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Science Matters

Science Faculty Newsletter

Message from the Dean

At the end of the momentous year of 2020 we look back at the collective efforts of academic and PASS staff, and students to complete the academic year. We have learnt so much about our abilities as a faculty. The PASS staff quickly adapted to working remotely; teaching went online in a very short space of time; and the MS Teams and Zoom became common platforms for our meetings. Something we missed in these meetings was a human touch, which powerfully reminded us of our common humanity!

The virtual graduation held on 14 and 15 December was an unusual and disappointing event to many students and parents. Students missed those memorable photographs from graduation ceremonies. Many of our new professors preferred giving face-to-face inaugural lectures that could not take place due to the COVID-19 pandemic but not for Professor Hussein Suleman, who was bold enough to give a very successful remotely delivered address.

Though our research was disrupted by a very long lockdown, I am heartened by colleagues who collaborated with the South African government to develop appropriate responses to the coronavirus pandemic, and who also contributed to national and international efforts towards the development of a vaccine. Our established and young researchers, including postgraduate students, continued with their research, with some earning accolades among their peers nationally and internationally. Two young researchers, Dr Itumeleng Monageng (Department of Astronomy) and Dr Susan Cunningham (Department of Biological Sciences) received the College of Fellows Young Researcher Award. PhD student Doaa Ali (Department of Chemistry) is the winner of the 2020 Sub-Saharan Africa Young Talents Awards L'Oréal-UNESCO For Women in Science's prize. The World Wide Fund for Nature (WWF) awarded Professor Timm Hoffman (Department of Biological Sciences) its prestigious Living Planet Award for 2020. Professors Amanda Weltman and Jeff Murugan (Department of Mathematics and Applied Mathematics) were both awarded Simons Associateships at the International Center for Theoretical Physics. The faculty is proud of these achievements.

I wish you a restful break and everything of the best in 2021

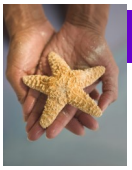
Maano Ramutsindela

UCT COLLEGE OF FELLOWS: YOUNG RESEARCHER AWARDS

The College of Fellows Young Researcher Award is offered annually in recognition of outstanding scholarly work by young academics who have made significant independent contributions to research in their field. The Science Faculty is proud to have had two of only 7 young researchers at UCT who received the award this year.

Dr Itumeleng Monageng, Department of Astronomy, holds a joint lectureship position between the Department of Astronomy at UCT and at the South African Astronomical Observatory. Dr Monageng is a stellar astrophysicist studying X-ray binary stars using data from telescopes operating at different wavelengths to understand the physical processes taking place in these systems, he has co-authored 17 publications.

Dr Susan Cunningham, has just been promoted to Senior Lecturer in the Fitz-Patrick Institute of African Ornithology in the Department of Biological Sciences. The major focus of Susie's research is understanding the mechanistic links between temperature and fitness (using proxies such as breeding success and body mass maintenance) in birds under climate change. She is now the co-PI of the Hot Birds Research Project, together with Prof Andrew McKechnie at the University of Pretoria.



Our Science Stars:

Professor Timm Hoffman wins prestigious Living Planet Award for 2020

The World Wide Fund for Nature (WWF) announced leading arid zone ecologist **Professor Timm Hoffman** as the winner of its prestigious Living Planet Award for 2020. The award was given to him for his contribution to both conservation and helping the people who are dependent on the land to make a living in some of the driest parts of South Africa.
The Living Planet Award is an annual award made to exceptional South Africans who, through their contribution to the conservation, inspire people to live in harmony with nature. This year's award was made during a special online ceremony which also showcased the splendours of the Succulent Karoo, which is a semi-desert biome (or ecological region) that stretches from the Little Karoo to southern Namibia and is home to more than 6,000 plant species, making it the most bio-diverse of its kind in the world.

WWF South Africa CEO Dr Morné du Plessis said: "Timm is not only one of South Africa's foremost arid zone ecologists but is also one of the humblest and most compassionate people you will ever meet." Du Plessis said through the award WWF-SA acknowledged an individual whose work exemplifies how conservation truly can benefit both people and nature. Hoffman, who hails from the Eastern Cape, has spent a lifetime working on dry land ecology, most recently as the director of the Plant Conservation Unit at the University of Cape Town.

Hoffman has co-authored over 130 scientific articles, contributed to more than 30 books, supervised numerous students, and added to the development of new knowledge and insights into both the Fynbos and Succulent Karoo biomes. He also led the national review of land degradation for South Africa and has contributed significantly towards the understanding of the impacts of land use and climate change. Using fixed-point photography, his work has highlighted massive changes occurring in South Africa's ecosystems over an extended period.

Beyond his ecological research, Hoffman also works to understand the complex ways in which rural social, cultural and economic livelihoods interact. In the village of Paulshoek in Namaqualand, in the Northern Cape, Hoffman has contributed positively to the community by creating a long-term contract job, other occasional employment and training for community members, as well as funding for development projects.

Meadows elected President of International Geographical Union

Emeritus Professor Michael Meadows, currently a Senior Research Scholar in the Department of Environmental & Geographical Science, was elected as President of the International Geographical Union (IGU) at its recent General Assembly, held online. Meadows, who was previously Vice-President (2008-10) and Secretary-General and Treasurer (2010-2018) of the organization is elected to the position for a four-year period. The IGU has a long and distinguished history. It was founded in 1922 and will commemorate its centennial at an Extraordinary General Assembly to be held in Paris in August 2022. Meadows is proud to be only the second person from an African country to be elected as IGU President in almost 100 years and says that he is especially excited by the prospect of presiding over the centennial celebrations.

The purposes of the IGU are essentially to promote the study of geographical problems. The organization, which is a founding member of the International Science Council, gives effect to this through more than 40 research commissions, as well as through its regular series of International Geographical Congresses, regional conferences and thematic meetings. In initiating and promoting geographical research, teaching and outreach internationally, the IGU has a crucial role to play in promoting the UN Sustainable Development Goals. As Meadows says: "Geography is, in many ways, the science of sustainability".

Awards for Biopharming Research Unit

The Biopharming Research Unit (BRU) received two awards at the Carnegie DEAL Awards: One Postdoctoral Research Fellow award and one Junior Research Fellow award.

British Ecological Society award for SA climate change researcher

The British Ecological Society's (BES) Marsh Award for Climate Change Research has been awarded to UCT **Professor Wendy Foden**, a world-leading researcher in climate change vulnerability assessments of threatened species. Prof Foden says said she hopes that this recognition inspires other women scientists to tackle conservation and climate change challenges.

Professor Foden, an honorary research associate at UCT's FitzPatrick Institute of African Ornithology, has been recognised for the global reach of her work with the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, as well as for her interest in translating science for practical conservation use, and in fostering conservation leadership.

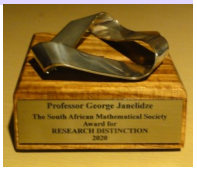
Foden is currently based at the South African National Parks' Cape Research Centre where she leads a team carrying out applied research in and around the region's national parks. She is also an associate professor at Stellenbosch University and has chaired the Climate Change Specialist Group of the IUCN Species Survival Commission since 2014. Foden said that a non-linear career path, which has left her with one foot in research and the other in applied conservation, has enabled her to spot gaps and opportunities for transdisciplinary collaboration: "Most of my research has been highly collaborative, so the award recognises the work of a community of very dedicated researchers. I'm simply fortunate to be in a position to gather key people together to create really useful products while we have a good laugh. I'm glad that such 'soft skills' are increasingly recognised in science." Foden said that she was surprised by the award, but extremely proud to represent Africa's woman scientists. "I hope that the award inspires other women scientists, particularly from developing countries, to step up to conservation and climate change challenges."

Simons Associateships at International Centre for Theoretical Physics for Weltman and Murugan

Professor Amanda Weltman and **Jeff Murugan** were both awarded Simons Associateships at the International Center for Theoretical Physics (ICTP) in Trieste Italy from 2020-2026. "The Simons Foundation, a private foundation that supports research in mathematics and the basic sciences, funds 20 ICTP associate positions for a six-year period starting in 2020.

The Simons Associates are awarded to scientists working in developing countries who have proven excellence in their field of research and who are active researchers in one of ICTP's areas of interest. In addition, the applicant must have contributed to the scientific community in the country where they reside, in the region or internationally. The Simons Associates Programme is designed to allow scientists to spend extended periods at the ICTP to participate in topical meetings of interest to them and to also have the possibility to collaborate with ICTP experts or those within the Centre's extensive international network. "

Janelidze awarded SA Mathematical Society 2020 Research Distinction Award



Professor George Janelidze from the Department of Mathematics & Applied Mathematics, was awarded the South African Mathematical Society 2020 Award for Research Distinction.

2020 Sub-Saharan Africa Young Talents Awards L'Oréal-UNESCO *For Women in Science's* prize awarded to Chemistry PhD student

Doaa Ali, a Ph.D. student from the laboratory of medicinal chemistry in UCT's Department of Chemistry was selected as a winner of the 2020 Sub-Saharan Africa Young Talents Awards L'Oréal-UNESCO *For Women in Science's* prize. Doaa, who hails from Sudan, is working on the development of new cancer treatments using a ground-breaking synthetic methodology based on garlic-like compounds (organotrisulfides), which are able to fight cancer cells. She hopes to become a professor of medicinal chemistry and thus help increase the proportion of women scientists in senior research positions in Africa.

MCB in Top 100 Subjects in World

In the 2021 US News and World Best Global University Rankings, which have an emphasis on academic research, the Department of Molecular & Cell Biology at UCT ranked 79th in the world.

EVENTS

Professor Hussein Suleman's Inaugural Lecture: The need to realign computer science with societal needs.

Computer science involves numerous fast-evolving fields, such as algorithm and software design, making it difficult for computer scientists to keep up with developments. But computer science is faced with another more pressing reality: it is overwhelmingly motivated by profit and does not focus nearly enough on human and values-driven innovation. This is particularly concerning in low-resource environments like South Africa where computer science is often necessary for the pursuit of human development. But how should computer scientists respond? And what will they produce if it is not for profit?

For **Professor Hussein Suleman,** head of the Department of Computer Science and now a full professor in UCT's School of Information Technology the response should be a return to the roots of the discipline and realigning computer science with societal needs. By removing the profit motive, he argued, computer scientists can provide increased value for society. "It's all about money. There's no ethics, no context, no human-centric values here. It's all about producing massive profits."

Professor Suleman shared these views, which are grounded in his extensive research, during the Vice-Chancellor's Inaugural Lecture on Wednesday, 30 September, which celebrated his appointment to full professorship. His was the first inaugural lecture of the year and the first to take place online. His research is situated within the Digital Libraries Laboratory and the UCT Centre in Information and Communications Technology for Development (ICT4D).

In his lecture, titled "Computer Science at times of crisis: reflecting on societal drivers for software and algorithm design", Suleman tackled the challenges facing the field, presented possible solutions and interventions, and advocated for a return to roots. Concluding his lecture, Suleman reiterated the need to realign and to return to the genesis of the discipline, which can be traced back to the Second World War when a team led by Alan Turing harnessed early computer science to save human lives and end the conflict. "We need to go back to our roots and understand that tackling crises is where we came from. And the way we're going to deal with the current crisis and future crises is by thinking about this in the way that we develop systems."

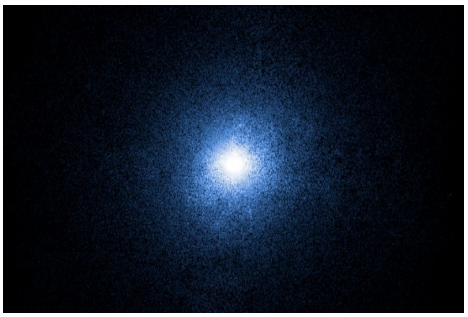
AFIRM: ACM SIGIR/SIGKDD Africa Summer School on Machine Learning for Data Mining and Search

Earlier this year the first ACM SIGIR/SIGKDD Africa School on Machine Learning for Data Mining and Search took place at UCT. The event was run by **Professor Hussein Suleman**

International Conference on Knowledge Engineering and Knowledge Mangement

Dr Maria Keet, from the Department of Computer Science, was a program committee chair for the 22nd international conference on knowledge engineering and knowledge management, which was held virtually. The proceedings of the conference were recently published with Springer and Dr Keet was the chief editor of the book.

Record attendance at virtual Strings conference in High Energy Theoretical Physics



Much of the discussion at the Virtual Strings 2020 conference focused on new

Professor Jeff Murugan's group, The Laboratory for Quantum Gravity & Strings hosted the premier international conference in high energy theoretical physics, Strings 2020. This year had a record 2300 participants from all over the world. "Basically, we had to reinvent this conference that [has] been around for 30 years," said Murugan, who leads UCT's String Theory Group in the Department of Mathematics and Applied Mathematics. But there's always that silver lining. The offshoot is that many more researchers participated from many more groups previously excluded by funds, gender, stage-of-life (young parents, for example) and juniority. By opening the conference on a virtual platform and making it free, participant numbers soared from 400 to 2 300.

This has important repercussions for a small field, said Murugan. South Africa's string community includes the UCT group, one at the University of the Witwatersrand and individual researchers at other universities. String theory is complex. Murugan calls it an edifice at the front lines of high-energy theoretical physics and mathematical physics. The **Live Science website** describes it as "an attempt to unite the two pillars of 20th century physics – quantum mechanics and **Albert Einstein's theory of relativity** – with an overarching framework that can explain all of physical reality". "Strings provided an elegant mathematical way of describing the strong force, one of the four fundamental forces in the universe, which holds together atomic nuclei." Murugan added: "Today, we realise that string theory is really a far more diverse set of tools to understand a vast spectrum of things – from quantum chaos to cosmology."

South Africa may have a small string theory community, but it's a very active group, said Murugan. Having won the right in 2014 to host the conference in 2020, the South African organisers were determined to use the platform to bring hundreds of new guests to the country and showcase local science."We initially proposed to the international advisory committee that we postpone it until late December in the event things would be okay. But as it became clearer that a vaccine wasn't imminent, and that international travel would not happen in 2020, we said, 'Let's take the whole thing online.' " As it turned out, they reinvented the meeting completely. A huge factor was that they would have participants from 20 different time zones at any one time. "Some did lament the lack of interpersonal interaction," said Murugan, "but overall we showed that we could take a 30-year-old tradition and transform it into a new, inclusive way of doing conferencing, and that it could be hosted from Africa just as well as it could be from anywhere else in the world. Even the time zone worked as South Africa is, zone-wise, more or less in the middle of everything. So, logistically, we've shown that it can be done, done well, and at a fraction of the cost."

A big topic at this year's conference was the idea of black hole information paradox. The National Aeronautics and Space Administration's (NASA) succinct description of a black hole describes it as "a place in space where gravity pulls so much that even light cannot get out. The gravity is so strong because matter has been squeezed into a tiny space. This can happen when a star is dying. Because no light can get out, people can't see black holes". Much progress has been made in understanding the information paradox of black holes. "We've learned that there are correlations in the temperature of the black hole that allow us to reconstruct what falls into a black hole. A big theme of this year's meeting was the resolution of [Stephen] Hawking's information loss paradox," Murugan said. "But string theory has proven to be an important tool in solving many other problems. A lot of the technology that we use in string theory is portable to other areas of physics. An example from my own research is our co-discovery a few years ago of a beautiful set of relations, called dualities, between different quantum field theories that lend themselves to a deep understanding of the properties of a remarkable new class of materials called topological quantum matter." He added, "This is what we expect will replace silicon as the basis for future technology. So trying to understand the properties of these materials is vital. And the mathematical techniques from string theory are the same techniques that will go towards understanding the stability, electrical properties and possible uses of these new materials."

The opportunity presented by the call for decolonization

Dr Margaret Blackie, from the Department of Chemistry and Polymer Science at Stellenbosch University, presented the Department of Chemistry Transformation Committee seminar with a talk entitled, "The opportunity presented by the call for decolonization"

Solid academic grounding: Dr Blackie started out with a BSc at Rhodes, BSc Hons and PhD in medicinal chemistry at UCT (supervised by John Moss and Kelly Chibale) and then went on to do three postdocs: one at the Universite des sciences et technologies in Lille, France (med chem), she held a Claude Leon Fellowship and worked with Kelly Chibale for two years. (med chem) and then finally did a postdoc with Jenni Case at the Center for Research in Engineering Education at UCT.

In terms of her journey to this point: between her BSc and BSc (hons) she took a gap year an taught high school maths. Between her first and second postdocs she worked in a spirituality center for 4 years before returning to chemistry. She describes how . “It was only when I did my postdoc with Jenni Case in engineering education that I found a way that I could be myself and be an academic. The combining of education research with Medicinal chemistry research gave me a way to not have to cut off half of myself to do the job. Now I also teach some theology, so all parts of my being are combined in my current job. I love the deep complexity of chemistry, but I also value human development tremendously”.

How Dr Blackie become interested in the topic of decolonization and Science:
Following the #ScienceMustFall video I was curious as to how to have a serious conversation about decolonisation. I thought the best approach was to take the call seriously, and then to try and figure out what it means in science education. Fundamentally the starting point is a little different in STEM subjects. The first point is not necessarily to radically change the curriculum, but to recognise that power and being are operational in science education too. We can’t change the knowledge but there is a good deal to be done in terms of recognising how power and being impact the student.

Why this topic is important to her:
The experience of alienation described by students should be taken seriously because it will impact their academic performance. And we need to adapt to a changing student body. We do need to ask seriously what it means to teach science in Africa, and how to prepare African scientists. That task may or may not be substantially different to doing these things elsewhere in the world. But we should at least entertain the possibility that it might be a little different, before we dismiss the idea out of turn.

The Opportunity Presented by the Call for Decolonisation

In her talk, Dr Blackie highlighted three major factors impacting tertiary education in South Africa now, namely (a) Decolonisation (b) the 4th Industrial Revolution and (c) The Covid-19 Pandemic. She expressed the need to form a broader view of what we are doing and what the value is of an undergraduate degree in Science—challenging our presumptions. Kicking off her talk, she asked the audience to think about how they were responding to the topic and perhaps questions regarding what a white Zimbabwean chemist was doing talking about decolonisation. Explaining that what started her off thinking about this topic was when the UCT student made the “Science Must Fall” video with a claim to throw out Newton, Dr Blackie recognised that although it wouldn’t be helpful to throw out Newton, it was important to consider that maybe the student had something important to say.

The alienation that students were experiencing needed to be acknowledged because this clearly does impact their engagement and this raised the issue of how to facilitate conversations between students and scientists. Dr Blackie clarified that decolonisation takes a different shape in STEM because the nature of the project of education is different. In STEM subjects the focus is on the conceptual understanding (what

you know), as contrasted with Humanities where the focus is on the development of the worldview and the orientation to society and knowledge). In Science the relationship to knowledge is strong and the relationship to society is weaker and scientists can be blind to the way that the other fields of education operate. The implications of this are that even though Science is favouring the relationship to knowledge, there is a relationship to society that is operational. She pointed out that regardless of the educational project we are involved in, there are three things that we need to take into account, namely: Power; Being & Knowledge. All three of these are operational whether we recognise them or not. In science, we are 'Knower Blind' - Scientific knowledge is objective and socially neutral, however we can be blind to the person as a scientist, who we cannot presume is objective and socially neutral. Dr Blackie emphasised how we tend to conflate neutrality of scientific knowledge with presumed neutrality of scientists and that this is a dangerous step to make. She made the point that the second conflation we make is that science education is not the same as science—education can never be socially neutral—the education project is always socially embedded.

What then is the value of an undergraduate Science degree? We will still need to teach the periodic table for example, but the question we need to ask is: How are power and being operational in our sphere? Dr Blackie suggested a process of embarking on the project of thinking about decolonisation and suggested that the decolonised curriculum is probably ten years away, however right now, we need large groups of community thinking about this and the ways in which being and power are operational in lecture theatres and courses.

Dr Blackie expressed her view that in terms of Chemistry education, we are good at the level of third year exams and making sure students have a good conceptual understanding—seeking to discern whether students can reproduce puzzle pieces and join them together in an attempt to prepare them for lifelong learning. However, she challenged the audience to question whether students know what they know and the know the limitations of their knowledge. She asked whether they can judge 'I'm confident to solve this problem' or 'I'm lost her and need to find some help'. As academics, she reflected, we can do a better job of helping students reflect on their knowledge. Furthermore, she challenged academics to think about how our education system is infused by Western individualism and that a student who experiences alienation is likely to do worse than a student who feels comfortable in their environment. Judgement requires students to ask, 'Have I correctly understood this concept in the way that the community of chemists understands this thing?' To test this understanding, the student needs to talk to a lecturer, look at a textbook, discuss with a friend—all of which are social activities. There is thus a crucial shift from me understanding, moving towards me understanding as the community understands. The shift is thus from the student trying to do their own thing, to the student becoming a member of the community who holds this knowledge.

This potentially changes what we are doing when we educate. Education is then not about an individual passing an exam rather it is about induction into the community—thus we have an obligation to help those who feel that they don't fit in. This shift into a space where power and being play a role potentially provides a platform for a better sense of engagement. It leads to me questioning myself: What do I think I am doing? And Where do I need to be more careful? Dr Blackie highlighted how examples are socially infused and how we need to question whether examples from our own experience become hurdles to understanding. This requires recognition that my life experience as a lecturer is not necessarily normative, but is my experience/ voice. She invited the audience to think about the most obvious starting points for themselves and encouraged them to think about how this could mould/ shape their teaching and how decolonisation might work in their classrooms; while being aware that we are 'knower blind' in science education. Dr Blackie ended her talk with the deep question of 'What is the purpose of our degree?' and what is the broader purpose of the degree beyond sound conceptual understanding.

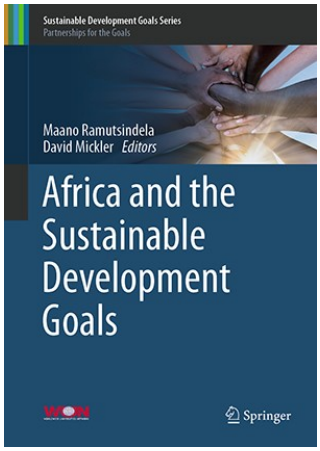
STAFF NEWS

FAREWELL TO STAFF RETIRING

Mrs Faezah Davids	Molecular & Cell Biology
A/ Prof Edmund February	Biological Sciences
Dr John Leslie Frith	Mathematics & Applied Mathematics
Dr Mariola Kirova	Mathematics & Applied Mathematics
Ms Adelaide Khoapa	Chemistry
Dr Robin Little	Biological Sciences
Professor Daya Reddy	Mathematics & Applied Mathematics
Mr Karl Stielau	Statistical Sciences

Sharon Adams celebrated what she described as a 3 decade "love affair" with the Department of Environmental & Geographical Science at UCT. She comments how in an economy where everyone is looking for job satisfaction, appreciating one's colleagues can be game–changing. She celebrated this milestone anniversary with appreciation for meeting amazing people throughout her journey and working with great people.

Groundbreaking new book: Africa and the Sustainable Development Goals



According to **Professor Maano Ramutsindela,** Dean of Science at UCT and co-editor of *Africa and the Sustainable Development Goals*, the book brings together over 80 researchers from a variety of disciplines on five continents to demonstrate an approach to an equitable global partnership in the production of knowledge relevant for Sustainable Development Goals (SDGs) in Africa. Ramutsindela, who co-edited the book with Dr David Mickler of the University of Western Australia, explains that the book is unique both in the range of its research perspectives and because it does not take the Sustainable Development Goals (SDGs) as given, it instead critically traces their development and the conditions under which they are implemented in Africa.

"Africa has witnessed many development plans that were imposed from outside that hardly improved the conditions of ordinary people. The SDGs are an aspirational blueprint for development because while they do not want to leave anyone behind, they do not as yet usher in a strong people-centred approach to development. This book places the SDGs in the context of an unequal, global economy and Africa's own developmental pathways as articulated in the AU (African Union) Agenda 2063," explains Ramutsindela.

Congratulations to the following staff on their Ad Hominem Promotions

Name	Department	Promoted to
Dr Ramon Hurdayal	Geological Sciences	Senior Lecturer
Dr Susan Cunningham	Biological Sciences	Senior Lecturer
Dr Melissa Densmore	Computer Science	Associate Professor
Dr Anneliese Schauerte	Mathematics & Applied Mathematics	Associate Professor
Dr Steve Peterson	Physics	Associate Professor
Dr Sheetal Silal	Statistical Sciences	Associate Professor
Dr Deena Pillay	Biological Sciences	Associate Professor
Dr Pippin Anderson	Environmental & Geographical Science	Associate Professor
A/ Prof Francesca Little	Statistical Sciences	Professor
A/ Prof Lindsay Gilson	Biological Sciences	Professor
Louisa Hutten	Archaeology	Chief Scientific Officer
Derick September	Molecular & Cell Biology	Principal Technical Officer

HISTORY IN THE FACULTY

The birth of Zoology at UCT (with an aside about a remarkable woman botanist) by Emerit Prof Jenny Day

The Zoology and Botany Building, Hiddingh Hall, 1920s; the Zoo Dept was on the third floor from 1905 to 1928 (from Ritchie 1918).

Once upon a time there were separate departments of Zoology and Botany at UCT. The Zoology Department was established in 1903 and a hundred years later we celebrated its centenary with a big birthday party. At the time I was Head of Department and highlighted some of the following:.

Zoology in 1903

The world of biological sciences would have been almost unrecognizable to us. Darwin had died only 21 years before, so the science of evolution was very new. Many biologists did not accept the reality of natural selection, at least partly because nothing was known about the mechanism of inheritance. The word "genetics' had yet to be coined. Mendel's 'Laws' had been rediscovered only three years before, in 1900, and de Vries recognised mutations only in 1902. It would take another fifty years before the DNA puzzle was solved, beginning with Watson, Crick and Franklin understanding its structure in 1953. Ross had discovered the link between malaria and mosquitoes no more than 6 years before, in 1897. The word 'ecology' had not yet been coined and indeed Charles Elton's book *Animal Ecology,* which reported the first significant quantitative ecological data, would not be published until 1927.

Zoology at UCT in 1903

In 1901, a decision was made to develop the first year of an MBChB degree, and thus Zoology, Botany, Physics and Chemistry were introduced. Passing all four of these courses would allow young men to proceed to England or Scotland to take up second-year medical studies. Botany, which had been taught from the 1840s to 1860s, had to be re-introduced, but the reason for separate Botany and Zoology departments is bizarre. Apparently Scottish Medical Schools would not recognise teaching by a professor who taught more than one subject, and in those days at the University of the Cape of Good Hope it was more or less one department = one professor (and sometimes no other staff at all).

In 1903, the entire university was housed on the Hiddingh Hall campus in Orange Street, Cape Town. Dedicated "science" laboratories (physics, chemistry, botany, zoology) had been built in the 1880s and UCT was still the 'University of the Cape of Good Hope'. The student body was about 250 strong. The Zoology and Botany departments had premises in a building known currently as the Michaelis Building which now houses the general Fine Art & Painting studios.

The most illustrious graduate from the point of view of UCT biologists was Edith Stevens - the first woman to graduate with a BA in both Zoology & Botany. Born in Cape Town in 1884, she matriculated at Rustenburg High School and on graduating in 1906 was awarded the Gold Medal for science and the Queen Victoria Scholarship, which led her to Cambridge University. That university did not award degrees to women in those days but she studied various aspects of botany and was elected a fellow of the Linnean Society of London. Around 1911, she returned to South Africa, became a temporary lecturer in botany and later a lecturer. She retired in 1940 and became Honorary Reader (no doubt unpaid) in the Bolus Herbarium, where she continued until her death in 1966, her career having spanned sixty years.

1903 *vs* 2020

Would you have preferred to have been at UCT in 1903 or in 2020? Life was relatively simple then – few students, (almost) no admin., no Covid, no Trump, no war (the Boer War had ended in 1902), no telephones (well there was one - in the Registrar's office). But the Spanish Flu and the First World War were on the horizon, and computers and the internet were still in the realm of science fiction. You choose.

Jellyfish Mating Day: an in-joke that became a tradition

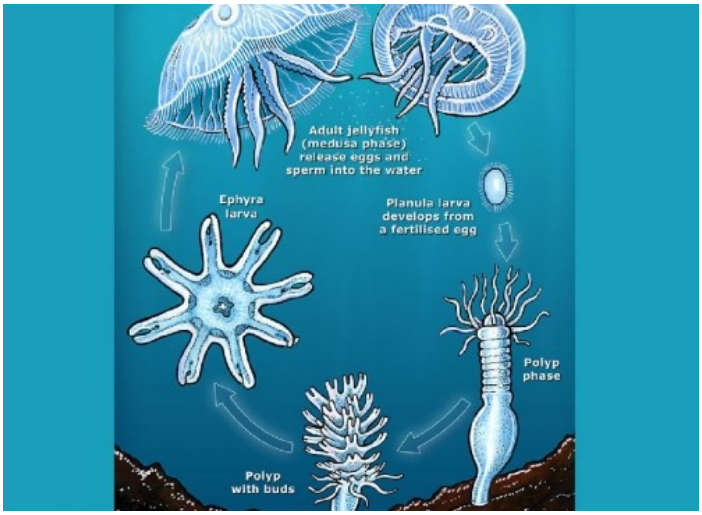
Jellyfish Mating Day, circa 1984, outside the then Zoology Building. Note the 'jellyfish' hanging from above and the larger one in the foreground. The suited man at the back is Prof Gideon Louw, the former head of zoology, and the man in the lab coat standing centre left is Michael Jacobs. Photo Supplied.

On World Jellyfish Day, 3 November, **Emeritus Professor Jenny Day** wrote about an in-joke at the University of Cape Town's (UCT) zoology department that became a tradition 50 years ago: national Jellyfish Mating Day (JMD).

Jellyfish Mating Day was celebrated annually in the Department of Zoology at UCT for many years. The reasons behind this event are couched in a variety of stories and myths. The story is that one Friday in late August 1970, several zoology students decided to bunk their Physics practical and go to the beach instead. When they were asked the following Monday why they hadn't been at the practical, they said that they had been celebrating Jellyfish Mating Day. They were forgiven by the lecturer concerned because the excuse was such a fine biological joke. (For non-zoologists, jellyfish are mainly broadcast spawners and don't mate.)

David Muir's recollection was a little different, and he should be believed because he and Christopher McQuaid were the major instigators. He wrote: "The whole thing began in 1970 when I was (again) doing physics and was hanging together with a rowdy group of repeat students. "We were continually looking for excuses to evade physics pracs and became aware that religious students frequently got holidays that we were not afforded, so we decided to make up our own and submit the requisite excuse notes. The first ever Jellyfish Mating Day was Friday, 31 August 1970." No matter how it started, JMD was celebrated in the zoology department each year for the next 20 years or more. At first it consisted of a few hand-drawn posters scattered around the building with jelly provided to staff by the third years. Later, more of the campus was decorated (much to the bewilderment of the less biologically literate on campus), students often staying up all night to make 'jellyfish', mostly from plastic bags. Famously, while the current John Day Building was being built, two students climbed up one of the huge building cranes to leave a plastic-bag jellyfish dangling from the hook of the crane. In some years, students would arm themselves with jelly-filled balloons, which they threw at passers-by in University Avenue, invoking the bemused wrath of the victims.

Dr Coleen Moloney recalled: "As third years (in 1982) we prepared jelly for tea, handed out Jelly Babies [and] decorated the department." According to McQuaid, "It reached its apogee when we eventually trained the second years to hand out Jelly Babies to the first years and decorated Jammie Hall with posters and jellyfish made from balloons." It must have been around that time that **Emeritus Professor George Branch** was 'kidnapped' on one JMD and required to ingest 'jellyfish spawn', which – he thankfully acknowledged – was regular jelly made with a good dose of beer.



As a continuing tradition, JMD had something about it that was tied to a sense of fellowship and community that characterised the zoology department in those days, perhaps one reason that it is still remembered so fondly. "It was as earnestly celebrated by the lab staff, for example, as it was by students and academic staff." It speaks of very real friendships that we enjoyed across age groups and academic status: "It was as earnestly celebrated by the lab staff, for example, as it was by students and academic staff," wrote Muir.

Research Bytes

Global South research: humpback whales and climate change

Humpback whale populations were decimated by whaling during the 20th century. Since the 1970s, when widespread protections outlawed humpback whaling, their numbers have started to recover. Now, however, they face a new threat: warming oceans brought about by climate change. Thanks to the recently launched Whales and Climate Program, **Professor Marcello Vichi** and Dr Subhra Prakash Dey from UCT will join scientists from seven research institutions in the Global South on a six-year project to better understand the effects of climate change on humpback whale populations and migration patterns.

For the last several years scientists and whale watching enthusiasts have noticed a puzzling new phenomenon occurring off the West Coast of South Africa: humpback whales have been gathering in their hundreds, in what have become known as super groups. Professor Marcello Vichi, a marine scientist who specialises in understanding climate effects on marine ecosystems, explains that it is these kinds of questions that the Whales and Climate Program will seek to answer. "Use of ocean models with whale observation networks can help us to understand how a changing climate is affecting humpback whales. The concurrent use of ocean models with whale observation networks can help us to understand how a changing climate is affecting humpback whales, including phenomena such as the recent large aggregations of humpbacks, which we have observed off the Cape West Coast."

The Whales and Climate Change Program was spearheaded by Professor Alakendra Roychoudhury, an environmental geochemist based at Stellenbosch University (SU), in collaboration with Professor Brendan Mackey, director of the climate change response program at Griffith University in Australia. According to Roychoudhury the Southern Ocean remains vastly unexplored. "There is an urgent need for both seasonal and long-term observations from this vast expanse of ocean. A lack of ground-truth data provides a skewed picture in climate models, creating uncertainties. Recent observations of fluxes in carbon dioxide, a major driver in climate change, show that the Southern Ocean is behaving quite differently from what we understand from climatology and satellite data".

The programme includes 25 researchers from five countries and a number of Antarctic voyages. Research teams from Brazil, Chile, Ecuador and Panama will investigate detailed movement of the South American west coast humpback whale population while South African-based researchers will analyse the combination of historic and more recent long-term datasets with future scenarios in multiple regions in the southern hemisphere.

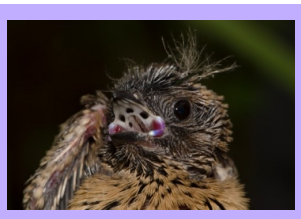
Over the past decade our understanding of the important role that whales play within ecosystems has also broadened. Dr Olaf Meynecke, a whale researcher from Griffith University, explains that recent research shows that baleen whales are integral to re-fertilising the upper 80 metres of the ocean. "This is the photic zone where light penetration drives primary productivity. Whales also act as recyclers, limiting iron micronutrients to the upper ocean by feeding on iron-rich Antarctic krill." Using data collected in different areas of the southern hemisphere will help to provide further clues as to the many-faceted way that humpback whales interact with their ecosystems.

Future scenarios for conservation

Mackey says the aim of a multi-year project such as this is to help establish a fundamental understanding of how changing ocean conditions are influencing the recovery of humpback whale populations.

"Climate change is drastically altering ecosystems and our oceans are experiencing fast changes, affecting all marine life. The project will develop adaptation scenarios for advancing whale conservation policies and programmes." To view Prof Vichi's interview with enCA, click here:

Parasitic finches mimic their hosts to deceive foster parents



Research recently published in the journal *Evolution* shows that the nestlings of brood-parasitic finches mimic the appearance, sound and movements of their host's chicks. Working in the savannas of Zambia, **Dr Gabriel Jamie** a research associate at the FitzPatrick Institute of African Ornithology at UCT**,** and a team of international collaborators collected images, sounds and videos over four years to demonstrate this striking and highly specialised form of mimicry. The study, funded by The Leverhulme Trust, focussed on a remarkable group of finches that occurs across much of Africa called the indigobirds and whydahs (genus *Vidua*). This is a group of 19 species, which, like many cuckoos, forego their parental duties and instead lay their eggs in the nests of other birds ("hosts"). The hosts then incubate the foreign eggs and feed the young. These hosts are unusual in having brightly coloured and distinctively patterned nestlings. Furthermore, the nestlings of each host species have their own unique appearance, begging calls and begging movements.

"*Vidua* finches are extremely specialised parasites with each species mostly exploiting a single host species. While previous work had suggested such visual mimicry may exist, this had never been quantitatively tested from a bird's visual perspective. Birds process colour and pattern differently to how humans do, so it is important to use models that approximate their visual systems" says Dr Jamie. "The current paper therefore answers a long-standing question as to whether these parasitic finches really do mimic their respective host's nestlings." While the mimicry is astounding in its accuracy, the authors found minor but striking imperfections. These imperfections may exist because 1) there has been insufficient time for more precise mimicry to evolve, 2) the current levels of mimicry are already good enough to fool the host parents, or 3) the imperfections are actually enhanced versions of the hosts signal that force them to feed the parasite chick even more than it would its own.

The diversity of nestling grassfinch (host) species. First and second row: photographs of the mouth markings of nestling grassfinch species, many of which are hosts to Vidua finches. Top row, left to right: locust finch, common waxbill, blue waxbill, green-winged pytilia, orange-winged pytilia. Second row, left to right: red-billed firefinch, Jameson's firefinch, zebra waxbill, African quailfinch, bronze mannikin. Bottom row, left to right, green-winged pytilia, red-billed firefinch and locust finch.

The mimicry is not only amazing in its own right but may also have important implications for how new species of parasitic finches evolve. Previous work has shown that speciation in *Vidua* finches is intimately connected to host switching, owing to a remarkable quirk of their natural history: young *Vidua* finches imprint on their host species, such that males grow up to imitate the song of their host and females grow up to be attracted to males who sing like the host she was raised by. Females also prefer to lay their eggs in the nest of the same host species as she was born in. Therefore, if a female accidentally lays her egg in the nest of a new host species, she has the potential to initiate a new lineage of *Vidua* that now specialises on the new host and is separated from *Vidua* lineages specialising on traditional hosts. Recent work has suggested that this process may not be sufficient to prevent the collapse of potential new *Vidua* species through hybridisation. Instead, the mimetic adaptations to different hosts identified in this study may also be critical in the formation of new species.

"This specialised mimicry is a vivid reflection of the role of learning in genetic evolution" says co-author of the paper from the FitzPatrick Institute at the University of Cape Town, **Professor Claire Spottiswoode**. The role of behavioural flexibility in influencing the course of genetic evolution is increasingly recognised among biologists. *Vidua* nestlings imprint on their hosts, altering their mating and host preferences based on early life experiences. These preferences strongly influence the host environment which their offspring grow up in, and therefore the evolutionary selection pressures they experience from foster parents. When maintained over multiple generations, these selection pressures are what generate the astounding host-specific mimetic adaptations that this paper reveals.

Citizen Science Return Mail Campaign Reveals Two Tap Water Worlds Across SA

South Africa is a water-stressed country. Increasing demand for water, together with uncertain supply due to climate change and catchment degradation, makes the delivery of municipal water a challenge. It is expected that, by 2030, the demand for water will be 18%–25% greater than the sustainable supply. There is thus an urgent need to understand more about the sources of tap water, their potential variability and how or when they are recharged.

Source of Tap Water across South Africa

Research by MSc student **Ruan de Wet,** together with **Associate Professor Adam West** and **Professor Chris Harris**, set out to discover the likely source of tap water across South Africa. They used the Post Office to assist them in getting a National-level dataset of tapwater in a rapid and cost-effective manner. By running the study in different seasons, they could pick up which places had stable (groundwater) versus variable (surface water) tap water sources. Previously, the only national level groundwater map was done at great expense by directly sampling boreholes across the country over 18 months from 2006-2007. This method is a major breakthrough for sampling this precious resource at high temporral and spatial frequency

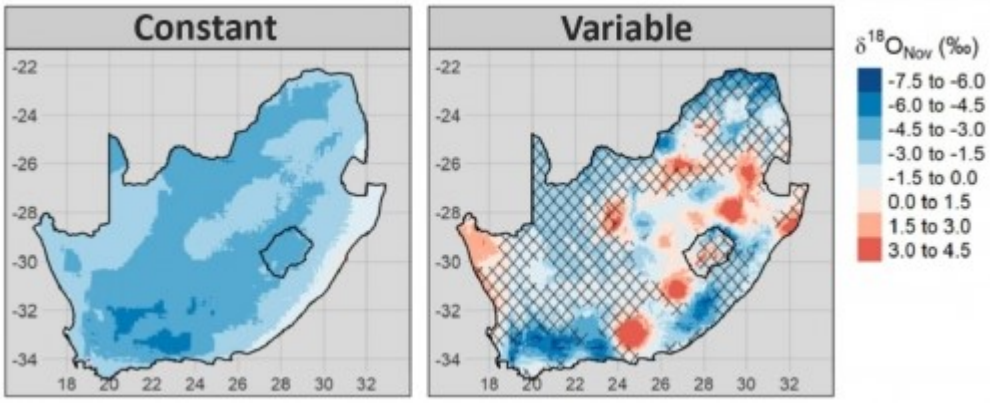
Citizen Science: Enlisting the Post Office to help with sampling

The researchers followed a citizen-science sampling approach to make the sampling cost-effective and rapid. They sent out envelopes addressed to 340 post office branch managers throughout the country at the end of the winter and summer season. In each envelope was an information pack, instructions and a request for their assistance in providing tap water along with two vials and a postage-paid return envelope to be sent back to our research lab. Within a short space of time, two-thirds of the post office branches had provided samples with their tap water. This allowed the researchers to create a cost-effective and nearly synchronous map of tap water across the whole country.

Two Tap Worlds

They then used the chemical signatures hidden in tap water (the so called “isotopic ratios” of oxygen and hydrogen) to show that there are two different “tap water worlds” - a surface world (that is linked to surface water resources like dams and reservoirs) and a underground world (that is linked to deep, possibly ancient, groundwater resources below the surface).

In doing so, this research helps to understand our dependence on surface versus deep water resources, and demonstrates a cheap and effective way to sample groundwater that should allow regular monitoring of this crucial resource into the future.



Universal kriging model predictions of , δ18O from the November 2017 category A (right) and B (left) samples. Hatching indicates areas where the model uncertainty is greater than one standard deviation of the underlying data.

UCT-built app to support babies in need of breast milk

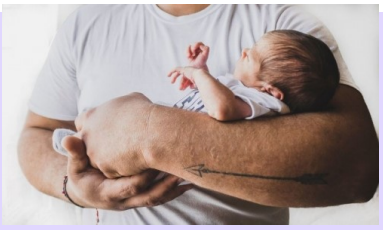


Photo Laura Garcia / Pexels

UCT computer science students have developed and are now upgrading an app for Cape Town-based human milk bank Milk Matters. What began with senior lecturer, **Dr Melissa Densmore** in the UCT Centre in Information and Communications Technologies for Development (ICD4D), donating her excess breast milk to Milk Matters, for babies in need, has resulted in a lasting relationship that has seen UCT students conducting research on and for the milk bank, as well as the development and upgrade of an app.

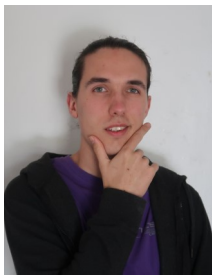
Milk Matters is a non-profit human milk bank based in Cape Town. Mothers who can express excess breast milk freeze their milk and donate it to the organisation. The milk is given to premature babies, who are particularly vulnerable to fatal complications if they are not fed breast milk, making the donations vital for saving lives and acting as a bridge to breastfeeding. Since the inception of Milk Matters in 2003, over 2 500 mothers have donated breast milk, and thousands of babies at 28 different hospitals across the Western Cape have benefited from this lifeline.

In 2016 **Chelsea-Joy Wardle** and **Mitchell Green** were the first of Dr Densmore's students to focus on Milk Matters for their honours research projects. This included designing an app that helped facilitate donations and communication. Wardle built on this and continued the research for her master's degree, which she completed in 2019. Under Densmore's supervision, Wardle took an inclusive approach, known as co-design, to develop the app. This approach sees the user community involved and consulted at every stage of the development process. The result was an app that provides donor mothers with a tool to track their donations and an estimate of how many babies their milk will feed. It also provides the donor mothers with useful breastfeeding information, details about Milk Matters depots and a simple tool to self-assess their ability to meet certain essential requirements of donating breast milk. They can also contact Milk Matters through the app for further information.

Now three honours students are building on this research under Densmore's supervision. **Gerhard Serton, Dino Bossi** and **Gustavo Amicis M de Souza Mendes** are aiming to make the app more widely available, improve communication between Milk Matters and donor mothers and make it easy and cost effective for the non-profit to share interesting and current information. Conducting their research and interviews during a pandemic presented a few challenges, which included depending on technology that wasn't always reliable, connection issues, problems with microphones and finding interview times that suited everyone. Upgrades to the app include making it available to both Android and iOS users, providing donor mothers with educational material, updating users on Milk Matters news and events, tracking and visualising donations and listing the locations of depots for registered users. Top of mind for the honours students is "minimal cost and maximum reward". This includes using technology that only requires writing one set of code for both operating systems and ensuring that supporting infrastructure remains "free tier". Bossi explained that by ensuring minimal cost and maximum reward, they hope to lay the groundwork for other non-profits that want to expand technologically but are concerned about cost.

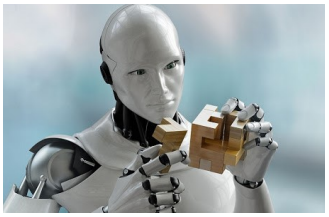
"It's actually possible with quite a small team in a small space of time with very limited funding," he said. In addition to developing and updating the app, as well as enriching the field of human–computer interaction with research about milk banking in South Africa, Densmore and her students are also contributing towards community building. "It takes a community to make it possible for a milk bank like ours to operate and feed babies."

Ethically Aware Robots: Majoring in Computer Science and Philosophy by George Rautenbach



George Rautenbach, from the Department of Computer Science, is co-majoring in Computer Science and Philosophy, which may seem like an odd combination, but the intersection of these disciplines interests me immensely. Fields like computer ethics, social Artificial Intelligence issues, and the philosophy of sentience all fall at least partially under this category and are all of major importance to the future of humanity. Being situated in this niche, I was quickly drawn to the opportunity of doing undergraduate research in the Computer Science department's 2005Z course. Specifically, having done her taught module on professional practice, I approached **Dr Maria Keet** about supervising me on a topic in computer ethics.

And so, we started research into artificial moral agents, which is the formal notion for methodologies of making computers "think" morally. There are many ways of doing this, as philosophers and computer scientists alike have argued in multitudes of research papers. The typical way is to choose one ethical theory (that is, a general description of what is morally good and bad) that the author deems most moral in the context of machines, and then to devise a technical strategy of having a computer implement this theory. For example, Anderson et al. (2018) chose utilitarianism and created a program that adds happiness and subtracts pain as numeric values to determine which of a set of options is most moral. In another approach, Benzmüller et al. (2018) created a framework for logical reasoning through ethical principles (taken as fundamental truths about morality).



Though the one thing all these past attempts had in common was that they each created programs that were only capable of using one ethical theory for reasoning. So, Anderson et al.'s machine and Benzmüller et al.'s machine would behave differently in certain scenarios, even though all the authors claim their machine is the most moral. Our research looked at finding a way to make a single machine that could reason under multiple different ethical theories, instead of just one. This has the advantage of hot-swappability - i.e. the owner of such a machine (e.g. a business) could configure it to reason on behalf of the company and using the company's very principles to make moral decisions.

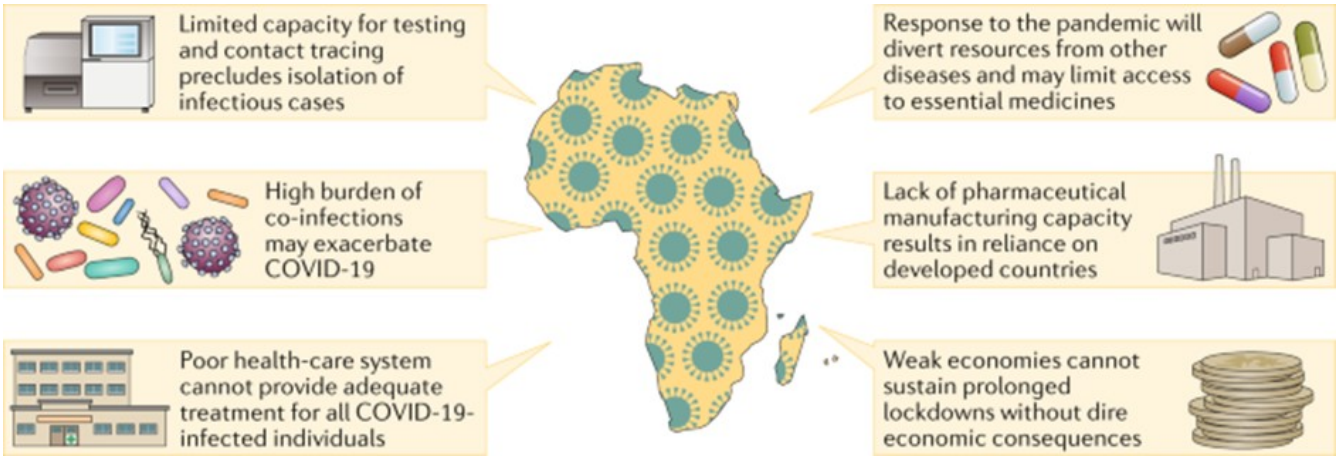
An interesting use case for this comes from Millar (2016): Mia is an alcoholic who, due to an injury, is unable to care for herself and is assigned a smart caregiver robot. One day Mia gets very drunk and requests that the robot fix her another drink. The dilemma arises of whether the robot should comply and serve more drinks or not, knowing that doing so will result in harm to Mia's health. Here depending on its configuration, the bot should either serve her a drink because the owner's wishes should always be respected, or decline to fix her a drink because Mia's health is ultimately of greater concern. Our framework provides a configurable **Gen**eral **E**thical **T**heory (dubbed Genet) that in this instance would allow Mia (or the hospital) to set the bot's moral reasoning principles themselves, instead of relying on some armchair philosopher to set the bot's morality.

The value of their research has not gone unnoticed - it has been publicised on arXiv and recently published in the Joint Ontology Workshops (JOWO 2020). The research course, credited as a second-year level course, but requiring me to spend by far the most of my academic time on it, was a huge sacrifice to make at second year, when you should still be enjoying the novel freedoms of university life. On the other hand though, doing research as an undergrad is extremely rare especially in SA, and will certainly do a lot of good to your CV. How many 21-year-olds do you think can say they have published a scientific paper in an academic journal?

In my free time, I work on all kinds of personal projects - from websites to real-time games to utility scripts. Most of them are open source and used regularly by many people. When I'm not coding, I like to blog about philosophical ideas, often related to technology. Next year, I will ly be doing an honours with research into some field of computer ethics.

Prospects for SARS-CoV-2 diagnostics, therapeutics and vaccines in Africa

Dr Mani Margolin a postdoc working with Professor Ed Rybicki and Prof Anna-Lise Williamson's was lead author on an article in *Nature* which reviews SARS-CoV-2 / COVID-19.

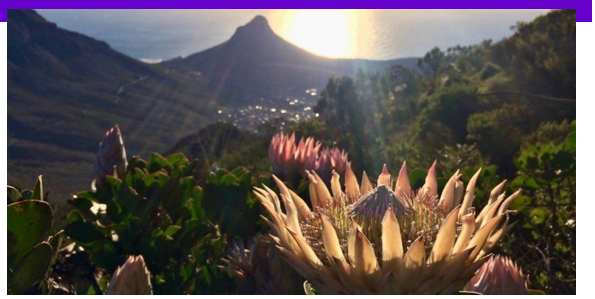


The COVID-19 pandemic has prompted unparalleled progress in the development of vaccines and therapeutics in many countries, but it has also highlighted the vulnerability of resource-limited countries in Africa. Margolin and colleagues review global efforts to develop SARS-CoV-2 diagnostics, therapeutics and vaccines, with a focus on the opportunities and challenges in Africa.

The limited capacity for testing and contact tracing, poor health-care systems, lack of pharmaceutical manufacturing capacity and underdeveloped infrastructure in Africa pose several challenges that constrain the response of the region to the coronavirus disease-2019 (COVID-19) pandemic. This is worsened by the high burden of infectious diseases, which may worsen disease outcome and compete for the available resources. A further challenge is the dire economic consequences of prolonged lockdowns in countries with weak economies.

Their conclusions are that the ongoing COVID-19 pandemic presents an unprecedented global humanitarian and medical challenge. Although this has prompted unparalleled progress in the development of vaccines and therapeutics in many countries, it has also highlighted the vulnerability of resource-limited countries in Africa. Not only do these countries have limited testing capacity but the infrastructure to manufacture tests, vaccines and therapeutic drugs is largely absent, and few clinical trials are underway on the continent to combat SARS-CoV-2. Clearly, there is an urgent need for capacity development and the available resources should focus on solutions that are specific to the needs of the continent. For example, there is an urgent need to inexpensively manufacture viral antigens for serological testing: this will determine the seroprevalence of the virus where PCR-based testing is not available for mild infections. Therapeutics development should focus on repurposing existing drugs, or using convalescent plasma that can rapidly be used to treat infection and could be prioritized for individuals who are at high risk. Appropriate manufacturing partnerships need to be established to produce vaccines that could be tested and licensed on the continent, to limit reliance on global initiatives that may be overwhelmed by the global demand for a vaccine. In fact, this may present an opportunity for governments to finally invest in much-needed cGMP-compliant vaccine manufacturing facilities. Although the situation is unquestionably dire, Africa has an important role in the global fight against COVID-19, and the resilience and resourcefulness of the people are not to be underestimated.

Cloud Computing to help save Cape's unique fynbos



In the mountains, valleys and plains of the Cape, there are about six thousand species of plants that are not found anywhere else in the world. But as the climate changes, and invasive species and human development elbow them out of their natural niches, they are rapidly disappearing. The fynbos region is one of the world's six floral kingdoms and it is under threat from human habitation, climate change and invasive species

It has been 70 years since *Erica turgida*, with its willowy thin branches and small cup-like pink flowers, was last seen in the wild, even though it was once common around Kenilworth in Cape Town. And this little plant is one of many. Almost 40 plants in the Western Cape have gone extinct since 1900. This is about 500 times higher than the background extinction rate, which is the natural rate at which plants become extinct.

A team of researchers from the South African Environmental Observation Network (SAEON) have developed a method of catching problems in the fynbos before they irreparably damage an area. With the seasonal fires that sweep through the Cape, its fynbos vegetation is always in a state of recovery. This makes it difficult to tell whether the plants and biome are healthy. Researchers from the SAEON have won a grant that will allow them to monitor the region's fynbos in real-time. In forests, it is relatively easy to tell whether there are changes and whether the trees are healthy; they are either green or they are not, says **Jasper Slingsby**, a SAEON biodiversity scientist and part of the project. However, with fynbos "we are working with an open system. There are fires, it is not always green, and the seasonal variability is huge," he says. "To say, 'This is normal and this isn't' is very difficult."

At the same time, the Cape Floristic Region is under increasing threat. The region is one of the world's six floral kingdoms, with many unique plants. However, the drought, invasive species, and urban development are putting increasing pressure on this fragile ecosystem. However, the SAEON team's model predicts what the fynbos should look like at any given time, and using Google Earth Engine, they can evaluate whether what is on the ground is within the natural range, says Slingsby. The two-year grant, awarded by Google Earth Engine (GEE) and the international Group on Earth Observation, will allow the team to use the GEE platform to develop their system. "[GEE is] a cloud computing platform that processes major remote-sensing data sets from satellites," he says. "It allows you to run insane analyses; the scale of it is mind-boggling."
But the real innovation is in the model that powers their analyses. In a recently published paper, the researchers – which include Slingsby, SAEON data scientist and grant lead Glenn Moncrieff, and Adam Wilson from the University of Buffalo in the United States – laid out the nitty-gritty of how to compare satellite data of the Cape's fynbos with the predictions of what it should look like. "Tools to aid the management of open ecosystems are desperately required as they dominate much of the globe and harbour substantial biodiversity and carbon," they write.

Slingsby and colleagues' monitoring tool will allow them to have a bird's-eye view of the fynbos biome. "For example, the Cederberg is a large area and you don't know the impacts of the drought or the spread of alien invasive species. This [monitoring system] gives us an idea of what's going on out there, especially in hard-to-reach areas," Slingsby says.

Exploitation changes leopard behaviour with long-term genetic costs

by Vincent Naude, Guy Balme & Jacqueline Bishop

Throughout their range leopards are in rapid decline, having disappeared from North Africa, much of the Middle East and Asia. Declines have been so severe that the species is now considered vulnerable to extinction. No comprehensive estimates of the number of leopards remaining in the wild exist. In southern Africa, 62% of leopard distribution falls outside of formally protected areas. This unprotected landscape is highly fragmented by both agriculture and urban development.

Threats to leopards include habitat fragmentation, killing for fear of livestock loss and poorly managed trophy hunting. Leopards are poached through deliberate or opportunistic poisoning and wire-snaring. Their body parts are also illegally traded for traditional medicine and cultural attire. Conservationists are concerned that these threats contribute to the overall decline in leopard numbers. Conserving leopards successfully requires us to track population numbers and trends. However, leopards are notoriously elusive and occur at low densities, which makes monitoring difficult. Threats to many wild cat populations across southern Africa are often age and sex-biased. How these threats influence leopard behaviour is poorly understood.

Our study explored the long-term genetic costs of exploitation-driven changes in the behaviour of leopards. To do this we compared the social and genetic structure of two well-studied populations in South Africa; a protected population and one recovering from over-exploitation since 2005, where 50% of leopard deaths were human-related. Using GPS collars, guide sightings and genetic samples, we gathered over 15 years of data to reconstruct home ranges and family pedigrees for 150 leopards across both reserves. This allowed us to examine the behaviour of related individuals over multiple generations, with and without exploitation.

Typically, female leopards establish territories close to their mothers, while males settle away from their natal range. At sexual maturity (~3 years), sons compete with surrounding males for access to territory and mates. Often overcome by these large established males, sons are forced to disperse out of the area, creating a "genetic out-breeding effect". By "moving out" to establish a territory away from "home", sons avoid breeding with closely related females. Inbreeding at the level of sisters, mothers and aunts can have severe consequences in big cats. These range from physical defects like tail "kinks", to severe reproductive costs and even sterility. In both populations, we found that daughters established home ranges near their mothers. Here they benefit from the resource knowledge of their mother's territory. In the fully protected population, sons dispersed out of their maternal home ranges, moving away from closely related females.

But in the historically over-exploited population, many young males did not disperse. Instead, their newly established home ranges overlapped with those of their sisters, mothers and aunts. Here, territory "gaps", created by the killing of large males, allowed sons to escape competition and establish territories alongside their mothers. The problem? Males in the exploited population stopped dispersing and, as a result, destabilised the out-breeding mechanism for this population. This increased the likelihood of young males fathering cubs with closely related females. We found evidence of this with a father-daughter and two half-sibling mating events. Known breeding pairs in this population were also highly related, the equivalent of at least half-siblings. While the overall population was growing, it retained signatures of inbreeding despite over 10 years of recovery.

What does this mean for leopard conservation?

The risk of inbreeding in small, over-exploited populations is well known. However, few studies have the necessary long-term data to demonstrate this direct link. We show clear evidence of how exploitation can disrupt the dispersal behaviour of leopards, ultimately leading to inbreeding. Our study is among the first to demonstrate these risks in a large solitary wild cat species. We emphasise that even "recovering" populations still carry the inbreeding "scars" of historical exploitation. While reduced genetic diversity exposes populations to the challenges of future disturbances, including disease outbreak, habitat loss and climate change. Increasing evidence suggests most leopard populations across southern Africa are threatened by exploitation. Long-term genetic costs should stimulate discussion among scientists, reserve managers and policymakers who aim to effectively conserve this species.

The recovery of leopard numbers in historically exploited protected areas is crucial to safeguarding the 62% of unprotected leopard range from loss. Promoting movement between reserves to encourage gene flow requires suitable wildlife corridors for leopards, even through already transformed land. Left unregulated, the unsustainable exploitation of leopards will have severe ecological and evolutionary costs.

GRADUATION STORIES

Masters focusing on ecological viability of marine ponds created by diamond mining activities

Liezl Maritz has just completed her MSc in Biological Sciences, with her research focusing on the ecological viability of marine ponds, created by diamond mining activities. Her study on the ecology of wetland ponds, that are created along the coast of the Namibian desert by diamond-mining activities, was the first (and only) one of its kind.

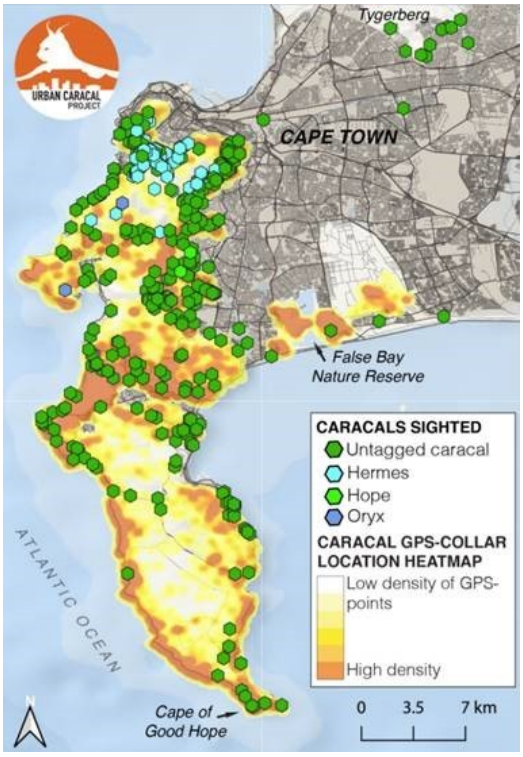
The diamond mining activities progressively push the coastline out into the sea so that the mining can take place in what was previously surf zone, in the lee of 'seawalls' that hold the sea at bay. In the process, multiple large marine ponds—some as much as 1km long—and visible on Google Earth—are created along the coast. Prior to diamond mining in southwest Namibia, the coast was covered by a natural occurring dune hummock system, something that has disappeared with the type of mining conducted in the area. This habitat is now substituted by an alternative one in the form of manmade marine ponds. Liezl's study was to assess these ponds as an ecologically viable habitat that could supplement the sparse estuarine and lagoonal systems that exist on that parched coast. She investigated the diversity and amount of saltmarsh vegetation, bird species and fish currently benefiting from these mining ponds. Her results showed that the ponds attract and support biodiversity by creating salt marshes that support populations of a limited number of marine fish species and a remarkably rich waterbird fauna.

What stood out for Liezl while doing her research?
During her study, 36 bird species were recorded, ten being endemics, and five listed in Namibia's Red Data Book. The ponds constitute an attractive alternative habitat for waterbirds to nest, forage and roost.

What were some of the challenges of this research?
Southern Coastal Mines is a high security area surrounded by a double fence where public access is strictly controlled. The majority of the time I worked in isolation on the coast of the southern Namibian desert with only a two-way radio to communicate with security about my whereabouts. Despite chalenging times, Liezl described many rewarding moments: She could always hear the waves crashing in the distance and some days even observe whales and dolphins splashing around in the deep waters behind. During her solo fishing expeditions, there would always be black-backed jackals nearby, indifferent to her presence, observing and patiently waiting for her to finish her dissections so they could collect fish scraps. Regular sightings of the peculiar Brown Hyena were a constant reminder of the wild nature of the coast. Liezl says this experience has taught her to make time to reflect and appreciate the small moments in life. She described how it was always a joy sharing her experiences with her supervisors, Prof Branch and Dr Deena Pillay, who visited and share the same passion for this unique area.

What lies ahead for Liezl?
Liezl will remain working for Namdeb Diamond Corporation, and continue with her research inside Southern Coastal Mines, especially bird and wildlife monitoring. She will further investigate to what extent the birds benefit from the existence of the mining ponds and investigate what threats the double security fence has on wildlife migration patterns and wildlife trapped inside the mine. Liezl says she is in a privileged position to incorporate her research into her work and hopes to continue contributing towards Namdeb's biodiversity conservation efforts.

Citizen Science Urban Caracal Project



iCWild's Urban Caracal Project has been making great strides this year but most notably for them is the incredible ongoing public engagement with the project. More than 500 people have submitted their sightings reports. They recently summarized data based on public sightings of caracal around Cape Town and mapped it together with their GPS collar data—see figure on right and read more at https://www.facebook.com/urbancaracal. Their Facebook page (which has approximately 11 000 followers!) has stunning photos of caracal, advice about what to do if you sight a caracal and information about them.

Caracals have been spotted on Chapman's Peak, Clifton, Kommetjie, the Pipe Track, Lion's Head, Bantry Bay and along Kloof Road and seem to have carved out a niche for themselves in Cape Town. **Dr Laurel Serieys**, principal investigator says, "Caracals are extremely flexible, behaviorally". Serieys and the team at iCWild captured and collared 26 of the cats with tracking devices to learn about them, what they eat and the environment they inhabit. Their research shows that these caracals have a diverse diet - consisting of more than 70 prey species: medium-sized birds, rats and frogs. The GPS coordinates from their collars show that they spend time on the coastline hunting seabirds and penguins. They also prey on domestic cats, chickens and ducks and Serieys describes them as a conflict species, who, in agricultural areas are persecuted by farmers.

Genetic surveys indicate that these cats have high levels of inbreeding—suggesting a closed off population. There are about 320 square kilometers available to them in the peninsula and typical male territory in other areas is about 75 square kilometers. It is estimated that there are about 50 cats in the area which suggests heavy competition in a small territory and Serieys says her team has detected caracals killing and eating other caracals. Their data showed that the cats prefer to spend time right at the edge of the urban areas, where they are likely to encounter increased foraging opportunities; indicating that these urban cats may have become habituated to exploiting food sources near humans.

Habitat loss is the greatest threat to biodiversity globally and when habitat is transformed by fragmented human development, species such as these show they adapt to environmental change and make the most of it by hunting prey like guinea fowl, vlei rats and Egyptian Geese which are abundant at the urban edge.

Photo: Krisleigh Marx

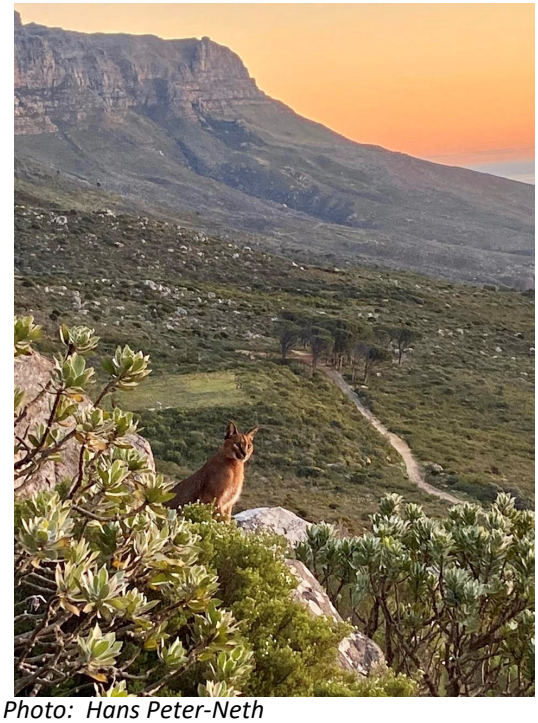
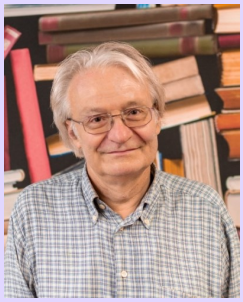


Photo: Hans Peter-Neth

In Memoriam: Hans Peter Kunzi



The Department of Mathematics and Applied Mathematics at UCT has been greatly saddened by the death of **Professor Hans-Peter Künzi** while on sabbatical in Switzerland. Although we knew he was ill, this has come as a shock to us all. Hans-Peter was the leader of the Topology Research Group here at UCT, but his support also extended to cooperation with colleagues working in Category Theory, Algebra and Analysis.

Hans-Peter first came to UCT in the 1980's as a postdoctoral student with Guillaume Brümmer. He returned to UCT and to the Department when, after appointments in various capacities in Europe and the USA, he was appointed as Full Professor in the year 2000. In 2011 he became a UCT Fellow.

He was highly respected internationally for his research, as evidenced by his NRF A-rating, and he was a leader in his primary area of research, aspects of asymmetric topology. In July 2004 he was the main organizer of the 19th Summer Conference on Topology and its Applications, one of the large annual conferences in his field, which was held at the University of Cape Town. He has a large number of publications – over 200 - and many co-authors. He also published in the areas of order and in combinatorics. He was on a number of Editorial Boards, including Quaestiones Mathematicae, the Journal of the South African Mathematical Society, and had a large number of research students.

Hans-Peter's willingness to take on the position of HoD for the period August 2012 – December 2016 was a clear indication of his commitment to the well-being of us all in the Department.

We will all miss him. He was very supportive of our individual efforts and initiatives, even when they were not necessarily in his direct line of research.

LAST LAUGH….

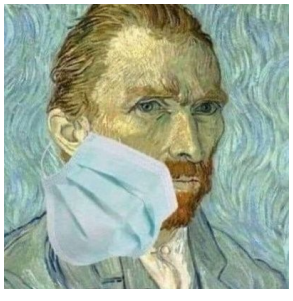
A fishy backyard lockdown tale

For **Dr Rob Little**, manager of the FitzPatrick Institute of African Ornithology Centre of Excellence, lockdown and being confined to living and working home, meant that his passion for fishing and outdoor activities were frustrated. He had booked a week on the Orange River in late April which was cancelled so to cope with his frustration during level 5 lockdown, he got creative and started casting a fly at paper fish in his swimming pool to recreate the thrill of the strike.

Dr Rob Little's plan to keep his fly-fishing wrists flexed during lockdown. Photo Karen Kearns

Dr Rob Little with a largemouth yellowfish, caught on the Orange River. Photo Grant Cannon.

Then almost six months later when level 1 lockdown was declared and he was finally allowed to cross interprovincial borders for leisure travel, he headed up to Onseepkans on the Orange River. Dr Little comments, "It was a great feeling to get back out there and to target some special Large Mouth Yellowfish of which I latched onto a particularly spectacular individual on 1 October 2020. Thank goodness for birding and fishing which give me my much needed out-there fixes".



IF 2020 WAS A MATH PROBLEM

IF YOU'RE WALKING ON THE ICE CREAM AT 5 OUNCES PER TOASTER AND YOUR BICYCLE LOSES A SOCK, HOW MUCH GRAVY WILL YOU NEED TO REPAINT YOUR HAMSTER?