FitzPatrick Institute of African Ornithology

DSI-NRF Centre of Excellence
University of Cape Town

Annual Report 2020

60th Anniversary

FRONT COVER: **The FitzPatrick Institute of African Ornithology is at the forefront of educating the next generation of conservation biologists. Since 1992, over 300 students have graduated from our flagship Conservation Biology MSc course and many are now leaders in conservation across Africa and the world. Here, a group of students from 2020 explore the biodiversity of the Cape Floristic Region on a field outing in February (prior to the arrival of COVID-19 in South Africa). Left to right: Varalika Jain, Eliupendo Laltaika, Rowan Hickman, Debbie Walsh, Imthiaz Sheik-Abbass (Photo: Callan Cohen).**

REPORT LAYOUT: HILARY BUCHANAN

FitzPatrick Institute Advisory Board 2020

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Prof. Mike Cherry (Botany & Zoology, U. Stellenbosch)
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A/Prof. Muthama Muasya (HoD, Biological Sciences, UCT)
Prof. Maano Ramutsindela (Dean, Faculty of Science)
Prof. Peter Ryan (Director, FIAO)
Dr Linda Mtwisha (Research Office, UCT)
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Dr Andrew Skowno (SANBI) Sept-Dec
Dr Hanneline Smit-Robinson (BirdLife South Africa)

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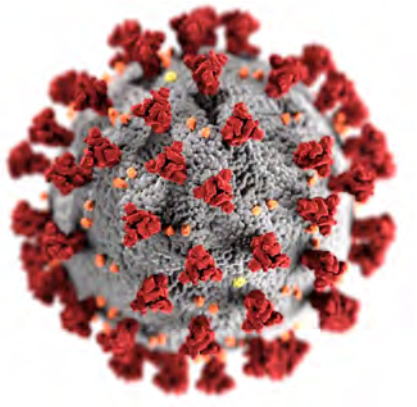


CDC image library

2020 marked the 60th anniversary of the FitzPatrick Institute, but this milestone was overshadowed by the upheavals caused by the COVID-19 pandemic. The year began with the usual start-of-year rush: welcoming a new cohort of post-graduate students, while encouraging senior students to finish their theses ahead of the mid-February submission deadline. The Fitz annual report was completed in record time, so we could hold the AGM in early March – all so that I could go to Gough Island to help prepare for the mouse eradication attempt. I got as far as putting my gear onto the yacht before the RSPB pulled the plug. We could have got to Gough, but the burgeoning pandemic was seen as a serious threat to getting the helicopter pilots and other essential personnel to Cape Town in May for the actual eradication attempt. And so the Gough Island Restoration Programme became one of the first of many conservation efforts to fall victim to COVID-19.

We all vividly remember that first three-week lockdown. How naïve we were, to think that life would start to return to normal after only a few weeks. Some students returned home; others hunkered down in their digs. We empathised with the new Conservation Biology class, whose field trip to Tswalu Kalahari was cancelled at the 11th hour. But life limped on. While UCT suspended all classes, the CB course moved online, and continued on schedule thanks largely to Susie Cunningham's efficient leadership. Susie sat through umpteen training seminars on how to run online courses, and then patiently imparted the essentials to the CB module leaders. Credit must also go to the CB class, who made the best of a decidedly challenging situation.

The impacts on other Fitz students were less overt. Fortunately, the lockdown started at a time when little fieldwork was planned. But as the travel restrictions wore on, more and more fieldwork had to be cancelled or greatly curtailed, often with serious implications for student research project data continuity. One of the more invidious impacts of the pandemic was the sense of isolation it brought, which was especially hard for students far from home. The Fitz postdocs initiated a 'virtual tea' to keep people in touch and maintain a sense of community. And the 'Zoom era' did bring some positives. We could host and attend seminars and discussions with colleagues from all over the world, bringing a distinctly more international feeling to our endeavours.

To make the best of a bad situation, we strived to take advantage of the novel research opportunities that resulted from the pandemic, and the so-called 'anthropause' that it triggered. Jessleena Suri, who was scheduled to commence a series of point counts in urban habitats for her PhD on urban bird ecology, moved her survey online to harness the observational powers of hundreds of frustrated birders. And I got the opportunity to measure plastic fluxes on deserted beaches without the complications resulting from beach cleaning and littering by beach-goers.

We also used the enforced down time for analyses and writing. 2020 was the most productive yet for the Fitz and the broader Centre of Excellence (CoE) in terms of publications, with over 160 papers published in peer-reviewed journals. And we continued to grow the proportion of papers in high impact journals. Over the last three years, the number of papers in journals with 2-year impact factors >5 has increased from 16 in 2018 to 27 in 2019 and 36 in 2020. This achievement is very much a team effort, and I thank the extended Fitz family of staff, students and research associates for their hard work, dedication, and enthusiasm. Two academics in particular warrant congratulating: Chevonne Reynolds received the Friedel Sellschop Research Award at Wits, and Susie Cunningham received a UCT Young Researchers Award, and was promoted to Senior Lecturer from January 2021.

The news was less positive on the funding front. COVID-linked cuts in government funding to the South African National Biodiversity Institute (SANBI) resulted in their reneging on promised support for the bird atlas and related citizen science projects in 2020. Sadly, this necessitated the retrenchment of Dr Rene Navarro, who joined the Fitz from the Animal Demography Unit in 2018. Rene continues to maintain the Virtual Museum websites on a part-time contract funded by a grant to Prof. Les Underhill. Michael Brooks' position was saved thanks to a funding appeal led by BirdLife South Africa. The African Bird Atlas Project, which includes SABAP2 as well as other regional atlases in East and West

Africa, is too important to be allowed to falter for want of $50,000 per year, and we are exploring various avenues to secure longer-term funding from international sources.

More bad news came in August 2020, when we were informed by the NRF that support for all six of the initial cohort of Centres of Excellence, including the Fitz, was being phased out over three years. The worst part was that the phase out had already begun, and our budget for 2020 was cut by 25%. Unsurprisingly, this cut was hard to accommodate so late in the year when much of the budget was already committed to student bursaries and other fixed costs. Despite the savings made by cancelled conference attendances and reduced field work expenses, the CoE had a R600,000 deficit by the end of the year. We are extremely grateful to the University's Research Committee for stepping in and providing emergency support to offset this deficit.

We still have two years of CoE support, but the steady reduction in the grant amounts, cuts of 50% in 2021 and 75% in 2022, means that almost all of these budgets are already committed to ongoing projects. Looking forward, it is inevitable that the end of CoE support will impact the Fitz. The CoE grant recently amounted to only one third of the Fitz research budget, but the freedom to decide how best to use the funds was invaluable. Judicious use of the CoE funds to supplement other projects greatly enhanced our productivity. And although the existing partnerships with colleagues at other South African institutions fostered by the CoE will continue, new partnerships will be harder to establish. I expect that the greatest challenge will be to secure funding for students, but this is likely to be a widespread problem given the cuts in government support for research, and the challenging new NRF bursary system.

In the short-term, we can use Fitz reserves to fill some of the gap left by the loss of CoE support. However, we need to use the next two years to find new sources of funds, and to develop new partnerships that will allow the Fitz to not only survive but to flourish. Increasingly these partnerships are going to be with the private sector, and with collaborators overseas.

The end of 2020 and the phasing out of the CoE also saw the retirement of Rob Little in December 2020. Rob has been a central point to the logistical and governance issues of the Fitz over the past 11 years and we wish him well in his retirement.

Peter Ryan, February 2021

Marina Niven sits front and centre in the group photo at the Fitztitute's 60th anniversary AGM, held just before the COVID lockdown in March 2020. The AGM for 2021 remains on hold, in the hope that we might be able to hold an in-person meeting later in the year (Photo: Gonzalo Aguilar).

Staff, Students and Associates

UCT GRADUATES

PhD
Amanda Bourne
Anthony Lowney
Luke McClean

MSc
Alexis Osborne
Eleanor Weideman

Conservation Biology MSc
René Brink
Cecilia Cerrilla
Conor Eastment
Jennifer Gedert
Jack Harper
Gilson Montrond
Matthew Orolowitz
Kate Sheridan
Debbie Stanbridge
Luke Wilson

NEW UCT STUDENTS

PhD
Christie Craig (Peter Ryan)

MSc
Nosipho Gumede (Peter Ryan)
Carrie Hickman (Susie Cunningham, Rita Covas)
Taylyn Risi (Peter Ryan)
Michelle Vrettos (Arjun Amar)

Upgrade from MSc to PhD
Miqkayla Stofberg

Conservation Biology MSc
Thirteen students began the CB MSc in January 2020.

BSc Hons
Kyle Maclean (Peter Ryan)
Emily Spencer (Peter Ryan)

Academic Staff

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

Academic and Research Staff:
Assoc. Prof. Arjun Amar, PhD (Aberdeen)
Dr Susan Cunningham, PhD (Massey)
Prof. Claire Spottiswoode, PhD (Cambridge)
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. Derek Engelbrecht, PhD (Limpopo) – U. Limpopo
Prof. Andrew McKechnie, PhD (Natal) – U. Pretoria
Dr Pierre Pistorius, PhD (Pretoria) – NMU
Dr Chevonne Reynolds, PhD (Cape Town) – Wits

Honorary Research Associates/Affiliates
Dr Phoebe Barnard, PhD (Uppsala)
Dr Diana Bolopo, PhD (Valladolid)
Dr Rita Covas, PhD (Cape Town)
Prof. Graeme Cumming, PhD (Oxford)
Dr Tom Flower, PhD (Cambridge)
Dr Wendy Foden, PhD (Wits)
Dr David Grémillet, PhD (Kiel)
Dr Azwianewi Makhado, PhD (Cape Town)
Dr Alistair McInnes, PhD (Cape Town)
Dr Megan Murgatroyd, PhD (Cape Town)
Dr Patrick O'Farrell, PhD (Cape Town)
Prof. Steven Redpath (PhD, Leeds)
Assoc. Prof. Mandy Ridley, PhD (Cambridge)
Dr Andrea Santangeli, PhD (Helsinki)
Dr Colleen Seymour, PhD (Cape Town)
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 Robert Flood (PhD, City University, London)
Dr Gabriel Jamie, PhD (Cambridge)
Dr Andrew Jenkins, PhD (Cape Town)
Dr Genevieve Jones, PhD (Cape Town)
Dr Grant Joseph, PhD (Cape Town)
Dr Alan Lee, PhD (Manchester Metropolitan)
Dr Ian Little, PhD (Cape Town)
Dr Kristi Maciejewski, PhD (NMU)
Dr Rowan Martin, PhD (Sheffield)
Dr Martim Melo, PhD (Edinburgh)
Dr Antoni Milewski, PhD (Murdoch)
Michael Mills, MSc (Cape Town)
Prof. Sue Milton, PhD (Cape Town)
Dr René Navarro, PhD (Cape Town) Aug-Dec
Adj. Prof. Lorien Pichegru, PhD (Strasbourg)
Dr Sebataolo Rahlao, PhD (Cape Town)
Dr Yan Ropert-Coudert (PhD, NIPR, Tokyo, Japan)
Dr Jessica Shaw, PhD (Cape Town)
Dr Richard Sherley, PhD (Cape Town)
Dr Antje Steinfurth, PhD (Kiel)
Dr Petra Sumasgutner, PhD (Vienna)

Dr Gareth Tate, PhD (Cape Town)
Dr Jane Turpie, PhD (Cape Town)
Jessie Walton

Post-doctoral fellows

Dr Anina Coetzee, PhD (Stellenbosch)
Dr Pietro D'Amelio, PhD (Munich)
Dr Ben Dilley, PhD (Cape Town), Jan-June
Dr Susan Miller, PhD (TUT)
Dr Chima Nwaogu, PhD (Groningen & St Andrews)
Dr Jessica van der Wal, PhD (St Andrews)

Support Staff

Manager, DSI-NRF CoE

Dr Rob Little, PhD (Cape Town)

Principal Technical Officer

Gonzalo Aguilar

Information System Specialists

Michael Brooks
Dr René Navarro, PhD (Cape Town), Jan -Aug

Administrative Assistants

Hilary Buchanan, BA, HDipLib (Cape Town)
Anthea Links

Senior Secretary, DSI-NRF CoE

Carmen Smith, Jan-Oct

Niven Library

Librarian: Janine Dunlop, MIT (Lib.Sci) (Pretoria)
Assistant librarian: Phelisa Hans

Project Assistants

SABAP2: Sanjo Rose, BSc (Hons) (Cape Town)
SAFRING: Kim-Kelly Hunt, MSc (Cape Town)

Ad hoc Research Assistants

Anna Basson, Cameron Blair, Rion Cuthill, Sally Hofmeyr, Amy Hunter, Danielle Keys, Justin Jacobs, Rebecca Muller, Jelena Reljic, Burghen Siebert, Vincent Ward

Students

Doctoral

Emmanuel Adekola, MSc (Jos)
Timothy Aikins Khan, MPhil (Ghana)
Amanda Bourne, MSc (Cape Town)
Christiaan Brink, MSc (Cape Town)
Daniël Cloete, MSc (Cape Town)
Carla du Toit, BSc (Hons) (Cape Town)
Selena Flores, BSc (San Diego)
Anthony Lowney, MSc (Manchester)
Luke McClean, BSc (Queens)
Kyle-Mark Middleton, BSc (Hons) (Pretoria)
Angela Moreras, MSc (Bielefeld)
Benjamin Murphy. MSc (Exeter)
Carina Nebel, MSc (Vienna)
Olufemi Olubodun, MSc (Ibadan)
Nicholas Pattinson, MSc (NMU)
Vonica Perold, MSc (Pretoria)
Stefan Schoombie, MSc (Cape Town)
Kim Stevens, BSc (Hons) (Cape Town)
Miqkayla Stofberg, BSc (Hons) (Cape Town)

MSc by dissertation

Robin Colyn, MTech (CPUT)
Farisayi Dakwa, BSc (Hons) (NUST)
Monique du Plessis, BSc (Hons) (Stellenbosch)
Campbell Fleming, BSc (Hons) (Cape Town)
Nosipho Gumede, BSc (Hons) (UNISA)
Carrie Hickman, BSc (Hons) (Open University)
David Lloyd-Jones, BSc (Hons) (Canterbury)
Jess Lund, BSc (Hons) (Cape Town)
Alexis Osborne, BSc (Hons) (Cape Town)
Samantha McCarren, BSc (Hons) (Cape Town)
Kailen Padayachee, BTech (TUT)
Abigail Ramudzuli, BSc (Hons) (Limpopo)
Taylyn Risi, BSc (Hons) (Cape Town)
Michelle Vrettos, BSc (Hons) (Cape Town)
Eleanor Weideman, BSc (Hons) (Cape Town)

Masters in Conservation Biology 2020/21

Jessica Burnette, MPub Admin (Texas)
Hannah Edwards, BSc (Melbourne)
Rowan Hickman, BSc (Hons) (Bangor)
Varalika Jain, BSc (Imperial)
Tamar Kendon, BSc (Hons) (Pretoria)
Eliupendo Laltaika, BSc (Mweka)
Merlyn Nkomo, BSc (Hons) (NUST)
Jonathan Plaistowe, BSc (Hons) (Cape Town)
Imithiaz Sheik Abbass, BSc (Hons) (Mauritius)
Debbie Stanbridge, BSc (Hons) (Cape Town)
Tom Thacker, MSc (Otago)
Gemma Walker, BSc (Hons) (Cape Town)
Debbie Walsh, BSc (University College, London)

Masters in Conservation Biology 2019/20

René Brink, BSc (Hons) (Cape Town)
Cecilia Cerrilla, BSc (Brown, USA)
Conor Eastment, BSc (Hons) (Cape Town)
Kathryn Gardner, BSc (Hons) (Stellenbosch)
Jennifer Gedert, BSc (Idaho)
Jack Harper, BSc (Hons) (Liverpool)
Gilson Montrond, BSc (Cape Verde)
Matthew Orolowitz, BSc (Hons) (Stellenbosch)
Kate Sheridan, BSc (Southampton)
Debbie Stanbridge, BSc (Hons) (Cape Town)
Luke Wilson, BSc (Hons) (Cape Town)

BSc Hons

Kyle Maclean, Emily Spencer

Externally registered students

Doctoral:

Cambridge –Tanmay Dixit
Helsinki – Teresa Abaurrea
Montpellier – André Ferreira, Aloïs Robert, Nicolas Silva
NMU – Tegan Carpenter-Kling, Danielle Keys, Katharina Reusch, Zanri Strydom
Porto – Rita Fortuna, Sandra Reis
Pretoria – Shannon Conradie, Marc Freeman, Ryno Kemp, Celiwe Ngcamphalala, Matthew Noakes, Michelle Thompson
Rhodes – Krista Oswald
Strasbourg – Martin Quque
UCT –Edmund Rodseth (MCB), Jessleena Suri (Stats)
Western Australia – Camilla Soravia
Wits – Geethen Singh

MSc/MPhil by dissertation:

Cambridge –Mairenn Collins Attwood
Porto - Barbara Freitas, Lucas Pacheco
Montpellier – Louis Bliard
NMU – Shamiso Banda, Catherine Currin, Lyle de Menezes, Lilli Ruiters, Praxedes Rukuni, Victoria Stockdale
Pretoria – Otto Makola, Barry van Jaarsveld

BSc Hons

Pretoria – Michelle Bouwer, Andries Janse van Vuuren, Liamé Marais

CoE research and education highlights

- Despite the COVID-19 pandemic, work continued on 19 research projects.
- The FIAO CoE supported 23 PhD and 36 MSc students, and eight Post-doctoral Fellows.
- 163 papers were published in peer-reviewed journals, including 65 papers in journals with ISI impact factor ratings ≥3.5.
- 54 popular articles, one book and seven book chapters were published.
- CoE members served on the editorial boards of 30 scientific journals and reviewed 128 papers for 67 peer-reviewed journals.
- Sadly, the NRF has decided to phase out CoE support by the end of 2022.

The Fitz Centre of Excellence (CoE) includes partners at three other South African institutions. The following summary includes students and outputs from all these partners. The 19 research projects during 2020 included one new project: investigating the direct and indirect effects of competition between Cape Fur Seals and seabirds.

The Fitz CoE continued to greatly exceed its publication target with 163 papers published in peer-reviewed journals in 2020, including 65 papers in journals with ISI impact factor ratings ≥3.5 and eight in journals >10. One book, seven chapters in semi-technical books and 54 popular articles were also published.

Dr Susan Cunningham received a UCT College of Fellows Young Teacher Award for 2020 and has been promoted to Senior Lecturer from the beginning of 2021, which is well deserved recognition for her hard work and dedication to research and teaching within the CoE and the broader Biological Sciences Department.

Education and training

During 2020, the Fitz CoE supported 23 PhD and 36 MSc students, of whom 17 (29%) were black and 30 (51%) were women. Eight post-doctoral fellows were registered. The Centre graduated 17 students: five PhD, two MSc by dissertation, and ten MSc Conservation Biology.

Although face-to-face interactions between students was curtailed by the COVID-19 pandemic, the Fitz CoE held a virtual Journal Club most Wednesdays, giving students the opportunity to debate relevant topics. The seminar series also continued online, allowing a much broader audience, and speakers from all over the world.

Collaboration and service rendering

The Fitz CoE continues to collaborate with at least 100 scientific peers and a variety of conservation NGOs and governmental organisations both nationally and internationally. We continue to build much-needed African capacity in the broad arena of biodiversity conservation. Although few visits by research and conservation partners were possible during 2020, exposure to the broader community was greatly enhanced by the proliferation of webinars during the pandemic.

Fitz CoE members served on the editorial boards of 30 scientific journals and as members of 92 membership and advisory fora during 2020. They served the broader scientific community by participating on scientific steering committees and working groups, by reviewing project proposals for science funding agencies, and by reviewing 128 papers for 67 peer-reviewed international and local journals.

Information brokerage

Most conferences scheduled during 2020 were either cancelled or postponed, but some virtual conferences were held. CoE staff and students presented research online at seven international and five local conferences during 2020.

In February, just ahead of the lockdown, Susan Cunningham was invited by the Royal Society of South Africa and The Academy of Science of South Africa to give a talk titled 'The costs of keeping cool: climate change and the future for desert birds'.

BirdLife South Africa's African Bird Fair was held online in September 2020. Peter Ryan gave a talk in the opening ceremony on Africa's rich diversity of birds and 12 students presented talks

in a 90-minute session allocated to the Fitz CoE.

Susan Cunningham and Andrew McKechnie (U. Pretoria) shared their cutting-edge research from the Hot Birds Research Project on why many birds are unlikely to cope with a warmer world during a webinar co-hosted by South African National Parks and the IUCN Climate Change Specialist Group in October 2020.

Eight Fitz CoE students gave oral presentations and two students presented posters at the virtual annual Biological Sciences postgraduate research day in November 2020. Three CoE MSc students, Cecilia Cerrilla, Monique du Plessis and Jess Lund were awarded 1st, 2nd, and 3rd prizes, respectively, for their oral presentations.

The lockdown during most of 2020 meant that added emphasis was placed on distributing research findings through press releases aided by UCT's Communications and Marketing Dept and the Science Faculty and posted on the FIAO website and Facebook page.

Research highlights

Although the pandemic caused havoc with field work schedules, it did provide more time for consolidating and writing up existing research, as well as creating some novel research opportunities. The 163 papers in peer-reviewed journals is a new record, one more than 2019. Peter Ryan led from the front, with 43 papers published in 2020, including 20 on marine plastics, of which he was first author on nine papers.

Highlights included the paper co-authored by Martim Melo in *Nature* confirming that MacArthur and Wilson's Theory of Island Biogeography is robust to the inclusion of evolution in the process of the assembly of island communities.

Claire Spottiswoode's post-doc, Gabriel Jamie, published a gloriously illustrated paper in *Evolution* showing how brood parasitic indigobirds and whydahs mimic the chicks of their host finches visually and vocally. It shows how imprinting and mimicry have promoted sympatric speciation in indigobirds and whydahs.

PhD student Carla du Toit published a paper in *Proceedings of the Royal Society B* showing that the ancestors of the ratites had touch-sensitive receptors in their bills before the demise of the dinosaurs. This helps to explain why ostriches and their allies still have vestiges of these receptors, even though they do not feed by probing.

Peter Ryan and PhD student Vonica Perold co-authored a paper in *Science Advances*, which showed that although man-made fibres are ubiquitous in the world's oceans, more than 90% are natural fibres made from cellulose, wool or silk, not synthetic 'microplastics' as widely assumed.

Winding down the CoE

The Fitz was one of the original six Centres of Excellence established in 2004. The third 5-year cycle of DSI-NRF support came to an end in 2019, but in November 2019 the NRF suggested that funding would continue for another three years. However, a letter outlining the closure of the original six CoEs, including the FIAO CoE, was received in early August 2020. It advised that the annual grant in 2020 would be at 75% of the 2019 grant value, reducing to 50% in 2021, and 25% in 2022, to effect a phase out of the CoEs. Although the 2020 budget was immediately amended, this late announcement of a 25% budget cut did not allow for sufficient time to reduce expenditure. Despite savings arising from the COVID-19 lockdown (mainly through cancelled conference attendance and reduced fieldwork running costs), the amount committed to student bursaries and staff and research assistant salaries was 63% of the 2019 CoE grant. The 75% grant amount was depleted by the end of September 2020, resulting in a deficit by the year end. Fortunately, the University Research Committee (URC) committed direct bailout support of R600 000 so we could start 2021 without a significant deficit. However, support to existing CoE students and their running expenses more or less fully account for the reduced grant allocations in 2021 and 2022, so we foresee no new students or significant research projects through the CoE before direct funding ceases at the end of 2022.

Coevolutionary arms races in brood-parasites and their hosts

Coevolution is the process by which two or more species influence each other's evolution. Brood-parasitic birds, the cheats of the bird world, give us an ideal opportunity to study coevolution in the wild. Coevolutionary "arms races" arise when 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. Three long-term projects address different aspects of this fascinating model system for coevolution.

Robert Thomson's team works in Finland, where their research focuses on how host pairs of Common Redstarts *Phoenicurus phoenicurus* can decrease the chance of a Common Cuckoo *Cuculus canorus* parasitising their nest. Hosts that are able to avoid parasites decrease the fitness costs of parasitism; the earlier that avoidance occurs during the breeding cycle, the lower the cost. Therefore, host adaptations before egg laying would be especially beneficial. The Finnish project investigates the redstart's frontline defences (nest site choice, habitat selection, nest building decisions) and the cuckoo's counter-adaptations (prospecting and laying strategies), which have received little attention to date. Redstarts are the only regular cuckoo host that breeds in cavities, which makes it difficult for female cuckoos to lay eggs and for their newly-hatched chicks to evict host eggs/chicks.

Claire Spottiswoode's team works in Zambia on three questions. First, how do interactions between species generate diversity among individuals? Specifically, how do 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 maintained? The genetic basis of signature-forgery arms races is almost entirely unknown. In collaboration with Michael Sorenson, 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 (e.g. Cuckoo Finches *Anomalospiza imberbis* and Greater Honeyguides *Indicator indicator*) in the absence of parasite speciation. We are also interested in the genetic basis of host defences, and whether convergent genetic mechanisms have evolved in their parasitic mimics. Third, what is the role of phenotypic plasticity (such as developmental differences and learning) in coevolution, and how might such plasticity facilitate exploitation of new host species in the absence of appropriate genetic adaptations? We are addressing this question for indigobirds, whydahs and honeyguides.

The cover of *Evolution* 74(11), featuring research on indigobird and whydah mimicry of their hosts by Gabriel Jamie, *et al*.

Fitz Research Associate Jessie Walton has been studying Brown-backed Honeybirds *Prodotiscus regulus*, which parasitise Karoo Prinias *Prinia maculosa* at a high rate in the Bot River area of the Western Cape. The remarkable adaptation that we are investigating is their blue eggs, highly unusual in piciform birds, that broadly mimic those of their hosts. Moreover, up to three honeybird chicks are raised in the same host nest, despite

killing host young with their bill hooks. How honeybirds escape being killed by their nestmates remains an intriguing mystery.

Activities in 2020

- The field season in Finland had to be abandoned due to COVID-19 travel restrictions; even the project's in-country collaborators were unable to visit the field site. Existing long-term project datasets were used by Angela Moreras and new PhD student Teresa Abaurrea during the year to explore potential interspecific protection against cuckoo parasitism and cuckoo host choice.
- In Zambia, we were able to carry out two-thirds of a productive rainy season before the COVID-lockdowns forced our team to hurry home. Tanmay Dixit carried out further egg rejection experiments on Cuckoo Finch hosts towards his PhD, and helped facilitate Stephanie McClelland, a visiting student from Royal Holloway (U. London), working on embryonic physiology of brood-parasitic birds.
- Post-doc Gabriel Jamie completed sampling to construct a high-quality genome of one of our main Zambian study species, the Tawny-flanked Prinia *Prinia subflava*, to enable an understanding of the genetic basis of its remarkable egg 'signatures' that have evolved as defences against brood parasitism.
- Unfortunately, dry season fieldwork in Zambia was impossible, but Jess Lund (honeyguides and their hosts) and Mairenn Collins Attwood (Fork-tailed Drongos *Dicrurus adsimilis* and African Cuckoos *Cuculus gularis*) look forward to returning in 2021 to begin their PhD fieldwork.
- During much of 2020 the research team focussed on data analysis and writing, drafting several manuscripts and preparing conference presentations.

Highlights

- Luke McClean (UCT) graduated with his PhD entitled "Coevolution between brood-parasitic honeyguides and their hosts", which included five chapters that he is now preparing for publication.
- Mairenn Attwood (Cambridge) graduated with her MPhil entitled "Angry birds: does it pay a cuckoo to parasitise a highly aggressive host?" which included three chapters that she is now preparing for publication.
- Masters students Jess Lund (UCT) and Mairenn Attwood (Cambridge) were each awarded PhD scholarships at the University of Cambridge, and will both continue their research on brood parasites and their hosts in Zambia during their PhDs from 2021.
- Gabriel Jamie, Claire Spottiswoode, Silky Hamama, Collins Moya and collaborators published a paper in *Evolution* showing how indigobirds and whydahs mimic the chicks of their specialist host species visually, vocally and with respect to their begging movements. This sheds light on how imprinting and mimicry have promoted sympatric speciation in indigobirds and whydahs. The research featured on the journal's cover.
- Gabriel Jamie published a review paper with Joana Meier in *Trends in Ecology and Evolution* exploring the phenomenon that the same polymorphisms often recur in many members of a species radiation. The paper was chosen as the editor's "Pick of the Month" and featured on the journal cover.
- CB MSc student Rowan Hickman collaborated with chief field assistant Collins Moya to identify all the bird calls on her sound recordings from northern Zambia as part of her research project on the effect of mining on miombo birds.
- We launched our revamped project website at www.AfricanCuckoos.com.

Key co-supporters

Biotechnology and Biological Sciences Research Council; The Leverhulme Trust; Societas pro Fauna et Flora Fennica; Finnish Cultural Foundation.

Research team 2020

Prof. Claire Spottiswoode (FIAO, UCT / U. Cambridge)
Dr Robert Thomson (FIAO, UCT)
Dr Gabriel Jamie (U. Cambridge)
Prof. Michael Sorenson (Boston University)
Dr Rose Thorogood (U. Helsinki, Finland)
Dr Jere Tolvanen (U. Oulu, Finland)
Jessie Walton (FIAO, UCT)

Students: Teresa Abaurrea (PhD, U. Helsinki); Tanmay Dixit (PhD, Cambridge); Luke McClean (PhD, UCT); Angela Moreras (PhD, UCT); Mairenn Attwood (MPhil, Cambridge); Jess Lund (MSc, UCT); Rowan Hickman (CB MSc, UCT).

Research assistants:
Zambia: Silky Hamama, Lazaro Hamusikili, Oliver Kashembe, Kiverness Moono, Collins Moya, Gift Muchimba, Sylvester Munk`onko, Sanigo Mwanza, Calisto Shankwasiya and many others.

The evolution, ecology and conservation of honeyguide-human mutualism

This project focuses on a unique mutualism: the foraging partnership between Greater Honeyguides *Indicator indicator* and human honey-hunters whom they guide 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 nests using axes. By working together, the two species can overcome the bees' defences, with benefits to both. Remarkably, this relationship has evolved through natural selection, rather than through training or domestication. The honeyguide-human system provides a wonderful opportunity to study the ecology and evolution of mutualisms in nature, because human and honeyguide populations vary strikingly in how they interact, and we can readily manipulate these interactions.

Together with her team at the Fitz and the University of Cambridge, Claire Spottiswoode has been studying human-honeyguide interactions in the Niassa National Reserve of northern Mozambique since 2013, collaborating with the honey-hunting community of Mbamba village, and receiving crucial support from the Mariri Environmental Centre led by Dr Colleen and Keith Begg of the Niassa Carnivore Project. A key focus to date 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. The Yao honey-hunters of northern Mozambique give a loud trill followed by a grunt: "brrrr-hm!". A 2016 experiment showed that honeyguides were twice as likely to initiate a cooperative interaction with humans who made this sound compared to humans giving control sounds, and three times as likely to lead such humans to honey. So honeyguides use these specialised signals to choose partners who are likely to be good collaborators.

Supported by a Consolidator Grant from the European Research Council, we now ask whether learning is involved in maintaining a geographical mosaic of honeyguide adaptation to local human cultures; how such reciprocal communication between humans and honeyguides mediates their interactions; what the effects of cultural co-extinctions may be on each partner and their ecosystems; and ultimately, how quickly such cultures can be re-ignited following their loss. In so doing we hope to test 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 varies in space and time, and to predict how they will respond to a rapidly changing world.

Our project, known as 'Projecto Sego' (sego is greater honeyguide in the Yao language), has the support of the community and traditional chiefs of the Mbamba and Nkuti Villages. We depend on the local community to collect data and assist with our field sampling and experiments.

Activities in 2020

- While COVID-19 meant that the UCT/Cambridge research team were unable to travel to Mozambique for fieldwork, our team of 20 honey-hunters continued to collect excellent data on their interactions with honeyguides throughout 2020.
- CB MSc student Eliupendo Alaitetei Laltaika carried out a very successful 3-month period of data collection in northern Tanzania for his CB project.
- We launched our citizen science project, Honeyguiding.me, managed by post-doc Jessica van der Wal, welcoming all records of Greater Honeyguides from anywhere in Africa. These will enable us to map the current extent of guiding behaviour, to track it over time, and help to shed light on how honeyguides acquire their ability to engage with humans.
- In early March, just before the COVID lockdown, we met in Cape Town for a 'sego summit' to plan our next research steps. The workshop

Chima Nwaogu holds a Greater Honeyguide at Honeywood Farm near Grootvadersbosch Forest (Photo: Claire Spottiswoode).

happened during the week of the Fitz AGM, when Jessica, David Lloyd-Jones and Dominic Cram all shared their work with UCT colleagues.

- The research team spent most of 2020 focussed primarily on data analysis and writing, drafting several manuscripts and preparing conference presentations.

Highlights

- Eliupendo Alaitetei Laltaika explored the honey-hunting culture of four coexisting human cultural groups in the Ngorongoro region who all rely heavily on honey: the Maasai, Ndorobo, Hazdabe and Sonjo people.
- In addition to our new citizen science project www.Honeyguiding.me, we launched our project website www.AfricanHoneyguides.com and have a social media presence @honeyguiding on Twitter, Facebook and Instagram.
- Post-docs Jessica van der Wal and Dominic Cram presented their research findings at the Study of Animal Behaviour Virtual Winter Meeting.
- Claire and Jessica, together with Fitz colleagues Chima Nwaogu and Gabriel Jamie, carried out pilot fieldwork at Honeywood Farm near Grootvadersbosch Forest in the Western Cape, South Africa. It was thrilling to see and to capture so many honeyguides so close to our home base.

Impact of the project

This project involves rural communities in understanding a unique human-animal relationship. We hope to further our understanding of how mutualisms evolve, and specifically how learnt traits mediating mutualisms may coevolve. Understanding the evolution of mutualisms sheds light on the mechanisms that can maintain cooperation among unrelated individuals. It is also important for effective conservation because mutualisms can have a wide reach in ecological communities. The honeyguide-human mutualism has disappeared from large parts of Africa, as the continent develops. It would be a tragedy if it vanished altogether before we fully understood this part of our own evolutionary history.

Claire Spottiswoode showing a honeyguide to Honeywood farm workers (Photo: Izidine Pinto).

Key co-supporters

European Research Council; National Geographic Society; Max Planck Institute for Evolutionary Anthropology; DSI-NRF CoE grant; British Ecological Society; Association for the Study of Animal Behaviour; American Ornithological Society.

Research team 2020

Prof. Claire Spottiswoode (FIAO, UCT / U. Cambridge)
Dr Jessica van der Wal (FIAO, UCT)
Dr Dominic Cram (U. Cambridge)
Dr Brian Wood (U. California, Los Angeles)
Prof. Timm Hoffman (Biological Sciences, UCT)
Dr Colleen Begg (Niassa Carnivore Project)
Keith Begg (Niassa Carnivore Project)

Students: David Lloyd-Jones (MSc, UCT); Eliupendo Alaitetei Laltaika (CB MSc, UCT).

Research Assistants: Musaji Muemede, Carvalho Issa Nanguar, Iahaia Buanachique, and Seliano Alberto Rucunua, with data collection by many others.

Cooperation and population dynamics in the Sociable Weaver

The elaborate social system and cooperative behaviour of Sociable Weavers *Philetairus socius* make this Kalahari endemic bird an ideal species to study the costs and benefits of cooperation. This long-term project started by focusing on cooperative breeding but is now starting to focus on other cooperative behaviours, such as nest building and vigilance against predators. In addition, the long-term data gathered is used to obtain a better understanding of how environmental changes influence basic demographic parameters, such as reproductive output and survival, and how this may ultimately influence population trends.

Understanding how cooperation evolved and is maintained is a challenging question in evolutionary biology because natural selection is thought to favour selfish individuals over co-operators. However, cooperation is widespread in nature. One of the key evolutionary forces favouring cooperative behaviour is thought to be kin selection, where individuals help close kin. However, theory and studies in humans also suggest that co-operators are preferred as social and sexual partners. Partner choice may therefore provide an additional explanation for the evolution and stability of cooperation, but we lack an understanding of its importance in natural systems. This is now an important focus of the Sociable Weaver project, led by Rita Covas and Claire Doutrelant.

Recent grants from the European Research Council (ERC) and French Research Agency (ANR) will allow us to focus on this topic over the next five years. With this sustained funding, we will also be able to continue our long-term research into how environmental changes influence population dynamics, and whether and how sociality may buffer against the negative effects of adverse conditions, such as heatwaves or prolonged droughts which are expected to increase under the current global climate crisis.

Activities in 2020

- The COVID-19 pandemic had an important impact on our field activities and overall productivity. Most field team members had to leave the study area before the end of March, when the Sociable Weavers were still breeding. We were fortunate to have the help of previous field manager Michelle Schroeder, who was able to continue the basic monitoring of reproduction until the end of the breeding season in June. However, some long-term behavioural data could not be collected.
- With the travel restrictions still in place, we were not able to conduct our annual captures of the study population at the end of winter (before the start of the breeding season), which has consequences for data continuity. We also had to postpone all the experiments and additional data collection that was planned for the 2020/21 breeding season.
- Field work resumed at the end of September with a small team from South Africa and Lesotho. Two new students joined the project: MSc student Lucas Pacheco (CIBIO, University of Porto, Portugal) started a project on roosting association, and PhD student Nicolas Silva (CNRS and U. Montpellier, France) is working on cooperative nest building behaviour.
- In spite of the travel restrictions, data analyses and writing up of manuscripts continued and four manuscripts were produced. These focused on methodological developments, maternal effects and potential physiological benefits of having helpers at the nest. All team members were also involved in online conferences and seminars, remaining engaged with the international research community. We continued to have weekly meetings (which became fully online), where all group members shared their work progress. These meetings provided opportunities to discuss problems or questions in spite of lockdown or travel restrictions.

Highlights:

- Two new grants started during 2020: Rita Covas received an ERC grant from the European Union

The Sociable Weaver project monitors each breeding attempt in detail and nests are recorded to identify all the individuals assisting to raise the young (Photo: Alexandre Vaz).

to study the role of partner choice on the evolution of cooperation and Claire Doutrelant received a French National Research Agency grant to study the role of sexual and social selection in the evolution of nest building in Sociable Weavers.

- Post-doc Pietro D'Amelio was awarded a Marie Curie fellowship to work on the role of social behaviour in mate choice.
- André Ferreira (CNRS, U. Montpellier) led a paper published in *Methods in Ecology and Evolution* describing a new method that uses artificial intelligence to identify small birds based on individual feather patterns. This study has received a great deal of attention from the international media (e.g. articles in *Science*, *The Guardian, New Scientist* and many others).
- Another paper with André as the leading author focused on the collection of social association data and was published in *Ecology and Evolution*.
- Rita Fortuna (CIBIO, U. Porto) had her first PhD paper accepted in the *Journal of Animal Ecology*. Her paper used long-term data to investigate maternal allocation in relation to weather, predation and social factors in Sociable Weavers. Rita also presented this work at the online Long-Term Animal Research Seminar Series hosted by Duke University, USA.

Impact of the project

The long-term nature of this project allows unique insights into the evolution of cooperation and the mechanisms that allow it to persist. The demographic data allow for examination of the factors affecting population dynamics in relation to environmental change.

Key co-supporters

European Research Council (ERC), French Research Agency (ANR); DSI-NRF CoE grant; Portuguese Foundation for Science and Technology (FCT).

Research team 2020

Dr Rita Covas (FIAO, UCT and CIBIO, U. Porto)
Dr Claire Doutrelant (FIAO, UCT and CNRS, France)
Dr Fanny Rybak (U. Paris-Sud, France)
Dr Pietro D'Amelio (FIAO)
Dr Julien Renoult (CEFE-CNRS, France)
Dr Damien Farine (Max Planck Institute, Germany)

Students: André Ferreira (PhD, Montpellier); Rita Fortuna (PhD, Porto); Martin Quque (PhD, Strasbourg); Nicolas Silva (PhD, Montpellier); Lucas Pacheco (MSc, Porto).

Research Assistants: Franck Théron, Liliana Silva, Corisande Abiven, Louis Bliard, Annie Basson, Michelle Schroeder, Shobana Makhubu, Richard Wilks, Bronwyn Dunlop, Stuart Dunlop.

Pied Babblers and Fork-tailed Drongos

Since 2003, Amanda Ridley has maintained a long-term study of habituated Southern Pied Babblers *Turdoides bicolor*, on the Kuruman River Reserve in the southern Kalahari Desert. Together with her collaborators, Amanda's work explores the evolutionary ecology of Pied Babblers providing unique insight into conflict and cooperation in societies, life-history strategies and mating systems. In 2006, Amanda began investigating community interactions between Fork-tailed Drongos *Dicrurus adsimilis*, babblers and other species. Tom Flower joined and greatly expanded the drongo research in 2008, establishing the Drongo Project to study the drongos' use of false alarm calls to steal food from other animals. Recently, Amanda and Tom have collaborated with Susie Cunningham and Claire Spottiswoode to explore how increasing temperatures will affect the demography of these species in marginal desert environments.

The causes of conflict and cooperation in group-living societies

The Pied Babbler research project investigates the costs and benefits of cooperation in this group-living species. Long-term life history data, along with short-term observations and experiments, have helped us understand the causes and consequences of cooperative breeding behaviour. Group sizes vary according to weather conditions, with the population decreasing when breeding seasons are hot and dry, and during very cold winters.

The range of questions that can be asked increases as the duration of the study grows, and we can now assess life-time fitness. PhD student Amanda Bourne, who graduated in 2020, used the long-term database to understand the impact of heatwaves and drought on survival and reproductive success. We are also investigating the impact of heat on cognitive ability, because cognition is vital to an individual's ability to behaviourally respond to changes in their environment. PhD student Camilla Soravia is studying the ontogeny of cognition and the relationship between cognition and sociality.

How interactions between species shape animal behaviour

The Fork-tailed Drongo project explores how interactions with other species can shape the evolution of behaviour. Over 40 pairs of individually colour-banded drongos have been habituated. Current research considers the cognitive mechanisms that enable drongos to produce false alarm calls and adjust the calls they use depending on feedback from the target species. Since 2014, we also have studied the impact of climate change on bird persistence in hot desert environments through impacts on foraging behaviour and offspring provisioning. PhD student Ben Murphy is studying how drongos adjust their behaviour to reduce the impact of high temperatures on reproductive success, including through offspring shading, foraging tactics and crepuscular/nocturnal activity. Such behavioural changes may compensate for the costs of missed opportunities when temperatures are high, enabling drongos to adapt to climate change. However, it remains to be determined whether the behavioural adjustments are sufficient to enable drongos to persist in their current range.

Activities in 2020

- Amanda Bourne obtained a PhD for her thesis "Can sociality buffer the impacts of climate change on a cooperatively-breeding bird, the Southern Pied Babbler *Turdoides bicolor*?"
- PhD student Camilla Soravia completed her second field season on the relationship between heat stress and cognitive performance, testing the hypothesis that increased heat stress leads to cognitive impairment, and hence a limited ability to respond to stimuli in their surrounding environment. COVID-19 put her fieldwork on hold for the 2020/21 field season.

Southern Pied Babblers are social cooperative breeders, but research completed by PhD student Amanda Bourne in 2020 shows that the presence of helpers does not buffer these birds against negative effects of drought and high temperatures (Photo: Nicholas Pattinson).

- PhD student Ben Murphy completed his second and third field seasons and is presently collating his data.
- BTech student Lesedi Moagi, working with Amanda Bourne, Andrew McKechnie, Ray Jansen (TUT) and Andre Ganswindt (U. Pretoria), completed the labwork and analyses for her project on faecal corticosterone metabolites (fGCMs) in babblers, showing that these increase at maximum daily temperatures above 38°C, but return to baseline levels the following day, suggesting that hot days represent acute stressors for these birds.

Highlights:

- Three papers on Pied Babblers were published by PhD student Amanda Bourne in 2020. A paper in the *Proceedings of the Royal Society B* documented the impacts of high temperatures on breeding success; one in *Ecology Letters* assessed interannual survival, and another in *Frontiers in Ecology and Evolution* reported compensatory breeding following drought. Taken together, they show that environmental effects are generally stronger than social effects in determining survival and breeding success and that helpers provided limited buffering on survival and productivity under harsh conditions.
- Pied Babbler and Fork-tailed Drongo research was presented at several national and international online conferences, including the Virtual Bird Fair run by BirdLife South Africa, and the online BOU conference BOUSci20: Climate change and birds: solutions to the crisis.

For more details on the collaborative work between the Pied Babbler and Fork-tailed Drongo Projects and the Hot Birds Research Project, see page 45.

Key co-supporters

DSI-NRF CoE grant; Australian Research Council

Research team 2020

A/Prof. Amanda Ridley (FIAO, UCT / UWA)
Dr Thomas Flower (FIAO, UCT / Capilano University)
Dr Martha Nelson-Flower (U. British Columbia)
Dr Susie Cunningham (FIAO, UCT)
Prof. Claire Spottiswoode (FIAO, UCT / U. Cambridge)
Prof. Andrew McKechnie (UP)

Students: Amanda Bourne (PhD, UCT); Ben Murphy (PhD, UCT); Camilla Soravia (PhD, UWA); Lesedi Moagi (BTech, TUT).

Research Assistants: Grace Blackburn, Lena Pina Ramirez, Justin Jacobs.

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.

Pygmy Falcons *Polihierax semitorquatus* are the most controversial user of the weaver colonies. They never construct their own nests, depending entirely on weaver colonies, which is a unique obligate nesting association. Pygmy Falcons also, albeit rarely, prey on weaver nestlings and even adults, suggesting a semi-parasitic relationship between the species. We aim to describe the natural history and ecology of Pygmy Falcons, and to characterize their interactions with Sociable Weavers; do falcons provide benefits to weavers or are they vertebrate parasites?

Sociable Weavers forage on plants and insects across the landscape and bring material back to their nest trees in the form of faeces, feathers and carcasses. This nutrient input at weaver nests results in these sites being islands of fertility in the landscape. We study how this alters the soil chemistry, as well as soil nematode and plant communities.

A Pygmy Falcon female mobs Olufemi as he checks the status of the falcon's nest (Photo: Anthony Lowney).

Activities in 2020

- Despite the COVID-19 challenges, PhD students Olufemi Olubodun and Timothy Aikins Khan completed their field seasons. Timothy is investigating the costs and benefits to Camelthorn *Vachellia erioloba* and Shepherd's *Boscia albitrunca* trees from hosting Sociable Weaver nests and collected most of the field data for soil and plant analyses. Olufemi is investigating various aspects of the life history of Pygmy Falcons and monitored the breeding success and group composition of the falcon population.
- This was the 10th field season at Tswalu Kalahari Reserve. Good summer rains finally fell on the study site resulting in an excellent Sociable Weaver and Pygmy Falcon breeding season. The boom year saw us ringing 65 fledging falcon chicks to date, despite the frequent presence of Boomslangs and Cape Cobras at nests, with second falcon broods still to be ringed.
- Olufemi and Anthony Lowney obtained the first detailed GPS tracking data from Pygmy Falcon pairs, to investigate territoriality and the workload of helpers.
- Data collection towards the Kalahari Endangered Ecosystem Project (KEEP), a

On the red Tswalu Kalahari dune, Sociable Weaver nests occasionally occur in *Terminalia* spp. trees. Here Olufemi is checking the location position of the Pygmy Falcon nest chamber (Photo: Anthony Lowney).

collaboration with WITS, UP, UNISA and UWC researchers, continued. These long-term data will contribute to identifying the impacts of climate change on the Kalahari ecosystem.

- Timothy and Olufemi presented talks highlighting their initial results at the Department of Biological Sciences research day.

Highlights:

- Anthony Lowney was awarded his PhD for his thesis "Sociable weaver nests as a resource to local animal communities". Anthony is the first PhD student to graduate from this project. He first helped on the project in 2013 and 2014, before starting his thesis in late 2015.
- 2020 was a productive year, with four articles published in international journals:
  1. Lowney et al. in *Behavioral Ecology* showed how Kalahari Tree Skinks *Trachylepis spilogaster* eavesdrop on Sociable Weavers to manage predation by Pygmy Falcons and expand their realized niche.
  2. Jess Lund's Honours project investigating winter thermoregulation in free-ranging Pygmy Falcons in the Kalahari Desert was published in the *Journal of Ornithology*.
  3. Honours projects by Kervin Prayag and Carla du Toit were combined into a paper in *Ecology and Evolution* on faunal input at host plants, showing how Camelthorn Trees use nutrients imported by Sociable Weavers.
  4. Lowney et al. in *Frontiers in Ecology and Evolution* used temperature data-loggers to show that the large communal nests of Sociable Weavers provide a year-round insulated refuge for weavers and Pygmy Falcons.
- Timothy Aikins Khan and others contributed a FitzNews piece in *African Birdlife* magazine highlighting the potential costs and benefits of Sociable Weaver nests to their host's trees.

Impact of the project

This project provides unique insights into the community ecology and between-species interactions in the Kalahari. It highlights fascinating natural history stories and brings attention to this unique system. We quantify the ecological engineering role of the Sociable Weaver and determine the potential role of Sociable Weaver nests in a warming and increasingly arid Kalahari. The outputs of this project also contribute to eco-tourism information that enhances the experience of visitors to landscapes within the distribution of the Sociable Weaver.

Key co-supporters

DSI-NRF CoE grant; Tswalu Foundation; University of Cape Town launching grant, Suzuki South Africa.

Research team 2020

Dr Robert Thomson (FIAO, UCT)
Dr Diana Bolopo (FIAO, UCT)
Prof. Michael Cramer (Biological Sciences, UCT)
Prof. Andrew McKechnie (U. Pretoria)
Dr Mariette Marais (ARC – Plant Protection Research Institute, Pretoria)
Dr Bryan Maritz (UWC)
KEEP team (led by Prof. Andrea Fuller, and Prof Graham Alexander, both WITS)

Students: Timothy Aikins Khan (PhD, UCT); Anthony Lowney (PhD, UCT); Olufemi Olubodun (PhD, UCT).

Understanding colour polymorphism in birds

Many species show a variety of different phenotypes. How such diversity is maintained is one of the main questions in evolutionary biology. Colour polymorphism represents an ideal system to explore these issues because the different phenotypes represent their genotypes. Researchers have long been fascinated by colour polymorphism 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. Colour polymorphism occurs in around 3.5% of bird species but is more common in raptors and particularly within *Accipiter* hawks where about 25% of species are polymorphic.

Colour morphs influence the performance and fitness of individuals through direct effects of pigment production (e.g. camouflage or thermoregulation) and indirect effects (e.g. physiological and behavioural traits). Hence, it is unlikely that different morphs are distributed randomly in the environment. Our focus species is the Black Sparrowhawk *Accipiter melanoleucus*, which occurs as either a dark or a light adult morph. The morph distribution across South Africa follows a cline associated with rainfall seasonality and the intensity of solar radiation, with a far higher proportion of dark morphs in the Western Cape than the rest of the country. Our research has shown that provisioning rates differ depending on ambient light levels, with dark morphs providing more food to chicks in duller light conditions than light morphs, possibly due to improved background crypsis. Thus, when the two morphs breed together in a 'mixed' pair, they might complement each other by expanding the conditions (daylight hour, prey or habitat types) in which parents can forage successfully.

The idea that pairs consisting of the two morphs complement each other is termed the complementarity hypothesis. Support for this hypothesis comes from prey provisioning behaviour. Nest camera data shows that mixed-morph pairs provide food more consistently to the nest than like-morph pairs. This indicates that the two morphs forage under different ambient light levels and are expanding their foraging niche as a pair. This research, which forms part of Carina Nebel's PhD thesis, was published this year in *Behavioral Ecology*.

Another aspect of Carina's PhD has been to extend our understanding of this system through population modelling. Working with Dylan Childs from the University of Sheffield, through a grant from The Royal Society, Carina has developed an Individual-Based Model (IBM) to better understand the different components of the system, and to explore whether the complementarity hypothesis could operate to maintain the stable polymorphism seen in our study population.

Additional research has focused on the genetics behind plumage polymorphism. In many vertebrates discrete colour polymorphisms have been linked to the *MC1R* gene, which is involved in the regulation of melanin production. However, we have established that this is not the case for Black Sparrowhawks, and several other potential candidate genes also have been excluded. The differences in melanin production between the two morphs appears to be associated with different regulation of key genes involved in melanin production. Interestingly, variation in phaeomelanic plumage in juveniles appears to be regulated by expression differences in the same genes. We are now testing for differences in telomere dynamics between the two adult morphs to determine if there are any pleiotropic effects of morph. We also quantified haemosporidian blood parasite prevalence and intensity from blood samples using qPCR, to supplement previous data based on microscopy screening of blood slides.

Activities in 2020

- The COVID-19 pandemic made it difficult to conduct fieldwork in 2020, but we managed to ring 30 Black Sparrowhawk nestlings from 15 nests. Ringing nestlings is an integral part of the long-term monitoring and research of this population.

A dark morph black sparrowhawk. This female was ringed in 2013 as a nestling and recruited to the breeding population in 2017. Through its unique colour ring combination, we can identify an individual's age and place of birth and follow its breeding success (Photo: Carina Nebel).

- PhD student Carina Nebel visited the University of Sheffield in January, funded by a Royal Society International Exchange grant, to construct an Individual-Based Model with Dylan Childs. This model will allow us to identify the driving mechanisms of colour polymorphism maintenance in the Black Sparrowhawk.
- Carina finalised her thesis. One manuscript, exploring whether immune function differs between nestlings of mixed- and like-morph pairs is currently under review, and another, focussing on morph inheritance, is ready to be submitted.
- Post-doc Chima Nwaogu analysed the influence of weather conditions on timing of egg-laying and breeding success on Black Sparrowhawk morphs. His results show that interactions between sex, timing of breeding and rainfall may underlie the maintenance of colour polymorphism and the increasing frequency of light morph Black Sparrowhawks in Cape Town.

Highlights

- Carina Nebel published her second PhD chapter in *Behavioral Ecology* in which she showed that Black Sparrowhawk parents breeding as a mixed-morph pair provide food more consistently to their nestlings than parents breeding as a like-morph pair. This supports the complementarity hypothesis, which posits that parents of different morphs can expand their temporal foraging niche, and could explain the higher reproductive success of mixed-morph pairs and higher fitness of their offspring.
- Former Honours student Samantha McCarren published her findings on the blood parasite *Haemoproteus nisi* infections in Black Sparrowhawks in the *Journal of Ornithology*. She related infection intensity to breeding performance and fitness, and found that blood parasites are not associated with selective pressure in the species.

Impact of the project

This project adds to our understanding of the maintenance of genetic diversity in populations. It provides the first empirical evidence for the light level hypothesis for the maintenance of colour polymorphism in birds that is now experimentally tested.

Key co-supporters

DSI-NRF CoE grant, UCT Visiting Scholars Fund, Royal Society International Exchange Grant.

Research team 2020

A/Prof. Arjun Amar (FIAO, UCT)
Dr Chima Nwaogu (FIAO, UCT)
Dr Rob Ingle (MCB, UCT)
Dr Petra Sumasgutner (FIAO, UCT/U.Vienna)
Dr Dylan Childs (University of Sheffield)
Dr Arne Hegemann (MEEL, Lund University)
Dr Gareth Tate (EWT)
Dr Jacqui Bishop (Biological Sciences, UCT)
Dr Chevonne Reynolds (Wits)
Dr Chris Briggs (Hamilton College, USA)

Students: Carina Nebel (PhD, UCT); Edmund Rodseth (PhD, MCB, UCT).

Research Assistants: Rebecca Muller, Burghen Siebert.

Volunteers: Ann Koeslag, Marlene Hofmeyr, Paddy Walker, Margaret MacIver, Antje and Bernard Madden.

Bird pollination in the Cape Floristic Region

Do anthropogenic effects change the ecosystem services provided by nectarivorous birds? The Cape Floristic Region hosts over 300 plant species that depend on only eight species of nectar-specialist sunbirds and sugarbirds. This unusually asymmetrical mutualism provides an ideal system to investigate the pivotal role that pollinators play in the evolution and conservation of plants. This project investigates how sunbirds influence flower colour evolution in bird-pollinated ericas, and how supplementary feeding along the urban fringe and ongoing habitat fragmentation are threatening these processes in many parts of the Cape Floristic Region.

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 colour morphs yet are pollinated predominantly by just one bird species, the Orange-breasted Sunbird *Anthobaphes violacea*. Post-doc Anina Coetzee and MSc student Samantha McCarren are investigating the origin and maintenance of these flower colour polymorphisms. Specifically, they are asking what role plant community context and sunbird foraging behaviour play in generating intra-specific flower colour diversity.

African nectarivorous birds are thought to be able to detect ultra-violet (UV) reflectance. Thus, UV colouration might be used by bird-pollinated flowers to increase visibility for their pollinators. However, nectar-robbing insects might also use this channel for foraging decisions and consequently there may be selection against UV signals. Samantha McCarren is quantifying UV reflectance in bird-pollinated flowers in the Cape Floristic Region, and using choice experiments to test whether sunbirds or insects exhibit a preference for certain flowers based on their UV reflectance.

PhD student Daniël Cloete is working in and around the Tsitsikamma section of the Garden Route National Park to assess how habitat fragmentation affects the fitness of bird-pollinated plants. Daniël is testing 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 Cape Sugarbirds *Promerops cafer* of *Protea* and *Erica* species across 17 fynbos patches, both natural and fragmented. This is a good area to address this question because it naturally comprises a mosaic of forest, fynbos and coastal thicket, further fragmented by agriculture, plantations, alien infestations, 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 might affect ecosystem function and services in the Cape Floristic Region.

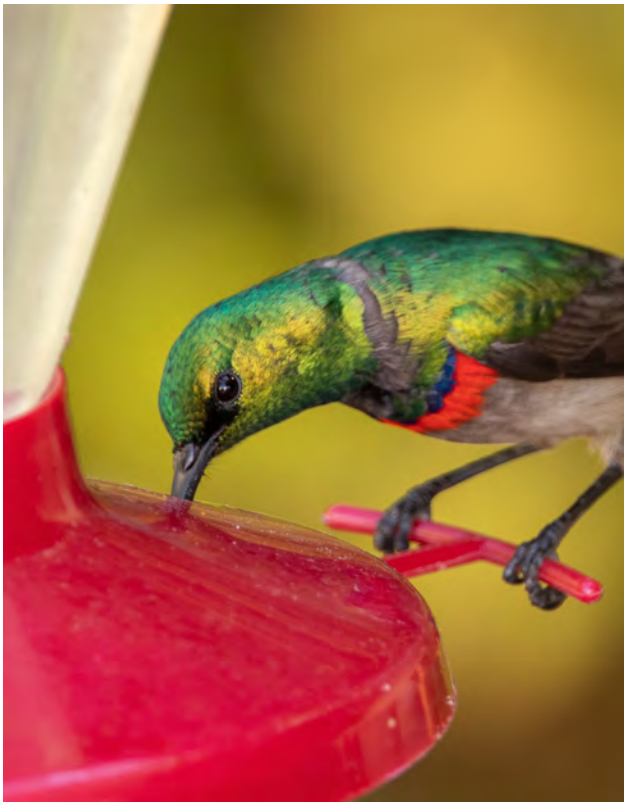
At the border between urban and natural fragments, supplementary feeding of nectar-feeding birds, which is increasing in popularity, may impact sunbird-plant mutualisms. MSc student Monique du Plessis is assessing the effect of feeders on sunbirds and bird-pollinated *Erica* species. By taking advantage of the tell-tale sign left when sunbirds probe *Erica* flowers, she is able to assess flower visitation rates at varying distances from nectar feeders in gardens bordering natural areas.

Activities in 2020

- Post-doc Anina Coetzee started experiments to test the role of sunbird foraging behaviour in flower colour evolution. She also tested whether flower colour can serve as a nectar robber avoidance mechanism.
- MSc student Samantha McCarren completed data collection and analysis on flower reflectance of a diversity of ericas, and choice experiments on sunbirds and insects to test their flower colour preferences. Her preliminary analyses suggest that UV colouration is absent or rare in ericas pollinated by short-proboscid insects, rodents, or wind. It occurs in some bird-pollinated ericas, but sunbirds do not show a preference for UV colouration. However, when presented with

different rewards they can learn to discriminate flowers based on their UV reflection. Ericas that are pollinated by long-proboscid flies show bright UV colouration, and these flies exhibit a strong preference for flowers with UV colouration.

- Monique du Plessis completed her field experiments for her MSc, conducting bird surveys in gardens and their bordering fynbos veld. She alternated presence and absence of feeders between the gardens, comparing bird abundance at sites with and without feeders, to test whether feeders attract nectarivorous birds away from the natural veld. She also measured *Erica* visitation rates in the bordering fynbos. By collecting visitation rate data at varying distances from gardens she was able to test whether the presence of feeders affects bird visitation pattern, potentially decreasing *Erica* pollination.
- PhD student Daniël Cloete's analyses show that the fynbos specialist endemics, Cape Sugarbird and Orange-breasted Sunbird, are both negatively affected by habitat fragmentation. Their numbers are much reduced in smaller fynbos patches. By contrast, more generalist species such as the Southern *Cinnyris chalybeus* and Greater Double-collared Sunbirds *C. afer*, and Amethyst Sunbirds *Chalcomitra amethystina* are more common in small fragments, and may even benefit because of their flexibility to use resources from the surrounding non-fynbos matrix.



Southern Double-collared Sunbird drinking at an artificial nectar feeder (Photo: Monique du Plessis).

Highlights

- Anina was awarded the Smuts Memorial Botanical Post-doctoral Fellowship and accepted a teaching position at Nelson Mandela University from 2021.
- Anina published results on reproductive isolation barriers in bird-pollinated ericas, as well as on the interdependence between nectarivorous birds and their associated Proteaceae species.
- Monique submitted her MSc dissertation.
- Samantha successfully applied to upgrade her MSc to a PhD from January 2021.

Impact of the project

The unique sunbird-*Erica* mutualism will allow us to gain insights into the mechanisms by which 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 and supplementary feeding on pollination systems such as this will inform the development of guidelines for maintaining biodiversity and ecosystem functioning.

Key co-supporters

Smuts Memorial Botanical Post-doctoral Fellowship; Biotechnology and Biological Sciences Research Council; South African National Botanical Institute, Joan Wrench Scholarship; Harry Crossley GreenMatter Scholarship.

Research team 2020

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Dr Colleen Seymour (SANBI, FIAO)
Dr Phoebe Barnard (FIAO, UCT)
Dr Mark Brown (Nature's Valley Trust)
Prof. Peter Ryan (FIAO, UCT)
Prof. Jeremy Midgley (Biological Sciences, UCT)

Students: Daniël Cloete (PhD, UCT); Monique du Plessis (MSc, UCT); Samantha McCarren (MSc, UCT)

Moult and migration

Together with breeding, moult and migration are the greatest challenges in a bird's annual cycle. Moulting birds suffer increased metabolic costs as well as impaired flight ability, insulation and camouflage/signalling. Birds vary greatly in how they manage these costs through changing the timing and intensity of moult, both within and between species. Migrant birds are at greater risk of extinction globally than are resident species due to the risks they face travelling across an increasingly transformed planet, and the need to have secure breeding and non-breeding areas. Understanding the strategies birds use to moult and migrate is crucial for their conservation.

Once formed, feathers are dead structures that start to degrade through mechanical abrasion, damage by UV light, and attack by ectoparasites, fungi and bacteria. Most feathers need to be replaced every year or so through a regular process of moult. The costs of moult are significant, so most birds schedule their moult to periods when they are not breeding or migrating (although there are numerous exceptions). New feathers grow from a ring of cells in the feather follicle, which limits their rate of growth to around 4-6 mm per day. Feathers that grow faster tend to be of poorer quality, providing less insulation and wearing faster than feathers grown more slowly. This largely invariant growth rate means that large birds take longer to replace a given feather than small birds. As a result, large birds have to adopt more complex moult strategies than small birds, either greatly increasing the intensity of moult (e.g. replacing all flight feathers at once, and becoming flightless for a few weeks while they grow new feathers) or staggering their moult over several years. The timing, intensity and symmetry of moult likely reflect individual health. And unlike breeding, moult is something that all birds must undergo. Thus monitoring how different birds moult, and how this changes over time, might be a way to track population health.

Migration is better studied than moult, but little is known about the migratory routes of intra-continental migrant birds in Africa compared to inter-continental migrants. Phoebe Barnard recruited Post-doc Dayo Osinubi in 2015 to start an intra-African migration project to investigate the migratory patterns of selected intra-African migrant birds. The project attempted to use a broad-scale spatial approach to address questions of phylogeography, movement ecology, phenotypic and genetic variation in intra-African migrant birds. The main focus was on Woodland Kingfishers *Halcyon senegalensis*, which have resident populations in central Africa and migrant populations at the northern and southern edges of their range.

Activities in 2020

- PhD student Emmanuel Adekola completed a paper on tail moult in Amur Falcons *Falco amurensis*, based on the examination of more than 2000 falcons collected by David Allan from the Durban Natural Science Museum after they were killed by hailstorms in KwaZulu-Natal in March 2019. Emmanuel found considerable individual variation in the extent of tail moult among both adult and juvenile falcons, with moult extent correlated with body condition. A paper describing his findings was recently accepted for publication in the *Journal of Ornithology*.
- Emmanuel also analysed moult data for adult Cape Gannets *Morus capensis*, comparing data collected at Malgas Island and Lambert's Bay in 2002–2004 with data he collected in 2018–2019. His thesis assesses how large, long-winged birds manage to replace their large number of secondaries; unlike primaries, which number 9-11 in all birds, the number of secondaries varies from 8-38 depending on bird size and wing shape.
- Taylyn Risi started an MSc on wing moult in oystercatchers, using existing data from South Africa, Australia and Europe. She also collected several hundred records for African Black Oystercatchers *Haematopus moquini* from images she and Peter Ryan took after the initial COVID-19 lockdown restrictions eased.
- Alexis Osborne completed his MSc and had a paper accepted in *Ostrich* on the use of

The extent of body moult among juvenile male Amur Falcons in mid-March varies from very little (left) to almost complete acquisition of adult plumage (right) (Photo: Peter Ryan).

photographs to score moult in breeding seabirds.

- The southern African field site for Woodland Kingfisher tracking work at the Mogalakwena Research Centre was visited at the end of December 2020, recovering a fifth geolocator.
- Abigail Ramudzuli completed work on her MSc project to explore moult patterns of Woodland Kingfishers and the use of stable isotope markers in their flight feathers, with a view to determining whether stable isotopes can indicate where migratory birds spend the non-breeding season. She will submit her thesis in early 2021.
- During summer 2020/21, Peter Ryan conducted repeat surveys of coastal birds in the Western Cape. Previous surveys showed alarming decreases in many migratory shorebird species from 1980/81 to 2010/11.

Highlights

- Data from the five geolocators retrieved from Woodland Kingfishers are currently being analysed with the support of the Swiss Ornithological Institute to identify the kingfishers' migration routes, timing and stop-over sites.

Impact of the project

The timing and intensity of moult is thought to be related to stress in bird populations, and monitoring changes in these parameters would provide a useful measure of global change impacts. The intra-African migration project facilitated a research network linking research institutions across Africa. This network serves to support the objectives of the UNEP/CMS African-Eurasian Migratory Land-birds Action Plan (AEMLAP) and the Migrant Land Bird Study Group (MLSG).

Key co-supporters

DSI-NRF CoE grant; National Zoological Gardens of South Africa (NZG); International Foundation for Science; BirdLife International; A.P. Leventis Ornithological Research Institute; Swiss Ornithological Institute (Vogelwarte); African Bird Club; British Ecological Society; iThemba LABS.

Research team 2020

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Evolution in island birds and the 'insularity' syndrome

Islands are important centres of endemism and key 'laboratories' for the study of ecology and evolution. However, some aspects of island ecology and evolution remain poorly understood. This programme studies patterns of adaptation and speciation on islands worldwide and conducts detailed studies using the Gulf of Guinea, Cape Verde and Tristan islands as study systems.

The Theory of Island Biogeography, which predicts how species richness on an island is a function of its size and isolation, remains one of the most elegant of ecological theories. Although the theory's architects, MacArthur and Wilson, were aware of the importance of speciation after colonisation, they were unable to include this variable in the model. In a project led by Luis Valente, we addressed this lack. By comparing sequences from almost 600 island birds from 41 archipelagos with those of their mainland relatives, we were able to estimate colonisation times and speciation rates. Amazingly, the empirical shape of the relationships between colonisation, extinction and speciation with island area and isolation is best explained by the original island biogeography model. These results were published in *Nature* in February 2020. That same month, Martim Melo and Luis Valente were on Bioko Island collecting blood samples from birds for a new project investigating how communities from continental islands (i.e. those that were formerly linked to the mainland) are assembled.

The Iago Sparrow *Passer iagoensis* is endemic to the Cape Verde archipelago where it occurs across a wide aridity gradient on most islands and islets. It constitutes an excellent study model for understanding how birds may adapt to an increasingly arid world. In addition, as humans only colonised the archipelago 500 years ago, and some islands remain uninhabited, the sparrow also makes a good model for the study of the evolution of commensalism. A collaboration led by Martim Melo, Ângela Ribeiro, Rauri Bowie and Mark Ravinet is combining fieldwork with genomics to untangle the micro-evolutionary processes occurring in historical times. Birds were sampled across 13 islands and islets, and across within-island aridity gradients to assess genetic structure using next generation sequencing.

Islands typically have impoverished communities, and our previous work confirmed that this extends to parasite diversity. Low parasite levels could lead to weaker immune systems, as suggested by the extinction of many Hawaiian birds after the accidental introduction of a malaria vector. This hypothesis is currently being studied through a collaboration between Claire Doutrelant, Rita Covas, Martim Melo, Claire Loiseau and Benoit Nabholz, which is investigating the genes underlying specific types of immune response. Additionally, human driven habitat change is likely to alter vector-parasite-host dynamics. Claire Loiseau and Martim Melo are leading a study to investigate whether land-use practices influence avian parasites on the endemic-rich São Tomé Island. Entomologists are documenting changes in the community of parasite vectors, a critical but often overlooked piece of this puzzle.

Activities in 2020

- During one month of fieldwork on Bioko Island, we sampled birds from lowland rainforest to Afromontane forest at 2 300 m, thanks to the support of the Bioko Biodiversity Protection Program and in particular Steve Miller and Amâncio Etingue.
- A survey along a human disturbance gradient on São Tomé was conducted, we sampled birds and their parasites and parasite vectors to assess the impact of human activities on bird-parasite interactions.
- José Cerca and Rosa Jiménez are running the bioinformatic analyses of 339 Iago Sparrow SNP RAD-sequences and 23 full genomes.
- Full genome sequences were constructed for several São Tomé endemic birds and their mainland counterparts to investigate whether insularity influences the evolution of the immune system by studying toll-like receptors. The genomes of range-restricted mainland species were also sequenced to compare with island species.
- PhD student Alois Robert showed that

A successful expedition into the wild areas of Bioko Island took place in February 2020. Two weeks after returning, we were in lockdown (Photos: Martim Melo).

impoverished bird and insect communities affect the way birds sing on islands, and MSc student Louis Bliard showed that impoverished predator communities affect plumage colour of island birds.

- Genomic data from Tristan's *Nesospiza* finches collated by Bengt Hansson and Martin Stervander have provided novel insights into this recent adaptive radiation.

Highlights:

- A paper published in *Nature* in February confirmed that, at least for birds, MacArthur's and Wilson's Theory of Island Biogeography is robust to the inclusion of evolution in the process of the assembly of island communities.
- A paper published in the *International Journal of Parasitology* reported the influence of land-use change in the bird parasite community of São Tomé Island.
- A paper published in *Biology Letters* examined the link between relaxed predation and bird coloration on islands.

Impact of the project

This project is uncovering novel patterns of adaptation in island birds and investigating the mechanisms underlying these adaptations. The findings contribute to our understanding of the ecology and evolution of island environments. Given the large number of species endemic to islands worldwide and the abundant threats to these biotas, our work will help to understand and conserve island species.

Key co-supporters

Forever Principe, National Geographic, CNRS (PEPS), University of Montpellier (PhD grant to Alois Robert), LIA Biodiversity, Portuguese Science and Technology Foundation.

Research team 2020

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Dr Rita Covas (FIAO, UCT / CIBIO, U. Porto)
Dr Claire Loiseau (CIBIO, U. Porto)
Dr Mark Ravinet (U. Nottingham)
Dr José Cerca (U. Oslo)
Rosa Jiménez (U. California Berkeley)
Dr Martin Stervander (U. Oregon)
Dr Luis Valente (Naturalis Biodiversity Center, Leiden)
Prof. Rauri Bowie (U. California Berkeley)
Prof. Bengt Hansson (Lund U.)
Prof. Peter Ryan (FIAO, UCT)

Students: Sandra Reis (PhD, CIBIO, U. Porto); Aloïs Robert (PhD, CNRS and U. Montpellier); Bárbara Freitas (MSc, CIBIO, U. Porto); Louis Bliard (MSc, CNRS and U. Montpellier).

Smart beaks – non-visual senses in birds

Most birds have excellent vision, which is part of what makes birds such an appealing group to study. However, birds also use other senses to navigate their world. This project investigates the tactile senses in their beaks to understand the links between bill-tip anatomy and foraging ecology. The main focus is on three species of southern African ibises that forage in different habitats. All three have a honeycomb pattern of pitting in the bones of the bill tips, which suggests they should be able to forage using the sixth sense "remote touch", detecting small vibrations made by prey as they burrow or swim through the foraging substrate (soil, mud or water).

Carla du Toit started this project as an MSc student in 2017, upgrading to a PhD in 2018. Her research focuses on the anatomy of the bill-tip organ in probe-foraging birds, including modern ibises and extinct species in the paleontological record. The bill-tip organ of probe-foraging birds is made up of mechano-sensory receptors embedded in densely clustered pits in the bone of the bill tip. Although the general structure of the bill-tip organ is similar across all probe foraging species that possess it, there is variation in the shape and orientation of receptors among species. Carla uses three ibises as a model to investigate the link between the morphology of the bill-tip organ and the birds' foraging ecology: Hadeda Ibis *Bostrychia hagedash*, Sacred Ibis *Threskiornis aethiopicus* and Glossy Ibis *Plegadis falcinellus*.

Carla du Toit with a Hadeda Ibis at the World of Birds. Carla has been studying the use of remote-touch by this species, and whether their foraging efficiency is affected by soil water content (Photo: Carla du Toit).

She also is exploring whether these patterns can be extrapolated to infer information about the foraging ecology of fossil birds. If there is a strong link between the morphology of the bony parts of the bill-tip organ and foraging behaviour, we can use the structure of fossil beaks to infer information about the palaeoecology of extinct birds. In 2020, we published an extensive review of the bone structures of the beaks of over 500 species from all orders of extant birds. This established that we can determine the presence of a remote-touch-capable bill-tip organ in modern birds solely from the structures of their beak bones. Using this knowledge, we have been able to infer the foraging ecology of some of the most basal members of the avian family tree, shedding light on some contentious questions regarding the evolution of modern birds.

Activities in 2020

- Our UCT team (Carla, Susie Cunningham and Anusuya Chinsamy-Turan) published one of Carla's thesis chapters on the beaks of fossil birds. Based on the extensive review of all orders of modern birds' beaks, we developed a classification system for beak tactile specialities and used this to study the beaks of the lithornithids, a group of fossil paleognathous birds related to modern ratites (ostriches, rheas, kiwis and allies). The lithornithids were medium-sized, flying birds that are the earliest known members of the Paleognathae. They evolved over 65 million years ago in the Cretaceous period, when non-avian dinosaurs still walked the earth. Our results suggested that these ancient birds were able to use remote-touch to locate buried prey in a similar way to modern day ibises. This finding helps to explain

the mysterious presence of a structurally similar bill-tip organ in all modern paleognathous birds (which, aside from the kiwi, do not probe forage for food) as a vestigial trait inherited from a long extinct common ancestor. Indeed, based on evidence from the fossil record, we believe that this trait may have evolved even earlier in non-avian theropods.

- Despite disruptions caused by the COVID-19 lockdown in March, Carla managed to finish her experiments with captive Hadeda Ibises at the World of Birds in Hout Bay, observing the birds as they probe in soil-filled trays containing desirable (to ibises at least) superworms. These experiments will allow her to gain detailed information on the use of remote-touch by Hadedas, and to determine to what extent their foraging success is affected by the levels of soil water, which will potentially lead to a better understanding of the recent range expansion of Hadedas across southern Africa.

Highlights:

- Our paper on the remote-touch capability of lithornithids was published in December 2020 in the prestigious journal, *Proceedings of the Royal Society B*. The paper has been downloaded over 900 times in two months, which is very high for restricted access articles.
- The paper has been featured in over 30 newspaper and magazine articles internationally, including some of the biggest in science and news media, such as *New Scientist* and *The New York Times*. More features are still being written, with upcoming features in *New Zealand Geographic* and *African Birdlife* magazines. Its Altmetric Attention score, a measure of how much people are talking about the paper on social media and news outlets, places it in the top 99th percentile of the more than 16 million research outputs tracked by Altmetric.

Impact of the project

This project helps us to better understand the links between anatomy, morphology and behaviour in birds. From a conservation and global change perspective, it allows a better understanding of the substrate conditions under which ibises are best equipped to forage, improving our understanding of potential mechanisms underlying the range expansion of Hadedas into the south and west of South Africa, and the likely impact of drought and ongoing climate drying on the foraging success of this and other ibis species.

Carla du Toit with a lithornithid fossil. These ancient paleognaths show beak morphology consistent with the avian sense of remote touch, suggesting that this sensory system evolved in the Cretaceous period, before the demise of non-avian dinosaurs (Photo: Carla du Toit).

The comparative work on palaeontological specimens has improved our understanding of the ecology of extinct birds, and shed light on the evolution of this unique sensory system. By changing our understanding of the morphology and behaviour of some of the earliest ancestors of large clades of modern birds, our findings have shed light on a major sensory ecological trend in the evolution of modern birds and dinosaurs.

Key co-supporters
DSI-NRF CoE grant; DSI-NRF CoE in Paleosciences.

Research team 2020

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Prof. Anusuya Chinsamy-Turan (Biological Sciences, UCT)
Dr Steve Portugal (Royal Holloway, U. London)
Dr Anton du Plessis (U. Stellenbosch)

Student: Carla du Toit (PhD, UCT)

Impacts of power infrastructure

This project mitigates the impacts of power generation and transmission infrastructure on birds and other biota. 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.

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. The aim of this programme is to provide practical solutions to reduce the impacts of renewable energy projects, as well as energy transmission infrastructure, on birds in southern Africa. The programme is run in collaboration with BirdLife South Africa's Birds and Renewable Energy programme and the Endangered Wildlife Trust (EWT). Modelling the impacts of wind farms on eagles and vultures is reported separately in the sections "Conserving Verreaux's Eagles" (p. 29) and "Vulture Conservation" (p 33).

Activities in 2020

- Former CB MSc student Christie Craig, now based at the Endangered Wildlife Trust, began a study on the viability of Blue Cranes *Anthropoides paradisea* in the Western Cape and Karoo at the end of 2018. She registered for a PhD at the start of 2020. Powerline collisions are one of the main threats to Blue Cranes. During 2020, Christie repeated quarterly surveys of 160 km of powerlines in the Karoo, finding 72 bird collisions, 33 of which were Blue Cranes. In December 2020, she repeated 155 km of Jess Shaw's Overberg powerline survey from 2008 as part of her CB MSc. There were only 8 Blue Cranes among 21 mortalities, far fewer than the 64 Blue Cranes out of 114 mortalities found by Jess in 2008. In 2021, Christie will try to understand this discrepancy by sampling more lines in the region to assess whether the current set of lines are representative of the Overberg as a whole, or whether increased line marking has greatly reduced mortality rates.
- In August 2020, Christie and the EWT team fitted 7 Iridium satellite tracking devices to Blue Cranes in the Western Cape, adding to the 15 devices already deployed over the last five years; a further 8 devices will be fitted in winter 2021. Movement data from these birds will be used to help assess Blue Crane powerline collision risk.
- In 2019, Christie conducted interviews with 22 farmers to understand how the agricultural landscape is changing and how this could affect cranes. Plans to interview more farmers in 2020 were postponed until 2021 due to the pandemic.
- Over the last two years, Blue Crane breeding success in the Overberg and Swartland has been 0.49 chicks per pair, only half the fledgling rate in the grasslands and Karoo. The mechanisms

Tanya Smith and Christie Craig release a Blue Crane fitted with the satellite tracker in the Agulhas region, Overberg. (Photo: Bradley Gibbons).

leading to nest failure are not clear, and we are looking to recruit a MSc student to investigate possible causes of low breeding success, including the possible impact of climate warming.

- Robin Colyn's proposal to upgrade his MSc to a PhD from Jan 2021 was approved. His study is aimed at better understanding the factors determining the distributions of range-restricted larks in the Karoo and montane grassland regions of southern Africa. The Red Lark *Certhilauda burra* is a species of particular concern, given the large number of wind energy projects planned in the range of this localised, vulnerable species, and the high mortality rate of larks that undertake aerial displays at windfarms. Despite the challenges of the COVID-19 lockdowns, he completed his fieldwork in the Karoo, and made good progress with drafting papers towards his thesis.
- Robin also started to analyse the long-term movements of Ludwig's Bustards *Neotis ludwigii* equipped with satellite transmitters by Jess Shaw in 2010-11. Three of her bustards are still transmitting data, with Ludwig, the first bustard to be tagged, having been tracked for more than 10 years. It is fascinating to see how rather than being erratic nomads, each bustard appears to have a few preferred sites which they move between in relation to seasonal rainfall patterns.
- Sanjo Rose completed a first field season working on Agulhas Long-billed Lark *Certhilauda brevirostris* in the Overberg. Sanjo's MSc project seeks to understand the breeding ecology and habitat use of this endemic range-restricted lark species which is poorly studied with virtually nothing known about its breeding ecology. Understanding the habitat use, breeding requirements and threats to nesting can help understand the likely impact of the wind energy infrastructure on this and other ground nesting lark species in the Overberg.
- Vonica Perold, Peter Ryan and Sam Ralston-Paton's review of bird mortality at wind energy facilities around South Africa was finally published in *Ostrich*. Although most casualties are raptors and swifts, 130 species of birds have been reported killed at 20 windfarms. Species accumulation models suggest that around 40% of species found in the vicinity of wind farms will be killed at least occasionally.
- Estimates of bird flight heights are crucial to assess the risk of collision mortality with wind turbines and other infrastructure. Nicolas Prinsloo, a student of Nico de Bruyn (U. Pretoria), developed a photogrammetric approach to estimate flight height from an array of linked digital SLR cameras. The system is much more accurate than a digital range-finder, but is also more cumbersome to set up and use. A paper describing the technique has been accepted for publication in the *Journal of Zoology (London).*

Highlights:

- The results of Jess Shaw's long-term experiment to assess the efficacy of marking earth wires on transmission lines to reduce bird collision mortality in the eastern Nama Karoo was finally accepted for publication in *The Condor – Ecological Applications*. It shows that flappers and static flight diverters are both effective at reducing the collision rate of Blue Cranes, but have little efficacy for bustards.
- A paper highlighting the wide diversity of birds killed by wind energy facilities in South Africa was published in *Ostrich*.
- Finding Agulhas Long-billed Lark nests proved extremely challenging; 5 nests were found and monitored in 2020.

Key co-supporters

Endangered Wildlife Trust-Eskom Strategic Partnership, The Bateleurs, Hans Hoheisen Charitable Trust, Leiden Conservation Fund, Dave Myers, BioTherm Energy.

Research team 2020

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Dr Megan Murgatroyd (FIAO, UCT)
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Samantha Ralston-Paton (BLSA)
Dr Tim Reid (ANU, Canberra)
Sanjo Rose (FIAO, UCT)
Dr Jess Shaw (Scottish Natural Heritage)
Tanya Smith (EWT)

Students: Christie Craig (PhD, UCT); Robin Colyn (MSc, UCT).

Ecology and conservation of Verreaux's Eagles

Verreaux's Eagle *Aquila verreauxi* was uplisted to Vulnerable in South Africa in 2015. This project which aims to help conserve the species initially focused on investigating the impacts of land use change and habitat loss in the Western Cape, but now centres on reducing the impacts of wind farms because Verreaux's Eagles are particularly vulnerable to colliding with wind turbines. The main goal is to be able to predict how the eagles use the landscape to prevent siting new turbines in risky locations for eagles.

Verreaux's Eagle is generally regarded as a dietary specialist that mainly feeds on Rock Hyraxes *Procavia capensis*. As a result, habitat transformation that reduces the availability of its preferred prey species was expected to increase foraging effort and/or reduce breeding productivity. However, the initial research in this project found that Verreaux's Eagles had more diverse diets in agriculturally developed areas and that breeding productivity was not affected by the levels of agricultural transformation currently experienced in the Sandveld region of the Western Cape.

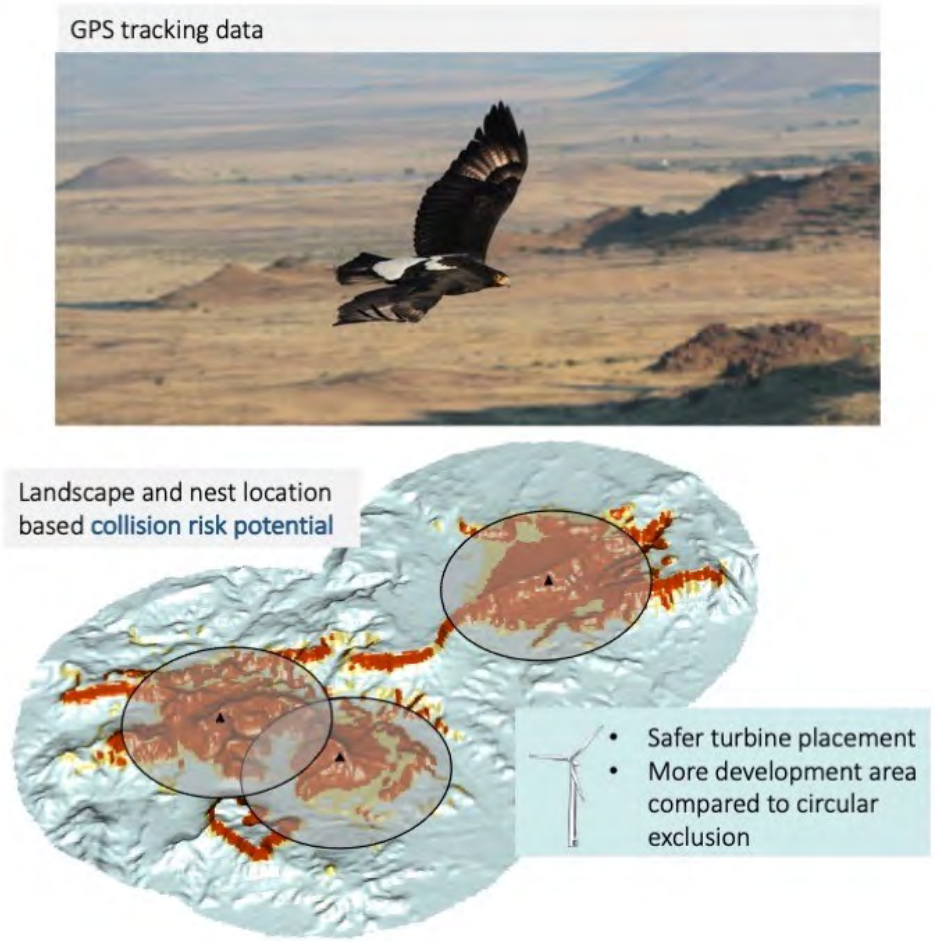
The demand for renewable power is increasing worldwide and electricity generation from wind power is growing rapidly. In South Africa, at least 23 wind farms are operational and hundreds more are planned. Although wind energy is often regarded as a sustainable energy source, there are negative impacts on birds through collisions with rotor blades (see also the "Impacts of power infrastructure" p. 27). Diurnal raptors are the most frequently killed bird group, representing around 35% of casualties. This disproportionate effect on raptors is extremely worrying and we are working towards predictive collision risk models for the most susceptible species.

At least 14 adult Verreaux's Eagles had been killed by turbines at South African wind energy facilities by the end of 2019. To help reduce further mortalities, we have built a predictive mapping tool using high-resolution GPS tracking data from adult eagles to understand flight behaviour, habitat use and the associated risk of wind turbine collisions. The resultant model is now being used by the wind energy industry to obtain collision risk maps of potential development areas early in the planning stage, thereby ensuring that wind turbines can be placed in locations that will minimise risk to eagles.

A dead Verreaux's Eagle at a wind farm (Photo: Megan Murgatroyd).

Activities in 2020

- Fieldwork included ongoing monitoring of GPS-tagged eagles in the Karoo, Overberg and West Coast areas. Due to the large volume of data generated by the tags (over 1,000,000 fixes per year) data downloads are done via base stations rather than via satellite, which requires frequent maintenance of remote field equipment.



GPS tracking data from Verreaux's Eagles were used to build a predictive model that accounts for habitat use, instead of simple circular exclusion buffers around a nest. This method can allow a greater area of land to be made available for wind energy development without increased mortality risk to raptors. Our model can be used to provide robust predictions on collision risk potential to inform wind turbine placement in South Africa in a way which minimises the conflict between a vulnerable raptor species and the development of renewable energy.

- The collision risk model was used to assess risk profiles for turbines at 13 proposed wind energy developments in South Africa.
- CB MSc student Merlyn Nkomo is analysing long-term Verreaux's Eagle data from the Matapos Hills, Zimbabwe, supervised by Arjun Amar and Megan Murgatroyd. Her project explores the influence of weather on breeding performance. She will submit her thesis in March 2021.

Highlights:

- A paper describing the methods for building the collision risk model was published in the *Journal of Applied Ecology*.
- Megan Murgatroyd and Arjun Amar wrote a popular article in *The Conversation* "Finding space for both wind farms and eagles in South Africa".

Impact of the project

This project has added to our understanding of the ecology and habitat requirements of Verreaux's Eagles. The risk model to reduce mortalities due to wind turbine collisions will contribute to the long-term sustainability of wind energy development within Sub-Saharan Africa.

Key co-supporters

ABAX Foundation; DSI-NRF CoE grant; BirdLife South Africa; Birdlife Zimbabwe; Hawk Mountain Sanctuary; Mainstream Renewables; Avisense Consulting; Tygerberg Bird Club.

Research team 2020

A/Prof. Arjun Amar (FIAO, UCT)
Dr Megan Murgatroyd (HawkWatch International / EWT / FIAO, UCT)

Student: Merlyn Nkomo (CB MSc, UCT).

Conserving Martial Eagles

The 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 observed within the largest protected area in the country, the Kruger National Park (KNP). This research is important to understand the role that protected areas have in species conservation and to understand specific threats and habitat requirements for the conservation of Martial Eagles.

The project was initiated in response to the decline in reporting rates of Martial Eagles between the Southern African Bird Atlas Projects (SABAP) 1 (1987-1992) and 2 (2007-2012). These surveys suggest a population decrease of up to 65% across South Africa. Declines were also observed inside large protected areas, such as the KNP, which experienced a 54% decline in reporting rate over this time.

We aim to improve our understanding of the threats faced by Martial Eagles and how these threats may drive population decreases even within protected areas, where species are usually expected to be conserved. 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 outside protected areas. Contrary to this hypothesis, we have not found evidence for low survival during these early life stages despite ranging widely beyond protected area boundaries. However, GPS tracking of adult birds and nest monitoring have detected two potential factors that may contribute to the observed population decreases: low adult survival and poor breeding productivity. Adult mortalities, including persecution and electrocution, during unexpected wide-ranging movements outside of the KNP, may be contributing to declines. Two factors contribute to the low productivity: a low proportion of pairs attempting to breed and low breeding success. We continue to study breeding performance in the KNP to enable a more comprehensive understanding of the environmental drivers of poor breeding performance, as well as to track eagles to determine the frequency and cause of mortalities.

Meg Murgatroyd preparing to climb to a Martial Eagle nest to service a camera trap (Photo: Merlyn Nkomo).

Activities in 2020

- Of 25 occupied breeding territories there were 13 breeding attempts, which is only the second time since the project started that more than half of the pairs attempted to breed. However, breeding success was low, at 0.30 chicks per attempt.
- Seven nest cameras were installed: four nests were used by Martial Eagle, of which two were successful. Two nests were regularly visited but no eggs were laid, and one nest was used by African Fish Eagles *Haliaeetus vocifer*, whose eggs were predated by a baboon.

CB MSc student Merlyn Nkomo releasing a GPS tagged Martial Eagle (Photo: Meg Murgatroyd).

- Two GPS transmitters were deployed on a pair of Martial Eagles, the first time both members of the same pair have been tagged in South Africa.
- CB MSc student Merlyn Nkomo joined us for field experience in Kruger.

Highlights

- Aerial surveys were carried out with the assistance of the Bateleurs aircraft pilots to look for nests in territories where the known nest is either no longer used or has fallen down. Only around a quarter of the 71 nests are likely to belong to Martial Eagles. All these nests will be checked in 2021.
- Martial Eagles were uplisted to globally Endangered by the IUCN Red List, further highlighting the importance of this research project. The project contributed information to this assessment, including conducting a repeat analysis of the SABAP data.

Impact of the project

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

The adult female Martial Eagle with colour rings just released by Merlyn (Photo: Merlyn Nkomo).

Key co-supporters

ABAX Foundation; DSI-NRF CoE grant; Endangered Wildlife Trust; Jock's Safari Lodge.

Research team 2020

A/Prof. Arjun Amar (FIAO, UCT)
Dr Megan Murgatroyd (HawkWatch International / EWT / FIAO, UCT)
John Davies (Endangered Wildlife Trust)
Dr Gareth Tate (Endangered Wildlife Trust)

Student: Merlyn Nkomo (CB MSc, UCT).

Vulture conservation

Several vulture populations in Africa have declined by up to 95% over the last few decades. The critical nature of this rapid decrease was highlighted when parties to the Convention of Migratory Species adopted the Multi-species Action Plan to Conserve African-Eurasian Vultures (Vulture MsAP). Unlike the Asian Vulture Crisis, where the veterinary drug diclofenac was responsible for the collapse, there appear to be multiple drivers of the African Vulture Crisis, with the importance of each varying between species and regions.

Vultures provide important ecosystem services and their rapid declines will have a dramatic effect on people and wildlife in Africa. The FitzPatrick Institute is committed to help conserve vultures by engaging in collaborative research projects throughout the continent.

Working with Raptors Botswana, we are involved in a research programme on Botswana's significant populations of vultures. All five species in the country are globally Endangered or Critically Endangered. Central to this research is an attempt to quantify changes in vulture populations in Botswana over the last 30 years by repeating road transects undertaken in the early 1990s, as well as to repeat aerial surveys of key colonies. Surveys across northern Botswana have been completed, and a Botswanan student, Rochelle Mphetlhe, was recruited to repeat the transects in the south of the country for her MSc.

We remain a key partner in the conservation of the Bearded Vulture *Gypaetus barbatus* in southern Africa. We continue to collaborate with Sonja Krüger from Ezemvelo KZN Wildlife and others on the conservation of this important population. Focus has shifted to building a captive breeding programme with the hope of establishing an 'insurance' population away from the Maloti-Drakensberg Mountain population. This project builds on Christiaan Brink's CB MSc project, which was published in 2020. Another CB student, Imthiaz Sheik Abbass, is studying habitat use of Bearded Vultures in relation to human settlement density for this research project.

We are developing a wind farm collision risk model for Cape Vultures *Gyps coprotheres*. In 2019, we collated data from almost all organisations that have tracked Cape Vultures and are using these data to produce a risk model that will help to ensure that developers can site wind turbines in locations that are seldom used by Cape Vultures and thereby minimise collision risk. Francisco Cervantes joined Arjun Amar and Meg Murgatroyd on this project in late 2020 and will register as a post-doc from January 2021. Francisco is currently building the risk model, with the aim to have the final tool available for use in early 2021.

With collaborators VulPro, EWT, CSVet and Ezemvelo KZN Wildlife, we published a database of vulture supplementary feeding stations (SFS) and their provisioning rates in South Africa. This will facilitate ongoing research on the effect of SFS on vulture demography and movement. The data are already playing an important role in the Cape Vulture Collision Risk Model.

In an effort to understand the prevalence and spatial distribution of poison-use for predator control, we have conducted interviews with farmers across the country. With these data we produced a heatmap of poison-use for South Africa and identified predictors of a landowner's propensity to engage in poison use. This study was published in *Ambio* in early 2021.

The star of the vulture project at the Fitz in 2020, Christiaan Brink, who published 3 of his PhD chapters as well as his MSc during 2020. Christiaan took a selfie in an agricultural shop where he conducted farmer interviews about wildlife-human conflict.

Activities in 2020

- Vultures Namibia fitted eight more juvenile Lappet-faced Vultures *Torgos tracheliotos* with GPS tracking units in the Namib Naukluft National Park in 2020 to study early-life movements and survival in this harsh landscape.
- Rochelle Mphetlhe, working in collaboration with Raptors Botswana, continued her repeat of nearly 25 000 km of raptor road transects, first surveyed in the 1990s in southern Botswana. Rochelle will register for an MSc in 2021.

Highlights

- Two papers from Christiaan Brink's PhD were published in 2020: one in *Animal Conservation* reported the distribution and resource contribution of vulture SFS in South Africa, and one in *Conservation Science and Practice* about the perceptions of SFS managers and possible risks in this conservation strategy.
- A third chapter from Christiaan's PhD, using the data of 823 farmer interviews across South Africa about the prevalence of poison-use for predator control and general attitudes towards vultures was accepted for publication in *Ambio*.
- Christiaan's MSc research which explored the feasibility of a reintroduced population of Bearded Vultures was published in *Ostrich.*
- Leungo Leepile's CB MSc project on changes in nesting numbers and breeding success of African White-backed Vultures *Gyps africanus* in northern Botswana was published in *Bird Conservation International.*
- Andrea Santangeli and colleagues from Vultures Namibia and Spain published a study in *Biological Conservation* on the survival of Lappet-faced Vultures based on resightings of wing-tagged individuals.
- BioTherm Energy funded two vulture projects: one, in collaboration with VulPro, to track Cape Vultures from Potberg, the Western Cape's only vulture colony, and one to help fund our Cape Vulture collision risk model, being led by Franciso Cervante.

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, poison 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 us understand why, what, where and how vulture threats occur, with implications for targeting cost-effective conservation actions.

A young Lappet-faced Vulture fitted with a GPS tracking unit is captured by a camera trap at a waterhole in the Namib Naukluft National Park. Movement of young Lappet-faced Vultures is being studied as they forage both within and outside of protected areas (Photo: Mark Boorman).

Key co-supporters

DSI-NRF CoE grant; NRF Innovation Scholarship; ABAX Foundation, BioTherm Energy. JW Jagger Grant; Denver Zoo; Raptors Botswana; Rufford Grant; Wilderness Wildlife Trust; Colombus Zoo; Leslie Brown Memorial Grant; Peregrine Fund; IDEA Wild; Ezemvelo KZN Wildlife; Endangered Wildlife Trust; N3TC through Wildlands, Vultures Namibia, VulPro, HawkWatch International, University of Marburg, Academy of Finland

Research team 2020

A/Prof. Arjun Amar (FIAO, UCT)
Dr Robert Thomson (FIAO, UCT)
Dr Sonja Krüger (EKZN Wildlife)
Dr Andrea Santangeli (U. Helsinki, FIAO, UCT)
Dr Megan Murgatroyd (HawkWatch International)
Dr Francisco Cervantes (FIAO, UCT)
Ms Kerri Wolter (VulPro)
Dr Glyn Maude (Raptors Botswana)
Dr Richard Reading (Raptors Botswana)
Dr Gareth Tate (Endangered Wildlife Trust)
Dr Andrew Tucker (CSVet, Pretoria)
Dr Beckie Garbett (BirdLife International)
Dr Francisco Cervante (FIAO, UCT)
Dr Chris Briggs (Hamilton College, USA)

Students: Christiaan Brink (PhD, UCT), Imthiaz Sheik Abbass (CB MSc, UCT).

Southern Ground-Hornbill conservation

Southern Ground-Hornbills *Bucorvus leadbeateri* are large, group-living birds that require extensive territories and relatively undisturbed areas with large trees for breeding and roosting. With high rates of habitat loss during the past century, these requirements have become increasingly rare, leading to a two-thirds reduction in the Southern Ground-Hornbill's range within South Africa. A long-term study at the Fitz, initiated in 2000, has investigated their habitat use, breeding success, and dispersal. Now we are studying their social behaviour, specifically how group members contribute to territory defence and reproduction, and whether larger groups are more resilient to global change.

The long-term project has provided nest boxes to 20 hornbill groups throughout the Associated Private Nature Reserves, adjacent to the Kruger National Park. These groups together make 12-15 breeding attempts each year, providing an ideal platform to study this elusive species. This project also is closely linked to the Mabula Ground-Hornbill Project, providing second-hatched chicks (which invariably die of starvation in the wild) to be captive-reared and later released as founder groups in new areas.

PhD student Kyle-Mark Middleton, supervised by Rita Covas, Claire Spottiswoode and Fanny Rybak, is focusing on understanding the hornbill's social structure and individual contributions to breeding success and territory defence. Kyle obtained many hours of recordings of the different groups' dawn chorus and his analyses have shown differences between the sexes, and among individuals and groups. Play-back experiments are being conducted to determine if the birds also perceive these vocalisations as different.

Kyle has also obtained footage from camera traps installed at the nests to obtain insights into the private lives of ground-hornbills. Initial results reveal disproportionate contributions to chick feeding among individuals, as well as temperature-linked variation in provisioning rates. Using the long-term breeding data, Kyle is also investigating which environmental factors affect breeding performance and how their cooperative behaviour might help to buffer harsh environmental conditions.

MSc student Carrie Hickman, supervised by Rita and Susan Cunningham, is investigating whether high ambient and nest temperatures impact hornbill nestlings by measuring nestling growth, fledging size and condition, and telomere length. Piecewise modelling will be used to investigate whether any impacts result from a decrease in the frequency or quality of provisioning or from direct effects of temperatures inside the nest. Initial analysis of camera trap footage suggests that provisioning rates decrease at high ambient temperatures. iButtons have been installed inside nests to obtain hourly temperature recordings.

Activities in 2020

- Carrie began her master's degree on the effects of high temperatures on nestling growth rates.
- Kyle's analyses show that different groups have unique 'signatures', and that males produce lower frequency calls than females. At least six different vocalisations have been identified: chorus, contact, excitement, alarm, begging and feeding calls. A distress call is also suspected to occur.
- Playback experiments were conducted to investigate whether groups can recognise neighbouring groups from stranger groups through vocalisations.
- Kyle completed his analyses of long-term breeding success in relation to environmental variables and group structure, which revealed an effect of rainfall, temperature and breeding group composition.
- Before the 2020/21 breeding season began, camera traps were placed in camouflaged boxes at 13 nests to record birds provisioning food, and iButtons were installed inside each nest.
- Distinctive facial features can be used to recognise individuals and thus assess how much different birds contribute to nestling feeding. Initial analyses suggest that adult males feed the incubating female and chick more than sub-

adult male helpers. Juveniles also occasionally contribute, although to a much lesser extent.

- Non-invasive genetic sample collection from known individuals is continuing through shed feathers to determine relatedness between individuals and how this influences investment in cooperative behaviour.
- Blood sampling of nestlings was started to determine the effects of temperature on nestling growth rates and allow chicks to be sexed.
- Carrie and Kyle attended the Southern Ground-Hornbill reintroduction workshop hosted by BirdLife South Africa and the Mabula Ground-Hornbill Project.
- The project created a new website, providing general information on the research and conservation conducted within the area.
- Five presentations were made to create awareness and four articles appeared in the *Klaserie Chronicle*, which is distributed to the greater Hoedspruit community. Two online articles were published on the Timbavati blog and on the Africa Geographic platform.
- Kyle and Carrie appeared on a 15-minute insert on the television program '50/50' where they described their research and how the project contributes towards ground-hornbill conservation.

Highlights:

- Kyle won the prize for best presentation from a developing country at the African Bioacoustics Conference.
- The 2019/20 breeding season saw eight chicks fledge from 12 nests. Egg candling was used to estimate hatch dates for harvesting and methods are being developed to sex birds whilst still in the egg.
- Ongoing repairs to and replacement of artificial nest boxes ensured that ground-hornbills can continue to thrive in the study area, which has few natural nest cavities. Five newly designed nests were installed, equipped with iButtons to determine if they provide ideal conditions for breeding.
- A new group of only two ground-hornbills began to breed in a new nest. This shows that breeding can occur without the assistance of helpers.
- Footage was obtained of leopards predating ground-hornbill nestlings.
- New funding collaborations were established with Wild in Africa, as well as Wild Wonderful World, and a new project vehicle was acquired, allowing the project to continue into the foreseeable future.

A 75 day old Southern Ground-Hornbill nestling (Photo: Carrie Hickman).

Impact of the project

This project continues to contribute to the population growth of Southern Ground-Hornbills in the APNR and has demonstrated the efficacy of artificial nests as a conservation tool in areas where natural cavities are scarce. The surrounding areas are now beginning to benefit from the project, with new groups occurring in areas previously lacking ground-hornbills. The project contributes to the national Southern Ground-Hornbill Species Action Plan and the Southern Ground-Hornbill Reintroduction Plan.

Key co-supporters

DSI-NRF CoE grant; The Foundation for Science and Technology FCT, Portugal; Associated Private Nature Reserves; National Geographic Society; Mary Oppenheimer & Daughters Foundation, Wild in Africa, Wild Wonderful World.

Research team 2019

Dr Rita Covas (FIAO, UCT and CIBIO, U. Porto)
Prof. Claire Spottiswoode (FIAO, UCT / U. Cambridge)
Dr Fanny Rybak (U. Paris-Sud, France)
Dr Rob Little (FIAO, UCT)

Students: Kyle-Mark Middleton (PhD, UCT); Carrie Hickman (MSc, UCT).

Conserving Benguela endemic seabirds

All three seabirds endemic to the Benguela upwelling ecosystem that rely on anchovies and sardines are threatened by local reductions in the availability of their preferred prey. Small pelagic fish abundance has decreased off the southern African west coast, where fishing effort is concentrated, and most seabird breeding islands are located. As a result, it is crucial to understand the foraging behaviour of breeding seabirds and how their populations respond to changes in fish abundance and distribution.

The lack of spatial management of the fishery for small pelagic fish has resulted in local over-exploitation of sardines and anchovy. Throughout the last decade, the small pelagics fishery has failed to meet its quota almost every year, indicating a paucity of these fish. African Penguins *Spheniscus demersus*, Cape Cormorants *Phalacrocorax capensis* and Cape Gannets *Morus capensis* all depend largely on these same fish, and all three species are now listed as Endangered. Understanding the drivers behind such population changes is essential to mitigate these declines. This is a large, multi-faceted programme with key participants including Pierre Pistorius, Lorien Pichegru and Maëlle Connan (NMU), David Grémillet (CNRS Montpellier), former post-docs Tim Cook (Paris) and Richard Sherley (Bristol), collaborators at BLSA (Alistair McInnes, Christina Hagen) and DEA (Azwianewi Makhado and Rob Crawford), as well as several post-doctoral students.

The densely packed Cape Gannets colony in front of the Bird Island lighthouse in Algoa Bay. This colony now supports almost half of the world population of this species (Photo: Pierre Pistorius).

Activities in 2020

- The experimental closure of commercial fishing for small pelagic fish around key penguin breeding islands continued in 2020, but no penguin data could be collected at either island due to strict COVID-19 lockdowns during the peak breeding season. Before the lockdown, only 1 500 breeding pairs were estimated on St Croix Island, which up until 2016 used to host 6 500–8 500 pairs.
- Strong arguments were made to the Small Pelagic Working Group and the Minister of the Department of Environment, Forestry and Fisheries (DEFF), Barbara Creecy, to urgently stop purse-seine fishing within 20 km of six penguin colonies, but no action was taken.
- A collaboration between NMU, BirdLife South Africa and the CNRS in France was established to investigate the factors driving the decline of the St Croix Island penguin colony since 2016, including the noise associated with maritime traffic, and its increase since the start of ship-to-ship bunkering activities near the island in 2016.
- NMU MSc student Praxedes Rukuni, supervised by Lorien Pichegru, Giannina Passuni and Shaun Deyzel from SAEON, is investigating food web stability in Algoa Bay using meso-zooplankton functional diversity metrics. Her research was

delayed due to the closure of laboratory facilities at NMU during the COVID-19 lockdown, but she managed to complete all her data analyses by the end of the year. She found differences in the diets of anchovies eaten by African Penguins from St Croix and Bird Island in Algoa Bay. Anchovies targeted by the Bird Island penguins fed mostly on large crustaceans, whereas anchovies targeted by St Croix penguins fed on a wider range of smaller, less energetically beneficial prey, reflecting the less productive waters close to St Croix.

- Another NMU MSc student, Catherine Currin, was also severely delayed by the pandemic, but managed to measure the levels of stress hormones in blood samples from various captive penguin colonies. She will explore the use of an electronic heart rate recorder to compare physiological stress levels caused by several stressors, such as human, conspecific or predator encounters.
- Former NMU post-doc, Giannina Passuni, mentored by Lorien Pichegru, submitted her paper on the contribution of penguin guano from St Croix Island on water quality and productivity around the colony. She estimated that 45.4 tons of nitrogen (N) and 8.4 tons of phosphorus (P) were produced annually by the birds although only 5-20% of the N washed into the ocean. As part of her work and collaboration with Paula Patrick from SAEON, another paper on the island mass effect on the retention rate of larval fish was submitted to *Estuarine and Coastal Shelf Science.*
- NMU PhD student Katharina Reusch continued her study of the foraging ecology of Kelp Gulls *Larus dominicanus*. Her paper tracking Kelp Gulls from various South African colonies in *Movement Ecology* showed that breeding gulls relied less on anthropogenic habitats than predicted, even when colonies were close to large landfill sites, where many gulls scavenge. Stable isotope analyses of Kelp Gull adults and chicks confirmed their heterogeneous diet, and their focus on natural foods when raising chicks. In collaboration with former SANCCOB vet, Nola Parsons, she also has compared blood and intestinal parasite loads among colonies.
- David Grémillet and Lorien Pichegru continued their long-term study tracking the foraging

A solitary adult African Penguin on the shoreline of Bird Island. Adults benefit greatly from foraging with other penguins, which makes it hard for penguins in dwindling colonies to catch pelagic schooling fish efficiently (Photo: Florian Orgeret)

Former Fitz CB MSc student Frances Taylor waiting for the return of GPS tracked Cape Gannets at Bird Island, Algoa Bay (Photo: Pierre Pistorius).

ranges of Cape Gannets breeding on Malgas Island, which was initiated in 2002. As part of this collaboration, a paper was published in *Animal Behaviour* suggesting that the elaborate dance ceremony adult Cape Gannets perform each time they return to the nest may contain information about individual foraging behaviour. Dance duration is inversely related to the distance to the main foraging grounds. Pierre Pistorius also continued annual tracking of Cape Gannets from Bird Island.

- Zanri Strydom started a PhD at NMU on the foraging behaviour of Cape Gannets in relation to their age and experience, co-supervised by Herve Fritz and Jan Venter from the George campus of NMU, and David Grémillet and Lorien Pichegru. Zanri went to Malgas Island with Lorien in November and together they sampled 37 individuals of known-age.
- Nosipho Gumede started an MSc at UCT, supervised by Newi Makhado, Mduduzi Seakamela and Peter Ryan, on long-term variation in the diet of Cape Fur Seals *Arctocephauls pusillus*, and the potential for competition with fisheries and seabirds.
- A study led by Richard Sherley using a Bayesian approach highlighted the rapid decline of African Penguins since 1989, confirming their Endangered status on the IUCN Red List. The results highlight the penguin colonies in urgent need of conservation actions.
- Lorien Pichegru co-authored a paper on the impact of fishing on Magellanic Penguins *Spheniscus magellanicus* as part of a long-term collaboration with the CENPAT from CONICET, Puerto Madryn, Argentina.
- Similarly, as part of a collaboration with Deakin University in Victoria, Australia, PhD student Grace Sutton published an article in *PeerJ* showing how African Penguins benefit from multi-predator assemblages with other seabirds, but are out-competed by predatory fish.
- Alistair McInnes published a paper in *Ibis* showing how calling behaviour of African Penguins at sea is dependent on social context

and the prey species that they are targeting. This arose from research he conducted as a post-doc at NMU.
- Pierre Pistorius and Alistair McInnes, now at Birdlife South Africa, successfully tracked Cape Cormorants breeding at Dyer Island with GPS loggers for the second year.
- Ralph Vanstreels published some of the work he conducted during his post-doc at NMU. In one paper he demonstrated that African Penguins ingest both seashells and debris while foraging at sea. Seashells presumably serve as a calcium source for egg production. Results from a study that he led on external and blood parasites were published in *Parasitology*.

Highlights:
- Lorien Pichegru was promoted to Adjunct Professor at the Coastal and Marine Research Institute at NMU.
- Following the decision in 2019 to reduce Kelp Gull numbers at key seabird colonies to reduce predation, the predation rate by gulls on Cape Gannet eggs and chicks at Malgas Island decreased by an order of magnitude in 2020.
- Lorien Pichegru took part in a UN-organised workshop on Benguela Current Forage Fish management.
- Ten papers were published in peer-reviewed journals during 2020, including one on the impacts of a warming climate on Bank Cormorant *Phalacrocorax neglectus* breeding in *Conservation Physiology*.

Key co-supporters
BirdLife International; BirdLife South Africa; DSI-NRF CoE grant.

Research team 2020
Prof. Pierre Pistorius (NMU)
Prof. Res Altwegg (SEEC, UCT)
Prof. Peter Ryan (FIAO, UCT)
A/Prof. Lorien Pichegru (NMU)
Dr Maëlle Connan (NMU)
Dr Timotheé Cook (U. Paris)
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 Alistair McInnes (NMU Post-doc and BLSA)
Dr Florian Orgeret (NMU Post-doc)
Dr Giannina Passuni (NMU Post-doc)
Dr Richard Sherley (U. Bristol)
Dr Andrea Theibault (NMU Post-doc)
Dr Ralph Vanstreels (NMU Post-doc)

Students: Katharina Reusch (PhD, NMU), Zanri Strydom (PhD, NMU), Catherine Currin (MSc, NMU), Nosipho Gumede (MSc, UCT), Praxedes Rukuni (MSc, NMU), Victoria Stockdale (MSc, NMU).

An adult Cape Gannet at sea (Photo: Florian Orgeret).

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, and by invasive species on land. Monitoring seabirds provides a window into the health of the Southern Ocean.

Most field work takes place through the South African National Antarctic Programme (SANAP) at the Prince Edward Islands, Tristan da Cunha and Gough Islands. Fitztitute seabird research on Marion Island, the larger of the two Prince Edward Islands, commenced in the 1970s. John Cooper initiated a series of seabird study colonies in the early 1980s, but servicing these long-term studies through a succession of three-year research projects is challenging. During 2020, monitoring at Marion was undertaken by three collaborative projects with CoE team members at NMU (Pierre Pistorius and Maëlle Connan) and DEFF (Azwianewi Makhado). Monitoring at Gough Island has been taken over by the RSPB. This project overlaps with the 'Island Conservation' and 'Moult and migration' projects.

Activities in 2020

- Florian Orgeret continued his post-doc at NMU, comparing seabird tracking data from Marion Island with similar data collected by French researchers at the neighbouring Crozet islands.
- Stefan Schoombie returned from a third year on Marion Island in May 2020 to complete his PhD on fine-scale foraging behaviour of albatrosses and petrels. In addition to working through vast amounts of daily diary data for his PhD, he drafted a paper on the year-round dispersal and moult of Sooty Albatrosses *Phoebetria fusca*. He will submit his PhD in March 2021.
- Tegan Carpenter-Kling published two papers from her PhD. The first, in *Ecology and Evolution*, dealt with the responses of four sympatric albatross species to environmental variability. The second, in *Movement Ecology*, provided a critical assessment of marine predator isoscapes in the southern Indian Ocean, based on tracking data from several seabirds breeding on Marion Island.

Common Diving Petrels have recolonised Marion since cats were eradicated in 1991. They nest on coastal slopes around the island, often close to other species. Here some curious Macaroni Penguins stop to watch Stefan measuring a diving petrel (Photo: Stefan Schoombie).

- Farisayi Dakwa made good progress with his MSc on the population ecology of sympatric *Eudyptes* penguins at the Prince Edward Islands. His first paper, on long-term variation in the diet of Macaroni *E. chrysolophus* and Eastern Rockhopper Penguins *E. filholi* was accepted for publication in the *African Journal of Marine Science*.
- Shamiso Banda started her MSc on behavioural plasticity in Sooty Albatrosses and Danielle Keys started a PhD on the interaction between foraging behaviour and demographic responses in Wandering Albatrosses *Diomedea exulans*.
- Former student Chris Jones published the main paper from his MSc on the at-sea distribution of Broad-billed *Pachyptila vittata* and MacGillivray's Prions *P. macgillivrayi* in *Marine Biology*. The

paper also used time-on-water data to identify the key moult areas for these species, which undergo a short, intense wing moult shortly after they finish breeding.

- Seabird tracking data collected over the last decade contributed to various papers attempting to identify key areas at sea for seabird conservation. The most high profile of these was a large synthesis lead by Mark Hindell and former NMU postdoc Ryan Reisinger in *Nature*. Other papers appeared in the *Journal of Applied Ecology, Animal Conservation* and *Endangered Species Research*.
- Ryan Reisinger published the paper comparing the at-sea distribution and habitat use between the two sibling giant petrel species breeding at Marion Island in *Royal Society Open Science.*
- Theresa Burg's MSc student, Dlini Abeyrama, had a paper on the population genetics of yellow-nosed albatrosses accepted for publication in *Conservation Genetics*.
- Pierre Pistorius co-authored a paper in the *Proceedings of the National Academy of Sciences USA* that analysed the genomes of all extant penguin species to infer the timing and location of their diversification. The study highlighted that penguins originated during the Miocene in New Zealand and Australia and not in Antarctica as previously thought.
- Pierre Pistorius co-authored two papers on Gentoo Penguins *Pygoscelis papua*: one in *Diversity and Distributions* demonstrating genetic differences between populations across their range, and one in *Molecular Biology and Evolution* highlighting pathogen-induced immunogenetic selection.
- Peter Ryan published a paper in *Antarctic Science* on Blue Petrel *Halobaena caerulea* moult, which reported a major moult area off West Antarctica discovered during the Antarctic Circumnavigation Expedition in 2016/17.
- Post-doc Ben Dilley published an estimate of the population of Great-winged Petrels *Pterodroma macroptera* breeding on Marion Island in *Ostrich*. Two other papers on seabird breeding biology also were published.
- Kim Stevens took a leave of absence from her PhD on the demography and at-sea movements of Grey-headed Albatrosses *Thalassarche chrysostoma* to lead the RSPB team on Gough Island from September 2020 to October 2021.
- Lyle de Menezes has been continuing his MSc focussed on the trophic ecology and plastics loads in Salvin's Prions and Blue Petrels at Marion Island. He is planning to hand in his MSc thesis in mid-2021.
- At the start of 2020, Maëlle Connan and Ben Dilley conducted 2.5-months fieldwork on burrowing petrels at Kerguelen thanks to a collaboration with French colleagues Christophe Barbraud and Yves Cherel.

Highlights:

- Twenty papers on Southern Ocean seabirds and their conservation were published in 2020.
- Tegan Carpenter-Kling completed her PhD and was appointed as a seabird researcher for BirdLife South Africa.
- Maëlle Connan and Peter Ryan were awarded one of only three island-based research grants through the South African National Antarctic Programme for 2021-2023. The project will focus on avian scavengers at Marion Island to establish robust baselines prior to the mouse eradication.

Key co-supporters

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

Research team 2020

Prof. Peter Ryan (FIAO, UCT)
Prof. Pierre Pistorius (NMU)
Prof. Res Altwegg (SEEC, UCT)
Dr Maelle Connan (NMU)
Dr Florian Orgeret (NMU)
Dr Theresa Burg (U. Lethbridge, Canada)
Dr Sarah Convese (Oregon)
Dr Richard Cuthbert (formerly at RSPB)
Dr Jacob González-Solis (U. Barcelona)
Dr Akiko Kato (CNRS, Chize)
Dr Azwianewi Makhado (Oceans & Coasts, DEA)
Dr Richard Phillips (British Antarctic Survey)
Dr Rob Ronconi (Canadian Wildlife Service)
Dr Yan Ropert-Coudert (CNRS, Chize)
Dr Antje Steinfurth (FIAO, UCT)
Dr Ross Wanless (FIAO, UCT and BLSA)
Dr Henri Wiemerskirch (CNRS, Chize)
Prof. Rory Wilson (Swansea U.)

Students: Tegan Carpenter-Kling (PhD, NMU); Danielle Keys (PhD, NMU); Stefan Schoombie (PhD, UCT); Kim Stevens (PhD, UCT); Shamiso Banda (MSc, NMU); Farisayi Dakwa (MSc, UCT); Lilli Ruiters (MSc, NMU).

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 subsequent import of people and materials. Birds are flagships for the conservation-management and restoration of island ecosystems. Our work centres on South Africa's Prince Edward Islands and the UK Overseas Territory of Tristan da Cunha and Gough Island.

This programme is mainly concerned with the impacts of introduced predators, especially House Mice *Mus musculus*, but also is involved in the eradication or control of introduced plants and invertebrates. 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 for the Protection of Birds (RSPB) at Gough Island. Since then, mice have been found to attack seabirds on Marion Island, and plans are underway to try to eradicate the species at both islands. The COVID-19 pandemic caused the postponement of the Gough Island Restoration Programme attempt to eradicate mice from the island from 2020 to 2021. However, on a more positive note, considerable progress was made with planning for the proposed mouse eradication on Marion Island, and action was taken against invasive species at Tristan da Cunha.

Activities in 2020

- A paper on the ongoing spread and rapid increase in impact of the introduced Soft Brown Scale *Coccus hesperidium* and its associated Sooty Mould *Seiridium phylicae* on *Phylica arborea* trees at Inaccessible Island, and its arrival on Nightingale Island, was published in *Biological Conservation*. Because the fruit of these trees is crucial for the large-billed *Nesospiza* finches on these islands, the findings prompted the RSPB to raise emergency funding to launch a biocontrol programme to limit the populations of Soft Brown Scale using parasitic wasps.
- The RSPB also arranged for another expedition to remove invasive New Zealand Flax *Phormium tenax* from Inaccessible Island.
- Post-doc Ben Dilley finalised two papers on Wilkins' Finches *Nesospiza wilkinsi*, a naturally extremely rare finch confined to Nightingale Island in the Tristan da Cunha archipelago. One paper on the finch's home range and population size is in press with *Ardea*. The other paper, contrasting the finch's breeding biology with that of the sympatric Nightingale Finch *N. questi*, is in press with the new online journal *Afrotropical Bird Biology*.
- Peter Ryan was involved in progressing plans to eradicate House Mice from Marion Island. Peter serves on the Mouse-Free Marion Management Committee and chairs its newly-constituted Scientific and Technical Advisory Group. He gave a presentation on the need for the eradication to Barbara Creecy, Minister of Environment, Forestry and Fisheries.
- Former MSc student Chris Jones led on a paper, recently published in *Emu – Austral Ecology*, that assesses the demographic impacts of House Mice predation on MacGillivray's Prions *Pachyptila macgillivrayi* on Gough Island. Virtually all the world's population of this seabird occurs on Gough Island, and breeding success is extremely low due to mouse predation. Ben Dilley published a similar paper on the impacts of Black Rats *Rattus rattus* on a colony of Broad-billed Prions *Pachyptila vittata* breeding in a coastal cave at Tristan da Cunha in *Ostrich*.
- A paper on the distribution and relative abundance of the Inaccessible Island Rail *Atlantisia rogersi* was published in *Bird Conservation International*, showing that the species remains common throughout Inaccessible Island, which is free of introduced predators.
- Martim Melo, with colleagues at the California Academy of Sciences and the University of

A large Island Tree *Phylica arborea* on Inaccessible Island that has collapsed following a heavy infestation of Soft Brown Scale *Coccus hesperidum* and its associated sooty mould (Photo: Peter Ryan).

Lisbon, worked towards creating a Gulf of Guinea Biodiversity Centre. The aim of this organisation, based on São Tomé Island, is to promote research, education, and conservation on this very important centre of endemism. An inaugural meeting with some 50 founding members from diverse institutions took place in October 2020.
(see http://gulfofguineabiodiversity.org).

Highlights:

- Considerable progress was made with plans to eradicate mice from Marion Island. Peter Ryan serves as a Director of the Mouse-Free Marion non-profit company set up to manage the operation as a partnership between the South African government and BirdLife South Africa. Anton Wolfaardt has been appointed as Project Manager from 1 February 2021, and an Operations Manager will be recruited on a part-time basis later in 2021.
- Emergency funding from the Darwin Fund has allowed the rapid screening of potential biocontrol vectors against Soft Brown Scale at the Tristan archipelago. After six months of trials, a preferred species of wasp has been identified, bred in captivity, and transported to Tristan da Cunha for a trial release on Nightingale Island in early 2021.
- Five papers were published in the peer-reviewed literature, with a further three papers in press.

Key co-supporters

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

Research team 2020

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Dr Richard Cuthbert (formerly at the RSPB)
Dr Ben Dilley (FIAO, UCT)
Dr Martim Melo (FIAO, UCT /CIBIO, U. Porto)
Dr Stefan Oppel (RSPB)
Dr Susan Miller (FIAO, UCT)
Andy Schofield (RSPB)

Research assistants: Chris Jones, Michelle Risi and Alexis Osborne (Gough 2018/19 and 2019/20); Kim Stevens, Vonica Perold and Roelf Daling (Gough 2020/21).

Hot Birds – Climate change and desert birds

The 'Hot Birds Research Project' (HBRP) is a research programme that integrates behavioural and physiological approaches to predict the impact of climate change on arid-zone birds in southern Africa and globally. The HBRP's research focuses mainly on birds in arid habitats in southern Africa, but also involves work in North America and Australia, and increasingly extends to habitats other than deserts.

In 2020, South Africa passed a grim milestone in terms of the impacts of global heating on birds. For the first time, on 8 November 2020, the country recorded a mass mortality event of birds and bats linked to an extreme heatwave in northern KwaZulu-Natal. Air temperatures on this day exceeded 40°C by mid-morning and rose to between 43 and 45°C by mid-afternoon. Staff at the Phongolo Nature Reserve reported large numbers of dead and dying birds, mostly passerines, around the reserve headquarters. Wahlberg's fruit bats *Epomophorus wahlbergi* were found dead in Pongola and Hluhluwe.

While devastating events like this are likely to become more common as climate warming progresses, HBRP work over the last 11 years has highlighted the importance of impacts that occur at cooler temperatures. In 2019, Shannon Conradie published a paper showing that the sublethal, chronic costs of behavioural changes for thermoregulation are likely to cause greater impacts on birds across southern Africa than acute mortality events. The responses of birds to hot temperatures below lethal limits, such as shade-seeking and reduced activity, limit the opportunity to forage, with important impacts on body mass and breeding success. In 2020, the HBRP expanded into Nambia, with MSc student Jess Roberts investigating thermal landscape use, opportunity costs and consequences in Dune Larks *Calendulauda erythroclamys*. In addition, Susie Cunningham, Rowan Martin and Janet Gardner published a review paper in the prestigious journal *Frontiers in Ecology and the*

Victims of a mass mortality event involving birds and bats that occurred during an extreme heatwave in northern KZN on 8 November 2020. This was the first such event recorded for southern Africa, though events like this are already common in Australia and are likely to become more common here in future. (Photos: Phongolo Nature Reserve Field Rangers).

Environment on the likely impacts of behavioural thermoregulation on fitness and population demographics in birds and mammals, and the potential of behavioural changes under high temperatures to have knock-on effects for ecosystem functioning.

Climate change impacts on breeding success

Krista Oswald was awarded her PhD at Rhodes University on Cape Rockjumpers *Chaetops frenatus* in the Fynbos mountains. She concluded that Rockjumper populations are likely to see strong negative impacts from climate change, predominantly through reduced breeding success. Warm temperatures increase nest predation by snakes, although nests in recently burned habitat have higher success. Krista also found Rockjumpers have little genetic diversity, and so may show limited adaptive capacity to rapid environmental changes. Krista published one paper in *Ibis* in 2020, and is preparing other manuscripts for publication.

Carrie Hickman began her MSc on the impacts of temperature on parental provisioning, nestling growth and telomere dynamics in Southern Ground-Hornbills, co-supervised by Susie Cunningham and Rita Covas.

Sociality and climate change

PhD student Amanda Bourne graduated in December 2020 with a thesis on the potential for helpers to buffer the fitness costs and consequences of exposure to high temperatures and drought in Southern Pied Babblers *Turdoides bicolor*. She assessed the factors that drive the evolution and maintenance of cooperation in harsh environments, while also providing insight into the ability of group living species to cope with climate change. Amanda found that both reproduction and survival are compromised during hot, dry weather, suggesting that Pied Babblers may struggle to persist as climate change advances. Although babbler groups with more helpers often produce more surviving young, larger group sizes do not appear to moderate the effects of high temperatures and drought, suggesting that these conditions act on individuals via physiological tolerance limits and resource constraints. Amanda's examiners were highly impressed with her work. She published three papers from her thesis in 2020, in *Ecology Letters, Proceedings of the Royal Society B,* and *Frontiers in Ecology and Evolution*, and currently has two further papers under review.

MSc student Jess Roberts is studying Dune Larks in the Namib Sand Sea to understand the trade-offs between foraging and thermoregulation and the consequences for body mass maintenance (Photo: Jess Roberts).

Former HBRP post-doc Margaux Rat published her data on the impacts of high and variable environmental temperatures on Sociable Weaver *Philetairus socius* social networks in *Oikos*, showing that increases in extreme temperatures and temperature variability under climate change may affect the social cohesion of colonies of this iconic Kalahari bird, with implications for individual fitness and colony function.

Non-invasive techniques

Handling stress may obscure the very signatures of environmental stress that the HBRP team is interested in, so finding less invasive ways to measure physiology in wild birds is an important research priority. The HBRP team have developed and tested non-invasive methods for measuring metabolic rates and water turnover using oral dosing with doubly-labelled water followed by faecal sampling instead of the more traditional injecting and blood sampling. Proof of this concept was published in 2019 by Amanda Bourne in *Functional Ecology*. In 2020, Amanda submitted a second study using this method to show that Pied Babbler nest failure during hot weather was linked to dehydration in incubating birds. In early 2020 Amanda went to Australia to use this methodology on Jacky Winters *Microeca fascinans* with HBRP collaborator Janet Gardner at the Australian National University (ANU). She was caught there by the pandemic and has now settled

permanently in Australia. Sadly, Janet's funding was cut by COVID-induced austerity measures, so this study will not be completed as planned.

Another part of this research, led by PhD student Celiwe Ngcamphalala, focuses on quantifying glucocorticoid ("stress hormone") concentrations. This involves validating appropriate enzyme immunoassays to quantify faecal glucocorticoid metabolites in four bird species. This analysis allows for non-invasive sampling by removing the need to catch and bleed birds to quantify stress responses. Using the assays validated by former HBRP Honours student Emma Jepsen, Celiwe and BTech student Lesedi Moagi have shown that stress responses to maximum daily temperatures differ between captive and free-ranging Pied Babblers, which reinforces the importance of these non-invasive sampling techniques. Lesedi Moagi completed this work in 2020 and is preparing a paper for publication. Honours student Michelle Bouwer validated this technique for Southern Yellow-Billed Hornbills *Tockus leucomelas* in 2020, and submitted her findings for publication, paving the way for Nick Pattinson to use faecal samples to examine stress glucocorticoid responses in breeding hornbills as part of his PhD.

Body temperature, heat tolerance, and variation in evaporative cooling capacity

PhD student Marc Freeman, together with post-doc Zenon Czenze, continued to investigate evaporative cooling capacity in multiple bird species across a gradient of maximum air temperatures within three climatically-contrasting biomes: desert, montane grassland, and subtropical thicket/forests. A key variable in Marc's research is humidity: even though maximum air temperatures in coastal forests are lower than those in deserts, high humidity is likely to limit the capacity of birds to use evaporative cooling. Marc and Zenon worked in the Richards Bay area throughout the beginning of 2020. As part of this work, they tested the temperature and heat tolerances of Red-billed Queleas *Quelea quelea*. Remarkably, they discovered that queleas could tolerate body temperatures up to 49°C, far in excess of those generally considered lethal for birds, and setting a new record for hyperthermia tolerance. These data were published in *Scientific*

A Southern Yellow-billed Hornbill male visits a nestbox in the blazing Kalahari summer. Hornbill nest success declines dramatically when temperatures exceed 35°C. This species is the current focus of work by several HBRP students (Photo: Lisa Nupen).

Reports. In addition, Zenon and his co-authors published a paper on the co-evolution of thermal physiology and movement ecology among arid-zone passerines in *Functional Ecology.*

Climate change past, present and future

Shannon Conradie continued work towards her PhD on developing novel modelling approaches integrating the thermal landscape, heat and water fluxes and behavioural decisions and trade-offs for desert birds. Ultimately, her study will enable us to construct detailed models of survival and reproduction in birds, reducing the need for detailed species-specific empirical datasets to predict avian responses to climate change. In 2020, Shannon worked on her biophysical modelling approaches and dynamic state variable models, refining these modelling techniques and validating model outputs with empirical data for Southern Yellow-billed Hornbills and Pied Babblers collected in the Kalahari.

Highlights:

- The HBRP published 21 papers in international peer-reviewed journals in 2020.
- Members of the Pretoria branch of the HBRP were involved in papers reporting new upper and lower records to avian body temperature: 49.1°C from a Red-billed Quelea and 3.3°C in a hummingbird from the Peruvian Andes.
- Amanda Bourne, Matt Noakes and Krista Oswald all graduated with PhDs. Matt and Amanda each had four papers published from their PhDs prior to graduation, and Krista had three.
- Amanda Bourne was awarded the Purcell Prize for the best UCT PhD thesis on a topic in Zoology.
- Barry van Jaarsveld received his MSc *cum laude* in September and Matthew Orolowitz graduated with his CB MSc in December.
- Matt Noakes left to take up a post-doctoral fellowship at Nicolaus Copernicus University in Poland, and Zenon Czenze was appointed as a lecturer at the University of New England, Australia, providing an important new Australian node for future HBRP research.
- The HBRP mobile physiology lab – a converted trailer with state-of-the-art thermal physiology equipment – was completed and will be deployed in Namaqualand in early 2021.
- Susie Cunningham was awarded a UCT College of Fellows Young Researcher Award, and Andrew McKechnie was elected an Honorary Fellow of the American Ornithological Society.
- HBRP team members presented at online conferences included the BOUSci 2020 *Climate change and birds: solutions to the crisis* conference, the United Nations *Deserts and Desertification* conference and the North American Ornithological Conference.
- The HBRP became officially affiliated to the IUCN Species Survival Commission, with PIs Andrew McKechnie and Susie Cunningham now serving as members of the IUCN Climate Change Specialist Group.

Key co-supporters

DSI-NRF CoE grant; SARChi Chair in Conservation Physiology, UCT URC, U. Pretoria; NRF Thuthuka Grant; Tygerberg Bird Club.

Research team 2020

Prof. Andrew McKechnie (U. Pretoria / SANBI)
Dr Susie Cunningham (FIAO, UCT)
Dr Janet Gardner (Australian National University)
Dr Alex Gerson (U. Massachusetts)
Dr Alan Lee (FIAO, UCT / SANBI)
Dr Rowan Martin (FIAO, UCT)
Dr Todd McWhorter (U. Adelaide)
Dr Ben Smit (Rhodes)
Dr Zenon Czenze (U. Pretoria)
Dr Blair Wolf (U. New Mexico)
A/Prof. Amanda Ridley (U. Western Australia)
Dr Tom Flower (FIAO, UCT / Capilano University)

Students: Amanda Bourne (PhD, UCT); Shannon Conradie (PhD, Pretoria); Marc Freeman (PhD, Pretoria); Ryno Kemp (PhD, Pretoria); Benjamin Murphy (PhD, UCT); Celiwe Ngcamphalala (PhD, Pretoria); Matthew Noakes (PhD, Pretoria); Krista Oswald (PhD, Rhodes); Nicholas Pattinson (PhD, UCT); Michelle Thompson (PhD, Pretoria); Miqkayla Stofberg (MSc, UCT); Jessica Roberts (MSc, Pretoria); Barry van Jaarsveld (MSc, Pretoria); Otto Makola (MSc, Pretoria); Matthew Orolowitz (CB MSc, UCT); Lesedi Moagi (BTech, TUT); Liamé Marais (Hons, Pretoria); Andries Janse van Vuuren (Hons, Pretoria); Michelle Bouwer (Hons, Pretoria).

Research Assistants: Lauren Bailey, Jo Balmer, Shelby Bohn, Cameron Brock, Rachel Bucksey, Josephine Bruning, John Diener, Lizzie Diener, Carla Dodd, Gabe Foley, Samantha Fourie, Amy Hunter, Justin Jacobs, Rowan Jordaan, Craig Kenny, Danielle Keys, Noxolo Kinzela, Vuyiseka Mbiko, Sakhile Mkhize, Sophie Monsarrat, Angela Moreras, Ceili Peng, Anna Probert, Keegan Schoeman, Alyssa Stulberg, Jack Thorley, Alex Thouxeau, Amy Tipton, Samantha Wagstaff.

Global change and urban birds

Urban environments create novel challenges and opportunities for birds. Understanding why and how some birds are able to adapt to urban landscapes, and others are not, is important to predict how ongoing urbanisation is likely to impact birds. This project aims to understand how birds in human-altered landscapes cope with the opportunities and pressures of human life.

Red-winged Starlings *Onychognathus morio* have developed a reputation amongst the UCT community for being sly, lunch-thieving pests. Since 2017 we have studied how these birds cope with highly variable food quality and quantity in urban environments, the stresses of sharing their space with large numbers of people, and of high summer temperatures as Cape Town's climate warms. Early correlative work showed that adult starlings benefit from high availability of anthropogenic food, gaining more weight on weekdays than on weekends, but that chicks seem to suffer, with those experiencing many high presence human days while in the nest showing reduced growth compared to those raised during lower human presence days. Miqkayla Stofberg's supplementary feeding experiment showed less clear morphological differences between nestlings fed different diets, but there were differences in the fatty acid profiles, with "junk food" chicks having lower omega-6, lower polyunsaturated fatty acid and higher saturated fatty acid blood profiles.

Miqkayla also assessed how urban environments might affect the starlings' ability to manage high temperatures. She found that, while starlings respond to high temperatures by increased panting and reduced foraging time, they did not lose body mass on hot days. This result contrasts with birds in natural environments, which lose mass at high air temperatures, and suggests the abundant food resources in urban environments may buffer some of the impacts of foraging-thermoregulation trade-offs.

Red-winged Starling male NMYY formed part of a supplementary-feeding study by Miqkayla Stofberg, investigating the effects of an urban diet on adult and nestling starlings (Photo: Susie Cunningham).

Jessleena Suri's PhD focuses on how urban land cover affects bird communities in South Africa. Based at SEEC, most of her research involves occupancy modelling of SABAP2 data, and she is ground-truthing these data with finer-scale point counts around Cape Town.

Activities in 2020

- Mikayla Stofberg completed analyses of supplementary-feeding experiments and temperature-related behaviour and is currently writing up the results of both for publication.
- Before the first COVID lockdown, Taylyn Risi showed that the availability of anthropogenic food discards to Red-winged Starlings was almost five-fold greater on weekdays versus weekends and vacation days. She submitted a paper to *Ostrich* based on her Honours project, showing that larger starlings in better body condition occupy more heavily built-up areas on campus.
- To understand the impacts of the COVID-19 lockdown, Susie Cunningham obtained permission to return to campus in June to collect weekly body mass data. Two interesting patterns emerged: first, during the hard lockdowns over winter, starlings vacated campus in the morning, returning in the afternoon to feed in flocks on fruiting fig trees. Second, birds weighed on average 4% less during winter 2020 than in 2019 or 2018. The 2020/21 breeding season is currently in full swing on campus, and we look forward to discovering whether the lockdowns have any effect on productivity. There are currently 204 colour-ringed adults and 108 juveniles and subadults on campus. Five ringed chicks have been recruited to the breeding population, with the youngest being two years old at first breeding.

- The COVID-19 lockdown prevented Jessleena from conducting her urban bird counts, but she more than offset this loss by asking homebound bird-watchers to conduct 10-minute point counts in their gardens. More than 280 birders contributed counts, some daily for over four months! These data will be valuable to determine how gardens contribute to green space and habitat for biodiversity in urban areas, as well as assess the impact of the lockdown on bird behaviour.
- Former Fitz post-doc Petra Sumasgutner moved to the Konrad Lorenz Centre (KLF) at the University of Vienna. Together, we have built a collaboration with the KLF including Dr Thomas Bugnyer, a specialist in avian cognition. CB MSc student Varalika Jain analysed movement patterns of Ravens *Corvus corax* in the Austrian Alps, using data collected over the last few years, co-supervised by Petra, Thomas and Matthias Loretto. In addition, starling volunteer Mila Truter will use an experimental approach to test whether urban starlings have the cognitive capacity to recognise individual people as dangerous, neutral or beneficial and generalise this recognition across contexts for her Honours project in 2021.

Highlights:

- Taylyn Risi graduated with her BSc (Hons), and submitted her Honours work for publication in a special issue of *Ostrich* on urban birds.
- The Red-winged Starling project collaborated in the PAN-Environment Working Group, an international team of >300 authors assessing the impact of humans on the biosphere by comparing datasets collected before, during and after COVID lockdown measures.
- Jessleena Suri's lockdown garden surveys generated considerable public awareness of her research. She contributed to a commentary on the effect of lockdown on citizen science that was published in *Ostrich*.
- We formed a collaboration with the Konrad Lorenz Centre, Vienna and look forward to working with them on starling cognition and ravens in the Austrian Alps.

Impact of the project

Studying the starlings on campus has allowed us to involve the wider university community in a citizen science project, making our research more visible and relevant. The accessibility of the project and its fieldwork has also resulted in an ideal training opportunity for younger students wanting to gain experience in behavioural research and bird observation/handling under careful supervision.

Starlings eagerly came to the scale to be weighed in return for a raisin during the hard lockdown in winter - but on average weighed 4% less than usual (Photo: Susie Cunningham).

Key co-supporters

DSI-NRF CoE grant; NRF-STINT South Africa-Sweden Research Collaboration; NRF ACESS grant.

Research team 2020

A/Prof. Arjun Amar (FIAO, UCT)
A/Prof. Res Altwegg (SEEC, UCT)
Dr Pippin Anderson (EGS, UCT)
Dr Martin Andersson (MEEL, Lund University)
Dr Thomas Bugnyer (KLF, University of Vienna)
Dr Susan Cunningham (FIAO, UCT)
Dr Arne Hegemann (MEEL, Lund University)
Dr Sally Hofmeyr (FIAO, UCT)
A/Prof. Caroline Isaksson (MEEL, Lund University)
Dr Matthias Loretto (Max Planck Institute of Animal Behaviour, Germany)
Dr Johan Nilsson (OIKOS office, Lund University)
Dr Petra Sumasgutner (KLF, University of Vienna)
Dr Robert Thomson (FIAO, UCT)
Dr Hannah Watson (MEEL, Lund University)

Students: Miqkayla Stofberg (PhD, UCT); Jessleena Suri (PhD, UCT); Varalika Jain (CB MSc, UCT); Taylyn Risi (BSc Hons, UCT)

Volunteers: Mila Truter, Chima Nwaogu, Emmanuel Adekola, Emma Swann, Carla du Toit, Rowan Hickman, Jono Plaistowe, Timothy Aikins, Anthony Lowney and many others.

The ecology of urban raptors

Urban development is increasing across the globe and poses a major threat to biodiversity, which is often relatively low in human-modified landscapes. After climate change, the United Nations considers urbanisation to be the biggest environmental challenge to the maintenance of biodiversity. Globally, there are now more people living in urban than in rural areas, and the trend towards urbanisation is faster in Africa and Asia than in any other regions of the world.

The Cape Peninsula is located on the southern tip of the African continent, where climate change is predicted to be particularly rapid and severe. In this project we focus on the responses of raptors to increasing urbanisation under climate change. On the Cape Peninsula, urban breeding Peregrine Falcons *Falco peregrinus* and Black Sparrowhawks *Accipiter melanoleucus* have been monitored for over 30 and 20 years, respectively. During this time, the populations of both species have increased markedly within the study area. Both species profit from the abundance of suitable nesting sites and their favoured avian prey, including pigeons, doves and Common Starlings *Sturnus vulgaris*. We use these two long-term data sets on individually-marked birds to investigate the effects of urban-living and weather on breeding phenology, reproductive performance and population trends.

Two curious Black Sparrowhawk nestlings peek over the rim of their nest. Both chicks were ringed as part of the long-term monitoring of the Black Sparrowhawks in Cape Town (Photo: Marlene Hofmeyr).

Besides habitat loss and fragmentation, wildlife in urban areas might also be negatively affected by altered bio-geochemical cycles and the introduction of novel urban stressors such as light, sound and chemical pollutants. Urban-exploiting or adaptable species that are able to make use of abundant resources in the short-term, might thus still suffer from other hidden costs of urban living, which could undermine their long-term health and persistence in urban environments. We use the Black Sparrowhawk study system and a biomarker approach to investigate such possible health impacts. Taking small blood samples from adults and their offspring, we have quantified eco-physiological parameters such as immune assays, oxidative stress and dietary antioxidants. The eco-physiological component of this research has been carried out in collaboration with Lund University, Sweden, as part of a bilateral project funded by the NRF and STINT which ended in 2020.

Activities in 2020

- Although the COVID-19 pandemic made field work difficult, we ringed 30 Black Sparrowhawk nestlings from 15 territories in 2020.
- Together with Assoc. Prof. Caroline Isaksson from Lund University, we finalised the three-year joint NRF/STINT South Africa-Sweden research collaboration focusing on urban avian ecology. We continued writing a review paper and several original research papers. Arjun Amar and Caroline Isaksson presented a summary of the completed project at the NRF/STINT closing ceremony.

Highlights

- A paper on the influences of weather and urbanisation on Peregrine Falcon phenology and breeding success was published by Petra Sumasgutner, Andrew Jenkins, Arjun Amar and Res Altwegg in *PLoS One*. The paper used

A Black Sparrowhawk nestling that was ringed by our project is fed by its mother. The ringing of Black Sparrowhawk nestlings is a vital effort in obtaining long-term data on the species (Photo: Marlene Hofmeyr).

Andrew's long-term dataset on breeding peregrines in Cape Town and highlighted the value of nest boxes for the species in a changing environment.

- Rebecca Muller published a paper in *Condor - Ornithological Applications*. Data collection was undertaken in collaboration with Dr Shane McPherson and Prof. Colleen Downs (UKZN) and unravelled the productivity of urban Crowned Eagles *Stephanoaetus coronatus.*
- Drs Petra Sumasgutner and Shane McPherson gave an invited talk at the 7th North American Ornithological Conference (NAOC) in a Round Table Discussion about the use of drones in avian research, specifically to survey raptor and raven nests in anthropogenic landscapes.
- Drs Chevonne Reynolds and Petra Sumasgutner wrote a chapter on urban animal diversity in the Springer Book *Urban Ecology in the Global South* (currently in press) which specifically highlights the role of predators for functional diversity in cities.

Impact of the project

The project is 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-supporters

DSI-NRF CoE grant; NRF-STINT South Africa-Sweden Research Collaboration, Claude Leon Foundation.

Research team 2020

A/Prof. Arjun Amar (FIAO, UCT)
Dr Chima Nwaogu (FIAO, UCT)
Prof. Res Altwegg (SEEC, UCT)
Dr Andrew Jenkins (ADU, UCT)
Dr Petra Sumasgutner (FIAO, UCT & U. Vienna)
Dr Arne Hegemann (MEEL, Lund University)
A/Prof. Caroline Isaksson (MEEL, Lund University)
Dr Hannah Watson (MEEL, Lund University)
Prof. Colleen Downs (UKZN)
Dr Shane McPherson (UKZN)

Student: Carina Nebel (PhD, UCT).

Research Assistants: Rebecca Muller, Burghen Siebert.

Volunteers: Ann Koeslag, Marlene Hofmeyr, Paddy Walker, Margaret MacIver, Antje and Bernard Madden.

Plastics in the environment

Plastic litter persists for many years, is readily dispersed by water and wind, and has been accumulating in the sea for decades, where it gradually breaks down into 'microplastics'. It entangles and is eaten by a wide diversity of aquatic fauna, killing them directly, or reducing their appetite. Concerns about microplastics introducing persistent organic pollutants (POPs) into aquatic foodwebs, combined with the discovery of 'garbage patches' in all the main ocean gyres, has sparked renewed interest in the subject. This project aims to understand and monitor plastic pollution with a view to reducing the amount entering the environment.

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 serious environmental and economic threat. The most significant threat arises from plastic ingestion, so it is important to understand why organisms ingest plastic. Vonica Perold's PhD is comparing plastics ingested by seabirds with those found in the environment, and assessing changes in ingested plastic since the 1980s. However, although much remains to be learned about the impacts of plastics on aquatic ecosystems, we know enough to act to reduce waste plastic entering the environment.

Reducing plastic pollution depends on changing human behaviour through education, policy

Vonica Perold and Kyle Maclean release marked blocks of expanded polystyrene, wood and high density polyethylene in the mouth of the Strandfontein outfall to determine the proportion of litter items coming down rivers that wash ashore in relation to litter buoyancy (Photo: Peter Ryan).

Large numbers of bottles washed up on the beach at the mouth of Rietvlei near Milnerton following a winter storm. Surveys around the coast of South Africa led by Peter Ryan and Maëlle Connan show that while local bottles dominate urban beach litter, they comprise less than half the bottles on remote beaches. Foreign PET drink bottles mainly are dumped illegally from ships, but many HDPE bottles have drifted across the Indian Ocean, mainly from Indonesia (Photo: Peter Ryan).

interventions, incentives, etc. The main role for Fitz researchers is to provide indicators of environmental plastics, to feedback on whether measures introduced to reduce plastic leakage are effective. We monitor plastic in the environment – through interactions with biota as well as sampling at sea and on beaches. We also infer the origins of 'general' marine litter, which could come from a variety of sources, through use of bottles and lids as indicators. Knowing where marine plastic comes from, and how it disperses through the environment, is crucial to target mitigation measures.

Activities in 2020

- Vonica Perold started a PhD on seabird plastic ingestion, comparing plastics in seabirds over the last three decades with plastics available at sea. She published a paper in *Marine Pollution Bulletin* on decadal changes in plastic litter regurgitated by albatrosses and giant petrels at Marion Island, and also co-authored a paper in the *Journal of Hazardous Materials* showing the presence of multidrug resistant bacteria on plastic litter in Zanzibar. She took a one-year leave of absence to assist the RSPB as a field assistant on Gough Island from Sept 2020.
- Eleanor Weideman graduated with her MSc on freshwater plastic pollution, and published two papers from her thesis in *Science of the Total Environment*: one on pollution in the Orange and Vaal Rivers, and one on macroplastic loads in three Cape Town storm water drains. She also wrote up two further papers, one in *Marine Pollution Bulletin* reporting three years of monthly sampling of intertidal litter on the rocky shore at Muizenberg conducted in collaboration with The Beach Co-op, and one in *Environmental Pollution* based on Christie Munroe's Hons project on plastic ingestion by the Sandy Anemone *Bunodactis reynaudi*.
- Brandon Opie completed his research project for an MSc in Applied Ocean Sciences based on daily litter arrival rates at Milnerton and Koeberg beaches in winter, spring and summer.

Honours student Emily Spencer studied the use of plastic and other litter as sunshades by Cape Urchins. Plastic is an order of magnitude more abundant on urchins at Dalebrook than any other site examined on the Cape Peninsula. Regular sampling every spring low tide provides an easy way to monitor seabed litter in the region (Photo: Peter Ryan).

Autumn sampling at Milnerton was conducted in April 2020, during the COVID-19 lockdown, led by Eleanor Weideman. Winter litter arrival rates have increased compared to the 1990s, but summer rates have decreased considerably at Milnerton, probably due to efforts to reduce litter loads in the Black River.

- Two BSc Hons students completed field-based plastic projects despite the COVID-19 pandemic. Kyle Maclean continued the 'litter trace' experimental release of marked plastic and wood blocks at river mouths to estimate the proportion of land-based litter that washes ashore shortly after entering the sea. Emily Spencer was prevented from processing microplastic samples collected by Vonica Perold and Eleanor Weideman during Antarctic cruises in 2019 by lack of access to UCT labs. Instead she explored the use of plastic and other litter as sunshades by Cape Urchins *Parechinus angulosus*. Sampling for this project continues every spring low tide at the key study site, near Kalk Bay, where urchins use plastic much more than all other sites sampled around the Cape Peninsula.
- At the start of 2020, Maëlle Connan and Ben Dilley conducted 2.5-months fieldwork at Kerguelen thanks to a collaboration with French colleagues Christophe Barbraud and Yves Cherel. They assessed plastic loads in small burrowing petrels by sampling Brown Skua *Stercorarius antarcticus* regurgitations.
- The City of Cape Town's Gregg Oelofse provided the opportunity to sample beach litter during the initial COVID-19 lockdown in April-May 2020. This prompted two papers, one on the impacts of COVID lockdowns on street litter published in *Environmental Processes*, and one showing the limited dispersal of litter from rivers entering into False Bay that is in press with *Estuarine, Coastal and Shelf Science*.
- Peter Ryan led on a paper that sampled superficial and buried plastic pollution across a wide range of spatial scales on a remote beach in the West Coast National Park, which was

published in *Frontiers in Marine Science*. This showed that although microplastics dominate in terms of the numbers of plastic items, surface macrolitter accounts for more than 90% of the mass of plastic. This highlights the value of cleaning macrolitter before it degrades into microplastics.

- Peter also published six other papers: two review papers among a suite of five regional reviews in the *South African Journal of Science*; one describing seafloor litter off South Africa based on rubbish caught during hake stock survey trawls in *Marine Pollution Bulletin*; one showing the diverse origin of bottles on Kenyan beaches in *Waste Management*; and two papers in *Marine Pollution Bulletin* arising from his visit to the Pitcairn Islands in 2019.

Highlights:

- An impressive 21 papers were published in 2020.
- Peter Ryan was awarded a two-year contract from 2021 to produce an inventory of litter interception devices currently deployed on South African rivers. 2020 Hons student, Kyle Maclean, will undertake this study, which includes assessments of the amounts of litter intercepted and the efficacy of different designs used to trap litter. HRA Patrick O'Farrell will help to supervise a CB MSc project using GIS to identify the most important sites in South Africa for installing additional interception devices.
- Peter Ryan and Eleanor Weideman teamed up with Martin Thiel and Daniela Honorato from Chile to successfully tender to conduct a review of marine plastic pollution in the Western Indian Ocean region.

The loss of several shipping containers of industrial pellets or 'nurdles' off the southern Cape coast in October 2020 resulted in millions of pellets washing up on beaches around South Africa (Photo: Peter Ryan).

Heavily polluted wetlands on the Cape Flats are a major source of plastic litter into the coastal waters around Cape Town, mainly when winter storms flush litter out of wetlands. However, regular monitoring of litter stranding on beaches shows that most litter from wetlands entering False Bay, such as Zandvlei shown here, wash ashore (Photo: Peter Ryan).

Key co-supporters

Plastics SA, South African Department of Science and Innovation, through the Waste RDI Roadmap, managed by the Council for Scientific and Industrial Research (CSIR), Commonwealth Litter Programme (CLiP), United Nations Environment Programme, WIOMSA.

Research team 2020

Prof. Peter Ryan (FIAO, UCT)
A/Prof. Coleen Moloney (Biological Sciences, UCT)
Dr Maelle Connan (NMU)
Dr Patrick O'Farrell (FIAO, UCT)
Aaniyah Omardien (The Beach Co-op)
Dr Stefano Aliani (CNR-ISMAR)
Guiseppe Suaria (CNR-ISMAR)

Students: Vonica Perold (PhD, UCT); Eleanor Weideman (MSc, UCT); Brandon Opie (AOS MSc, UCT); Kyle Maclean (Hons, UCT); Emily Spencer (Hons, UCT).

Assistants and volunteers: Nicola Okes, Melissa Rankin.

Detecting aliens from space

Biological invasions are responsible for some of the most devastating impacts on the world's ecosystems, and freshwater ecosystems are among the worst affected. Invasions not only threaten freshwater biodiversity, but also the key ecosystem services provided by wetlands. Tackling the impact of invasive species on wetlands is a major challenge that requires detailed information on alien species distribution and spread. This is particularly urgent in South Africa, where freshwater resources are scarce and increasingly pressured.

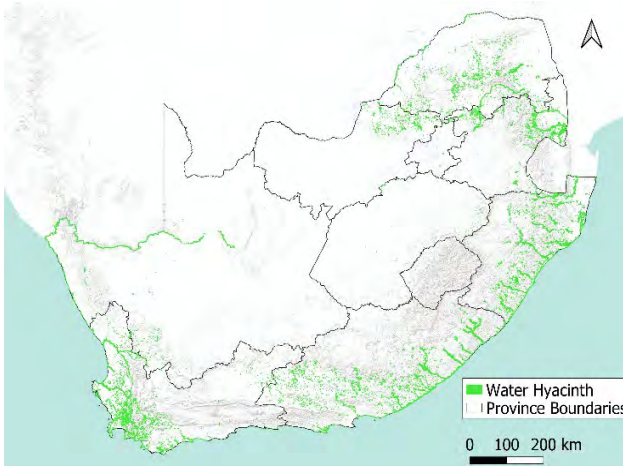
This project utilises satellite data and cloud computing platforms to map the distribution of Water Hyacinth *Eichhornia crassipes* across South African waterbodies and explore reasons for its spread. PhD student Geethen Singh is undertaking this valuable research in collaboration with Chevonne Reynolds, Benjamin Rosman and Marcus Byrne of the University of the Witwatersrand.

South Africa's surface water is frequently imaged by overpassing satellites. These images can track water level changes from national extents down to individual dams, providing scientists and water managers with near real-time monitoring of water resources. Invasive aquatic alien plant species present a serious threat to South Africa's freshwater resources as they increase water loss through evapotranspiration. Water weeds can increase water loss by 130–180%. Water body area and the percentage cover of invasive aquatic weeds are crucial information needed to facilitate the removal and management of invasive plants such as Water Hyacinth. However, field assessments to obtain this information are often time-consuming, costly and labour intensive. Freely available satellite images provide a cost-effective alternative to reliably and regularly estimate the cover of water weeds. In this way, the extent of water weed infestation and its associated drivers can be tracked.

Once an invasive alien species has become established in a wetland, it can be very difficult to stop or even slow its invasion. Thus, the early detection of and rapid response to invasive alien species are needed to make management targeted, feasible and effective. Consequently, there is an urgent need for techniques that enable consistent, fast and accurate monitoring. This will allow invasion biologists the unprecedented capability to systematically monitor invasive alien species over the introduction, establishment and secondary dispersal phases of the invasion process, across large areas with a reduced risk of accidental invasive alien plant dispersal by field personnel.

Over the last year, Geethen has made excellent progress in creating a remote sensing method to monitor water, aquatic vegetation and the invasive Water Hyacinth. He is using semi-automated satellite image analysis techniques, such as semantic segmentation of freely available Landsat and Sentinel-2 imagery, to map the distribution of Water Hyacinth across South Africa. In collaboration with the Centre for Biological Control at Rhodes University, who provided valuable ground-truthing data for the species, Geethen has been able to produce accurate and robust predictions of aquatic vegetation and its subsequent discrimination across South Africa.

By conducting his analyses in the Google Earth Engine cloud computing platform, Geethen is able to produce up-to-date maps of invasive species distributions and percentage cover on a near-real-time basis. He has created an application to make



The (maximum extent) distribution of (green) Water Hyacinth across South Africa during 2013.

Step 1: Sentinel-2 Input Image	Step 2: Water Detection	Step 3: Aquatic Vegetation Detection

The high-level process used to derive the 2013 Water Hyacinth distribution (In fig. 1). A water detection algorithm is applied to an input Sentinel-2 image. Thereafter, by limiting the processing to this water boundary, aquatic vegetation is detected, and Water Hyacinth is discriminated from surrounding vegetation using a machine learning model. The images shown represent Hartbeespoort dam as seen on 10th December 2020.

these products available to managers and decision makers when they require them. Geethen is currently investigating how other satellite-derived data products can provide information on biotic and abiotic drivers of water hyacinth at a national and waterbody scale. This will include using satellite telemetry data of southern African waterbirds to assess the contribution of this little considered vector in invasive species spread. With the ability to identify the dominant drivers within regions comes the ability for managers to tailor more effective strategies to combat invasive populations.

Activities in 2020

- Geethen published a manuscript on a method to derive the national distribution of Water Hyacinth.
- Geethen presented a GIS course to Wits honours students.
- Geethen co-created and presented a two-day introductory course on the Google Earth Engine to OTS students and staff.
- Geethen created and presented a one-day workshop to SASSCAL grant members.
- Geethen created and presented a Google Earth Engine for conservation practical component for a master's Course and co-created one for the Conservation and Ecology online OTS course.
- Geethen attended numerous online 'geo for good' summit talks, webinars and talks during the lockdown.
- Geethen was involved in the discussion stages of a European Space Agency-funded project for mapping invasive aquatic weeds.

Highlights:

- Geethen has published the first paper based on his PhD research.
- Geethen has gained teaching/instructor experience through the multiple courses he has created and/or delivered.

Key co-supporters

DSi-NRF CoE grant.

Research team 2020

Dr Chevonne Reynolds (APES, Wits)
Dr Benjamin Rosman (Applied Maths, Wits)
Prof. Marcus Byrne (APES, Wits)

Student: Geethen Singh (PhD, Wits)

Conservation Biology Masters programme 2020

The 2020 intake of CB students comprised 13 students from ten countries, South Africa, Australia, India, Malawi, Mauritius, Tanzania, the UK, the USA, Zambia and Zimbabwe. This diverse group included the first part-time student. Debbie Stanbridge balanced new motherhood with the stringent academic demands of the course, successfully completing over half of the coursework modules and her project work in 2019 and finishing the remaining modules in 2020, with a coursework distinction. The 2020 cohort was an extremely strong group academically, with nine students achieving distinctions in the coursework component, despite extremely trying learning conditions, with the course forced online in March due to the pandemic. At the time of writing, the class are busy completing their dissertations for submission by 15 March 2021.

Course structure and teachers

The course continues to be taught by a wide range of module leaders from within and outside UCT. In 2020, the module leaders were: Arjun Amar (Statistical Analyses); Colin Attwood (Marine Conservation); Jacqui Bishop (Conservation Genetics); Susie Cunningham (Biodiversity Basics); David Cumming (Big Picture and Philosophy of Science); Wendy Foden (Conservation Leadership); Dalton Gibbs (Urban Ecology and Conservation); Lindsey Gilson (Climate Change); Patrick O'Farrell and Mireille Lewarne (Landscape Ecology and GIS); Justin O'Riain and Vincent Naude (Conservation in Practice); Sebataolo Rahlao and John Hoffman (Invasion Ecology); Peter Ryan (Demography and PVA); Jeremy Shelton (Freshwater Conservation); Claire Spottiswoode and Gabriel Jamie (Project Planning); Gladman Thondhlana (Conservation and Society); Robert Thomson and Timm Hoffman (Community Ecology); and Jane Turpie (Resource Economics). In addition, many others contribute through guest lectures, field trips and discussions. This diversity of perspectives adds greatly to the course.

Challenges and opportunities

The COVID-19 pandemic created a huge challenge for the course in 2020, and this continues into 2021. The lockdown from March 2020 meant we had to move the course entirely online and cancel the Tswalu field camp. This was extremely difficult for the students and module leaders, but all adapted well and rose to the challenge of working online, and all students successfully completed the coursework component with good grades. The pandemic also impacted research project choices, with all but two being desk-based studies.

A combination of careful planning and good timing meant we were able to run a catch-up "boot camp" in November during which the students took part in a mini-field camp to Grootbos Nature Reserve with Peter Ryan and Coleen Moloney, went to sea in False Bay with Colin Attwood and had the opportunity to network with past CB students. In this way, some of the field experiences the students missed out on during the year were partly made up.

To reduce the risk of online teaching again in 2021, we decided to shift the start date of the class to 17 May 2021, in the hope that COVID restrictions would be lifted by then. The 2021 cohort will complete their coursework between May and December 2021 and their projects between January and June 2022. Despite this delay, the ongoing pandemic means that we are likely to use a mixture of online and face-to-face teaching. We are nonetheless still hopeful that field trips will be able to go ahead, and hope to be able to return to a normal schedule in 2022.

Highlights

- Research carried out by CB MSc students for their dissertations continues to produce publication-quality results. In 2020, at least four papers from CB projects were published in international journals. We are excited that our CB students' research is being disseminated widely and can improve conservation outcomes in Africa and globally.
- Despite the disruption caused by the coronavirus pandemic, all 13 of the 2020 cohort of students completed the coursework component of the degree, with nine achieving distinctions.
- Debbie Stanbridge graduated in December 2020, as the first student to complete the CB MSc part-time. Debbie paves the way for other young mothers to complete the course, proving that there need not be a trade-off between motherhood and higher education.

MSc Conservation Biology projects 2020

Jessica Burnette: The role of images in freshwater conservation in South Africa. Supervisors: Jeremy Shelton, Arjun Amar and Olaf Weyl.

Hannah Edwards: Population density estimates of spotted hyena, *Crocuta Crocuta* in KwaZulu-Natal reserves. Supervisors: Justin O'Riain and Gareth Mann.

Rowan Hickman: How does surface mining impact surrounding Miombo woodland bird communities? Supervisors: Gabriel Jamie and Claire Spottiswoode.

Varalika Jain: How do non-breeding ravens vary in their spatial use of anthropogenic food resources across temporal scales? Supervisors: Petra Sumasgutner, Thomas Bugnyar and Susan Cunningham.

Tamar Kendon: Snare incidence and ranger monitoring data optimise anti-poaching efficacy in the Boland region of South Africa. Supervisors: Justin O'Riain, Anita Wilkinson and Vincent Naude.

Eliupendo Laltaika: Understanding the mutualistic interaction between Greater Honeyguides and four co-existing human cultures in northern Tanzania. Supervisors: Claire Spottiswoode and Jessica van der Wal.

Merlyn Nkomo: The influence of rainfall on the Verreaux's Eagle and their prey species in Matobo, Zimbabwe. Supervisors: Arjun Amar and Megan Murgatroyd.

Jonathan Plaistowe: An assessment of adaptation services in South Africa's terrestrial protected area network. Supervisors: Wendy Foden, Patrick O'Farrell, and Timm Hoffman.

Imithiaz Sheik Abbass: The effect of land-use change on the availability of foraging habitats for the Bearded Vultures in southern Africa. Supervisors: Arjun Amar, Megan Murgatroyd and Sonja Kruger.

Debbie Stanbridge: Rhinos on the move: What can Kruger's black rhinos tell us about the genetic consequences of translocation? Supervisors: Justin O'Riain and Nikki le Roex.

Tom Thacker: The genetics of leopards across southern Africa – a new perspective for conservation. Supervisors: Jacqui Bishop and Vincent Naude.

Gemma Walker: The effects of urbanisation on pollinator communities in Cape Town, South Africa. Supervisors: Charlene Janion-Scheepers, Peta Brom and Patrick O'Farrell.

Debbie Walsh: Can communicating a better understanding of conservation problems shift attitudes to conservation measures? A case study using chacma baboons on the Cape Peninsula. Supervisors: Justin O'Riain, Nicoli Nattrass and Dave Gaynor.

The CB MSc class of 2020 on an early field trip to Betty's Bay prior to the COVID-19 lockdown (Photo: Callan Cohen).

Niven Library

The Niven Library is often touted as the largest ornithological library in the Southern Hemisphere. Named after Dr Cecily Niven, the main architect of the FitzPatrick Institute of African Ornithology, it houses the joint collection of the Fitz and BirdLife South Africa. The main reading room also serves as a meeting place for staff, students, and visitors as it hosts Fitz Friday teas, meetings, seminars, the annual general meeting, and occasional classes.

Introduction:

As was generally the case, 2020 was an unusual and somewhat frustrating year for the Niven, with numerous tasks and projects put on hold due to the COVID-19 pandemic. There was very limited access to the library between mid-March and August, and even after that the librarian only visited campus once a week to fill SAFRING orders and complete essential library tasks.

Open to the public?

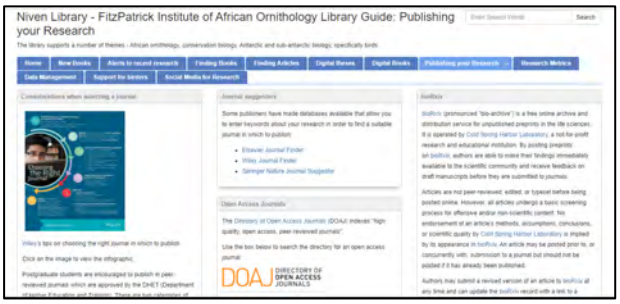
Although some library work had to be postponed, the Niven remained very much "open" to staff, students, and other users as the librarian kept researchers informed of library resources via emails and online meetings. To support researchers working from home, instructions were distributed at the beginning of lockdown on how to access online library resources while off-campus.

COVID-19 lockdown restrictions instigated greater cooperation amongst libraries, with many international insitutions making their resources freely available. With the help of these libraries and the various online resources available via the UCT network, the Niven librarian sent almost 300 files in response to local and international queries, ensuring that information was supplied and requests were fulfilled digitally while everyone worked from home.

Requests for information only available in hard copy were set aside for the weekly visit to the library, when pdf copies could be made and emailed to users.

Business (mostly) as usual:

Most awareness services, such as the email service advertising new papers and articles written by Fitz researchers, continued uninterrupted. Others took on a new guise: With lockdown restrictions on postal services from certain countries, hard copy journal and newsletter issues could not be delivered to the library. In response, some publishers made their publications available digitally and these were distributed via email by the librarian.



"Publishing your research": A web page being populated to support early career researchers new to publishing.

As library users were unable to browse physical copies of current journals, the librarian made available a hyperlinked list of the Niven's digitally accessible subscription journals and, throughout the year, contents pages of these were distributed via email.

Although meetings in the library were on hold for most of the year, an online journal club meeting focussed on how to choose a publication for your research sparked an idea for a writing resources web page. The librarian has since been liaising with the postgraduate journal club organiser and populating the site, which will be completed this year.

Collection development, preservation, and donations

Despite lockdown and postal restrictions, the library purchased six new books and acquired two books for review. We are also grateful for the donation of books from Marilyn Scholtz.

All issues of *Africa Birds & Birding* and *African Birdlife* were bound, along with 19 years of issues of *Promerops* and 15 years of *Ostrich*, ensuring the preservation of these publications for future researchers.


Kalahari skinks eavesdrop on sociable weavers to manage predation by pygmy falcons and expand their realised niche.

Cite | Download all (137.81 kB) | Share | Embed | + Collect

1157 views | 96 downloads | 0 citations

Dataset posted on 30.04.2020, 09:33 by Anthony Lowney, Tom P. Flower, Robert L. Thomson

Eavesdropping on community members has immediate and clear benefits. However, little is known regarding its importance for the organisation of cross-taxa community structure. Furthermore, the possibility that eavesdropping could allow species to coexist with a predator and access risky foraging habitat, thereby expanding their realised niche, has been little considered. Kalahari Tree Skinks (*Trachylepis spilogaster*) associate with Sociable weaver (*Philetairus socius*) colonies, as do African pygmy falcons (*Polihierax semitorquatus*), a predator of skinks and weavers. We undertook observational and experimental tests to determine if skinks eavesdrop on Sociable weavers to mitigate any increase in predation threat that associating with weaver colonies may bring. Observations reveal that skinks use information from weavers to determine when predators are nearby; skinks were more active, more likely to forage in riskier habitats and initiated flight from predators earlier in the presence of weavers, compared to when weavers were absent. Playback of weaver alarm calls caused skinks to increase vigilance and flee, confirming that skinks eavesdrop on weavers. Furthermore, skinks at Sociable weaver colonies were more likely to flee than skinks at non-colony trees, suggesting that learning is mechanistically important for eavesdropping behaviour. Overall, it appears that eavesdropping allows skinks at colony trees to gain an early warning signal of potential predators, expand their realised niche and join communities, whose predators may

CATEGORIES
- Animal Behaviour
- Behavioural Ecology
- Evolutionary Biology
- Zoology

KEYWORDS
heterospecific eavesdropping


High temperatures are associated with substantial reductions in breeding success and offspring quality in an arid-zone bird

Cite | Download all (57.47 kB) | Share | Embed | + Collect

536 views | 75 downloads | 0 citations

Dataset posted on 06.04.2020, 08:47 by Tanja van de Ven, Andrew E McKechnie, Sebnem Er, Susan Cunningham

Datasets include hornbill provisioning data (20200402_ProvisioningData; table 1), female and chick body mass change (20200402_MbChange; table 2 and figure 1), fledgling development data (20200402_FledglingDevelopment; figure 2), probability of fledging success data (20200402_FledgingProbability; figure 3) and data for SEM analysis (20200402_SEMdata; figure 4).

Data sets with the most views on ZivaHub in the 2nd quarte of 2020: https://doi.org/10.25375/uct.8248064.v1; https://doi.org/10.25375/uct.12063591.v1

Climbing the research data charts

In 2019, Fitz researchers were introduced to the concept of research data management and training was provided on the use of UCT's research data repository, ZivaHub. The Niven librarian assists Fitz researchers with their submissions to the repository as well as moderating and publishing these submissions.

Fitz researchers have been enthusiastic about submitting their data to this platform and this has paid off in terms of the attention our data sets have received. A data set uploaded in 2019 by postdoctoral fellow, Dr Susan Miller, was used in 2020 in a case study showcasing ZivaHub. Mid-year, we received news that two of our data sets were among the ten most viewed items in the second quarter of the year.

In addition, the Biological Sciences department, which had 25 data sets on ZivaHub, 17 of which originated at the Fitz, moved from 6th to 3rd place in the list of top research categories on ZivaHub. The librarian continues to encourage research data management practices by distributing reminders and ZivaHub statistics and supporting researchers in their submissions to the platform. To date, data sets from the Fitz still make up the majority of the Department of Biological Sciences' ZivaHub entries.

***The Hornbill*: One of the newsletters received electronically.**

A new role: journal management

Alongside the revision of *Roberts Birds of Southern Africa*, edition 7, *Roberts* editors and the Fitz initiated the establishment of an e-journal to encourage the publishing of data and personal observations. The journal, named *Afrotropical Bird Biology: Journal of the Natural History of African Birds* (ABB), is hosted by UCT Libraries' Open Journal Systems platform, and managed by the Niven librarian.

In 2020, UCT Libraries staff provided training on the online journals platform and the librarian populated the ABB website. When the journal is launched this year, the librarian will be responsible for the day-to-day management of the journal and ensuring the movement of manuscripts from submission to publication.

Niven Library Staff 2020

Janine Dunlop (Niven Librarian)
Phelisa Hans (Niven Library Assistant)

We have to say a sad 'farewell' to Phelisa Hans, who has worked in the Niven since 2007 and became a familiar and valued member of the Fitz community. As Library Assistant, Phelisa filled many roles over the years, including digitisation of theses, responding to requests for information, processing of new material, shelving and shelf-reading, and managing the library while the librarian was away. Her many years of experience in the Niven meant that she was able to provide continuity and institutional knowledge when needed and her knowledge of the collection proved invaluable to new students and staff.

SAFRING report

SAFRING, the South African Bird Ringing Unit, administers bird ringing within southern Africa, and to some extent throughout the rest of Africa, supplying rings and services to volunteer and professional ringers. SAFRING curates all the southern African ringing records and maintains close links with other ringing schemes. It performs a critical function for bird research in the region.

2020 was a relatively quiet year for SAFRING. Various levels of COVID-19 lockdown and limited access to campus meant that only core functions continued. Despite this, the value of bird rings sold increased over 40% compared to 2019, suggesting that many bird ringers spent lockdown ringing in their gardens.

SAFRING received stock and made payment for several thousand new rings from orders made in 2019. In addition, with the help of the Endangered Wildlife Trust, SAFRING ordered and received delivery of two new rings series (1000 rings each) for vultures and large eagles which will improve the ring options for researchers working on these groups. Towards the end of the year a large order was placed for 159 000 rings, which will be delivered during the course of 2021.

Data requests remain a key task for Kim-Kelly Hunt. Although most requests come from researchers and ringers in southern Africa, there are requests from scientists around the world. In 2020, SAFRING received data requests from Canada, New Zealand and the UK.

Resighting posted onto the SAFRING Facebook page of a ringed and wing tagged Hooded Vulture from the Kruger National Park (Photo: Evert Post).

Social media

SAFRING has a Facebook group and a Twitter page which are used to inform the public of interesting re-sightings as well as to advertise ringing events and ringing equipment sales to licensed ringers. These sites are also used by members of the public to report their own sightings and to find out more about them. The Facebook group was the favoured reporting site in 2020, receiving numerous posts from members requesting information on birds that had been sighted. Some sightings are of wing tags on birds of prey, such as that of a Hooded Vulture *Necrosyrtes monachus* that, having been ringed while being rehabilitated in 2019, was spotted in the Kruger National Park.

The Twitter page also received information requests, including some international records. One of these was about a Garden Warbler *Sylvia borin*, which, having been ringed in Gauteng in 2019, had found its way to Saudi Arabia. A picture of a fragment of the ring was posted on Twitter, and after an exchange in Arabic and English (and with the assistance of Google Translate), it was established that the bird was dead.

Activities in 2020

- Led by Kim-Kelly Hunt, the SAFRING ringing reports for 2018 and 2019 were drafted and will be published in 2021.

SAFRING team 2020

Dr Robert Thomson (Co-ordinator, FIAO, UCT)
Janine Dunlop (Niven Librarian, FIAO, UCT)
Kim Kelly Hunt (Data Manager, NRF/SAFRING Intern)
Michael Brooks (FIAO, UCT, SAFRING website maintenance)

Southern African Bird Atlas Project (SABAP2)

The second Southern African Bird Atlas Project (SABAP2) has collected nearly 20 million bird sighting records over the last 13 years. The data are provided primarily by citizen scientists and form the largest single dataset for birds in Africa. SABAP2 falls under the umbrella protocol of the wider BirdMap project, which is active in numerous countries in Africa, providing a single robust protocol and dataset for use in research across the continent.

In 2020, the COVID-19 pandemic had a dramatic effect on all citizen science projects. The strict lockdowns and other travel restrictions had a huge effect on the ability of citizen scientists to collect data. Although the restrictions were lifted to some extent during the second half of the year, the net effect of the pandemic was a decrease in records for 2020 compared to 2019. Despite these challenges, 986 Citizen Scientists sampled 4428 pentads during 2020, collecting 2.16 million records in the SABAP2 region.

Another, more serious impact of the pandemic was the loss of funding for core administrative support for SABAP from SANBI, the South African National Biodiversity Institute, due to dramatic cuts in their budget from the South African government. Fortunately, a funding appeal lead by BirdLife South Africa saw much of the funding gap filled, and we joined with ABAP (African Bird Atlas Project) partners in West and East Africa to develop a grant application to the Global Biodiversity Information Facility (GBIF). If successful, this grant will cover most of the running costs of SABAP2 for the next two years.

New processing software for ABAP became operational in early 2020, and there were numerous tweaks to the system throughout the year to improve its efficiency. The new system allows changes to be made with minimal disruptions to the processing of incoming data, and has streamlined species vetting. Vincent Parker in particular has made a major contribution by correcting anomalies created by species splits.

BirdLife South Africa's bi-monthly magazine, *African Birdlife*, has a page dedicated to SABAP in each issue, which highlights project news, participant interviews and data use. Dr Chevonne Reynolds assists the management team in sourcing and editing stories. A list of the 7 papers published in 2020 that utilised SABAP2 data is available at http://sabap2.birdmap.africa/media/bibliography#pgcontent.

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SABAP2 team (Admin)

Ernst Retief (Project Coordinator BirdLife SA)
Sanjo Rose (Project Communications, FIAO)
Michael Brooks (Information Systems Specialist, FIAO)

SABAP2 team (Regional Atlas Committees)

Carl Beel, Eastern Zambia
Jeff Curnick, Eastern Cape
Dawie de Swardt, Free State
Joe Grosel, Limpopo
Andrew Hester, Western Zambia
Peter Lawson, Mpumalanga
André Marx, Gauteng & Northwest
Bob Medland, Malawi
Vincent Parker, Northern Cape
Colin Summersgill, KZN
Chris Brewster, Botswana
Andrew de Blocq, Western Cape
Ian Gordon, KwaZulu-Natal
Doug Harebottle, Northern Cape
Holger Kolberg, Namibia
Etienne Marais, Mozambique
Duncan McKenzie, Mpumalanga
Ara Monadjem, Eswatini
Ian Riddell, Zimbabwe
Dave Winter, Western Cape

Scientific publications 2020

Bold authors: Fitz CoE staff and Research Associates
Bold and underlined authors: Fitz CoE post-docs and students (current and graduated)

IF = Thomson Scientific Impact Factor score (2019, 2-year impact factor)

Final Journal Published Papers

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