was based on Marion Island for a second year in 2015/16. In addition to the routine monitoring work, he deployed miniature video cameras that he developed on Wandering Albatrosses *Diomedea exulans*, and during the 2016 takeover period, deployed some of Rory Wilson's 'daily diary' loggers. Stefan spent three weeks in Rory's lab in Sept-Oct 2016 learning how to interpret the massive amounts of data generated by these devices. He plans to register for a PhD using video and accelerometer data to better understand seabird foraging strategies.
- One of Richard Phillips' PhD students, Tommy Clay, published a paper on the non-breeding dispersal of Grey-headed Albatrosses from South Georgia and Marion Island published in *Scientific Reports*. He found that despite dispersing widely, and often circling the Southern Ocean, birds from the two islands foraged in different areas. Also, failed breeders tended to forage in different areas, but there was little evidence of sexual segregation in this species.
- Former field assistant Chris Jones (Gough Island 2014/15) made good progress with analysing movement patterns of the two prion *Pachyptila* species that breed on Gough Island based on

A Wandering Albatross carrying a daily diary that measures air speed and wing flaps (Photo: Peter Ryan).

GLS deployments and stable isotope analyses. Two other papers based on seabird tracking data were accepted for publication: one analysed movement patterns for eight species of *Pterodroma* petrels breeding in the Atlantic Ocean (Ramos et al. *Divers. Distrib.*) and one used multiple approaches to use seabirds to define marine protected areas (Krüger et al. *Anim. Conserv*.).

- PhD student Otto Whitehead finally got stuck into writing up his PhD on the comparative foraging ecology of crested penguins *Eudyptes* spp. at the Prince Edward Islands (following numerous distractions, including three months working for National Geographic in the Galapagos). He had a second paper from his thesis accepted for publication in *Marine Ecology Progress Series.* He will complete his thesis in mid-2017.
- PhD student Ben Dilley had a paper accepted on the population size of Blue Petrels *Halobaena caerulea* on Marion Island, and former PhD student Genevieve Jones had a paper accepted on the comparative breeding phenology of Wandering Albatrosses.
- Ditiro Moloto, one of the original cohort of Limpopo students who came to the Fitz as an exchange student in 2014, registered for an MSc investigating the structural adaptations of flight feathers for flight underwater in procellariiform seabirds.
- Former Marion Island field assistant Alexis Osborne completed his BSc honours degree at UCT, with a research project on the impact of breeding status on moult in Wandering Albatrosses. He presented his preliminary findings at the SANAP symposium in Pretoria in July 2016, and will register for an MSc taking this study further in 2017.
- Res Altwegg's PhD student, Gordon Botha, made steady progress in analysing patterns of survival and breeding propensity in Wandering Albatrosses at Marion Island.
- Two papers reporting regional differences in levels of pollutants in seabirds were published arising from the collaboration with Jacob González-Solis. Becker et al. 2016 (*Environ. Pollut.*) considered mercury contamination in a suite of seabirds, and Roscales et al. 2016 (*Environ. Res.*) reported levels of persistent organic pollutants in giant petrels *Macronectes* spp.

Highlights:

- Seven papers on Southern Ocean seabirds and their conservation were published in 2016, and a further 10 are in press in 2017.
- Peter Ryan completed a popular book on the seabirds of southern Africa, which will be released in time for BirdLife South Africa's *Flock at Sea* cruise in April 2017.
- Peter was a member of a project led by Henri Weimerskirch (CNRS Chize) that was supported for the Antarctic Circumnavigation Expedition at the end of 2016. Peter was one of only two PIs who went on all three legs of the expedition.

Key co-sponsors

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

Research team

Prof. Peter Ryan (FIAO, UCT)
Prof. Res Altwegg (SEEC, UCT)
Dr Alex Bond (RSPB)
Dr Theresa Burg (U. Lethbridge, Canada)
Dr Maelle Connan (NMMU)
Dr Rob Crawford (Oceans & Coasts, DEA)
Dr Richard Cuthbert (RSPB)
Dr Jacob González-Solis (U. Barcelona)
Dr Akiko Kato (CNRS, Strasbourg)
Dr Azwianewi Makhado (Oceans & Coasts, DEA)
Dr Richard Phillips (British Antarctic Survey)
Dr Pierre Pistorius (NMMU)
Dr Yan Ropert-Coudert (CNRS, Strasbourg)
Dr Antje Steinfurth (FIAO, UCT)
Dr Ross Wanless (FIAO, UCT and BLSA)
Prof. Rory Wilson (Swansea U.)

Students: Gordon Botha (PhD, SEEC, UCT) Dominic Rollinson (PhD, UCT), Kim Stevens (PhD, UCT), Otto Whitehead (PhD, UCT), Ditiro Moloto (MSc, UCT),

Research assistants on Marion Island: Stefan Schoombie, Janine Versteeg (2015/16) Christiaan Brink, Kim Stevens (2016/17)

Conserving islands and their birds

Oceanic islands hold a disproportionately large amount of terrestrial biodiversity, yet are extremely vulnerable to introduced species: more than 90% of recent bird extinctions have been of island birds. Fortunately, eradicating invasive species can restore island ecosystems, provided there are strict controls on the import of people and materials. Birds are flagships for the conservation-management and restoration of island ecosystems.

Our work focusses on South Africa's Prince Edward Islands and the UK Overseas Territory of Tristan da Cunha and Gough Island. We are mainly concerned with the impacts of introduced predators, specifically House Mice *Mus musculus*, but also are involved in the eradication or control of introduced plants at Gough Island and the uninhabited islands in the Tristan archipelago. The impacts of House Mice on seabirds were only discovered in the early 2000s, following research by Fitz students in collaboration with the Royal Society of the Protection of Birds at Gough Island. Since then, they have been found to attack seabird chicks on Marion Island, and recently have even been found to attack adult albatrosses at colonies in the North Pacific Ocean.

A Light-mantled Albatross *Phoebetria palpebrata* chick attacked by introduced House Mice on Marion Island (Photo: Peter Ryan).

Activities in 2016

- Regular surveys were conducted from March to May 2016 to monitor the spread of mouse attacks on large chicks of Grey-headed Albatrosses *Thalassarche chrysostoma* and sooty albatrosses *Phoebetria* spp. at Marion Island. Attacks were just as extensive and widespread as in 2015, and the occurrence of attacks at widely spaced locations all around the coast of Marion Island indicate that the behaviour is evolving independently at multiple sites. However, there are some consistent hot-spots, which might reflect cultural transmission among mice at specific locations.
- Ben Dilley and Delia Davies completed their contract with the Tristan government to help train Tristan Conservation Department staff. They were then appointed to an EU-BEST project awarded to Tristan Conservation to collect basic biology information on Wilkins' Bunting *Nesospiza wilkinsi*. They spent the summer of 2016/17 on Nightingale Island, ringing large numbers of individuals to obtain robust survival estimates, and found 49 nests, allowing the first estimate of breeding success of this Endangered species.
- *Sagina procumbens* control/eradication operations continued on Gough Island throughout 2016. The new regime spraying with a combination of pre-emergent and standard herbicides appears to be making a difference, with decreasing numbers of seedlings detected in successive summers.

Highlights:

- Two papers were published on the impacts of introduced mice on birds at Marion Island in 2016; one reported massive increases in attacks on albatross chicks at Marion Island (Dilley et al. *Antarctic. Sci.*) and one showed how Brown Skua *Stercorarius antarcticus* diets haven't changed since the eradication of cats on Marion, suggesting that the recovery of burrowing petrel populations is being hampered by mice (Cerfonteyn and Ryan *Antarctic. Sci.*). A further paper showing limited recovery of petrel populations is still in press (Dilley et al. *Antarctic. Sci.*). Data from this study was contributed to a meta-

analysis on recovery of seabird populations following restoration programmes (Brooke et al. in press, *Anim. Conserv.*).

- Peter Ryan is one of many co-authors on a paper reviewing the impact of light pollution on seabirds (Rodriguez et al. in press *Conserv. Biol.*).
- A paper summarising the biology of Gough Island mice was finally published (Cuthbert et al. 2016, *J. Mammal.*).
- A paper on the clinical pathology of the Gough Bunting *Rowettia goughensis* was accepted for publication (Dagleish et al. 2017, *J. Comp. Pathol.*). This study, and a similar one on Gough Moorhens *Gallinula comeri*, forms part of the preparation for taking insurance populations of buntings and moorhens into captivity during the mouse eradication attempt on Gough Island planned for the winter of 2019.

One of the South Georgia Heritage Trust helicopters spreading poison bait on South Georgia. This is one of the three helicopters donated to the DEA (Photo: Peter Ryan).

Julian Repetto from the Tristan Conservation Department measuring a Wilkins Bunting chick (Photo: Ben Dilley).

- Frederik Paulsen, sponsor of the Antarctic Circumnavigation Expedition, was so horrified by the antics of the mice on Marion that he donated the three helicopters used to eradicate rats and mice from South Georgia to the South African Department of Environmental Affairs (DEA) on condition that they are made available for mouse eradication attempts on Gough and Marion Islands. He also donated $100,000 to DEA on production of a plan to eradicate mice from Marion Island. This has stimulated DEA to announce plans for an eradication attempt on Marion in 2020, if the Gough eradication goes ahead in 2019.

Key co-sponsors

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

Research team

Prof. Peter Ryan (FIAO, UCT)
Dr Alex Bond (RSPB)
Dr Richard Cuthbert (RSPB)
Trevor Glass (Tristan Conservation Department)
Dr Ross Wanless (FIAO, UCT and BLSA)

Students: Ben Dilley (PhD)

Research assistants: Jan Bradley, Derren Fox, Chris Taylor (Gough 2015/16), Emma Witcutt, David Kinchin-Smith and Phil Lambdon (Gough 2016/17), and Delia Davies.

Hot Birds – Climate change and desert birds

The 'Hot Birds' project integrates behavioural and physiological approaches to develop predictions of how climate change is affecting birds that inhabit arid habitats in southern Africa and globally. The main focus of the Hot Birds project is bird communities of the southern Kalahari Desert, but we also work in the arid regions of North America and Australia.

Fitness and the importance of behaviour

Ongoing research by Susie Cunningham and PhD student Tanja van de Ven has shown that many bird species face temperature thresholds, inflection points above which they experience sublethal fitness costs. These temperatures normally fall around mid-30°C, with associated costs including reduced foraging success (recorded in Southern Fiscals *Lanius collaris*, Southern Yellow-billed Hornbills *Tockus leucomelas*, Southern Pied Babblers *Turdoides bicolor*), accompanied by inability of adults to maintain body mass (hornbills and babblers); declines in nestling provisioning rates, growth rates of nestlings, size and quality of fledglings and fledging success (hornbills and fiscals). The underlying mechanism driving these sublethal fitness costs appears to be behavioural trade-offs made by adults in order to minimise exposure to the physiological costs of high temperatures. These trade-offs result in lost foraging opportunities through reductions in activity and birds' use of shaded locations suboptimal for foraging (fiscals, hornbills); and/or handicaps on foraging efficiency imposed by the use of respiratory evaporative cooling (panting & gular flutter; babblers and hornbills).

CB MSc student Ryan Olinger carried out experiments with Fork-tailed Drongos *Dicrurus adsimilis* in November and December 2016, to assess whether (a) changes in prey availability or increasing costs of foraging drive reduced foraging effort under high temperatures; (b) reduction in provisioning rates to nests at high temperatures is due to changes in prey capture rates or changes in parental decision-making, and (c) high temperatures negatively affect growth rates of drongo chicks. Ryan found that thermo-regulatory costs caused declines in foraging and provisioning at high temperatures, even when prey availability was held constant. However, these costs did not seem to be passed on to chicks; as temperature did not affect nestling growth. The Hot Birds team will engage a new MSc student in 2017 to examine these questions further. In addition, Susie Cunningham will travel to Australia in March 2017 to expand research into the costs of thermoregulatory trade-offs for desert birds in the Outback, in collaboration with Dr Janet Gardner from the Australian National University.

A Southern Pied Babbler panting to offload excess heat (Photo: Samantha Kirves).

The buffering effects of sociality

In July 2016, PhD student, Amanda Bourne registered to assess whether social behaviour can buffer the fitness costs of high temperatures. Amanda's work is part of a collaboration between the local Hot Birds team and the Pied Babbler Research Project lead by Fitz Honorary Research Associate, Assoc. Prof. Mandy Ridley (UWA). The study uses cooperatively breeding Southern Pied Babblers as the model species to investigate the hypothesis that cooperation, and particularly cooperation in larger groups, should reduce the physiological costs of heat stress and the fitness costs of time spent on thermoregulation. Behavioural data collected through the summer over three field seasons will be used to assess the impacts of heat stress and behavioural thermoregulation on individual

survival, body mass, and reproductive success in birds belonging to smaller and larger social groups. Fifteen years of life history data collected as part of the Pied Babbler Research Project will be applied to identify long term patterns related to critical temperature thresholds. Amanda is working on the Kuruman River Reserve in the Northern Cape with 17 groups of free-living, habituated babblers.

Societies and climate change

Post-doc Margaux Rat continued her work investigating the impact of climate change on the social structure of group-living Kalahari birds, with a focus on Sociable Weavers *Philetarius socius*. Margaux has combined a correlative field study (Feb-Mar 2016) and an experimental, laboratory-controlled approach (Dec 2016-Feb 2017) to examine the impacts of variation in temperature on the nature and frequency of social interactions exhibited by Sociable Weavers and ultimately the impact on their social network. Results to date from the field component of the project suggest that when individuals experience high air temperatures, their social network becomes less dense and breaks down into smaller components. This suggests that individuals interact less with their conspecifics during periods of hot weather. Hence, changes in social network structure appear to be linked to the severity of heat stress experienced by individuals. Margaux presented these preliminary results at the North America Ornithological Congress 2016 in Washington DC.

Hot Birds in the southern scrubland biomes

The Hot Birds team ventured into the Fynbos biome in 2013, joining forces with Alan Lee, Phoebe Barnard and Ben Smit. Since then, the project has expanded to study the impacts of climate on the large array of small birds endemic to the three distinct semi-arid scrubland biomes of South Africa; the Fynbos, Nama Karoo and Succulent Karoo. Since 2015 three projects have been concluded under this topic, involving NMMU MSc students Krista Oswald (supervised by Ben Smit and Alan Lee) and Jerry Molepo (supervised by Ben Smit, Alan Lee and Susie Cunningham) working on two Fynbos species, and Nick Pattinson (supervised by Ben Smit) working on a Succulent Karoo species. Jerry is in the final stages of writing up his MSc dissertation, and Krista and Nick will graduate with their MSc degrees in April 2017.

Fynbos projects

Krista Oswald's MSc showed that Cape Rockjumpers *Chaetopos frenatus*, endemic to the mountain peaks of the Fynbos, have comparatively limited capacity to seasonally adjust their thermoregulatory responses to hot temperatures. The most important finding was that Cape Rockjumpers have higher evaporative water rates during summer (i.e. the driest and hottest part of the year) with no change in metabolic heat load or body temperature regulation patterns. These patterns are opposite to those observed in desert species where adjustments are centered on reducing the costs of thermoregulation under hot conditions. These results help to explain why Cape Rockjumpers appear limited to the coolest regions of the Fynbos biome, and specifically why their reporting rates have declined most in regions showing significant climate warming over the past two decades.

Jerry Molepo started behavioural and physiological work on Cape Sugarbirds *Promerops cafer* in 2015. His aim was to determine if there are differences between male and female Cape Sugarbirds in 1) daily feeding patterns at different air temperatures (wild birds), and 2) thermoregulatory responses at hot temperatures (under laboratory conditions). Jerry spent several months in the Van Stadens Wild Flower Reserve (near Port Elizabeth) where he conducted behavioural observations on Cape Sugarbirds feeding on *Protea* flowers. He also obtained physiological measurements,

MSc student Jerry Molepo monitoring Cape Sugarbirds at his study site in the Van Stadens Wild Flower Reserve near Port Elizabeth (Photo: Ben Smit).

using a field laboratory setup, in wild birds of both sexes (20 males and 20 females). Jerry's findings suggest that female Cape Sugarbirds are more prone to energy-, water- and thermal stress during hot and dry summers in the Fynbos region. This has implications for understanding Cape Sugarbird population responses to climate change in the Fynbos region, and could explain why female sugarbirds (but not males) show reduced body mass during unusually warm and dry periods over the last 30 years (SAFRING database).

Succulent- and Nama Karoo projects

Nick Pattinson started his MSc at the beginning of 2015, studying the physiological and behavioural seasonal responses of a small passerine, the Rufous-eared Warbler *Malcorus pectoralis*, which is resident in the Nama and Succulent Karoo regions of South Africa. Nick demonstrated that Rufous-eared Warblers show seasonal flexibility in both their physiological and behavioural responses to high temperatures, which illustrates the links between physiological and behavioural adjustments of a small bird and the environmental extremes they face when foraging.

Thermoregulation in the heat

Another major research theme of Hot Birds focuses on the physiological mechanisms that allow birds in hot environments to maintain body temperatures below environmental temperatures. Work in this area during 2016 focused on validating a behavioural index of heat stress, and testing predictions about how birds respond to temperatures higher than they currently experience. In an attempt to assess the usefulness of a behavioural heat dissipation variable as a proxy for assessing species' vulnerability to rising temperatures, PhD student Michelle Thompson has observed nine Kalahari bird species in large outdoor aviaries to examine the functional links between heat dissipation, shade seeking and activity patterns, hydration status and body temperature on days differing in air temperature maxima. These species all differ in their relationship between the onset of heat dissipation behaviour and air temperature, and in six out of nine species wild populations behave similarly to captive populations when it comes to dissipating heat. However, White-browed Sparrow-Weavers *Plocepasser mahali,* Cape Glossy Starlings *Lamprotornis nitens* and Cape Turtle-Doves *Streptopelia capicola* all began dissipating heat at higher air temperatures in captivity.

During the 2015/16 summer, PhD student Ryan O'Connor investigated the thermal environments of six Rufous-cheeked Nightjar *Caprimulgis rufigena* roost sites. Roost site thermal conditions were quantified by measuring operative temperature using 3-D printed biophysical models designed to match the morphological dimensions and thermal properties of the nightjars. Ryan found that Rufous-cheeked Nightjars regularly chose partially shaded roost sites where individuals were frequently subjected to periods of intense solar radiation. Roosting nightjars can experience periods of operative temperatures well above body temperature, a circumstance undoubtedly exposing individuals to prolonged periods of evaporative water loss. Furthermore, given that Rufous-cheeked Nightjars are nocturnal birds, Ryan's data raises questions as to how individuals can maintain water balance throughout the day without taking in water.

White-browed Sparrow-weaver translocation project

During most of 2016 the Pretoria-based members of the Hot Birds team constructed an ambitious aviary translocation experiment that is part of Matt Noakes' PhD. This project, dedicated to and based on an idea by the late Phil Hockey, investigates the flexibility of physiological and behavioural heat-coping mechanisms in White-browed Sparrow-weavers by translocation experiments where birds from cooler sites are housed in aviaries at a hotter site.

In December 2016, three eager teams of researchers travelled to sites about 700 km apart along a climatic gradient across South Africa. Each team set up an outdoor aviary, caught 15 sparrow-weavers, and collected pre-translocation baseline data for two weeks at their respective sites. It was then time for the much-anticipated "assisted migration" of sparrow-weavers to the Kalahari Desert, and thus began a two-day, 1400 km, cross-country trip with birds and aviaries in tow. By mid-December we were at our study site near Askham in the Kalahari Desert with three aviaries and 45 sparrow-weavers: 15 birds native to this hot arid environment, 15 from a warm semi-arid site and 15 from a cool, more mesic location. We

Three aviaries constructed at Murray Game Ranch near Askham in the Kalahari for the White-browed Sparrow-weaver translocation experiment (Photo: Andrew McKechnie)

monitored post-translocation responses of the birds to assess the manner and extent that birds from the cooler sites could adjust their physiology and behaviour in response to hotter conditions. The results are currently being analysed, and we anticipate submitting the manuscripts emanating from this project during 2017.

Highlights:

- The Hot Birds team was well-represented at the North American Ornithological Congress where we organised a symposium in which team members from UCT, U. Pretoria, Nelson Mandela Metropolitan University, and the University of New Mexico presented talks. This symposium received coverage in *Science News.*
- PhD student Amanda Bourne joined the team, funded by an NRF grant to Susie Cunningham.
- CB MSc student Penny Pistorius graduated with distinction in June 2016 with her thesis on the effects of temperature on flight initiation distances in Kalahari birds.
- Susie Cunningham was awarded a URC travel grant to visit Dr Janet Gardner at the Australian National University and set up a collaborative project investigating whether variation in physiological traits underpins differences in susceptibility to sublethal fitness costs at high temperatures.
- The team had an excellent year in terms of publication output, collectively publishing 10 papers in *Diversity Distributions, Journal of Experimental Biology, PLoS ONE; Climate Change Responses; Journal of Comparative Physiology, Physiological Biochemical Zoology.* and *Proceedings of the National Academy of Sciences. USA* during 2016.
- Krista Oswald graduated with her MSc on the seasonal thermal physiological responses of Cape Rock Jumpers, and registered for a PhD to continue work on this species
- Nick Pattinson graduated with his MSc *cum laude* for his dissertation on seasonal physiological and behavioural responses of Rufous-eared Warblers.
- Andrew McKechnie presented a paper at the 15th International Hibernation Symposium in Las Vegas, USA.

Key co-sponsors
DST-NRF CoE grant; NRF Thuthuka Grant; NMMU Research Themes Grant; University of Cape Town URC; University of Pretoria.

Research Team
Prof. Andrew McKechnie (U. Pretoria)
Dr Susie Cunningham (FIAO, UCT)
Assoc. Prof. Mandy Ridley (FIAO, UCT and UWA)
Dr Janet Gardner (Australian National University)
Dr Alex Gerson (U. Massachusetts)
Dr Alan Lee (FIAO, UCT and SANBI)
Dr Rowan Martin (FIAO, UCT)
Dr Todd McWhorter (U. Adelaide)
Dr Margaux Rat (FIAO, UCT amd U. Pretoria)
Dr Ben Smit (NMMU)
Dr Blair Wolf (U. New Mexico)

Students: Amanda Bourne (PhD, UCT), Matthew Noakes (PhD, Pretoria), Ryan O'Connor (PhD, Pretoria), Krista Oswald (PhD, NMMU), Michelle Thompson (PhD, Pretoria), Tanja van de Ven (PhD, UCT), Mokgatla Jerry Molepo (MSc, NMMU), Ryan Olinger (CB MSc, UCT), Nick Pattinson MSc, NMMU), Penny Pistorius (CB MSc, UCT), Ryno Kemp (BSc Hons, Pretoria), Mpho Malematja (BSc Hons, Pretoria)

Research Assistants: Alex Atkins, Cathy Bester, Rachel Bucksey, Josephine Bruning, Carla Dodd, Ashleigh Donaldson, Pieter Erasmus, Samantha Fourie, Aurora Garcia-Berro Nava, Alexandra Howard, Craig Kenny, Noxolo Kinzela, Samantha Kirves, Rita Leal, Sello Matjee, Vuyiseka Mbiko, Dean Portelli, Alia Moller, Ana Morales Gonzales, Lisa Nupen, Aurélie Quinard, Pearl Rivers, Pauline Ruffenach, Sofia Scheltinga, Iris Seto, Sue-Joy Schultz, Lauren Stansfield, Jack Thorley, Mervyn Uys, Tim Vink, Natasha Visser, Laura Wade.

Spatial resilience of protected areas

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

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

People create and manage protected areas in order to provide ecosystem goods and services (whether aesthetic, cultural or economic) to society. Social goals influence management activities; and in turn, management successes or failures influence both ecosystem service provision and societal attitudes. For example, demand for game viewing drives the stocking of large animals in small southern African protected areas; die-offs of elephants in times of drought have resulted in the creation of artificial watering points in many protected areas, with negative impacts (via elephant activities) on baobab trees and other ecosystem components; and societal values and preferences, such as a dislike of fire and burned areas, may influence supposedly scientific ecological management plans. Protected areas are thus best described as linked social-ecological systems, rather than the pristine fortresses of popular belief.

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

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

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

Can we rely on private nature reserves to support biodiversity conservation over the next 50-100 years? Can we predict where they will be successful and where they fail? How do they contribute to both social and ecological elements of conservation goals and strategies? And how resilient will they be, in an uncertain future, to the winds of social, economic, and ecological change?

The answers to these questions depend heavily on spatial patterns and relationships: where reserves occur along biophysical and socio-economic gradients, how their location relates to infrastructure, and how – or whether – membership in networks of such things as

animal exchanges, transactions, and information processing influences their long-term viability. We have adopted a comparative, spatially explicit, and network-based approach to analyse and understand the dynamics that drive pattern-process relationships relating to private protected areas.

Highlights:

- This programme has received a considerable amount of external funding support: a Complexity Scholar award to Graeme Cumming from the James S. McDonnell Foundation in 2012, an NRF Competitive Programme for Rated Researchers grant in 2013, and an NRF Blue Skies grant in 2015. These external funds have helped it to be highly productive.
- The group published 15 peer-reviewed journal articles on protected areas over the reporting period.
- Julia Baum completed her PhD on the socioeconomic interactions between private protected areas and the relevance of location and network membership for protected area resilience. Her work has been published in *Biological Conservation* and a second paper has been provisionally accepted by *Ecology and Economics.*
- Hayley Clements completed her PhD on the conservation and economic objectives and long-term sustainability of private protected areas. She has published or in press papers from her thesis in *Biological Conservation, Ecology and Society, Conservation Biology and Ecosystem Services.*
- 2014 CB MSc student Jenna Bowker, supervised by Graeme Cumming and Alta de Vos, published her research on forest cover change in African protected areas in *Conservation Biology*.
- CB MSc student Jessleena Suri published her MSc CB thesis on the conservation value of the Liesbeek River, advised by Pippin Anderson, Eleonore Hellard, and Graeme Cumming, in *Landsape and Urban Planning.*
- Former visiting Fox scholar and lab manager Judith Ament led an analysis of data from our extensive survey on 'Why people visit South African protected areas'; this was published in *Conservation Letters*. She also led a paper on land cover change outside protected areas, published in *Conservation Biology*.
- Graeme Cumming published a review of structure-function relationships, linking networks and hierarchies, in the prestigious journal *TREE (Trends in Ecology and Evolution)* and synthesis articles on spatial resilience and protected areas in *Ecosystems* and *Anthropocene*.

Nils Cumming feeding an elephant at Imire, a private game reserve in Zimbabwe (Photo: Graeme Cumming).

Key co-sponsors
James S. MacDonnell Foundation's Complex Systems Program; NRF; SANParks; numerous private nature reserve owners and managers.

Research team
Prof. Graeme Cumming (FIAO, UCT)
Prof. David Cumming (FIAO, UCT)
Dr Duan Biggs (Australian National University)
Dr Alta de Vos (Rhodes University)
Marna Herbst (SANParks)
Dr Kristi Maciejewski (U. Stellenbosch)
Zaccheus Mahlangu (ZWA)
Dr Colleen Seymour (SANBI)
Prof. Jane Southworth (U. Florida)
Prof. Craig Allan (U. Nebraska)
Prof. Andreas Buerkert (U. Kassel)
Dr Ellen Hoffman (U. Kassel)
Prof. Teja Tscharntke (U. Gottingen)
Prof. Stephan von Cramon-Taubadel (U. Gottingen)

Students: Julia Baum (PhD, UCT), Hayley Clements (PhD, UCT), Jessleena Suri (CB MSc, UCT)

Research Assistants: Judith Ament, Dominic Henry, Kim Zoeller

Ducks, dispersal and disease

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

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

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

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

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

A Cape Teal being combed for propagules (top) and an Egyptian Goose being measured and swabbed for diseases (bottom) (Photos: Chevonne Reynolds).

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

Extending our focus beyond disease, we have investigated how waterbird movement may affect other aspects of aquatic ecology. Waterbirds often disperse propagules of aquatic plants and invertebrates, which is important for colonising isolated aquatic systems and for maintaining genetic continuity among populations. Samples collected from multiple waterbird species across three wetland sites in South Africa confirm that waterbirds have a high capacity for dispersing seeds and invertebrates, either transported attached to feathers or passing through the gut. In some cases over 80 seeds have been germinated from a single faecal sample. We have also conducted experiments with captive waterbirds to gauge the time taken for seeds to pass through the digestive tract and which seed traits facilitate their survival through the gut. Dispersal of aquatic invasive species by waterbirds is plausible (especially for invertebrates) and has to be considered when managing these invasive species.

Although this programme is currently winding down following Graeme Cumming's move to Australia, we are still tracking several Egyptian Geese as part of a translocation experiment; and several additional publications are either planned or under review.

Highlights:

- This programme produced 9 peer-reviewed journal articles during 2016.
- Dominic Henry graduated with his PhD in June 2015 and has since published papers from his thesis chapters in *Movement Ecology*, *Ecosphere* and *Landscape Ecol*ogy
- Chevonne Reynolds submitted her PhD at the end of 2015 and graduated in June 2016. After a large amount of field work and data collection, Chevonne has published six related papers (two in *Diversity Distributions,* two in *Freshwater Biology* and one each in *African Zoology* and *Basic and Applied Ecology*).
- Eléonore Hellard has been working on the complex interrelationships between bird communities and haematozoon parasties ('avian malaria'). Communities rich in ecological functions favour disease and she has found evidence that the prevalence of more pathogenic parasites is primarily driven by host susceptibility, while that of less pathogenic parasites is primarily driven by host exposure. Some of this research has been published in *Ecosphere*.
- Marcela Espinaze's 2015 CB MSc project on tick-host interactions showed that juvenile ticks are more generalist than adults and that evolutionary history can constrain host breadth. This research was published in *Parasitology*.
- Graeme Cumming and collaborators completed a major review of waterfowl breeding patterns across southern Africa. They identified five major breeding patterns in African waterfowl and found support for the hypothesis that juvenile food availability and predation pressure drive the timing of reproduction in these species. This research and the accompanying data set of ca 22 000 nest records are published in the open access journal *Ecology and Evolution.*

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

Research team
Prof. Graeme Cumming (FIAO, UCT)
Dr Celia Abolnik (University of Pretoria)
Dr Alexandre Caron (Cirad, Harare)
Dr Nicolas Gaidet (Cirad, Montpellier)
Dr John Grewar (Veterinary Services, Elsenburg)
Dr Ivan Horak (Onderstepoort, U. Pretoria)
Dr Eléonore Hellard (Biological Sciences, UCT)
Prof. Jeffrey Peters (Wright State University)

Students: Dominic Henry (PhD, UCT), Chevonne Reynolds (PhD, UCT)

Balancing biodiversity and agriculture

Modern agriculture has revolutionised the planet's capacity to support humans, yet has simultaneously had a greater negative impact on biodiversity than any other human activity. Balancing the demand for food with the conservation of biodiversity is one of the most pressing issues of our time. While these concerns are relevant globally, there is an urgent need to conduct research of this nature in the developing world, characterised by high population growth rates and rapid agricultural development. This project focuses on providing the evidence to underpin better planning of production landscapes to offset the negative effects of agriculture on biodiversity in southern Africa. Post-doc Chevonne Reynolds is tackling this question in collaboration with Claire Spottiswoode, Res Altwegg of the Statistics in Ecology, Environment and Conservation group in the Department of Statistical Sciences, and Andrew Balmford of the University of Cambridge.

Is a land-sharing or a land-sparing strategy best for conserving southern African birds? These two strategies represent alternatives whereby conservation and production are integrated in space ("land-sharing") or separated in space ("land-sparing"). Advocates of land-sparing suggest that although land-sharing is beneficial within farmland, if it reduces yield then a larger area must be farmed to meet any given production target. However, the merits of each strategy are still hotly debated, in part because this question is typically addressed by short-term field studies that ignore processes relevant to biodiversity occurring at longer and larger scales.

Making use of the remarkable South African Bird Atlas Project (SABAP2) dataset, Chevonne is assessing how agricultural land-use patterns affect bird populations, and ultimately which strategy is best suited to the conservation of southern Africa's bird diversity. SABAP2 is a citizen science initiative collecting information about bird occurrence at a 9 x 7 km resolution. Over 16 000 checklists have been submitted thus far, generating an excellent time series dataset, which is further complemented by fine-resolution land-use data for the region. Chevonne is currently investigating how farmland configuration within a 9 x 7 km grid cell predicts the population density of individual bird species using occupancy models. She is conducting the analysis across three separate biomes in South Africa to determine whether bird populations respond in a consistent way across different regions and therefore whether results can be extrapolated to other landscapes. We hope to extend this analysis to determine whether particular ecological and life-history traits predict a bird species' response to agricultural intensification, further adding to the development of a generalizable framework. At the time of writing, Chevonne was nearing completion on the first stages of the data analysis. Although still in its early days, we anticipate that the results will provide useful insights for conservation planners, farmers and policy makers on how to improve management for biodiversity in production landscapes.

Chevonne is also collaborating with researchers at the University of Florida and the

Students, Alison Ke and Muzi Sibiya, conducting early morning bird counts in Swaziland (Photo: Chevonne Reynolds).

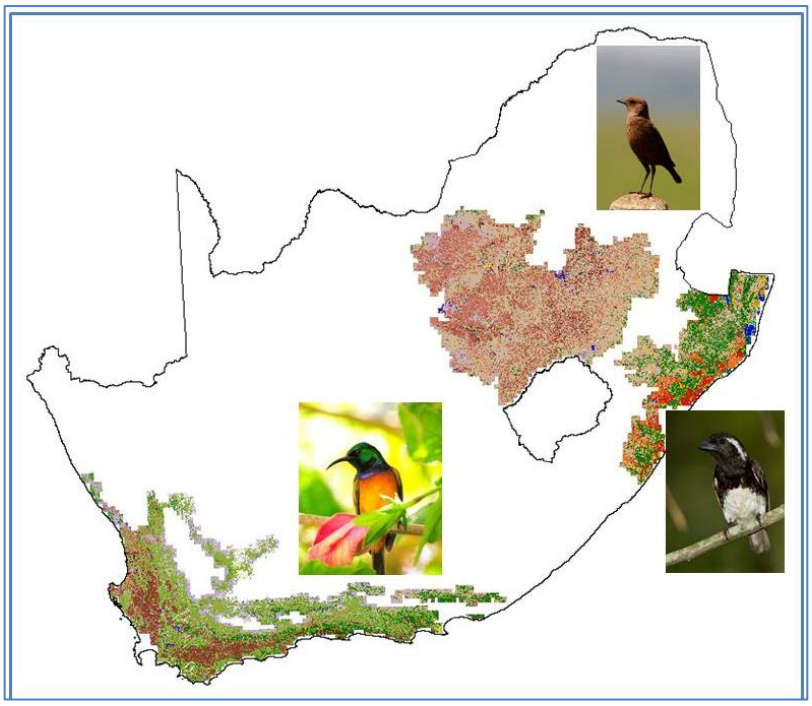


Fig 1: Map of South Africa indicating the three biomes for which biodiversity-agriculture tradeoffs are being analysed: fynbos, grassland and savanna-forest mosaic.

University of Swaziland to investigate how landscape heterogeneity in agricultural mosaics affects biodiversity. A key feature of the developing world is that agriculture is typically interspersed among other land-uses, creating heterogeneous landscapes. While there is evidence that landscape heterogeneity positively influences biodiversity, the application of this hypothesis is hindered by a lack of understanding of which components of landscape heterogeneity drive these effects, and at what spatial scale(s). We also need to know whether diverse taxonomic groups are similarly affected before we can apply this hypothesis as a general conservation strategy in agricultural mosaics. Chevonne led a team of international students to collect data on several taxonomic groups in the savanna-sugarcane mosaics of north-eastern Swaziland in June and July 2016. Using *a priori* identified independent gradients of compositional and configurational landscape heterogeneity, they tested how bird, dung beetle, ant and meso-carnivore diversity responded across different spatial scales. They found that biodiversity responds to landscape composition, but that the responses differ across taxonomic groups in their magnitude, direction and scale. This suggests that one-size-fits-all conservation strategies will not address the challenge of protecting biodiversity in agricultural landscapes, and that diverse, multi-scale strategies are of paramount importance.

Activities in 2016

- Chevonne Reynolds joined the project as a Post-doctoral researcher and made large strides in refining analysis techniques and preparing the land-use data.

Highlights

- Further collaboration between the Fitz and the Statistics in Ecology, Environment and Conservation (SEEC) research group.
- Teaching and training of Swazi and U. Florida students on field and research techniques.
- Two papers resulting from Chevonne's team's research in Swaziland, one led by an undergraduate student, are in review with *Journal of Applied Ecology* and *Diversity Distributions,* with an additional two papers in preparation.

Key co-sponsors
DST-NRF CoE grant; National Science Foundation (USA).

Research team
Prof. Claire Spottiswoode (FIAO, UCT and U. Cambridge)
Dr Chevonne Reyolds (FIAO, UCT)
Prof. Res Altwegg (SEEC, UCT)
Prof. Andrew Balmford (U. Cambridge)
Prof. Bob McCleery (U. Florida)

Understanding the ecological impacts of Pied Crows

Pied Crow *Corvus albus* numbers are increasing in many parts of South Africa. Recent work at the Fitz suggests that the increase in Pied Crow numbers is a result of global warming and other anthropogenic factors including the availability of nest sites on electrical infrastructure and increased food availability in urban areas and from road kill. In combination, these factors have seen the Pied Crow increase its abundance in some regions, expanding its range locally. Our project investigates the expansion of this species, now termed a 'native invader' species, and tries to understand what impacts these changes might have for other biodiversity.

As a generalist predator, Pied Crows may impose heavy predation pressure on a variety of prey species. Anecdotal evidence suggests that Pied Crows present a risk to threatened species, such as endangered breeding waders and range-restricted tortoises. Recently, researchers and conservation organisations have begun drawing attention to the knowledge gap with regards to the ecological impacts of Pied Crows, emphasizing the need for more studies. Indeed, there is little information about the basic life history of Pied Crows, which is an essential component for understanding the potential impacts of a predator. We aim to contribute to filling these knowledge gaps. The project specifically aims to address the impact of Pied Crows on potential prey species of conservation concern. Predation on tortoises and avian nest predation are currently being examined.

Activities in 2016

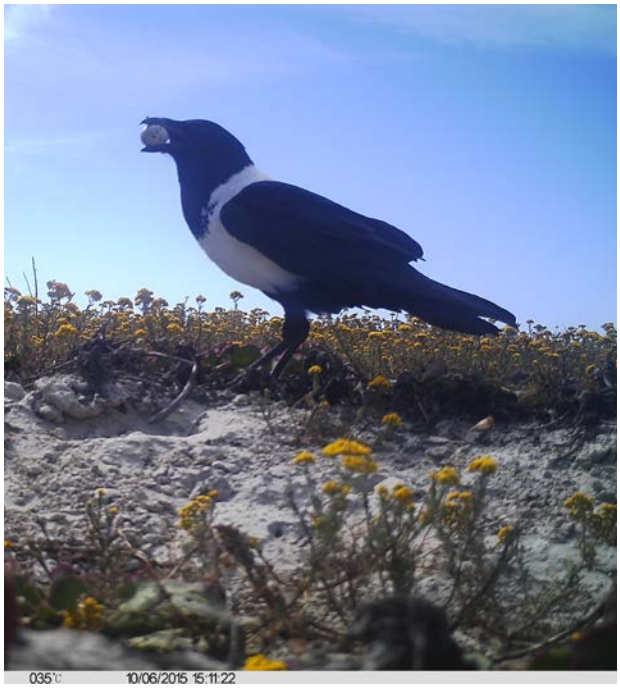
- CB MSc student Carles Durà's examined the extent of tortoise predation by breeding Pied Crows. Monitoring 125 active crow nests, he found evidence of tortoise predation at 26% of the nests, which were clumped in certain areas.
- 2015 CB MSc student Angela Ferguson submitted a manuscript to *Animal Conservation*, demonstrating that in recently colonised areas, Pied Crows are the primary predator of wader nests. Additionally, Angela explored the use of conditioned food aversion as a management tool to mitigate crow predation of wader nests.
- Rona van der Merwe started pilot work for a study on the ecology of Pied Crows. Rona will register for her Masters by dissertation with the Fitz in 2017.

A brood of Pied Crow nestlings (Photo: Carles Durà).

Highlights:

- A 2015 review paper on the impact of corvids to other bird species by CB MSc student Chrissie Madden and Arjun Amar was the most highly cited and the most downloaded paper from the journal *Ibis* in 2016.
- Susie Cunningham, Arjun Amar and Chrissie Madden published an article that investigated the factors that explain the recent expansion of Pied Crows in western South Africa (Cunningham *et al*. 2016. *Divers. Distrib*).
- Susie Cunningham and Arjun Amar also published an article in *The Conversation* entitled: "How climate change is causing Pied Crow numbers to soar".
- Grant Joseph and Colleen Seymour had an article accepted (published in early 2017) on the influence of road kill in explaining Pied Crow population increases (Joseph *et al*. 2017. *Biol. Conserv.*).

A Pied Crow mobbing a Martial Eagle (Photo: Peter Ryan).



A camera trap photo of a Pied Crow predating an artificial wader nest at the Berg river estuary. Artificial nests were made of two quail eggs partially buried in the ground (Credit: Angela Ferguson).

Impact of the project

This research aims to build our understanding of whether the increase in Pied Crows in certain regions of South Africa represents a conservation problem, and if so, what management actions might be most effective to deal with these concerns.

Key co-sponsors

DST-NRF CoE grant.

Research team

Dr Arjun Amar (FIAO, UCT)
Dr Susie Cunningham (FIAO, UCT)
Dr Robert Thomson (FIAO, UCT)
Dr Thomas Flower (FIAO, UCT and Simon Fraser University)
Dr Grant Joseph (FIAO, UCT and University of Venda)
Dr Colleen Seymour (FIAO, UCT and SANBI)
Dr Phoebe Barnard (SANBI)
Dr Beatriz Arroyo (CSIC, University of Castilla-La Mancha)

Students: Carles Durà (CB MSc, UCT), Angela Ferguson (CB MSc, UCT)

Understanding urban raptor populations

With most of the world's human population now living in urban areas, the impact of urbanisation on biodiversity continues to grow. Wildlife populations in urban areas may be affected by habitat loss and fragmentation, altered bio-geochemical cycles and the introduction of novel urban stressors such as light, noise and air pollution, nutritional changes, disease transmissions and novel predators like domestic pets. Within urban ecology, birds are perhaps the most well studied taxon. Some species thrive by exploiting human-subsidised resources, whereas others are unable to cope with habitat transformation and disturbance. As such, urban birds can be split into three groups – 'urban avoiders', 'urban adapters' and 'urban exploiters'. However, whilst an urban-exploiting or adaptable species may be able to make use of abundant resources in the short-term, there may be other hidden costs of urban living which could undermine its long-term health and persistence in an urban environment.

By monitoring the Black Sparrowhawk *Accipiter melanoleucus* population in Cape Town we are exploring how a top avian predator copes with living in an urban environment. This population of raptors has been monitored since 2000, shortly after it started breeding in the area. The species can be characterised as an urban adapter, taking advantage of the availability of nesting trees in alien *Eucalyptus* and pine plantations and the high prey abundance of pigeons and doves that occur in parks and gardens. Although the species seemingly thrives in the city, we are interested to explore whether they suffer hidden health impacts or changes in their breeding performance compared to birds in more rural environments.

A female Black Sparrowhawk, with her chick on the nest (Photo: Ann Koeslag).

We are now expanding our research to include another urban nesting raptor – the Peregrine Falcon *Falco peregrinus*. The project led by Petra Sumasgutner, Arjun Amar, Res Altwegg and Andrew Jenkins will combine long term-data for both Black Sparrowhawks and Peregrine Falcons to understand the interplay between urbanisation and climate change and how it might affect our avian top-predators. Climate change is predicted to have a particularly high impact on the Cape Peninsula. Thus, our study with access to long-term data of individually colour ringed raptor populations provides an important model system to predict the impact of such changes.

Activities in 2016:

- Jessleena Suri completed her CB MSc dissertation exploring whether there were any health issues for Black Sparrowhawk nestlings along an urban-rural gradient.
- Sanjo Rose completed her Honours project investigating the timing of breeding and breeding performance of pairs along an urban-rural gradient.
- In 2016, 52 Black Sparrowhawk territories were monitored with a 74% success rate of breeding pairs, which was higher than in previous years. In total 58 chicks fledged, of which 43 were colour ringed.
- Petra Sumasgutner visited Lund University in May to establish a biomarker approach for

We are now including the Peregrine Falcon in our study on urban raptors (Photo: Peter Ryan).

the Black Sparrowhawk Project. These ecophysiological data were part of a pilot study on urban impacts on raptor health.

- We presented our research at the Pan-African Ornithological Congress (PAOC), Dakar, Senegal; the International Society of Behavioural Ecology (ISBE), Exeter, UK; the North American Ornithological Conference (NAOC), Washington DC; and the British Ornithologist Union (BOU) conference on urban birds in Leicester, UK.

Highlights:

- The urban raptor group was invited to contribute a paper for the research topic *"Behavioural and Ecological Consequences of Urban Life in Birds"* in *Frontiers in Ecology and Evolution*. The manuscript with Sanjo Rose as lead author was submitted in early 2017.
- We received funding for a three year joint South Africa-Sweden Research Collaboration focusing on urban avian ecology by the NRF and STINT (Assoc. Prof. Caroline Isaksson, Lund University).
- We organized the joint symposium "*Birds as city slickers"* with our collaborators from Lund University at the NAOC in Washington DC; and contributed a blog on how rapid urbanisation is changing the profile of wildlife in cities for *The Conversation* (African Edition).
- Petra Sumasgutner was honoured with the early career research award for her talk *"Street-wise: polymorphism, productivity, health and prey of urban black sparrowhawks"* at the BOU conference.
- We published a paper in *BMC Evolutionary Biology* on how Black Sparrowhawks cope with breeding alongside Egyptian Geese who steal their nests (Sumasgutner *et al*. 2016).
- We published a paper on the home range size of male Black Sparrowhawks using GPS tagged birds in *Bird Study* (Sumasgutner *et al*. 2016).
- A paper based on Julia van Velden's BSc Honours dissertation on knemidokoptes mite infections in Black Sparrowhawks was accepted for publication in *Auk.*
- Ann Koeslag completed her final year of monitoring the Black Sparrowhawk population. Ann has been instrumental in monitoring the Cape Peninsula population for over a decade. The project owes Ann a huge debt of gratitude.

Impact of the project

Our project represents one of the first to examine individual health and productivity of a bird species in relation to urbanisation in Africa. Our results have considerable implications for potential changes in phenology or productivity for the regions' avifauna as African urbanisation continues.

Key co-sponsors
DST-NRF CoE grant; NRF-STINT South Africa-Sweden Research Collaboration, Claude Leon Foundation.

Research team
Dr Arjun Amar (FIAO, UCT)
Dr Petra Sumasgutner (FIAO, UCT)
Dr Res Altwegg (SEEC, UCT)
Dr Andrew Jenkins (ADU, UCT)
Ann Koeslag (Volunteer)

Students: Jessleena Suri (CB MSc, UCT), Sanjo Rose (BSc Hons, UCT)

Research Assistant: Mark Cowen

Plastics in the ocean

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

Much remains to be learned about the threats that plastics pose to marine ecosystems, but we know enough to act to reduce the amount of waste plastic entering the environment. The most significant impacts of plastics on marine organisms arise from plastic ingestion, so it is important to understand why organisms ingest plastic. Tracking trends in plastic ingestion provides perhaps the best indication of the efficacy of mitigation measures introduced to reduce the amount of plastic in the oceans. However, it is not always feasible to sample plastic ingested by organisms, so we also monitor plastic in the environment, both at sea and washed up on beaches. Much of the recent research in this project has focused on understanding how plastics move through marine systems, and how this affects estimates of plastic abundance.

Peter Ryan sampling surface waters for microplastics from the bow of the *Akademik Tryoshnikov* during ACE, using a stainless steel bucket and natural-fibre rope (Photo: Fabrice Le Bouard).

Activities in 2016

- After the five-yearly beach litter survey conducted around the South African coast in 2015, field work for this project was more subdued in 2016. The monthly clean-ups of intertidal litter at Muizenberg corner that are run in conjunction with a volunteer group continued throughout 2016. In addition to generating interesting data on litter types and amounts relative to the adjacent sandy beach, the project has stimulated several community-led initiatives to reduce plastic use in single-use applications such as straws and fast-food packaging.
- Peter Ryan gave several talks on plastic pollution to community groups, and other interested parties. In September he was invited to address officials from the Department of Environment Affairs and visiting experts from the EU on our understanding of plastic pollution in South African marine systems. Peter also is working with the WWF's Green Trust, which started a programme in November 2016 to limit the environmental impacts of waste plastics.
- In October, Peter was invited to attend a meeting in Barcelona to standardise approaches for estimating the abundance of floating macro debris at sea. Peter was unable to convince the group that his approach (Ryan 2013, *Mar. Pollut. Bull.*) was the best compromise between statistical rigour and practical feasibility, with the group preferring an even simpler approach which fails to account for changes in detectablity with distance from the vessel. A useful by-product of the trip was a new collaboration with Dr Stefano Aliani, who has been working on floating debris in the Mediterranean for the past decade or so.
- From December 2016 to March 2017, Peter took part in the Antarctic Circumnavigation

Jasmine Lee and Giuseppe Suaria collect sediment cores for microplastics on the low shore at the sandy beach adjacent to Port aux Français, Kerguelen (Photo: Peter Ryan).

Expedition (ACE). Shortly before the expedition left Cape Town, he was appointed PI of a project designed to assess the abundance and distribution of microplastics in the Southern Ocean. Stefano Aliani's PhD student, Giuseppe Suaria, was recruited to sample macro and microplastics on leg 0 of the expedition, as the ship repositioned from Bremerhaven, Germany, to start the ACE cruise in Cape Town, and ended up remaining aboard throughout the entire expedition, providing valuable continuity in sampling protocols. Sediment samples were collected from sandy beaches at six sub-Antarctic and Antarctic islands. Neuston and bongo net samples were collected to sample surface waters for drifting plastic, and zooplankton for ingested plastic, respectively. Very small particles and fibres were sampled by filtering water from the ship's underway system (4.5 m below sea level) as well as surface samples collected with a bucket from the ship's bow. Finally, direct observations were conducted to record the abundance and distribution of macro-litter.

Highlights

- Five papers were published in 2016: two papers arising from Francesca Fazey's CB MSc project (*Environmental Pollution and Marine Pollution Bulletin*), one on plastic and other anthropogenic debris in Kelp Gull nests from Minke Witteveen's MSc (*Marine Pollution Bulletin*), and two papers on ingestion by albatrosses, fur seals and marine turtles (both in *Marine Pollution Bulletin*).
- Peter's review on the ingestion of plastics by marine organisms, invited to appear in Shige Takada's book *Hazardous Chemicals Associated with Plastics in the Environment*, was published online in 2016.
- A project on microplastics in the Southern Ocean was funded by the ACE Foundation.
- A new collaboration was formed with Dr Stefano Aliani's group at CNR-ISMAR (the Italian Research Council's Institute of Marine Sciences) in La Spezia.
- Peter Ryan spent three months on the *Akademik Tryoshnikov* collecting data on macro and microplastics in the Southern Ocean during the Antarctic Circumnavigation Expedition.

Key co-sponsors
Plastics SA, ACE Foundation.

Research team
Prof. Peter Ryan (FIAO, UCT)
Assoc. Prof. Coleen Moloney (MaRe, UCT)
Prof. Hideshige Takada (Tokyo)
Dr Stefano Aliani (CNR-ISMAR)

Field assistants : Lucy Smythe, Eleanor Weideman

Conservation Biology Masters programme 2016

The 2016 CB class taking a break during a field-trip to see the disa flowers on the mountains above Hout Bay (Photo: Susie Cunningham).

The 24th cohort of CB students who started their studies in January 2015 were exceptionally strong academically with four of the ten students graduating with Distinction in June 2016.

The 2016 intake of CB students, our 25th cohort, comprised 14 students from Australia, Catalonia, South Africa, Sudan, USA and Zimbabwe. Unfortunately one student from South Africa took leave of absence due to ill-health, but the remaining 13 students completed the coursework component. Due to the Fallist protests, the submission date for the 2016 cohort was pushed back to mid-March 2017. At the time of writing, the students are hard at work finalising their theses for submission.

The 26th cohort of students started in early 2017. Repercussions from protest action in late 2016 meant that two international students who had been offered places withdrew their acceptance. Furthermore, tightened Home Affairs visa regulations continued to bite, and two foreign students from Zimbabwe and the Republic of Congo started the course late due to visa delays. Nonetheless, we now have a full class of 13 students from Botswana, Finland, Republic of Congo, South Africa, UK, USA and Zimbabwe. We are pleased to welcome another talented and diverse cohort to the course.

Course structure and teachers

The overhauled coursework structure trialled in 2016 was a great success, with the new Conservation Leadership (led by Dr Wendy Foden) and Project Planning/Grant Writing (led by Prof. Claire Spottiswoode) modules, and lengthened Conservation in Practice (led by Prof. Justin O'Riain and Drs Guy Balme and Ross Wanless) modules scoring high levels of approval with the 2016 cohort of students. Prof. David Cumming taught the introductory module, and then rounded off the coursework with a summary at the end.

Other module leaders from within UCT included Dr Arjun Amar (Statistical Analyses and Project Planning), Assoc. Prof. Colin Attwood (Marine Ecology), Assoc. Prof. John Hoffmann (Invasion Ecology), Dr Jacqui Bishop (Conservation Genetics), Prof. Peter Ryan (Demography & PVA) and Dr Jane Turpie (Resource Economics). From further afield, Dr Gladman Thondhlana (Rhodes University) leads

our Conservation & Society module and Dr Sebatolo Rahlao (SANBI) is taking an increasing role in the Invasion Ecology module. In addition, many other people continue to contribute through guest lectures, field trips and discussions. This diversity of perspectives adds greatly to the value of the course.

Challenges and opportunities

A module on Restoration Ecology is still missing from the course since the departure of Peter Carrick in 2015 - we continue to look for opportunities to reinstate this module. In addition, Home Affairs regulations continue to cause problems for international students, mostly related to extremely long delays in obtaining study visas. Finally, the Fallist protests have affected class composition in 2017. We hope many of these issues will resolve themselves with time. In the meantime, we remain committed to offering a balanced programme exploring the social and ecological aspects of Conservation Biology, and to producing world class graduates in this field.

MSc Conservation Biology projects 2016

Abbas, Huyam: The effects of drought on vegetation dynamics in African Savanna (Supervisors: Jeremy Midgley, William Bond)

Blanckenberg, Michelle: Resurrection ecology of temporary wetlands in the Cape Floristic region: effects of urbanisation and fire (Supervisors: Cecile Reed, Musa Mlambo)

Casola, Sarah: The potential impact of climate change on the genetic landscapes of two endemic South African amphibians (Supervisors: Claire Spottiswoode, Krystal Tolley)

Chinho, Tendai: Testing the information centre hypothesis in a colonial seabird foraging information transfer in breeding Cape gannet pairs (Supervisors: Lorien Pichegru, David Grémillet, Peter Ryan)

Craig, Christie: Assessing the anthropogenic threats to vultures in the communal farmlands of Namibia (Supervisors: Robert Thomson, Andrea Santangeli)

Day, Belinda: Changes in the abundance and distribution of Afro-Palaearctic migrants and ecologically matched resident species, with special reference to their climate change vulnerability (Supervisors: Arjun Amar, Wendy Foden, Simon Butler)

Durà, Carles: Quantifying the level of predation on tortoises by Pied Crows in south western South Africa (Supervisors: Arjun Amar, Robert Thomson)

Gush, Wesley: The ecology and persistence of a highly threatened South African grassland bird, Rudd's Lark (Supervisors: Claire Spottiswoode, Paul Donald, David Maphisa)

Jeal, Corey: Assessing the impacts of the Bokpoort 'trough' concentrated solar power facility on birds and other animals (Supervisors: Peter Ryan, Samantha Ralston-Paton)

Ly, Alicia: Associations between MHC class I variation and blood pathogen prevalence in caracal (Supervisor: Jacqui Bishop)

Macray, Matthew: Tortoise mortalities along fences in the southereastern Karoo, South Africa (Supervisors: Alan Lee, Graham Alexander, Peter Ryan)

Nenzhelele, Elelwani: Long-term impacts of livestock grazing in the Succulent Karoo: a 20-year overview (Supervisors: Timm Hoffman, Simon Todd)

Olinger, Ryan: How does temperature affect Fork-tailed Drongo *Dicrurus adsimili* foraging effort, nestling food provisioning and growth rates? (Supervisors: Susie Cunningham, Tom Flower)

Parrish, Maggie: Heavy grazing in the Highveld: impact on forb communities (Supervisors: Jeremy Midgely, Sally Archibald)

Niven Library

Overview

The biggest change in 2016 was the conversion of part of the back section of the library which housed the newsletters and some of the reprint collection into student offices. The displaced holdings, which were seldom consulted, have been moved to two windowless rooms that previously had been used as offices. Students and staff still have 24 hour access to the collection.

In 2016 the Integrated Research Management Application (IRMA) system was upgraded. IRMA is a web-based information management system used to capture peer-reviewed scientific publications primarily for annual research reports and publication counts. The new Electronic Research Administration (eRA) software was introduced to efficiently record publication counts which are used to attract funding to the University. Susan Mvungi, the Niven Librarian and Phelisa Hans, the Assistant Librarian, attended training on eRA. Digitisation of Fitz publications into PDFs began in August 2015 and by November 2016, all scientific publications from 1960 onwards were available in this convenient digital format. Due to copyright restrictions the PDFs are not available on the web, but they are available on request.

Staff Development

Susan Mvungi presented an information skills workshop to the CB MSc class. The students were taught how to search using Amlib (Niven Library Catalogue) and Aleph (UCT Catalogue), and how to use the referencing software Mendeley. Susan also attended training on a webinar 'Reimagining the Academic Library' hosted by UCT Libraries. Various cataloguing errors encountered when moving from the old library management system to the new Amlib system during 2016 were rectified.

Phelisa Hans made good progress with annual shelf-reading, responding to user information requests, digitising student theses and Biological Sciences Honours projects. She is continuing to develop the Richard Brooke reprint collection, consisting of 18th and 19th century articles and manuscripts which are not available on the catalogue.

New Developments

The Antarctic Legacy of South Africa (ALSA) is updating and adding to the South African list in the Scott Polar Research Institute's Polar Directory of institutions (museums, libraries and the like) with polar holdings. John Cooper, the Principal Investigator at ALSA, listed the Niven Library in the South African list in the Scott Polar Research Institute's Polar Directory of institutions. This list is available at the URL: http://www.spri.cam.ac.uk/resources/directory/libraries/southafrica.html#id714

The coats of arms at the entrance to the library were placed in storage and have been replaced with a display of Shy Albatross *Thalassarche cauta* wings donated by Fotini Babaletakis.

The coats of arms replaced by the Shy Albatross wings (Photos: Susan Mvungi).

Collection Development

Conservation Biology MSc theses for 2015 have been launched in pdf format and will be hosted on the Animal Demography Unit (ADU) server, and accessed through the Niven catalogue.

Donations

The Niven Library received a number of generous donations of books, journals, review books and artefacts.

- A brass tray was donated to the Niven by Johan Dorfling in January. The tray was given to his parents, Zacharias Johannes Dorfling and Maria Susanna Grobler, as a wedding gift in 1936 by Cecily Niven from the estate of her father, Sir Percy FitzPatrick.
- BirdLife South Africa received an extensive collection of books from Roelof van der Merwe's collection. Roelof was a staunch supporter of conservation, especially with regards to BLSA. Sixteen of these titles were added to the Niven catalogue.
- Michael Sweatman donated a valuable copy of Meinertzhagen's *Birds of Egypt* Volumes I and II which were restored by Sigourney Smuts for the rare books collection. These

books have annotated notes in the margins by Rodney Searight who was often in the company of Dick Meinertzhagen.

- John Cooper donated a copy of Brian Huntley's Marion Island diary.
- The Wits Bird Club made a substantial donation to the Niven, with seven books being added to the collection.
- Michael Lloyd Sumner donated seven books, with one title being added to the collection and the duplicates sold in the annual Niven book sale.
- John Grainger donated several books, journals and articles in 2016. Most of the titles were added to the Niven collection, and the botanical titles were offered to the Bolus Herbarium Library.
- The Wits Bird Club made a substantial donation to the Niven, with seven books being added to the collection.
- Authored books by Rob Little and Peter Ryan were donated to the Niven; Peter Ryan also donated three other books.
- Robert Thomson donated the journals: *Afring News; Birding Asia*; *Forktail*; Newsletter of BirdLife South Africa; and missing issues of *Laniarius*.
- Single title donations were received from Lutendo Mabata, Roy Siegfried, Francisco Suárez, BLSA and an anonymous donor.

New titles

The Niven Library purchased 23 books and five books were received for review in *Ostrich,* Significant titles added to the collection include:

- Guide to birds of the Kruger National Park
- Terrestrial Gamebirds and Snipes of Africa: guineafowls, francolins, spurfowls, quails, sandgrouse, and snipes
- Roberts bird guide: illustrating nearly 1,000 species in southern Africa (2nd ed)
- Birds of Botswana
- The AGRED guide to gamebird management in South Africa
- Magellanic sub-Antarctic ornithology: first decade of long-term bird studies at the Omora Ethnobotanical Park, Cape Horn Biosphere Reserve
- Avian evolution: the fossil record of birds and its paleobiological significance

Book Sales

The annual book sale raised R 8,643.

Library Use

The Niven Library was used on 69 occasions for presentations, meetings and seminars during 2016. Prof. Anusuya Chinsamy-Turan and the UCT Centre for Innovation in Learning and Teaching (CILT) interviewed six UCT lecturers in the Library for her Extinctions Massive Open Online Courses (MOOC). Prof, Peter Ryan's presentation on 'Oceans of Plastic' was also filmed by media studies students. The Library was the main venue for the Fitz lunch time seminars held every Tuesday. The *African Birdlife* Management Committee meeting was held in the Library.

Niven Library Stock Circulation

	2016	2014	2012
Monographs	218	230	264
Theses	16	12	18
Journals	304	161	48
Audio-visual	13	5	1
Nest Record cards	8	26	57
Total	559	434	388

The high journal use is largely attributed to the wide-spread focus of the 'Hot Birds project', while it is interesting to note a decline in the use of the nest record cards over the past five years.

Requests for Information

The Library received 2 154 requests for information in 2016; 499 pdfs were emailed to users nationally and internationally. Other uses of the Library were for the calculation of H-indices, citation information confirmation, URL links to articles, journal impact factors, UCT Libraries book location, Inter-library loan requests, nest record cards, UCT library loan renewals, and other general requests. Literature searches were done on request, compiled and then emailed to users.

Books published by Fitz staff during 2016.

Outreach and collaboration 2016

Apart from research, education and training, the Fitztitute also engages regularly with outreach and collaboration activities to enhance, profile and disseminate its ornithological achievements.

Delegates at the BirdLife and Fitz co-hosted 'Learn about Birds' conference held in the Kruger National Park during March 2016 (Photo: Albert Froneman).

Fitz members published 96 semi-popular articles in the public media, three books and two chapter contributions to semi-technical books. They also presented over 50 seminars and illustrated talks at numerous universities, bird clubs and membership-based societies, and participated on 70 membership fora and advisory services during 2016.

The Fitz and BirdLife South Africa co-hosted the third biennial Learn About Birds (LAB) conference at the Skukuza Camp, Kruger National Park, during March 2016. The conference was attended by over 400 delegates and was regarded as a great success, particularly for young scientists. Six Fitz staff members and 12 Fitz students attended the conference.

Susie Cunningham and PhD student Dominic Rollinson facilitated a half-day course on arid zone bird behavioural ecology and adaptation to climate change for the Cape Bird Club during May 2016.

Peter Ryan, Arjun Amar and six students presented a Fitz CoE exhibition stand at the launch of the Department of Science and Technology (DST) National Science Week at the University of the Western Cape on 5-6 August 2016. The National Science week, launched by the Minister of Science and Technology, Naledi Pandor, is a countrywide celebration of science, initiated by the DST in partnership with the South African Agency for Science and Technology Advancement (SAASTA) and various other stakeholders. The initiative contributes to the development of a society which values and appreciates science, engineering and technological fields, to provide a platform for scientists to instil interest in learners to follow careers in the scientific community. The 2016 event was attended by 1 625 learners from 65 schools, and over 1 000 members of the general public, and the programme included career exhibitions from across the country, representing various stakeholders in the scientific community, public lectures, seminars and presentations on the latest innovations made through scientific research.

Peter Ryan, Rob Little and two post-docs, Dayo Osinubi and Chevonne Reynolds, attended the 2016 NRF CoE Directors Forum at UKZN during August 2016 and presented a Fitz CoE exhibition stand which was exposed to hundreds of school learners during the event.

Demonstrating ornithological field techniques at UCT's 'Life on Land' undergraduate course (Photo: Andrew de Blocq).

Robert Thomson, Campbell Fleming and Andrew de Blocq represented the Fitz CoE at the UCT 2nd year BIO2012S Life on Land course at the West Coast National Park during the last week of August 2016. Students captured birds with mist nests and learnt standard bird identification, handling and anatomical measurement procedures.

Collaboration & service rendering highlights:

Peter Ryan was a member of the UNEP's GESAMP Working Group 40 on the impacts of microplastic debris in the oceans, and gave advice to Department of Environmental Affairs' Working for the Coast Programme (DEA's Extended Public Works Programme) to improve beach cleaning efforts, and was invited to address the African Marine Litter Network meeting on key research issues and methods, in Port Elizabeth during November 2016, and to give a keynote address on marine litter to a joint meeting between the DEA and EU advisors in Pretoria during September 2016. He was also invited to attend the EU workshop on monitoring marine litter at sea during October 2016 in Barcelona, Spain. He also continues to conduct autopsies on pelagic birds killed by long-line and trawl fisheries off South Africa for the DEA/Albatross Task Force.

Peter Ryan and Dr Pierre Pistorius have a significant ongoing collaborative relationship with the South African National Antarctic Programme (SANAP). Lorien Pichegru continues as a member of a Penguin Task Team organized by the Department of Agriculture, Forestry and Fisheries' Pelagic Working Group to address conservation issues relating to fishery closures around African Penguin colonies in Algoa Bay.

Arjun Amar collaborates regularly with Prof. Steve Redpath from the University of Aberdeen, Scotland, regarding research into understanding and managing human-wildlife conflict and related issues.

Robert Thomson collaborates with Dr Jukka Forsman from the University of Oulu, Finland and Dr Tomáš Grim from Palacky University, Czech Republic, investigating front-line defences in host-brood parasite systems using Common

Post-docs Dayo Osinubi and Chevonne Reynolds speak to learners at the Fitz CoE stand at the NRF Directors' forum held at the University of KwaZulu-Natal on 25-26 August 2016 (Photo: Rob Little).

Cuckoo parasitism of cavity nesting Redstarts. He also works with Dr Andrea Santangeli from the University of Helsinki, Finland, to reconcile farmers with vulture conservation in southern Africa.

Claire Spottiswoode's ongoing research in Zambia has led to a MoU between UCT, Cambridge and Copperbelt Universities, with Dr Lackson Chama as lead collaborator in Zambia. She has also fostered strong links with the Niassa Carnivore Project in Niassa Province, Mozambique, for her research on honeyguide-human interactions. Claire is investigating the mechanistic basis of egg colouration in honeyguides in collaboration with Jessie Walton, Rob Martin and a physicist, Dr Silvia Vignolini, from Cambridge University. Her research on the maintenance of evolutionary processes in bird-plant pollination interactions is done in collaboration with Dr Colleen Seymour at SANBI.

Yao honey-hunter Musaji Muamedi, presenting wax to a honeyguide in Niassa Province, Mozambique (Photo: Claire Spottiswoode).

Susie Cunningham is investigating the comparative anatomy of ibis bill-tip organs, using histological and micro-CT scanning techniques to understand bill-tip organ morphology and the structure of bill-tip organ mechanoreceptors. Collaborators on this project are Dr Isabel Castro (Massey University, New Zealand), A/Prof. Jeremy Corfield (Salisbury University, New Zealand), Prof. Anusuya Chinsamy-Turan (BioSci UCT) and Morea Petersen (HUB histology lab, UCT). Susie has also been approached by Dr Steve Portugal (Royal Holloway, University of London) and Dr Alex Bond (RSPB) for a collaboration to understand bill-tip structure in petrels and albatrosses.

Post-doc Dayo Osinubi has supported the MSc Conservation Biology programme at the AP Leventis Ornithological Research Institute (APLORI) in Nigeria by teaching courses in behavioural ecology, field techniques, and writing and presentation skills. His services on the African-Eurasian Migratory Landbirds Working Group led to the adoption of the Abuja Declaration on Sustainable Land Use for People and Biodiversity in West Africa.

Post-doc Megan Murgatroyd was a reviewer for BirdLife South Africa's 'Verreaux's Eagle and wind farms: Guidelines for impact assessment, monitoring and mitigation', and provided recommendations from GPS tracking research data from her PhD.

Post-doc Chevonne Reynolds co-ordinates an international research experience for students (IRES) based in north-eastern Swaziland. This University of Florida project, funded by a USA National Science Foundation (NSF) grant, is designed to train young ecologists to conduct field-based research. The project also aims to broaden the experience of the students by encouraging collaboration across countries and cultures. In 2016, four students from various US-based institutes and three students from the University of Swaziland undertook extensive field surveys of several taxonomic groups along gradients of increasing agricultural land-use in Swaziland. The students were exposed to a variety of survey and trapping techniques, from point counts to determine bird diversity to baited camera trapping to detect meso-carnivores. To further enhance their numeracy skills, each student analysed the data for a specific taxon and presented the findings to the Swaziland National Trust Commission in a feedback session. Several papers arising from this research have been submitted to peer-reviewed journals, including one on bird diversity co-led by a Swazi student and an American student.

Scientific publications 2016

Names in **bold** are members of the Fitztitute or the Centre of Excellence.
IF = Impact Factor. Some papers that appeared online in 2016 but in print in 2017 have been updated.

Abolnik, C., Olivier, A.J., Reynolds, C., **Henry, D.A.W.**, **Cumming, G.S.**, Rauff, D., Romito, M., Petty, D. and Falch, C. 2016. Susceptibility and status of avian influenza in ostriches. *Avian Diseases* 60: 286-295. (IF 1.241)

Albright, T.P., Mutiibwa, D., Gerson, A.R., Smith, E.K., Talbot, W.A., **McKechnie, A.E.** and Wolf, B.O. 2017. Mapping evaporative water loss in desert passerines reveals an expanding threat of lethal dehydration. *Proceedings of the National Academy of Science USA* 114: 2283–2288. (IF 9.674)

Allen, C.R., Angeler, D.G., **Cumming, G.S.**, Folke, C., Twidwell, D. and Uden, D.R. 2016. Review: quantifying resilience. *Journal of Applied Ecology* 53: 625-635. (IF 4.564)

Amar, A. 2016. Using independent nest survey data to validate changes in reporting rates of Martial Eagles between the Southern African Bird Atlas Project 1 and 2. *Ostrich* 87: 1-5. (IF 0.414)

Amélineau, F., Bonnet, D., Heitz, O., Mortreux, V., Harding, A.M.A., Karnovsky, N., Walkusz, W., Fort, J. and **Grémillet, D.** 2016. Microplastic pollution in the Greenland Sea: background levels and selective contamination of planktivorous diving seabirds. *Environmental Pollution* 219: 1131-1139. (IF 4.143)

Amélineau, F., **Grémillet, D.**, Bonnet, D., Le Bot, T. and Fort, J. 2016. Where to forage in the absence of sea ice? Bathymetry as a key factor for an Arctic seabird. *PLoS ONE* 11: e0157764. (IF 3.234)

Ament, J.M. and **Cumming, G.S.** 2016. Scale dependency in effectiveness, isolation, and social-ecological spillover of protected areas. *Conservation Biology* 30: 846-855. (IF 4.165)

Ament, J.M., Moore, C.A., Herbst, M. and **Cumming, G.S.** 2016. Cultural ecosystem services in protected areas: understanding bundles, trade-offs and synergies. *Conservation Letters* DOI: 10.111/conl.12283. (IF 7.241)

Ball, A.D., van Dijk, R.E., Lloyd, P., Pogány, Á., Dawson, D.A., Dorus, S., **Bowie, R.C.K.**, Burke, T. and Székely, T. 2016. Levels of extra-pair paternity are associated with parental care in penduline tits (Remizidae). *Ibis* 159: 449-455. (IF 1.921)

Barnard, P., Altwegg, R., Ebrahim, I. and Underhill, L.G. 2016. Early warning systems for biodiversity in southern Africa – How much can citizen science mitigate imperfect data? *Biological Conservation*. DOI: 10.1016/j.biocon.2016.09.011. (IF 3.762)

Becker, P.H., Goutner, V., **Ryan, P.G.** and González-Solís, J. 2016. Feathery mercury combinations in Southern Ocean seabirds: variation by species, site and time. *Environmental Pollution* 216: 253-263. (IF 4.143)

Benítez-López, A., Viñuela, J., **Mougeot, F.** and García, J.T. 2017. A multi-scale approach for identifying conservation needs of two threatened sympatric steppe birds. *Biodiversity Conservation* 26: 63-83. (IF 2.365)

Bolopo, D., Canestrari, D., Martínez, J.G., Roldan, M., Macías-Sanchez, E., Vila, M., Soler, M. and Baglione, V. 2016. Flexible mating patterns in an obligate brood parasite. *Ibis* 159: 103-112. (IF 1.921)

Bond, A.L., McClelland, G.T.W., **Ryan, P.G**. and Glass, T. 2016. Using measurements to predict laying order in harvested Northern Rockhopper Penguin (*Eudyptes moseleyi*) eggs. *Emu* 116: 467-471. (IF 1.107)

Bond, A.L., Michelle, M.R., Jones, C.W. and **Ryan, P.G.** 2016. Potential for primary poisoning of a critically endangered endemic land bird during rodent eradication operations at Gough Island, Tristan da Cunha. *PeerJPrePrints* DOI: 10.7287/peer.j.preprints.1744V1. (No IF)

Bowie, R.C.K., Fjeldså, J., Kiure, J. and Kristensen, J.B. 2016. A new member of the greater double-collared sunbird complex (Passeriformes: Nectariniidae) from the Eastern Arc mountains of Africa. *Zootaxa* 4175: 023-042. (IF 0.906)

Bowker, J.N., **De Vos, A., Ament, J.M.** and **Cumming, G.S.** 2016. Effectiveness of Africa's tropical protected areas for maintaining forest cover. *Conservation Biology* DOI: 10.1111/cobi.12851 (IF 4.165)

Brown, M.J.F., Dicks, L.V., Paxton, R.J., Baldock, K.C.R., Barron, A.B., Chauzat, M-P., Freitas, B.M., Goulson, D., Jepsen, S., Kremen, C., Li, J., Neumann, P., Pattemore, D.E., Potts, S.G., Schweiger, O., **Seymour, C.L.** and Stout, J.C. 2016. A horizon scan of future threats and opportunities for pollinators and pollination. *PeerJ* 4: e2249. (No. (IF)

Cáceres, A., **Melo, M.,** Barlow, J. and **Mills, M.S.L.** 2016. Radiotelemetry reveals key data for the conservation of *Sheppardia gabela* (Rand, 1957) in the Angolan Escarpment forest. *African Journal of Ecology* 54: 317-327. (IF 0.853)

Chambers, L.E., **Barnard, P.**, Poloczanska, E.S., Hobday, A.J., Keatley, M.R., Allsopp, N. and

Underhill, L.G. 2016. Southern Hemisphere biodiversity and global change: data gaps and strategies. *Austral Ecology* 42: 20-30. (IF 1.837)

Clay, T.A., Manica, A., **Ryan, P.G.**, Silk, J.R.D., Croxall, J.P., Ireland, L. and Phillips, R.A. 2016. Proximate drivers of spatial segregation in non-breeding albatrosses. *Scientific Reports* 6: 29932. (IF 5.578)

Clements, H.S., **Baum, J.** and **Cumming, G.S.** 2016. Money and motives: an organizational ecology perspective on private land conservation. *Biological Conservation* 197: 108-115. (IF 3.762)

Clements, H.S. and Cumming, G.S. 2016. Positives and pathologies of natural resource management on private land conservation areas. *Conservation Biology*. DOI: 10.1111/cobi.12864. (IF 4.165)

Clements, H.S., **Cumming, G.S.** and Kerley, G.I.H. 2016. Predators on private land: broad-scale socioeconomic interactions influence large predator management. *Ecology and Society* 21(2): 45. (IF 2.774)

Congrains, C., Carvalho, A.F., Miranda, E.A., **Cumming, G.S.**, **Henry, D.A.W.**, Manu, S.A., Abalaka, J., Rocha, C.D., Diop, M.S., Sá, J., Monteiro, H., Holbech, L.H., Gbogbo, F. and Del Lama, S.N. 2016. Genetic and paleomodelling evidence of the population expansion of the Cattle Egret *Bubulcus ibis* in Africa during the climatic oscillations of the Late Pleistocene. *Journal of Avian Biology* 47: 846–857. (IF 1.971)

Connan, M., Hofmeyr, G.J.G. and **Pistorius, P.A**. 2016. Reappraisal of the trophic ecology of one of the world's most threatened spheniscids, the African Penguin. *PLoS ONE* 11: e0159402. (IF 3.762)

Crawford, R.J.M., Randall, R.M., **Cook, T.R.**, **Ryan, P.G.**, Dyer, B.M., Fox, R., Geldenhuys, D., Huisamen, J., McGeorge, C., Smith, M.K., Upfold, L., Visagie, J., Waller, L.J., Whittington, P.A., Wilke, C.G. and Makhado, A.B. 2016. Cape Cormorants decrease, move east and adapt foraging strategies following eastward displacement of their main prey. *African Journal of Marine Science* 38: 373-383. (IF 1.0)

Cumming, G.S., Harebottle, D.M., Mundava, J., Otieno, N. and Tyler, S.J. 2016. Timing and location of reproduction in African waterfowl: an overview of >100 years of nest records. *Ecology and Evolution* 6: 631-646. (IF 2.32)

Cunningham, S., **Madden, C.**, **Barnard, P.** and **Amar, A.** 2016. Electric crows: power lines, climate change and the emergence of a native invader. *Diversity and Distributions* 22: 17-29. (IF 3.667)

Cuthbert, R.J., **Wanless, R.M.**, Angel, A., Burle, M-H., Hilton, G.M., Louw, H., Visser, P., Wilson, J.W. and **Ryan, P.G.** 2016. Drivers of predatory behavior and extreme size in house mice *Mus musculus* on Gough Island. *Journal of Mammalogy* DOI: 10.1093/jmammal/gyv199. (IF 1.84)

De Vos, A., **Cumming, G.S.**, **Cumming, D.**, **Ament, J.M.**, **Baum, J.**, **Clements, H.**, Grewar, J., **Maciejewski, K.** and **Moore, C.** 2016. Pathogens, disease, and the social-ecological resilience of protected areas. *Ecology and Society* 21: 20. (IF 3.889)

De Vos, A., **Cumming, G.S.**, **Moore, C.A.**, **Maciejewski, K**. and Duckworth, G. 2016. The relevance of spatial variation in ecotourism attributes for the economic sustainability of protected areas. *Ecosphere* 7: e01207. (IF 2.255)

Dilley, B.J., Schramm, M. and **Ryan, P.G.** 2016. Modest increases in densities of burrow-nesting petrels following the removal of cats (*Felis catus*) from Marion Island. *Polar Biology* 40: 625-637. (IF 1.586)

Douglas, D.J.T., Buchanan, G.M., Thompson, P., Smith, T., Cole, T., **Amar, A.**, Fielding, D.A., Redpath, S.M. and Wilson, J.D. 2016. Reply to comment on: Vegetation burning for game management in the UK uplands is increasing and overlaps spatially with soil carbon and protected areas. *Biological Conservation* 195: 295-296. (IF 3.762)

Doutrelant, C., Paquet, M., Renoult, J.P., Grégoire, A., Crochet, P-A. and **Covas, R.** 2016. Worldwide patterns of bird colouration on islands. *Ecology Letters* 19: 537-545. (IF 10.689)

Engesser, S., **Ridley, A.R.** and Townsend, S.W. 2016. Meaningful call combinations and compositional processing in the Southern Pied Babbler. *Proceedings of the National Academy of Science USA* 113: 5976-5981. (IF 9.674)

Fazey, F.M.C. and **Ryan, P.G.** 2016. Biofouling on buoyant marine plastics: an experimental study into the effect of size on surface longevity. *Environmental Pollution* 210: 354-360. (IF 4.143)

Fazey, F.M.C. and **Ryan, P.G.** 2016. Debris size and buoyancy influence the dispersal distance of stranded litter. *Marine Pollution Bulletin* 110: 371-377. (IF 2.991)

Fogell, D.J., **Martin, R.O.** and Groombridge, J.J. 2016. Beak and feather disease virus in wild and captive parrots: an analysis of geographic and taxonomic distribution and methodological trends. *Archives of Virology* 161: 2059. (IF 2.39)

Grémillet, D., Péron, C., Kato, A., Amélineau, F., Ropert-Coudert, Y., **Ryan, P.G.** and **Pichegru, L.** 2016. Starving seabirds: unprofitable foraging and its fitness consequences in Cape Gannets competing with fisheries in the Benguela

upwelling ecosystem. *Marine Biology* 163: 35. (IF 2.391)

Guo, D., Zietsman, G. and **Hockey, P.A.R.** 2016. Climate change impacts on the Common Swift in South Africa. *International Journal of Environmental Science and Development* 7: 306-311. (No IF)

Handley, J., Bayliss, A.M.M., Brickel, P. and **Pistorius, P.A**. 2016. Temporal variation in the diet of Gentoo Penguins at the Falkland Islands. *Polar Biology* 39: 283-296. (IF 1.586)

Handley, J. and **Pistorius, P.A.** 2016. Kleptoparasitism in foraging Gentoo Penguins *Pygoscelis papua. Polar Biology* 39: 391-395. (IF 1.586)

Hart, J., Hart, T., Salumu, L., Bernard, A., Abani, R. and **Martin, R.** 2016. Increasing exploitation of Grey Parrots in eastern DRC drives population declines. *Oryx* 50: 16. (IF 1.849)

Hellard, E., **Cumming, G.S.**, Caron, A., Coe, E. and Peters, J.L. 2016. Testing epidemiological functional groups as predictors of avian haemosporidia patterns in southern Africa. *Ecosphere* 7: e01225. (IF 2.255)

Henry, D.A.W., **Ament, J.M.** and **Cumming, G.S.** 2016. Exploring the environmental drivers of waterfowl movement in arid landscapes using first-passage time analysis. *Movement Ecology* 4: 8. (No IF)

Henry, D.A.W. and **Cumming, G.S.** 2016. Spatial and environmental processes show temporal variation in the structuring of waterbird metacommunities. *Ecosphere* 7: e01451. (IF 2.255)

Henry, D.A.W. and **Cumming, G.S.** 2017. Can waterbirds with different movement, dietary and foraging functional traits occupy similar ecological niches? *Landscape Ecology* 32: 265–278. (IF 3.5)

Humphries, D.J., Finch, F.M., Bell, M.B.V. and **Ridley, A.R.** 2016. Vocal cues to identity: Pied Babblers produce individually distinct but not stable loud calls. *Ethology* 122: 609-619. (IF 1.791)

Huntley, B., Collingham, Y.C., Singarayer, J.S., Valdes, P.J., **Barnard, P.**, Midgley, G.F., Altwegg, R. and Ohlemüller, R. 2016. Explaining patterns of avian diversity and endemicity: climate and biomes of southern Africa over the last 140,000 years. *Journal of Biogeography* 43: 874-886. (IF 4.59)

Jones, M.G.W., Dilley, B.J., **Hagens, Q.A., Louw, H., Mertz, E.M., Visser, P.** and **Ryan, P.G.** 2016. Wandering Albatross *Diomedea exulans* breeding phenology at Marion Island. *Polar Biology*. (IF 1.586)

Joseph, G.S., **Seymour, C.L.** and Foord, S.H. 2016. The effect of infrastructure on the invasion of a generalist predator: Pied Crows in southern Africa as a case-study. *Biological Conservation* 205: 11-15. (IF 3.762)

Joseph, G.S., **Seymour, C.L.**, Coetzee, B.W.T., Ndlovu, M., De La Torre, A., Suttle, R., Hicks, N., Oxley, S. and Foord, S.H. 2016. Microclimates mitigate against hot temperatures in dryland ecosystems: termite mounds as an example. *Ecosphere* 7(11): e01509. (IF 2.255)

Kreiderits A., Gamauf A., Krenn H.W. and **Sumasgutner P.** 2016. Investigating the influence of local weather conditions and alternative prey composition on the breeding performance of urban Eurasian Kestrels (*Falco tinnunculus*). *Bird Study* 63: 369-379. (IF 1.107)

Lardy, S., Rey, B., Salin, K., Voituron, Y. and Cohas, A. 2016. Beneficial effects of group size on oxidative balance in a wild cooperative breeder. *Behavioral Ecology* 27: 1820-1825. (IF 3.177)

Lee, A.T.K. and **Barnard, P.** 2016. How well do bird atlas reporting rates reflect bird densities? Correlates of detection from the fynbos biome, South Africa, with applications for population estimation. *Ostrich*. DOI: 10.2989/00306525.2016.1219413. (IF 0.414)

Leighton, G.R.M., Hugo, P.S., Roulin, A. and **Amar, A.** 2016. Just Google it: assessing the use of Google Images to describe geographical variation in visible traits of organisms. *Methods in Ecology and Evolution* 7: 1060-1070. (IF 6.554)

Leos-Barajas, V., Photopoulou, T., Langrock, R., Patterson, T.A., Watanabe, Y.Y., **Murgatroyd, M.** and Papastamatiou, Y.P. 2016. Analysis of animal accelerometer data using hidden Markov models. *Methods in Ecology and Evolution* 8: 161-173. (IF 6.554)

Lescroël, A., Mathevet, R., Péron, C., Authier, M., Provost, P., Takahashi, A. and **Grémillet, D.** 2016. Seeing the ocean through the eyes of seabirds: a new path for marine conservation? *Marine Policy* 68: 212-220. (IF 2.61)

Little, R. 2016. Book review: Roberts bird guide, second edition. *Ostrich*. DOI: 10.2989/00306525.2016.1272039. (IF 0.414)

Little, R. 2016. Book review: Guide to birds of the Kruger National Park. *Ostrich*. DOI: 10.2989/00306525.2016.12720398. (IF 0.414)

Lloyd, P., **Frauenknecht, B.D.**, **du Plessis, M.A.** and Martin, T.E. 2016. Comparative life history of the south temperate Cape Penduline Tit (*Anthoscopus minutus*) and north temperate Remizidae species. *Journal of Ornithology* 168: 569-577. (IF 1.711)

Lloyd, P. and Martin, T.E. 2016. Fledgling survival increases with development time and adult

survival across north and south temperate zones. *Ibis* 158: 135-143. (IF 2.172)

Lloyd, P., Martin, T.E., Taylor, A., Braae, A. and Altwegg, R. 2016. Age, sex and social influences on adult survival in the cooperatively breeding Karoo Scrub-robin. *Emu* 116: 394-401. (IF 1.107)

Lobato, E., Geraldes, M., **Melo, M.**, **Doutrelant, C.** and **Covas, R.** 2016. Diversity and composition of cultivable gut bacteria in an endemic island bird and its mainland sister species. *Symbiosis*. DOI: 10.1007/s13199-016-0419-6. (IF 1.438)

Loewenthal, D., **Paijmans, D.M.** and **Hockey, P.A.R.** 2016. Factors affecting the breeding success of the African Black Oystercatcher (*Haematopus moquini*): a perspective on protection and food availability. *African Zoology* 51: 193-202. (IF 0.612)

Maciejewski, K., Baum, J. and **Cumming, G.S.** 2016. Integration of private land conservation areas in a network of statutory protected areas: implications for sustainability. *Biological Conservation* 200: 200-206. (IF 3.762)

McClelland, G.T.W., **McKechnie, A.E.** and Chown, S.L. 2016. Basal metabolic rate of the Black-faced Sheathbill (*Chionis minor*): intraspecific variation in a phylogenetically distinct island endemic. *Physiological and Biochemical Zoology* 89: 141-150. (IF 2.398)

McKechnie, A.E., Coe, B.H., Gerson, A.R. and Wolf, B.O. 2016. Data quality problems undermine analyses of endotherm upper critical temperatures. *Journal of Biogeography* DOI: 10.1111/jbi.12941. (IF 4.59)

McKechnie, A.E., Smit, B., **Whitfield, M.C., Noakes, M.J.**, Talbot, W.A., Garcia, M., Gerson, A.R. and Wolf, B.O. 2016. Avian thermoregulation in the heat: evaporative cooling capacity in an archetypal desert specialist, Burchell's Sandgrouse (*Pterocles burchelli*). *Journal of Experimental Biology* 219: 2145-2155. (IF 2.897)

McKechnie, A.E., **Whitfield, M.C.**, Smit, B., Gerson, A.R., Smith, E.K., Talbot, W.A., McWhorter, T.J. and Wolf, B.O. 2016. Avian thermoregulation in the heat: efficient evaporative cooling allows for extreme heat tolerance in four Southern Hemisphere columbids. *Journal of Experimental Biology* 219: 2137-2144. (IF 2.897)

Mills, A.J., **Milewski, A.V.** and Sirami, C. 2016. A preliminary test of catabolic nutrients in explanation of the puzzling treelessness of grassland in mesic Australia. *Austral Ecology*. DOI: 10.1111/aec.12385. (IF 1.837)

Moks, K., Tilgar, V., **Thomson, R.L.**, Calhim, S., Järvistö, P.E., Schuett, W., Velmala, W. and Laaksonen, T. 2016. Predator encounters have spatially extensive impacts on parental behavior in a breeding bird community. *Proceedings of the Royal Society London B* 283: 20160020. (IF 5.051)

Monteiro, M., Reino, L., **Melo, M.**, Beja, P., Bastos-Silveira, C., Ramos, M., Rodrigues, D., Neves, I.Q., Consciência, S. and Figueira, R. 2016. The collection of birds from São Tomé and Príncipe at the Instituto de Investigação Científica Tropical of the University of Lisbon (Portugal). *ZooKeys* 600: 155-167. (IF 0.933)

Morosinotto, C., **Thomson, R.L.**, Ruuskanen, S., Korpimäki, E., Lehikoinen, E., Möstl, E. and Laaksonen, T. 2016. Maternal transfer of androgens in eggs is affected by food supplementation but not by predation risk. *Journal of Avian Biology* 47: 629-641. (IF 1.971)

Murgatroyd, M., Avery, G., Underhill, L.G. and **Amar, A.** 2016. Adaptability of a specialist predator: the effects of land use on diet diversification and breeding performance of Verreaux's Eagles. *Journal of Avian Biology* 47: 834-845. (IF 1.971)

Murgatroyd, M., Underhill, L.G., Bouten, W. and **Amar, A.** 2016. Ranging behavior of Verreaux's Eagles during the pre-breeding period determined through the use of high temporal resolution tracking. *PLoS ONE* 11: e0163378. (IF 3.234

Murgatroyd, M., Underhill, L.G., Rodrigues, L. and **Amar, A.** 2016. The influence of agricultural transformation on the breeding performance of a top predator: Verreaux's Eagles in contrasting land use areas. *Condor* 118: 238-252. (IF 1.00)

Navarro, J., **Grémillet, D.**, Afán, I., Ramírez, F., Bouten, W. and Forero, M.G. 2016. Feathered detectives: real-time GPS tracking of scavenging gulls pinpoints illegal waste dumping. *PLoS ONE* 11: e0159974. (IF 3.234)

Ndhlovu, T., **Milton, S.J.** and Esler, K.J. 2016. Impact of Prosopis (mesquite) invasion and clearing on vegetation species composition and diversity in semi-arid Nama-Karoo rangeland, South Africa. *African Journal of Range and Forage Science* 33: 101-110. (IF 0.971)

Nelson, J.T., Wilson, R.E., McCraken, K.G., **Cumming, G.S.**, Joseph, L., Guay, P-J. and Peters, J.L. 2016. Divergence and gene flow in the globally distributed blue-winged ducks. *Journal of Avian Biology*. DOI: 10.1111/jav.00998. (IF 1.974)

Noakes, M.J., Wolf, B.O. and **McKechnie, A.E.** 2016. Seasonal metabolic acclimatization varies in direction and magnitude among populations of an afrotropical passerine bird. *Physiological and Biochemical Zoology* 90: 178-189. (IF 2.398)

Noakes, M.J., Wolf, B.O. and **McKechnie, A.E.** 2016. Seasonal and geographical variation in heat tolerance and evaporative cooling capacity in a

passerine bird. *Journal of Experimental Biology* 219: 859-86. (IF 2.897)

O'Connor, R.S., Wolf, B.O., Brigham, R.M. and **McKechnie, A.E.** 2016. Avian thermoregulation in the heat: efficient evaporative cooling in two southern African nightjars. *Journal of Comparative Physiology B* 187: 477. (IF 2.619)

Osinubi, S.T. 2016. Review: The birds of Ghana: an atlas and handbook. *Ostrich* 87: 197-198. (IF 0.414)

Osinubi, S.T., Hand, K., Van Oijen, D.C.C., Walther, B.A. and **Barnard, P.** 2016. Linking science and policy to address conservation concerns about African land use, land conversion and land grabs in the era of globalization. *African Journal of Ecology* 54: 265-267. (IF 0.824)

Paquet, M., Doutrelant, C., Loubon, M., Theron, F., **Rat, M.** and **Covas, R.** 2016. Communal roosting, thermoregulatory benefits and breeding group size predictability in cooperatively breeding sociable weavers. *Journal of Avian Biology* 47(6): 749-755. (IF 1.971)

Péron, G., Altwegg, R., Jamie, G.A. and **Spottiswoode, C.N.** 2016. Coupled range dynamics of brood parasites and their hosts responding to climate and vegetation changes. *Journal of Animal Ecology* 85:1191-1199. (IF 4.504)

Pichegru, L., **Edwards, T.B., Dilley, B.J.** and **Ryan, P.G.** 2016. African penguin tolerance to humans depends on historical exposure at colony level. *Bird Conservation International* 26: 307-322. (IF 1.784)

Portugal, S.J., Green, J.A., Halsey, L.G., Arnold, W., Careau, V., Dann, P., Frappell, P.B., **Grémillet, D.**, Handrich, Y., Martin, G.R., Ruf, T., Guillemette, M.M. and Butler, P.J. 2016. Associations between resting, activity, and daily metabolic rate in free-living endotherms: no universal rule in birds and mammals. *Physiological and Biochemical Zoology* 89: 251-261. (IF 2.398)

Reynolds, C. and **Cumming, G.S.** 2016. Seed traits and bird species influence the dispersal parameters of wetland plants. *Freshwater Biology* 61: 1157–1170. (IF 2.738)

Reynolds, C. and **Cumming, G.S.** 2016. Seed dispersal by waterbirds in southern Africa: comparing the roles of ectozoochory and endozoochory. *Freshwater Biology* 60: 349-361. (IF 2.738)

Robertson, B.C., Stephenson, B.M., Ronconi, R.A., Goldstein, S.J., Sheperd, L., Tennyson, A., Carlile, N. and **Ryan, P.G.** 2016. Phylogenetic affinities of the *Fregetta* storm-petrels are not black and white. *Molecular Phylogenetics and Evolution* 97: 170-176. (IF 3.916)

Rollinson, D.P., **Dilley, B.J.**, **Davies, D.** and **Ryan, P.G.** 2016. Diving behavior of Grey Petrels and its relevance for mitigating long-line by-catch. *Emu* 116: 340-349. (IF 1.107)

Roscales, J.L., González-Solís, J., Zango, L., **Ryan, P.G.** and Jiménez, B. 2016. Latitudinal exposure to DDTs, HCB, PCBs, PBDEs and DP in giant petrels (*Macronectes* spp.) across the Southern Ocean. *Environmental Research* 148: 285-294. (IF 3.906)

Ryan, P.G., Cole, G., Spiby, K., Nel, R., **Osborne, A.** and **Perold, V.** 2016. Impacts of plastic ingestion on post-hatchling loggerhead turtles off South Africa. *Marine Pollution Bulletin* 107: 155-160. (IF 2.991)

Ryan, P.G., De Bruyn, P.J.N. and Bester, M.N. 2016. Regional differences in plastic ingestion among Southern Ocean fur seals and albatrosses. *Marine Pollution Bulletin* 104: 207-210. (IF 2.991)

Schoombie, S., Crawford, R.J.M., Makado, A.B., Dyer, B.M. and **Ryan, P.G.** 2016. Recent population trends of Sooty and Light-mantled Albatrosses breeding on Marion Island. *African Journal of Marine Science* 38: 119-127. (IF 1.00)

Seymour, C.L., **Joseph, G.S.**, Makumbe, M., **Cumming, G.S.**, Mahlangu, Z. and **Cumming, D.H.M.** 2016. Woody species composition in an African savanna: determined by centuries of termite activity but modulated by 50 years of ungulate herbivory. *Journal of Vegetation Science* 27: 824-833. (IF 3.709)

Sherley, R.B., Botha, P., Underhill, L.G., **Ryan, P.G.**, van Zyl, D., Cockcroft, A.C., Crawford, R.J.M., Dyer, B.M. and **Cook, T.R.** 2016. Defining ecologically-relevant scales for spatial protection using long-term data on an endangered seabird and local prey availability. *PeerJPrePrints* 4: e2122v1. (No IF)

Smit, B., Zietsman, G., **Martin, R.O.**, **Cunningham, S.J.**, **McKechnie, A.E.** and **Hockey, P.A.R.** 2016. Behavioural responses to heat in desert birds: implications for predicting vulnerability to climate warming. *Climate Change Responses* 3: 9. (No IF)

Smith, T., Page-Nicholson, S., Morrison, K., Gibbons, B., **Jones, M.G.W.,** van Niekerk, M., Botha, B., Oliver, K., McCann, K. and Roxburgh, L. 2016. The African Crane database (1978-2014): records of three threatened crane species (Family: Gruidae) from southern and eastern Africa. *Biodiversity Data Journal* 4: e9794. (IF 0.53)

Sorensen, M.C., Asghar, M., Bensch, S., Fairhurst, G.D., Jenni-Eiermann, S. and **Spottiswoode, C.N.** 2016. A rare study from the wintering grounds provides insight into the costs of malaria infection for migratory birds. *Journal of Avian Biology* 47: 575-582. (IF 1.971)

Sorensen, M.C., Fairhurst, G.D., Jenni-Eiermann, D., Newton, J., Yohannes, E. and **Spottiswoode, C.N.** 2016. Seasonal rainfall at long-term migratory staging sites is associated with altered carry-over effects in a Palearctic-African migratory bird. *BMC Ecology* 16: 41. (IF 3.15)

Sorensen, M.C., Jenni-Eiermann, S. and **Spottiswoode, C.N.** 2016. Why do migratory birds sing on their tropical wintering grounds? *American Naturalist* 187: E65–E76. (IF 3.832)

Spelt, A. and **Pichegru, L.** 2016. Sex allocation and sex-specific parental investment in an endangered seabird. *Ibis* 159: 272-284. (IF 1.921)

Spottiswoode, C.N., Begg, K.S. and Begg, C.M. 2016. Reciprocal signaling in honeyguide-human mutualism. *Science* 353: 387-389. (IF 33.611)

Spottiswoode, C.N., Fishpool, L.D.C. and Bayliss, J.L. 2016. Birds and biogeography of Mt Mecula, in Mozambique's Niassa National Reserve. *Ostrich* 87: 281–284. (IF 0.414)

Sumasgutner, P., **Millán, J.**, Curtis, O., Koeslag, A. and **Amar, A.** 2016. Is multiple nest building an adequate strategy to cope with inter-species nest usurpation? *BMC Evolutionary Biology* 16: 97. (IF 3.406)

Sumasgutner, P., **Tate, G.J.**, Koeslag, A. and **Amar, A.** 2016. Seasonal patterns in space use of Black Sparrowhawks *Accipiter melanoleucus* in an urban environment. *Bird Study* 63: 430-435. (IF 1.107)

Sumasgutner, P., **Tate, G.J.**, Koeslag, A. and **Amar, A.** 2016. Family morph matters: factors determining survival and recruitment in a long-lived polymorphic raptor. *Journal of Animal Ecology* 85: 1043-1055. (IF 4.504)

Suri, J., Anderson, P.M., Charles-Dominique, T., **Hellard, E.** and **Cumming, G.S.** 2016. More than just a corridor: a suburban river catchment enhances bird functional diversity. *Landscape and Urban Planning* 157: 331-342. (IF 3.037)

Suri, J., **Sumasgutner, P.**, **Hellard, E.**, Koeslag, A. and **Amar, A.** 2016. Stability in prey abundance may buffer Black Sparrowhawks *Accipiter melanoleucus* from health impacts of urbanization. *Ibis* 159: 38-54. (IF 1.921)

Szymkowiak, J., **Thomson, R.L.** and Kuczyński, L. 2016. Wood warblers copy settlement decisions of poor quality conspecifics: support for the tradeoff between the benefit of social information use and competition avoidance. *Oikos* 125: 1561-1569. (IF 3.444)

Tate, G.J., Bishop, J.M. and **Amar, A.** 2016. Differential foraging success across a light level spectrum explains the maintenance and spatial structure of colour morphs in a polymorphic bird. *Ecology Letters* 19: 679-686. (IF 10.689)

Tate, G.J., **Sumasgutner, P.**, Koeslag, A. and **Amar, A.** 2017. Pair complementarity influences reproductive output in the polymorphic black sparrowhawk (*Accipiter melanoleucus*). *Journal of Avian Biology* 48: 387–398. (IF 1.971)

Techow, N.M.S.M., O'Ryan, C., Robertson, C.J.R. and **Ryan, P.G.** 2016. The origins of White-chinned Petrels killed by long-line fisheries off South Africa and New Zealand. *Polar Research* 35: 21150. (IF 1.141)

Thiebault, A., **Pistorius, P.**, **Mullers, R.** and Tremblay, Y. 2016. Seabird acoustic communication at sea: a new perspective using bio-logging devices. *Scientific Reports* 6: 30972. (IF 5.578)

Townsend, S.W., Koski, S.E., Byrne, R.W., Slocombe, K.E., Bickel, B., Boeckle, M., Goncalves, I.B., Burkart, J.M., **Flower, T.M.**, Gaunet, F., Glock, H.J., Gruber, T., Jansen, D.A.W.A.M., Liebal, K., Linke, A., Miklósi, Á., Moore, R., van Schaik, C.P., Stoll, S., Vail, A., Waller, B.M., Wild, M., Zuberbühler, K. and Manser, M.B. 2016. Exorcising Grice's ghost: an empirical approach to studying intentional communication in animals. *Biological Reviews*. DOI: 10.1111/brv.12289. (IF 9.67)

Troscianko, J., Wilson-Aggarwal, J., **Spottiswoode, C.N.** and Stevens, M. 2016. Nest covering in plovers: how modifying the visual environment influences egg camouflage. *Ecology and Evolution* 6: 7536-7545. (IF 2.32)

Troscianko, J., Wilson-Aggarwal, J., Stevens, M. and **Spottiswoode, C.N.** 2016. Camouflage predicts survival in ground-nesting birds. *Scientific Reports* 6: 19966. (IF 5.078)

Valle, S., Barros, N., Ramírez, I. and **Wanless, R.M.** 2016. Population estimates of the breeding birds of the Tinhosas islands (Gulf of Guinea), the only major seabird colony of the eastern tropical Atlantic. *Ostrich* 87: 209-215. (IF 0.414)

Van de Ven, T.M.F.N., **Martin, R.O.**, Vink, T.J.F., **McKechnie, A.E.** and **Cunningham, S.J.** 2016. Regulation of heat exchange across the hornbill beak: functional similarities with toucans? *PLoS ONE* 11: e0154768. (IF 3.234)

Van Eeden, R.B., **Reid, T.**, **Ryan, P.G.** and **Pichegru, L.** 2016. Fine-scale foraging cues for African Penguins in a highly variable marine environment. *Marine Ecology Progress Series* 543: 257-271. (IF 2.619)

Van Velden, J.L., Altwegg, R., Shaw, K. and **Ryan, P.G.** 2016. Movement patterns and survival estimates of Blue Cranes in the Western Cape. *Ostrich*. DOI: 10.2989/00306525.2016.1224782. (IF 0.414)

Van Velden, J.L., Smith, T. and **Ryan, P.G.** 2016. Cranes and crops: investigating farmer tolerances toward crop damage by threatened Blue Cranes (*Anthropoides paradiseus*) in the Western Cape, South Africa. *Environmental Management* 58:972. (IF 1.724)

Vega, M.L., Willemoes, M., **Thomson, R.L.**, Tolvanen, J., Rutila, J., Samaš, P., Strandberg, R., Grim, T., Fossøy, F., Stokke, B.G. and Thorup, K. 2016. First-time migration in juvenile Common Cuckoos documented by satellite tracking. *PLoS ONE* 11: e0168940. (IF 3.234)

Vincze, O., Kosztolányi, A., Barta, Z., Küpper, C., Alrashidi, M., Amat, J.A., Ticó, A.A., Burns, F., Cavitt, J., Conway, W.C., Cruz-López, M., Desucre-Medrano, A.E., dos Remedios, N., Figuerola, J., Galindo-Espinosa, D., García-Peña, G.E., Angel, S.C.D., Gratto-Trevor, C., Jönsson, P., **Lloyd, P.**, Montalvo, T., Parra, J.E., Pruner, R., Que, P., Liu, J., Saalfeld, S.T., Schulz, R., Serra, L., St Clair, J.J.H., Stenzel, L.E., Weston, M.A., Yasué, M., Zefania, S. and Székely, T. 2016. Parental cooperation in a changing climate: fluctuating environments predict shifts in care division. *Global Ecology and Biogeography* 26: 347–358. (IF 6.531)

Wheeler, H.C., Berteaux, D., Furgal, C., Parlee, B., Yoccoz, N.G. and **Grémillet, D.** 2016. Stakeholder perspectives on triage in wildlife monitoring in a rapidly changing Arctic. *Frontiers in Ecology and Evolution* 4: 128. (No IF)

Whitehead, T.O., Kato, A., Ropert-Coudert, Y. and **Ryan, P.G.** 2016. Habitat use and diving behavior of Macaroni *Eudyptes chrysolophus* and Eastern Rockhopper *E. chrysocome filholi* penguins during the critical pre-moult period. *Marine Biology* 163: 19. (IF 2.391)

Whittington, P.A., Crawford, R.J.M., Martin, A.P., Randall, R.M., Brown, M., **Ryan, P.G.**, Dyer, B.M., Harrison, K.H.B., Huisamen, J., Makhado, A.B., Upfold, L., Waller, L.J. and **Witteveen, M.** 2016. Recent trends of the Kelp Gull (*Larus dominicanus*) in South Africa. *Waterbirds* 39: 99-113. (IF 0.637)

Wilson-Aggarwal, J.K., Troscianko, J.T., Stevens, M. and **Spottiswoode, C.N.** 2016. Escape distance in ground-nesting birds differs with individual level of camouflage. *American Naturalist* 188: 231-239. (IF 3.832)

Witteveen, M., Brown, M. and **Ryan, P.G.** 2016. Anthropogenic debris in the nests of Kelp Gulls in South Africa. *Marine Pollution Bulletin* 114: 699-704. (IF 2.991)

Wogan, G.O.U., Feldheim, K.A., Tsai, A.S., Brown, A.A., Kapelke, J., Galinato, M., Tung, J.N., Bates, J.M., Kaliba, P., Voelker, G. and **Bowie, R.C.K.** 2016. New genetic resources and a preliminary multi-locus assessment of species boundaries in the Batis *capensis* species complex (Passeriformes: Platysteridae). *Biochemical Systematics and Ecology* 65: 83-88. (IF 0.967)

Zoghby, B.A., **Little, R.M.**, **Ryan, P.G.** and **Hockey, P.A.R.** 2016. Patterns of roost site selection and use by Southern Ground-Hornbills in north-eastern South Africa. *Ostrich* 87: 125-130. (IF 0.414)

Books and book chapters

Little, R. 2016. *Terrestrial gamebirds and snipes of Africa: guineafowls, francolins, spurfowls, quails*, sandgrouse and snipes. Jacana Media, Johannesburg)

Masson-Delmotte, V., Gauthier, É., **Grémillet, D.**, Huctin, J-M. and Swingedouw, D. 2016. *Le Groenland: climat, écologie, société.* CNRS editions, La Rochelle, France)

Ryan, P.G. 2016. Ingestion of plastics by marine organisms. In: Takada, H. and Karapanagioti, H.K. (eds) *Hazardous Chemicals Associated with Plastics in the Environment*. Springer, Berlin, pp. 1-32, DOI: 10.1007/698_2016_21

Tarboton, W. and **Ryan, P.G.** 2016. *Guide to the birds of the Kruger National Park*. Cape Town: Struik Nature)

Thorén, S., **Carstens, K.F.**, Schwochow, D. and Radespiel, U. 2016. Your food, my food: patterns of resource use in two sympatric mouse lemur species. In: Lehman, S.M., Radespiel, U. and Zimmermann, E. (eds) The Dwarf and Mouse Lemurs of Madagascar: Biology, Behavior and Conservation Biogeography of the Cheirogaleidae. Cambridge University Press, Cambridge, UK, pp. 307-318)

Semi-popular publications 2016

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

Allport, G. and **Cohen, C.** 2016. Finding Steppe Whimbrel – discovery and identification in southern Africa. *African Birdlife* 4(6): 48-54.

Barnard, P. 2016. Meet the conservationist: a passion for the ocean – Kerry Sink. *Africa Conservation Telegraph* 10. (posted 22 April 2016).

Barnard, P. 2016. Biodiversity horizons. *SANBI Science*. (posted 29 June 2016).

Barnard, P. 2016. Women in science, changing how the world works. *SANBI Science*. (posted 27 September 2016).

Bladon, A.J., Jones, S.E.I., Collar, N.J., Dellelegn, Y., Donald, P.F., Gedeon, K., Green, R.E., **Spottiswoode, C.N.**, Töpfer, T. and Wondafrash, M. 2016. Further notes on the natural history of the Ethiopian Bush-crow *Zavattariornis stresemanni*. *Bulletin of the African Bird Club* 23: 27–45.

Carstens, K. 2016. Thriving despite the heat. *Klaserie Chronicle* 35: 15.

Coetzee, A., Pauw, A., Geerts, S. and **Barnard, P.** 2016. Do sunbirds like pink flowers? *Promerops* 305: 13.

Cohen, C. 2016. Sacred Ibis. *The Muse* February 2016: 1.

Cohen, C. 2016. House Crow. *The Muse* March 2016: 1.

Cohen, C. 2016. Citrus Swallowtail. *The Muse* April 2016: 1.

Cohen, C. 2016. Cape Dwarf Chameleon. *The Muse* May 2016: 1.

Cohen, C. 2016. Cape Skink. *The Muse* June 2016: 1.

Cohen, C. 2016. Cape Sparrow. *The Muse* July 2016: 1.

Cohen, C. 2016. Acacia Pied Barbet. *The Muse* August 2016: 1.

Cohen, C. 2016. Grey Squirrel. *The Muse* September 2016: 1.

Cohen, C. 2016. African Fish Eagle. *The Muse* October 2016: 1.

Cohen, C. 2016. Psychedelic caterpillars in Pinelands. *The Muse* November 2016: 1.

Cohen, C. 2016. Yellow Bishop. *The Muse* December 2016: 1.

Cohen, C., Mills, M.S.L. & Francis, J. 2015. First records for Somalia of Bonelli's Eagle *Aquila fasciata*, Short-toed Snake Eagle *Circaetus gallicus* and Red-breasted Wheatear *Oenanthe bottae*. *African Bird Club Bulletin* 22: 225-8.

Covas, R. 2016. Bird of the year 2016: Sociable Weaver. *African Birdlife* 4(2): 56.

Covas, R. 2016. Social structure and cooperation. *African Birdlife* 4(3): 61.

Covas, R. 2016. Nest structure and construction. *African Birdlife* 4(4): 62.

Craig, C. 2016. Arctic Tern from Iceland. *Promerops* 304: 9.

Cunningham, S. 2016. Killer moves southern Fiscal. *African Birdlife* 4(2): 14.

Cunningham, S. 2016. Adapting to a hostile environment. *African Birdlife* 4(5): 67.

Cunningham, S. 2016. Body heat. *Wild Card Magazine* Autumn 2016.

De Blocq, A. 2016. Birding big day win for UCT. *UCT website Daily news* (posted 7 December 2016).

De Blocq, A. 2016. Leucistic White-chinned Petrel. *Promerops* 304: 21.

De Blocq, A. 2016. Grey Heron preys on Little Grebe. *Promerops* 305: 23-24.

De Blocq, A. 2016. Oom Albatross - 40-year old albatross seen on Cape Pelagic: *The Fledgling* 2: 5.

De Blocq, A. 2016. Birding the Cape: Cape Peninsula. *The Fledgling* 10: 4-5.

De Blocq, A. 2016. Inauguration of the UCT Birding Club. *The Fledgling* 4: 8.

De Blocq, A. 2016. Bundu-bash birding in Great Britain. *The Fledgling* 5: 6.

De Blocq, A. 2016. Birding the Cape: West Coast. *The Fledgling* 11: 5-6.

Flood, B. and **Ryan, P.G.** 2016. Ageing shy albatrosses. *African Birdlife* 4(2): 49-53.

Isaksson, C. and **Sumasgutner, P.** 2016. How rapid urbanisation is changing the profile of wildlife in cities. *The Conversation – Environment + Energy* (posted 16 May 2016)

Krüger, S. 2016. An investigation into the decline of the Bearded Vulture in southern Africa. *KZN Birds* 47: 10-11.

Lee, A.T.K. 2016. Turning the page: a new editor for Ostrich. *African Birdlife* 4(6) 66.

Little, R. 2016. Hybrid spurfowl unravelled. *African Birdlife* 5(1): 6-8.

Little, R. 2016. Photographing African gamebirds. *African Birdlife* 4(6): 14.

Little, R. 2016. Mix and match: hybrid spurfowl. *African Birdlife* 4(5): 16.

Little, R. 2016. Phil Hockey – 'Education is what is left when what has been learnt has been forgotten'. Environment: People and conservation in Africa, *Eco-heroes* 25: 52-55.

Little, R. 2016. How to reverse the decline of southern ground hornbills. *The Conversation – Environment + Energy* (posted 02 February 2016).

Little, R. 2016. Commentary (A lucky catch for powerful raptor). *SANParks Times* Summer edition December 2016: 35.

Little, R., **Wanless, R.** and **Ryan, P.G.** 2016. Gill Memorial Medal Award 2016. *African Birdlife* 4(4): 61.

McKechnie, A. 2016. Enormous, enigmatic and extinct: the elephant birds of Madagascar. *African Birdlife* 4(2): 10-11.

McKechnie, A. 2016. Heavy metal: vultures and lead poisoning. *African Birdlife* 4(3): 15.

McKechnie, A. 2016. Mercury rising: South Africa's national parks are getting warmer. *African Birdlife* 4(3): 14.

McKechnie, A. 2016. Not so chilled? Burchell's Sandgrouse. *African Birdlife* 4(4): 15.

McKechnie, A. 2016. It's a no-brainer: migrants mobilise mercury during flight. *African Birdlife* 4(6): 10.

McKechnie, A. 2016. Knot the right size. *African Birdlife* 4(6): 11.

McKechnie, A. 2016. Hot hatch: zebra finches prepare their chicks for warm conditions. *African Birdlife* 5(1): 11.

McKechnie, A. 2016. Our parks are getting hotter. *SANParks Times* Spring Edition (Sept. 2016): 5.

Mills, M.S.L., Bennett, B., Baptista, N., and Pinto, P.V. 2016. Red-necked Falcon Falco chicquera in Angola. *Bulletin of the African Bird Club* 23: 89-90.

Mills, M.S.L., Msimanga, A., Reygel, A., and Louette, M. 2016. Kungwe *Apalis Apalis* [*rufogularis*] *argentea*: a summary. *Bulletin of the African Bird Club* 23: 176-184.

Murgatroyd, M. 2016. Eagles and agriculture can co-exist, a good news story: land use change is not necessarily detrimental to Verreaux's Eagles. *British Ornithologists' Union* (posted 29 February 2016).

Murgatroyd, M., **Amar, A.** and Underhill, L. 2016. Eagles and agriculture: not a zero sum game. *The Conversation – Environment + Energy* (posted 10 February 2016).

Nupen, L. 2016. Fancy footwork: the dazzling diversity of avian feet. *African Birdlife* 4(6):34-38.

Paijmans, D.M. 2016. An unusual meal for African Black Oystercatcher *Haematopus moquini* chicks. *Biodiversity Observations* 7(12) 1-2.

Paijmans, D.M. 2016. New SAFRING longevity record for the Crowned Lapwing (*Vanellus coronatus*). *Laniarius* 132:24-25.

Paijmans, D.M. 2016. A Western Osprey (*Pandion haliaetus*) – visiting from Russia. *Promerops* 305:13-14.

PFIAO. 2016. Conserving Angola's scarp forests. *African Birdlife* 5(1):18.

PFIAO. 2016. The FitzPatrick Report: The impacts of solar energy. *African Birdlife* 4(2):16.

PFIAO. 2016. The FitzPatrick Report: Lost in Action. *African Birdlife* 4(3):20.

PFIAO. 2016. The FitzPatrick Report: Connecting with intra-African migrants. *African Birdlife* 4(4):18.

PFIAO. 2016. The FitzPatrick Report: The year in review. *African Birdlife* 4(5):18.

PFIAO. 2016. The FitzPatrick Report: Death trap. *African Birdlife* 4(6):18.

Rollinson, D.P. 2016. Sighting at sea: Speckled Pigeon *Columba guinea* off Durban, South Africa. *Biodiversity Observations* 7(18): 1-2.

Rollinson, D.P. 2016. At-sea sightings of banded Tristan Albatrosses off the Western Cape and a review of records in southern African waters. *Biodiversity Observations* 7(66): 1-4.

Rollinson, D.P. 2016. Rare seabird sightings from a pelagic longline vessel off South Africa, July-September 2013. *Bulletin of the African Bird Club* 23:164-175.

Rollinson, D.P. and Rollinson, P.L. 2016. Observations of the courtship display of a White-Backed Night Heron from South Africa. *Biodiversity Observations* 7(53): 1

Rollinson, D.P. and Rollinson, P.L. 2016. Snowy Egret *Egretta thula* in Cape Town, South Africa – second record for continental Africa. *Bulletin of the African Bird Club* 23:219-222.

Ryan, P.G. 2016. Crops and pixels. *African Birdlife* 5(1):70-71.

Ryan, P.G. 2016. Old school, new school. *African Birdlife* 5(1):55.

Ryan, P.G. 2016. Sleeping with one eye open. *African Birdlife* 5(1):22-25.

Ryan, P.G. 2016. New: scops owl on Príncipe. *African Birdlife* 5(1):10.

Ryan, P.G. 2016. Crash-test dummies: foraging ecology of Cape Gannets. *African Birdlife* 4(6):22-30.

Ryan, P.G. 2016. See-saw: contrasting population trends in Phoebetria Albatrosses. *African Birdlife* 4(5):10-11.

Ryan, P.G. 2016. On the shelf. *African Birdlife* 4(4):16.

Ryan, P.G. 2016. Another year, another tree. *African Birdlife* 4(4):14.

Ryan, P.G. 2016. World Seabird Conference making waves. *African Birdlife* 4(2):13.

Ryan, P.G. 2016. Pocket rockets: point-and-shoot cameras. *African Birdlife* 4(2):44-47.

Ryan, P.G. 2016. Gulls hunting kelp flies. *Promerops* 306: 16.

Ryan, P.G., Ramudzuli, A., Tebogo, S., and Madumane, W. 2016. Kelp Gulls apparently hunting Little Grebes. *Promerops* 306: 16.

Ryan, P.G. 2016. Many a bird's rise from the ashes uncertain. *SANParks Times* Winter edition (June 2016):25.

Ryan, P.G. 2016. Flying colours. *Wild Card Magazine* Spring 2016:68-72.

Ryan, P.G. and Graham, J. 2016. Review: Nikon goes big. *African Birdlife* 4(3):66-67.

Simmons, R, and Martins, M. 2016. Harriers in the Hoanib. *African Birdlife* 4(5):61-63.

Spottiswoode, C.N. 2016. Forming the perfect pair for a honey hunt. *SANParks Times* Summer Edition (December 2016): 30.

Spottiswoode, C.N. 2016. Honeyguides and people cooperate and communicate with each other. *Science Faculty Newsletter* 5(2): 11.

Sumasgutner, P. 2016. Hawks versus Geese: combatting nest usurpers by building more nests. *Promerops* 306:8-9.

Sumasgutner, P. 2016. The colour of survival – how parental morph influences the fitness of the offspring in black sparrowhawks. *Animal Ecology in Focus* (posted 16 May 2016)

Thomson, R. and **Flower, T.** 2016. Bird of the year 2016 Sociable Weaver: living together. *African Birdlife* 4(6):65.

van de Ven, T. 2016. Keep-cool tool. *African Birdlife* 4(5):15.

Wanless, R.M. 2016. Oceans of life. *African Birdlife* 4(6):62-63.

Wanless, R.M. and Small, C. 2016. Data collection opportunities for assessing the use and effectiveness of seabird conservation measures. IOTC-2016-WPEB12-32.

Wanless, R.M. and Misiak, W. 2016. A status update of seabirds in the IOTC area. IOTC-2016-WPEB12-28.

Key 2016 co-sponsors

The FitzPatrick Institute is extremely grateful for the generous support from co-sponsors. Without this support it would not be possible to maintain our high levels of research, teaching and output.