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Newsletter of the Faculty of Natural and Agricultural Sciences

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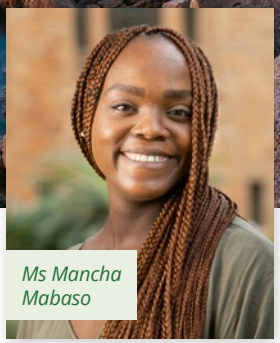
Make today matter

Prof Thulani Makhalanyane



Ms Mancha Mabaso

UP team sheds light on microbial communities in the oceans

Marine microorganisms are important regulators of oceanic ecosystems and constitute just under 70% of marine biomass. Due to their remarkable role as facilitators of the elemental recycling of carbon and nitrogen, microbial communities are vital for our planet's health.

However, we lack an understanding of microorganisms across a variety of ecosystems. This knowledge deficit is due to several reasons, including the logistical and technological challenges associated with studies in the open ocean. Recent estimates suggest that a litre of water may contain up to 100 billion microorganisms, and a drop of seawater is estimated to contain 10 million viruses, one million bacteria and about 1000 protists. In addition to their numerical abundances, microorganisms have considerable metabolic versatility and vary markedly due to differences in nutrient availability and environmental factors.

Given the known importance of microorganisms, it is crucial to establish a catalogue of microorganisms across the world's oceans. This is particularly important as some regions may be especially vulnerable in a changing climate with increased marine pollutants. For example, although anecdotal evidence suggests that rivers may be a potential source of marine pollutants, no studies have assessed the major reservoirs, such as the Orange and the Congo rivers.

Recent global studies suggest that microbial communities may represent potential feedbacks further exacerbating the effects of climate change. The microbiome is an important indicator of the Ocean's state of health. There is an urgent need to shed light on microbial communities, their evolution, and their likely impacts on marine ecosystems.

As part of these efforts, **a team from the Department of Biochemistry, Genetics and Microbiology in the Faculty of Natural and Agricultural Sciences** are set to participate in a global effort to study the South Atlantic.

The project, called Mission Microbiomes, aims to study microbiomes in the South Atlantic Ocean with major stopovers in Chile, the Amazon, Antarctica, and the West Coast of Africa. Members of the Microbiome Research Group; **Prof Thulani Makhalanyane and PhD student Ms Mancha Mabaso**, will join the oceanographic cruise as Chief Scientist and Scientist, respectively from 1 June to 10 July. The team will board the ship for the 14th leg of the voyage and travel along the West Coast of Africa from Walvis Bay (Namibia) and disembark in Matadi (Democratic Republic of Congo) (see map).

This five-week cruise, aboard the schooner TARA, is under the auspices of Atlantic Ecosystems Assessment, Forecasting and Sustainability (AtlantECO), a European Union funded program (www.atlanteco.eu). Mission Microbiomes will explore the mechanisms behind each of the major functions that make the oceans essential to our planet. This includes oxygen production by photosynthesis, carbon sequestration, and major nutrient cycles. Broadly, the project focuses on three research pillars including microbiomes, plastic and the plastisphere, and seascape connectivity. The multidisciplinary team of experts includes researchers from Europe, South America, and South Africa.

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Message from the Dean

Prof Barend Erasmus

"Time to reflect, recharge and remember what matters"

It's hard to believe that we have been away from campus for two years. As we prepared to leave for the first lockdown in March of 2020 and began to return to campus in more significant numbers in March 2022, it almost seemed seamless, like we hadn't left. To some extent, the expectation of picking up right where we had left seemed possible. In retrospect, old habits and routines have been replaced with new ones, and it is not as easy as we thought it would be. For some, face-to-face contact has been a welcomed change from the social isolation we endured. However, for others still reeling from losses of COVID-19 and the devastating floods that continue to ravage KwaZulu-Natal, they continue to endure the lasting effects that will likely remain with us for some time to come.

Now is the time to reflect, recharge and remember what matters to us at NAS. While we reflect, it is important to consider the achievements and continuation of operations in the Faculty and the fundamental changes that have taken place in society and individuals in general. It is evident from the excellent research outputs, numerous achievements and continued quality in teaching and learning activities that NAS has stood tall, unwavering and steadfast in our mission to produce quality graduates (see page 28 and page 32) and research. There are too many to mention in this brief message, and I hope you enjoy reading through them. None of these achievements would have been possible without the commitment of the staff and students of NAS. To each of you, I thank you sincerely for your continued efforts; they have not gone unrecognised.

There have been a few changes in the leadership of NAS, the most recent being the appointment of four new heads of departments: Actuarial Science (read more in next edition), Chemistry (page 39), Consumer and Food Sciences (page 39), Statistics (page 38) in the Faculty. I look forward to working with you and plotting the way ahead for new and exciting initiatives. To the predecessors, no amount of thanks or words of praise could sum up the individual contributions you have made to the Faculty. You have left a long-lasting impact and solid foundations for your successors.

We have exciting initiatives planned for the Faculty for the rest of the year. As part of RETHINK@NAS, we will be partnering with the Faculty's student house to celebrate Mandela Day and the Faculty research outputs in the coming months. Please keep an eye out for these exciting initiatives.

COVID-19 is still with us, and we have to remain vigilant. But we are getting better at living with COVID-19 in our midst. The parking lots are filling up, the student and staff foot traffic are increasing on campus, and laughter and NAS spirit once again echo through the corridors of NAS. It truly is an exciting time! While we forge ahead in 2022, I urge all staff and students to make time to recharge and find out what matters to each of you.

Now is the time to define how we approach the return to campus and life. Let's do so mindfully, where health and wellbeing are also prioritised alongside work and studies. I look forward to seeing you all on campus.

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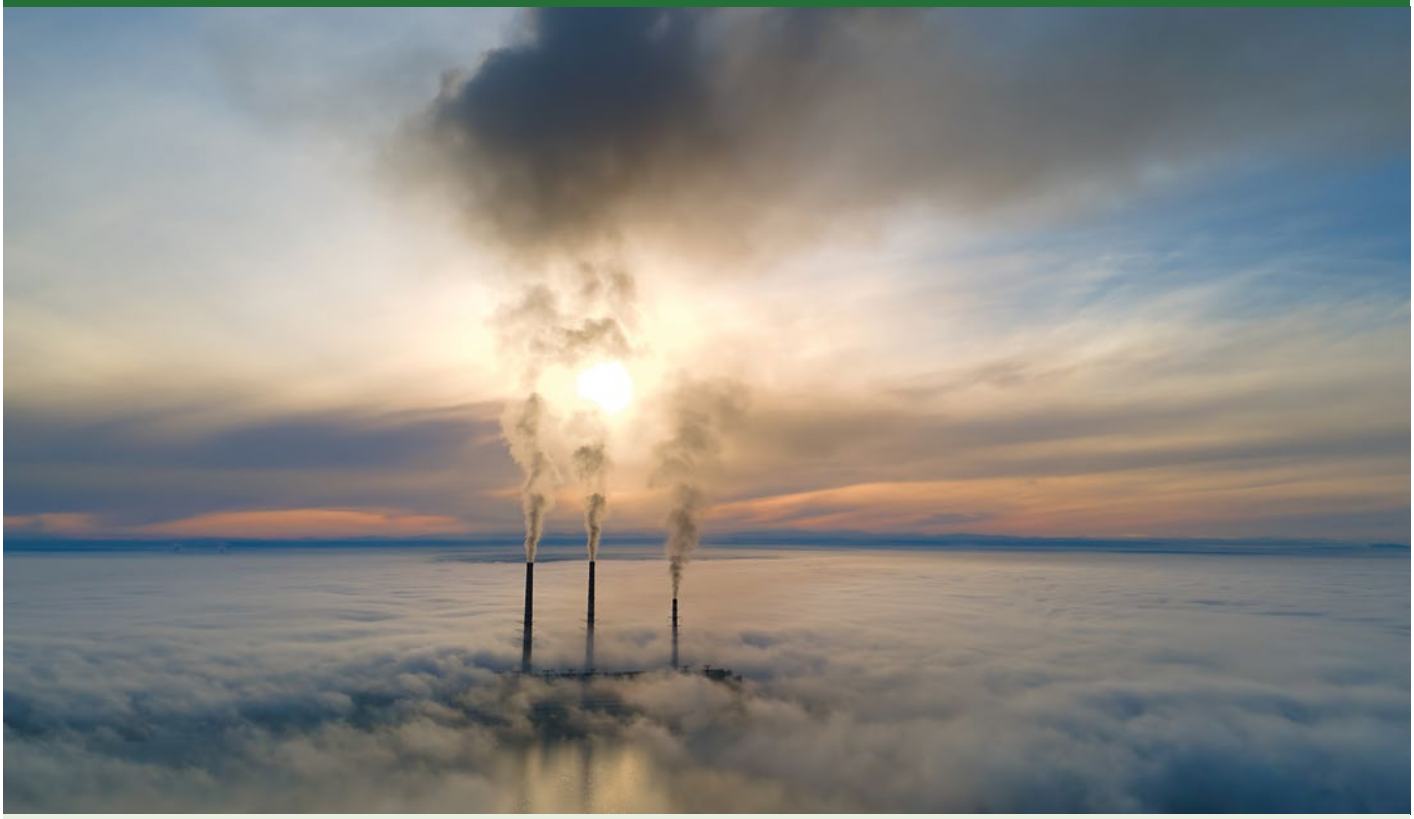
Research

Dangerous air pollution detected with machine learning



Researchers found high levels of air pollution in areas of Mpumalanga and Gauteng. UP's Prof Rebecca Garland helped create an artificial intelligence tool to monitor and predict daily air pollution against national air quality standards.

She was part of an international research team that fed data into a smart computer model to predict PM2.5 levels where there are blind spots in the available data. PM2.5 refers to particles less than 2.5 micrometres in size emitted by polluting industries like coal-fired power plants and many other sources in the atmosphere.

These particles can cause severe damage to the lungs. According to the World Health Organisation (WHO), PM2.5 particles have been linked to 4.2 million premature deaths worldwide. Since so many different sources emit PM2.5 where people live, it is essential to make sure PM2.5 levels don't exceed healthy levels.

The researchers used satellite, weather, and land use data to develop a highly accurate machine learning model that estimates daily PM2.5 levels in Gauteng and Mpumalanga. The team used their advanced machine learning model to fill the gaps left by the sparse ground monitors.

"When you want to know about pollution and its impacts on health, you want to understand how this pollution is distributed in space," says Garland, who is based at UP's Department of Geography, Geo-informatics and Meteorology. She brought her atmospheric science experience to the international team of researchers at Emory University in the USA.

"One way of doing this is a machine learning approach to integrate multiple data streams to map out pockets of air pollution."

One hundred thirty ground stations monitor air quality all over South Africa, but these are not enough to get an accurate picture of daily PM2.5 levels. Most of these stations also do not have adequate PM2.5 data, creating even larger areas where air quality isn't monitored properly.

Their model successfully mirrored the seasonal trends from the real world, and they used these to predict daily PM2.5 levels. The model identified that many areas across Gauteng and neighbouring provinces have high levels of PM2.5, with high levels seen in some low-income settlements.

"There are PM2.5 sources within low-income settlements, and we see high particulate matter levels in winter in the highveld region," she says. "So, part of this increase is the use of solid fuels for cooking and for heating, which of course, gets higher in the winter."

Prof Rebecca Garland

The model showed reduced PM2.5 levels in Tshwane from 2016 to 2018, but worryingly, they have stayed the same in Johannesburg and surrounding areas.

While specific to Gauteng, this research has opened the door for governments all over the world to use this method to track PM2.5 for their own areas. This method can help create and properly monitor policies that manage the risk associated with high PM2.5 levels.

UP study finds that lions hunt particular cattle types

When wild lions sneak up on a herd of cattle to grab an easy meal, the dice seem to be loaded more heavily against certain herd members, which are more likely than the others to be killed and eaten, according to a new study conducted by scientists from the University of Pretoria (UP).

The research, which was conducted with international collaborators, suggests that tiny horns, certain hide colours and patterns, youth and social behaviour all seem to play a part in whether a particular herd member ends up in a lion's belly.

While big bulls with long, sharp horns may be better equipped to fight off a lion attack, the more social behaviour of female herd members can offer considerable advantages.

"Heifers [younger females] are likely to benefit from safety in numbers, whereas bulls spend more time on their own away from the herds, rendering them more susceptible to predators," said Professor Michael Somers and Dr Florian Weise, co-authors of a paper entitled 'Lions prefer killing certain cattle types'.

As part of his postdoctoral studies co-funded by UP, Dr Weise has been involved in a range of studies on lion predation and human conflict along the northern border of Botswana, in collaboration with Prof Somers of the Eugène Marais Chair of Wildlife Management, which is part of UP's Mammal Research Institute.

Overall, the researchers found that lions show preferences for particular cattle types. They exploit cattle when available and repeatedly kill cattle in areas where they are left unguarded or unprotected, also targeting animals that are easiest to catch.

Prof Somers notes that lion populations across Africa have dropped precipitously over the past century, putting them at risk of local extinction in some areas, especially when they move out of protected parks and are killed by livestock owners protecting their herds.

"We found that lions were most active at night, with 87% of cattle killings happening between dusk and dawn," said Dr Weise, Prof Somers and their fellow authors.

Because the Okavango lion population is one of the last strongholds for the long-term survival of lions, the joint research of the US-based CLAWS Conservancy with UP has investigated several potential strategies to reduce such conflict, also in collaboration with the University of Newcastle in Australia and the University of Siegen, Germany.

> *"Cattle with black and brown mottled pelage (coat colouring) were most preferred, while pure black, pure white and dark brown colouring were significantly avoided."*

Previous research has included a "lion alert" pilot study in which herders got advance warning of potential lion attacks by combining GPS, tracking transponders and cellphone technology. Other research has focused on encouraging herders to reduce predation by using and building better lion-proof kraals (stockades), especially during the dry season when cattle travel further in search of water and grazing.

In the latest study to mitigate conflict with livestock herders, five wildlife researchers teamed up to establish whether lions show any marked preferences for certain cattle, such as animals with no horns or very small horns.

Interestingly, say the researchers, cattle with no horns were targeted preferentially by lions, while long-horned cattle were "highly avoided" in general.

"Cattle with black and brown mottled pelage (coat colouring) were most preferred, while pure black, pure white and dark brown colouring were significantly avoided," said the research team, which also included Mathata Tomeletso and Andrew Stein of the CLAWS Conservancy and Matt Hayward of the University of Newcastle's School of Environmental and Life Sciences.

The preference to attack cattle with small or tiny horns was understandable, since this reduced the risk of lions getting injured.

However, the more frequent attacks on cattle with mottled or non-uniform colour coats were more difficult to explain.

Dr Weise and his colleagues note that lions, like domestic cats, have more rods and cones in their eye retinas and a tapetum lucidum (a reflective layer behind the retina) that increases the amount of light available for enhanced night vision.

"This, however, comes at the cost of not seeing colour so well as, for instance, humans," the authors say. "This explains why mixed pelage does not afford any protection – but not why plain coloured cattle are eaten less. Perhaps, as lions respond rapidly to moving prey but seem to have difficulty seeing stationary animals, the mixed pelage pattern helps identify movement and is attacked more frequently."

Young calves with little experience of predation were also targeted preferentially, especially when they stampeded in panic during lion attacks inside poorly protected enclosures.

Another notable observation from the study was that it could be counterproductive for herders to drive lions off cattle kills. While this reaction was understandable, lions were more likely to mount repeated "hit and run" attacks to get enough food to meet their nutritional requirements.

The study was based on 168 cattle deaths linked to lions in the eastern Panhandle area of the Okavango Delta between 2016 and 2018.

Researchers discover many predators roam private land in Limpopo

Image: Jade Harris

Scientists have studied wild carnivores roaming protected areas for a long time, but predator numbers in unprotected areas remained unclear until recently. In Platjan, Limpopo, where farmers share the land with leopards and other predators, researchers led by Philip Faure have now tracked these elusive animals.

They were surprised to find large populations of leopards, spotted hyaena, brown hyaena, and African civet after reviewing photos snapped by camera traps every time an animal walked past. The research team, which included Professor Jan Venter from the UP Mammal Research Institute, reviewed over 3 000 images taken by 72 camera traps for three months.

The researchers say it is crucial to understand how predators coexist with humans in unprotected areas peppered with farms so conservation and agricultural activities can align rather than oppose one another.

"Commercial farmers own large proportions of land in South Africa," says Venter. With just 9.2% of land in South Africa under formal protection for wild species, large numbers of wild carnivores find themselves near privately-owned farms, which can be a recipe for conflict.

"For farmers and predators to coexist into the future, I think new generations of farmers should employ 'green practices', such as certifications that show that agricultural products are 'predator friendly'," says Venter. These kinds of initiatives involve consumers, who can make the choice to support farmers in their ecosystem protection efforts.

He says farmers should feel the need to protect carnivores living nearby, since they help to protect the ecosystems of agricultural areas.

For example, small predators like the civet hunt smaller critters that might be considered pests to farmers, while larger predators, like the African leopard, suppress populations of other animals that can cause damage, like black-backed jackal. Venter says predators like hyaenas also prevent the spread of disease by removing carcasses.

This study has given researchers, local authorities in charge of conservation, and local farmers in Platjan an idea of how many predators roam unprotected lands for the first time.

"It is just as important to know what's going on in protected areas as much as in unprotected areas," Venter says. "I like this kind of study because it creates a natural history record that will be important decades from now."

Fewer than 70 Albertina Sisulu orchids are left; researchers say fungi key to saving the species

The Albertina Sisulu orchid was described as a new species in 1955, the same year the struggle stalwart launched the Freedom Charter with her compatriots in the ANC Women's League. Researchers at the University of Pretoria want to help save this endangered plant by understanding the unique fungi it depends on for survival.

Dr Tanay Bose, a postdoctoral fellow at UP's Forestry and Agricultural Biotechnology Institute (FABI), co-supervised Modjadji Makwela's research on the orchid's fungi, which was published in the South African Journal of Botany. They studied the plant's mycorrhizosphere, which refers to the soil in which the orchid's roots and fungi (known as mycorrhizae) share nutrients to support each other.

"If this population is lost, the orchid species will be lost forever – extinct," says Bose of the only 68 plants known to exist. The critically endangered plant appears on the South African National Biodiversity Institute's (SANBI) redlist, with just over 60 plants found at the Walter Sisulu Botanical Gardens, the last place it can be found anywhere in the world.

As these plants are so rare, researchers had to carefully collect the soil around the plants so as not to disrupt them or destroy them in any way.

"With the help of the Wild Orchid Society of Southern Africa (WOSA) Andrew Hankey from the Walter Sisulu Botanical Garden, we collected soil samples near the plants where the orchid is not known to grow, and some soil samples close to the plants", says Bose.

After extracting DNA from the soil samples, the researchers identified the populations of fungi types unique to the mycorrhizosphere surrounding the Albertina Sisulu orchid.

"We've now got a rough idea of the mycorrhiza, or fungi, but we could not identify them at the species level," says Bose. This map of fungi surrounding the orchid can tell the researchers the exact concoction needed to help the orchid develop when it is planted in other areas to conserve it.

The orchid relies on the symbiotic relationship it has with its unique ecosystem of fungi, since its seeds lack an endosperm, the flashy encasing that gives other plant seeds the nutrients it needs to germinate.

"The billions of seeds each plant produces need to be infected by a specific kind of mycorrhizae to germinate and keep growing throughout its life," says Bose.

Dr Tanay Bose

And, in turn, the orchid completes the symbiotic relationship by giving the fungi the carbon it needs to survive.

The Albertina Sisulu orchid is unique in that it has this particular set of conditions currently only found in this small area in Gauteng, but the secret to saving it from extinction might lie in this soup of fungi researchers are slowly learning more about.

Moving forward, Bose says researchers must now investigate the roles different fungi play in the orchid's mycorrhizosphere. They need to find out which ones are beneficial to the plant, which ones are beneficial to each other, and what balance is best for this unique ecosystem.

Albertina Sisulu orchid. Photo credit: Andrew Hankey

Albertina Sisulu orchid. Photo credit: Karsten Wodrich

West Africa should prepare for strong earthquakes

A powerful earthquake of magnitude 6.5 hit Accra, Ghana, in 1939. It is still considered the most powerful earthquake to have hit West Africa, killing 22 people and injuring close to 200. While rare, scientists at UP are using new data and modern techniques to help predict when such an earthquake could strike that side of the continent again.

Professor Andrzej Kijko, Director of UP's Natural Hazard Centre, recently helped create one of West Africa's seismic hazard maps. However, he says important information about earthquake hazards in the sparsely populated region has been incomplete because of a lack of high-resolution earthquake detection networks.

"We know very little about the seismicity of Africa. In China, we have a catalogue more than 4 000 years old. However, reliable instrumental data for Africa only goes back about 70 years, or 100 years if you consider the strong earthquakes that have been recorded," Prof Kijko says.

While the region has seen its fair share of significant earthquakes, such as the 1984 magnitude 6.4 earthquake in Guinea, scientists still don't know enough about the seismic nature of West Africa to predict the impact of the next quake reliably. As West Africa gears up to develop critical infrastructure, seismic hazard data becomes essential for critical infrastructure plans.

"If another magnitude six (6) earthquake were to occur, it would cause tremendous damage to infrastructure, and so a seismic hazard assessment is needed for engineers to properly design structures," he says.

To conduct a seismic hazard assessment for a specific area, researchers need to know the past earthquakes in a region and the near-surface structure of the earth's crust at that location. Prof Kijko and his team used data from the International Seismological Centre and local seismic stations to assess the seismic hazard and settle an old debate about the region's seismicity.

They found that West Africa can be called a Stable Continental Region (SCR) instead of a region of shallow crustal seismicity, as some researchers believe. The result implies that West Africa should expect strong earthquakes from time to time, which can cause significant damage that threatens economic activity. "Researchers are changing their opinions about this region as more information becomes available," he says.

Prof Andrzej Kijko

The work of a seismic hazard researcher is never done, as new information becomes available and accepted ideas become overturned. Prof Kijko says there are still significant knowledge gaps across the African continent that need to be filled with more seismic hazard assessments.

"Earthquakes are rare and everybody relaxes and lives peacefully until a strong earthquake, like the 2006 earthquake of magnitude 7 in Mozambique, hits," he says. This 2006 quake hit Mozambique so strongly that it caused damage as far-afield as Durban in South Africa, and is considered one of the strongest events to have ever occurred in Africa.

"This all shows that our knowledge of the seismicity of Africa is very limited, and we need more research if we want to sleep in peace," he says.

Survey of wattle pests and pathogens in Ethiopia

Dr Ilaria Germishuizen, Prof Brett Hurley and Dr Mesfin Gossa

Recently, the Ethiopian Environment and Forest Research Institute (EEFRI) in collaboration with the University of the Sunshine Coast, Australia and two institutes from South Africa, namely the University of Pretoria's Forestry and Agricultural Biotechnology Institute (FABI) and the Institute for Commercial Forestry Research (ICFR) have developed a research project to determine the diversity and distribution of wattle pests and pathogens in the Awi Zone of Ethiopia, and investigate potential management options. The project is coordinated by Prof Simon Lawson and Dr Madaline Healey (University of Sunshine Coast) and funded by the Australian Centre for International Agricultural Research (ACIAR).

As part of this project, three researchers from South Africa (Prof Brett Hurley and Dr Mesfin Gossa from FABI and Dr Ilaria Germishuizen from ICFR) joined EEFRI researchers (Dr Agena Tanga, Weldesenbet Beze and Kumela Regasa) and conducted the first visit of this project to wattle plantations in the Awi Zone. This region is extensively planted to non-native *Acacia*, which are of crucial socio-economic importance, with a multipurpose role in the

society including for soil reclamation/improvement and as source of wood, charcoal and fodder. The *Acacia* species was previously considered to be *A. decurrens* (green wattle), but the initial visits to the site indicate that it is likely *A. mearnsii* (black wattle) – confirmation of the species is underway.

During the visit, severe and widespread infection of wattle rust (species to be determined) and infestation by various insect pests, including bagworms, scale insects and tree hoppers were observed. Prof Hurley and Dr Germishuizen have returned from Ethiopia after this scouting trip, but Dr Gossa will continue in the field to collect samples for identification. Further field trips are also planned for this year, but in different seasons.

UP researchers call for the urgent protection of bat-inhabited caves

Miniopterus natalensis in a cave. ▲
Photo credit: Centre for Viral Zoonoses

Percival's trident bat (Cloeotis percivali) in flight. ◀
Photo credit: Mariette Pretorius

University of Pretoria researchers Dr Mariëtte Pretorius and Professor Wanda Markotter have published a study which shows that land around important bat-inhabited caves are changing and that natural habitats are being destroyed.

Changes to natural habitats are bringing previously unencountered animal populations into contact with humans. This is especially true of bats, which are considered to be significant zoonotic transmission vectors; zoonotic diseases are illnesses that transfer from animals to humans.

The study also notes that caves and cave-dwelling bats are under-represented in conservation plans. The researchers detailed this shortfall by observing about 50 bat roosts. "The study found an overall 4% decrease in natural woody vegetation (trees) within 5km buffer zones of all roost sites, with a 10% decrease detected at the co-roosting sites alone," Dr Pretorius says. "As human populations grow, we are requiring more food – we found that agricultural land cover increased the most near roost sites, followed by plantations and urban land cover."

Dr Pretorius explains that in South Africa, at least two cave-dwelling species are of interest as potential zoonotic hosts: the Natal long-fingered bat (*Miniopterus natalensis*) and the Egyptian fruit bat (*Rousettus aegyptiacus*). "This is because of their large population sizes and widespread abundance. Very little information is available about the pressures that humans place on species like bats and specifically around the habitats for their roosts."

The researchers also found that the distances of habitats where roosts were found were decreasing as urban areas expanded. "According to the South African National Biodiversity Institute's ecosystem threat status assessment, which we used in our analyses, 72% of cave roosts fall outside of well-protected ecosystems," Dr Pretorius says. "As humans encroach on the territories of animals, we are putting ourselves at greater risks of severe pandemics because of how we are changing the use of our land.

"Our study calls for the urgent and formal protection of bat-inhabited caves to safeguard both bats and humans. Bats are vital to our ecosystem as they are one of nature's most effective pollinators and seed dispersers. They also help to keep insect populations in balance and they help with our food security."

"This study is critical in our understanding of One Health because of the interplay of three facets: the health of animals, humans and the environment," says Prof Markotter, Head of UP's Centre for Viral Zoonoses which leads in the One Health initiative to investigate zoonotic diseases. One Health refers to the interaction and intersection of the health of humans, animals and the environment.

Dr Mariette Pretorius

Click on the video to learn more about why bats are so important to our ecosystem. For a few interesting facts about bats, click on the infographic.

Dr Mariëtte Pretorius joined UP in 2018 when she began her PhD studies with Dr Mark Keith at the Mammal Research Institute. Dr Pretorius completed her PhD, which focused on bat research, in 2020 before embarking on a postdoctoral fellowship with Prof Wanda Markotter at the Centre for Viral Zoonoses in March 2021.

Unpacking a mystery of physics: Why processes in nature operate only in one direction

Why do processes in nature only work in one direction? For example, why can't we heat up a cup of coffee in the fridge or prevent a drop of ink from spreading spontaneously in water?

It's a question that's puzzled many generations of physicists – and it stems from an incompatibility in the laws of physics, specifically between those that dictate the behaviour of macroscopic versus microscopic systems. Macroscopic systems can be seen with the naked eye; they consist of an extremely large number of atoms and molecules. Microscopic systems represent a different world: small enough that the behaviour of each individual atom or molecule can be described, but is not visible to our eyes.

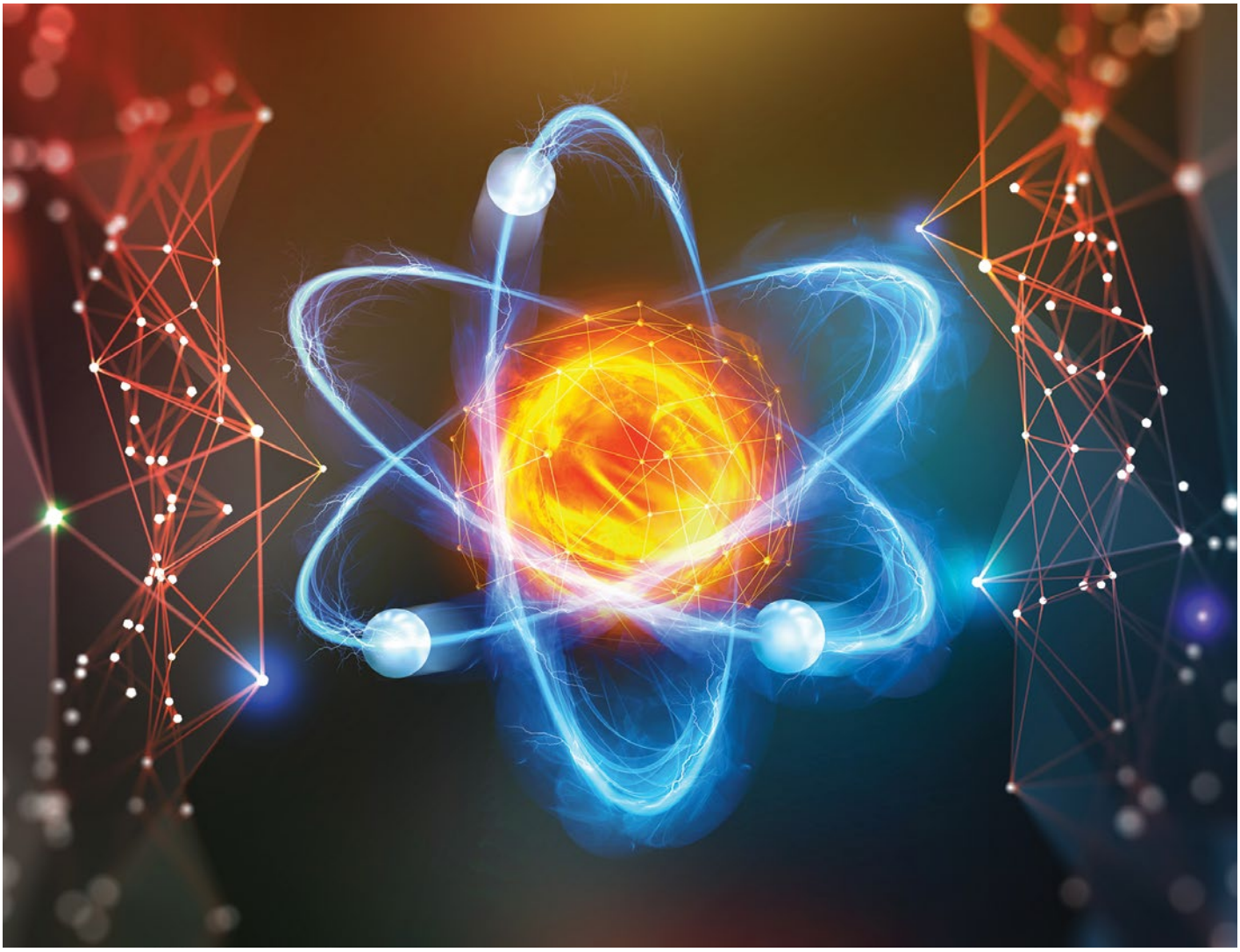
Physicists can easily explain why the processes of macroscopic systems can't reverse themselves spontaneously. It comes down to the second law of thermodynamics, which centres on the nature of the energy of a macroscopic system like a glass of water. This law provides a criterion that predicts the direction of spontaneous processes through the concept of entropy, a measure of order in matter.

Liquids are less ordered than crystals, and gases are even less ordered. Hotter or more dispersed matter is higher in entropy. Simply put, entropy always increases; systems become more disordered as they progress spontaneously – and they cannot regress unless we supply energy.

A different set of physical laws exists when looking at the individual atoms and molecules that comprise a microscopic system. But these laws don't explain what direction the processes in this system must take.

The matter and the processes are the same – but when they are studied from the macroscopic viewpoint the result may contradict that of the microscopic viewpoint. This is of course a problem.

In our new paper we argue that there's a solution to this conundrum. The key is to distinguish between two types of reversibility: time-reversibility and thermodynamic reversibility. A smooth transition of the two types would pave the way to a unified theory that can describe all states of matter and all processes based on a single set of principles. This is what scientists are eagerly looking for.



Equilibrium and gradients

Consider a pendulum. It swings back and forth indefinitely in the absence of friction. If this motion is recorded and played backwards, there's no difference; it would still look entirely natural. That's a time-reversible process – the pendulum's motion is symmetric with respect to time reversal.

But the heat that is dissipated from a cup of hot coffee never flows back. The heat inevitably flows from the hot coffee into the cooler air and the heat flow stops when the coffee and surrounding air have the same temperature. This final state is called equilibrium. Since it does not reverse like the pendulum the process is time-irreversible. A recording of it played backwards looks unnatural. This forward direction of processes in nature that stops at equilibrium is famously known as the arrow of time.

Then there's thermodynamic reversibility. Heat dissipation is an example: it is driven by a heat gradient, going from warmer to cooler. In fact, all spontaneous processes are driven by some type of gradient – a temperature, concentration, or pressure difference. These processes proceed "downhill" along the gradient, from the higher to lower temperature, higher to lower concentration, or higher to lower pressure. This gradient provides the driving force of the process. Any process in the universe that is driven by some gradient is thermodynamically irreversible.

Gradients govern the course of events in small and large systems. The earth receives energy radiated from the hot surface of the sun and dissipates energy at a much lower temperature into the cold background of the universe. The processes of life (for plants, animals and humans, among other organisms) are also driven by gradients – their source of energy ultimately comes from the sun in the form of tiny light packets called photons.

All living organisms dissipate energy in the form of colder photons, which is eventually released into outer space.

Molecular memory

Time-reversibility doesn't have anything to do with an entropy gradient. It's about memory. A process is time-reversible if all the molecules can "remember" where they were and how fast they moved at every instance of time, so that every molecule's motion can be reversed and the initial state restored. This can be simulated by modern computers if a system isn't too large. As computer technology advances, increasingly larger and more complex systems can be described at the level of their individual atoms and molecules.

So, the apparent incompatibility between microscopic and macroscopic systems has nothing to do with the size of the system. It has to do with the type of process and whether that process wipes out the molecules' "memory".

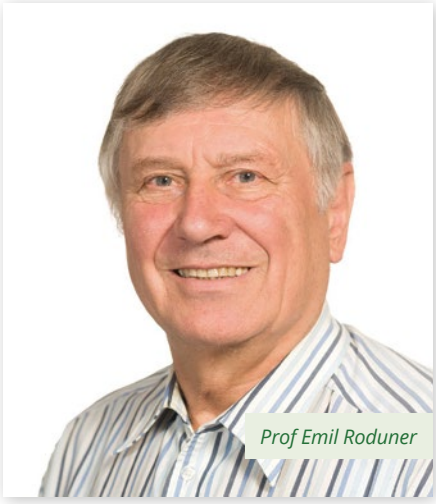
In the case of heat, or of energy more generally, the same amount of energy that is used to synthesise a sugar molecule is set free when the molecule fuels a process in our body and decays back to its initial constituent molecules. This is the thermodynamic view; it neglects the aspect of time.

If it takes five minutes to synthesise the molecule it does not mean that the molecule also decays after exactly five minutes. We can't predict the exact time that a molecule will decay because the process of decay is governed by a certain probability per unit time. And, importantly, probabilistic processes are never time-reversible because they contain no memory for the state in earlier times. A complete description of a probabilistic process requires one to take account of both the energetic and the timing aspects.

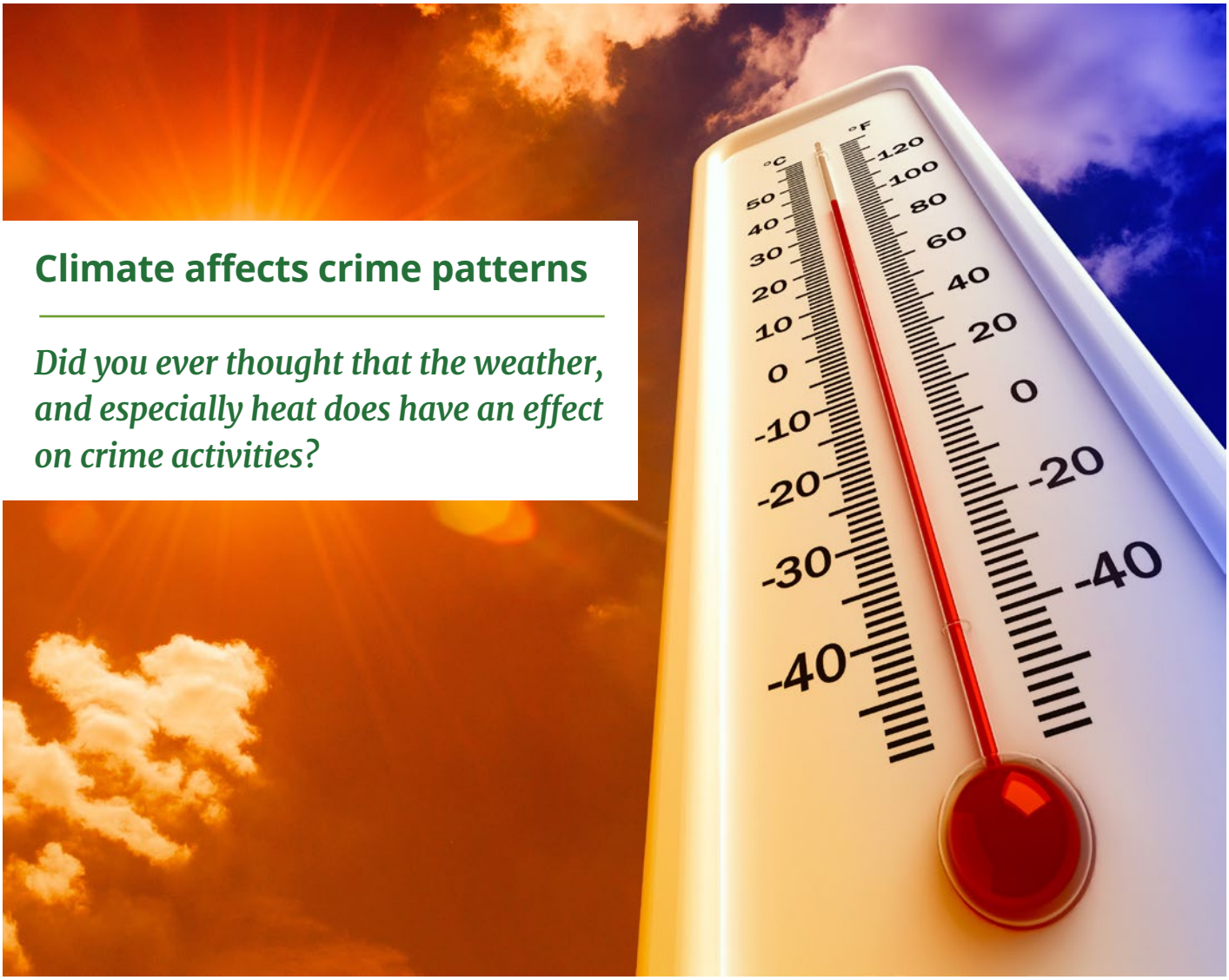
In this example both the synthesis of the sugar molecules and their decay are thermodynamically irreversible processes because a lot of energy must be added to reverse them. But this is completely different from time reversibility where memory is involved. So in this case, thermodynamic reversibility and time reversibility do not have the same origin. This is the essence of the problem at hand. It is generally assumed that thermodynamic irreversibility and time irreversibility have the same probabilistic origin, which is often the truth but not always. Our paper argues that these two types of reversibility must be separated.

Prof Tjaart Kruger is an associate professor in Biophysics at the University of Pretoria, and Prof Emil Roduner is a chair in Physical Chemistry at the University of Stuttgart and a visiting professor at the Centre for the Advancement of Scholarship and the Department of Chemistry at the University of Pretoria.

Prof Tjaart Krüger



Prof Emil Roduner



Climate affects crime patterns

Did you ever thought that the weather, and especially heat does have an effect on crime activities?

Prof Greg Breetzke

Professor Greg Breetzke from the Department of Geography, Geoinfomatics and Meteorology recently co-authored an article that investigated the link between heat and crime in Khayelitsha, Cape Town.

He and his co-authors found that when temperatures exceed 25°C, crime in Khayelitsha increased by 32%. This compares to an earlier study from 2019, where a 1°C increase in temperature translated to a 1.5% increase in murder (see the Open Access article published here).

Why would this be? If temperatures increase, people mingle more outside, often consuming more alcohol, explaining the increase in crime. What cannot be easily explained is the 'lag effect' of the current study – that crime often continues (up to a week) at a higher rate after the initial warmer weather.

It is not only warmer weather that leads to changes in crime. On cold days (days below 7°C), property crime increased by 50%; an increase of 40% was observed for rainy days.

This may be due to climogenic strains (strains or stresses brought on by a changing climate), which are explained by Professor Agnew's general strain theory – that people commit crime because of specific stresses they are exposed to. Climate change thus increases stressors, leading to increasing crime rates. But only where people cannot mitigate the warmer (or colder) temperatures. For example, having access to an air-conditioner to reduce the effects of a hot day outside, will minimise the climate-induced stress and crime rates will not increase because of such factors.

So how can this information be used to manage these effects? If we know that an area will experience hot days, police can ensure they have a greater visible presence, such as conducting more patrols, to prevent potential crime.

This news item was mostly derived from the Daily Maverick article here.

The journal article details are given below. Potgieter, A., Fabris-Rotelli, I.N., Breetzke, G., Wright, C.Y. The association between weather and crime in a township setting in South Africa. International Journal of Biometeorology (2022), DOI: 10.1007/s00484-022-02242-0.

Most recent NRF rated researchers (A- and B -rated)

A-rated researchers (Leading international researchers)		
Prof Nigel Bennett	Zoology and Entomology	A1
Prof Don Cowan	Centre for Microbial Ecology	A1
Prof Pedro Crous	Biochemistry, Genetics and Microbiology/FABI	A1
Prof Yves Van de Peer	Biochemistry, Genetics, and Microbiology/FABI	A1
Prof Mike Wingfield	FABI	A1
Prof Michael Bruford	Biochemistry, Genetics and Microbiology	A2
Prof James Raftery	Mathematics and Applied Mathematics	A2
Prof Brenda Wingfield	Biochemistry, Genetics and Microbiology/FABI	A2

B-rated researchers (Internationally acclaimed researchers)		
Prof Jacek Banasiak	Mathematics and Applied Mathematics	B1
Prof Robin Crewe	Zoology and Entomology	B1
Prof Johan Malherbe	Physics	B1
Prof Zander Myburg	Biochemistry, Genetics and Microbiology/FABI	B1
Prof Sue Nicolson	Zoology and Entomology	B1
Prof Bernard Slippers	Biochemistry, Genetics and Microbiology/FABI	B1
Prof John Taylor	Consumer and Food Sciences	B1
Prof Roumen Anguelov,	Mathematics and Applied Mathematics	B2
Prof Danie Auret	Physics	B2
Prof Armanda Bastos	Zoology and Entomology	B2
Prof Dave Berger	Plant and Soil Sciences/FABI	B2
Prof Marthan Bester	Zoology and Entomology	B2
Prof Lyn-Marie Birkholtz	Biochemistry, Genetics and Microbiology	B2
Prof Ding-Geng Chen	Statistics	B2
Prof Teresa Coutinho	Biochemistry, Genetics and Microbiology/FABI	B2
Prof Marietjie Frick	Mathematics and Applied Mathematics	B2
Prof Jaco Greeff	Biochemistry, Genetics and Microbiology	B2
Prof Abba Gumel	Mathematics and Applied Mathematics	B2
Prof Sheryl Hendriks	Agricultural Economics, Extension and Rural Development	B2
Prof Andrzej Kijko	Geology	B2
Prof Lise Korsten	Plant and Soil Sciences	B2
Prof Willem Landman	Geography, Geoinformatics and Meteorology	B2
Prof Emil Roduner	Chemistry	B2
Prof Mamadou Sango	Mathematics and Applied Mathematics	B2
Prof Clarke Scholtz	Zoology and Entomology	B2
Prof Pavel Selyshchev	Physics	B2
Prof Emma Steenkamp	Biochemistry, Genetics and Microbiology/FABI	B2
Prof Rudi van Aarde	Zoology and Entomology	B2
Prof Braam van Wyk	Plant and Soil Sciences	B2
Prof Fanus Venter	Biochemistry, Genetics and Microbiology/FABI	B2
Prof Wilhelm de Beer	Biochemistry, Genetics and Microbiology/FABI	B3
Prof Peter le Roux	Plant and Soil Sciences	B3
Prof Marion Meyer	Plant and Soil Sciences	B3
Prof Louis Nel	Biochemistry, Genetics and Microbiology	B3
Prof Christian Pirk	Zoology and Entomology	B3
Prof Egmont Rohwer	Chemistry	B3
Prof Hettie Schönfeldt	Animal Science	B3

Global Engagement

Prof Nigel Bennett was awarded prestigious JFW Herschel Medal

Professor Nigel C Bennett, an internationally renowned researcher and an NRF A1-rated scientist in the Department of Zoology and Entomology at the University of Pretoria, has been awarded the prestigious JFW Herschel Medal by the Royal Society of South Africa.

"I am both honoured and humbled to be bestowed this prestigious award by the Royal Society of South Africa. This is the pinnacle of recognition for one's work by the Society. So it means a great deal receiving this award for the research of my many students, postdoctoral fellows and colleagues over three and a half decades by such an esteemed Society," Prof Bennett said when asked how he felt about this award.

He added that "the JW Herschel medal is considered the Society's highest honour and has been sparingly given over the years. The award reflects an outstanding career in mammalogy, physiology and social evolution, and it reflects the significant contributions to these fields. It is a wonderful highlight in my career," Prof Bennett concluded.

Prof Bennett is no stranger to awards. He was awarded honorary membership of the American Society of Mammalogists in 2021 for outstanding contributions to Mammalogy.

He also occupies the Department of Science and Technology/National Research Foundation (NRF) Research Chair in Mammalian Behavioural Ecology and Physiology and the UP Austin Roberts Chair of African Mammalogy.

Prof Nigel Bennett

Prof Bennett's research focus is reproductive physiology, animal physiology and behaviour, using the African mole-rat as his model animal. His research record ranks him among the best researchers studying the social regulation of reproduction in any group of mammals in the world.

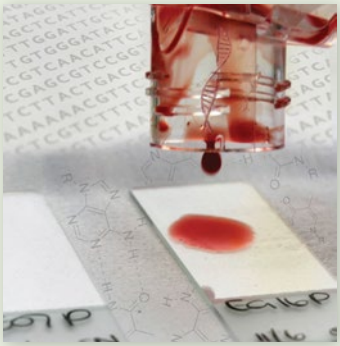
Prof Bennett has been the recipient of the Gold medal from the Zoological Society of Southern Africa and the Havenga Prize for outstanding contributions to Life Sciences awarded by the Academy of Science and Arts of South Africa. Prof Bennett is editor-in-chief of the Journal of Zoology, London, and a past editor of Proceedings of the Royal Society of London Biological Sciences B and current handling editor of Biology Letters, another Royal Society journal. Bennett is the world leader in African mole-rat biology and reproductive physiology.

More about the John F.W. Herschel Medal

The senior medal of the Royal Society of South Africa is named after Sir John Frederick William Herschel (1791-1871), who lived in Cape Town as an astronomer from 1834 to 1838 and whose grave lies close to Isaac Newton's in Westminster Abbey.

Herschel was a remarkable scientist; he was well known for surveying the southern skies and describing the Cape's unique flora but was also exceptionally gifted in many other disciplines. While diversity at such a level was possible in the 19th century, it is generally not feasible in the 21st. Because science has become far more complex, many basic sciences are multifaceted and may even be inter-disciplinary in their own right.

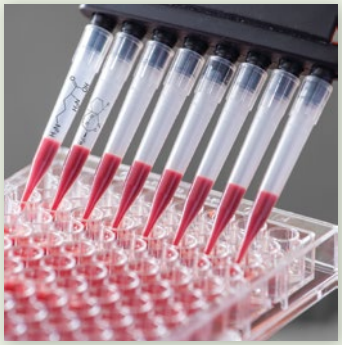
UP featured in Nature Communications celebrating World Malaria Day



Nature Communications has put together a themed collection that showcases Malaria research toward disease elimination published in the journal. The breakthrough paper 'Multistage and transmission-blocking targeted antimalarials discovered from the open-source MMV Pandemic Response Box' has been included in this collection.

The collection can be accessed at www.nature.com/collections/jjfifjaiai and is linked prominently on a dedicated page on their journal website (www.nature.com/ncomms/collections).

Excellent work on drug discovery for malaria transmission-blocking from our Malaria Parasite Molecular Laboratory (M2PL) team and our collaborators.



Rwandan government awards Prof Kayitesi with Research Award

Prof Eugénie Kayitesi

Prof Eugénie Kayitesi from the University of Pretoria's Department of Consumer and Food Sciences recently received a Research Award from the National Council for Science and Technology (NCST-Rwanda) and the Ministry of Gender and Family Promotion (Rwanda).

She was honoured with this accolade to recognise her research and scientific contribution and achievements. Particularly, research productivity is widely recognised and has made a significant impact on society.

"I am excited and honoured to get this award. Being recognised by the members of society for my work is an inspiration to continue doing impactful research. The award has highlighted my contribution towards achieving nutrition and food security for all in Africa and sparked interest in my work. This makes a big difference in my career, particularly in advancing my research and attaining more visibility but also inspires young and aspiring women scientists,"

Prof Kayitesi responded when asked about this award.

Prof Kayitesi has expertise in various research areas of Food Science and Technology, particularly food chemistry, food processing and sensory science. She undertakes fundamental and applied research relating to the improved utilisation of indigenous, underutilised African plant foods to attain nutrition and food security for all in Africa. She has published more than 60 peer-reviewed international journal articles and book chapters and presented her research findings in reputable local and international conferences.

Prof Kayitesi has earned several awards in recognition of her contributions to science. She won the African Women in Agricultural Research Development (AWARD) fellowship in 2009 and was named Food Science Educator of the Month by the Institute of Food Technologists in 2015. She is currently a recipient of the World Academy of Science (TWAS) young affiliateship and serves as a member of the TWAS Advisory Committee on COVID-19. She is also a Fellow of the Pan-African Scientific Research Council.

Two UP professors featured in BSPP Forty Faces of Plant Pathology

Prof Dave Berger

Prof Mike Wingfield

Two esteemed international plant pathologists, Professors Dave Berger and Mike Wingfield from the University of Pretoria's Forestry and Agricultural Biotechnology Institute (FABI) and the Faculty of Natural and Agricultural Sciences, have recently been featured in the British Society for Plant Pathology's (BSPP) "Forty Faces of Plant Pathology" that forms part of the Society's 40th-anniversary celebrations.

These two plant pathologists are also long-standing members of the Southern African Society for Plant Pathology and were interviewed as part of the BSPP celebrations.

BSPP members were asked to describe some things about themselves, what plant pathology challenges they would most like to see solved, and what could improve the world of plant pathology in terms of inclusivity.

When asked what he would have been if he were not a plant pathologist, Prof Wingfield responded: "I have had a wonderful career as a plant pathologist. Admittedly, I fell into this profession rather accidentally – *en route* to an education in medicine. I would have been a very unhappy medical doctor. If I were not a plant pathologist (and knew what it was like to be one), I would want to be a plant pathologist."

Read Prof Mike Wingfield's interview with BSPP here.

Prof Berger emphasised that

"I was featured as one of the "Forty Faces of Plant Pathology" mainly to illustrate that the BSPP has a diverse membership worldwide. It highlights that it is important for us to support our local and international scientific societies in our disciplines as scientists. These societies play a pivotal role in promoting the discipline to policymakers and the public."

Read his interview here.

The BSPP was founded in 1981 to study and advance plant pathology and has members from 51 countries across the globe and all branches of plant pathology.

Two Plant Science professors are on Top 2% Stanford list of World Scientists

Profs Namrita Lall and Lise Korsten, both from the University of Pretoria (UP)'s Department of Plant and Soil Sciences, have recently been nominated to form part of the top 2% of the Stanford University list of Scientists in the world (2020/2021), based on research and publication output.

The database was created to provide updated analyses and a publicly available database representing topmost-cited scientists in various disciplines.

Prof Lall admitted that "I am honoured to form part of the top 2% of the Stanford University list of Scientists. Recognition like this can have a cascading effect on a researcher's career and helps to Increase the citations to some extent. Every citation spreads one's name a little bit more."

"This contributes to facilitating networking and finding relevant national and international collaborators, which may eventually help increase the global university rankings of the respective university, which has become increasingly important. It is also 'calculative devices' for assessing the 'quality' of higher education and research,"

Prof Lall concluded.

Prof Lall holds a DSI/NRF South African Research Chair in Indigenous Knowledge Systems as part of the South African Research Chairs Initiative (SARChI).

She has been placed in the top 1% of the Essential Science Indicators list for publication citations in Pharmacology and Toxicology.

Prof Lall has made a significant contribution to the field of medicinal plant science. Several medicinal plants with valuable biological activities have been discovered, leading to the granting of several patents. She has published over 170 research articles and 54 book chapters, and her H-index is 44 (researcher id: http://www.researcherid.com/rid/A-2635-2012) and RG score is over 40 (Top 5%).

Fifty-three master's and PhD students have obtained degrees under Prof Lall's supervision/co-supervision.

She has received several prestigious awards in recognition of her work, including "The Order of Mapungubwe", South Africa's highest honour, the Distinguished Young Women in Science Award and the Biotech Fundi Lifetime Contribution Award by the Gauteng Department of Agriculture and Rural Development.

Prof Korsten is equally delighted to be on the top 2% of the Stanford University list of scientists globally. "This recognition is so important to me because it acknowledges a lifetime of hard work, dedication, passion and commitment. As a female scientist, it is even more special because it was a tough journey. Being one of the first female professors in the Agricultural Faculty, I had to walk the extra mile and endeavour many challenges and prejudice. The system was not optimally geared towards creating a conducive environment for young academics to rapidly excel and achieve international recognition while raising a family. I, therefore, feel that the current focus on mentoring and support for young academics is significant to enable them to move into that top 2% position".

Prof Korsten is currently the Co-Director of the Department of Science and Innovation (DSI)-National Research Foundation (NRF) Centre of Excellence (CoE) in Food Security.

Prof Korsten is the chair of the Global Task Force of Food Security for the International Society for Plant Pathology and the senior editor for the Springer journal Food Security. She has also been identified as one of the top 20 plant scientists in South Africa. She has recently been awarded the MT Steyn price for Natural Sciences and Technology from the South African Academy of Science and Technology Council.

Prof Namrita Lall

Prof Lise Korsten

She developed South Africa's first biocontrol agent to control fruit diseases and established a biocontrol research group at UP in 1992. She was one of the founding members of SABO (South African Bioproducts Organisation) and held a patent for a biocontrol agent that was later commercialised.

The value of her research programme is best illustrated by sustained local industry and international funding. Prof Korsten has supervised more than 100 master's and PhD students and ten postdoctoral fellows. She currently has an h-index of 45.

Horticultural master's student won Young Minds Award

Ms Michelle Stanton

Michelle Stanton, who recently completed an MSc(Agric) in Horticultural Sciences at the University of Pretoria's Department of Plant and Soil Sciences, won the International Society for Horticultural Sciences (ISHS) Young Minds Award for best oral presentation in the First International Symposium on Reproductive Biology of Fruit Tree Species at the end of 2021.

Her winning presentation, titled, "The combination of a novel pollen counting methodology and light microscopy reveal pollen abnormalities as a result of cold stress in the anthers of avocados (*Persea americana*) cultivated in sub-tropical climates", also led to an article in the ISHS magazine, *Chronica Horticulturae*.

"Throughout the last three years, I have gained valuable knowledge and indispensable experience, for which I am very grateful. It is an honour and blessing to have this work acknowledged by the International Society for Horticultural Sciences," Michelle said when asked about the award and article in the ISHS magazine.

"I'm very proud of Michelle Stanton's achievement – we participated in the abovementioned symposium on Reproductive Biology of Fruit Tree Species, where she made us proud," said Prof Elsa du Toit (Department of Plant and Soil Sciences), who supervised Michelle's master's degree.

Michelle explained that "Within the realm of my study, one of my chapters 'Novel counting methodology and light microscopy reveal pollen abnormalities in cold stressed avocado (*Persea americana* Mill.) flowers cultivated in sub-tropical climates' explored the under-researched facet of cold stress and its effects on pollen health and development in avocado trees cultivated in sub-tropical regions."

"It was this chapter that I had the joy of presenting at the virtual symposium. A novel pollen counting methodology, believed to be the first of its kind, was used to counteract the inconsistent cutting depths encountered with semithin sectioning preparations for light microscopy. Problems with anthers themselves were perceived as absent and/or empty compartments. While many pollen grains appeared healthy, some were malformed, and a few were observed as empty shells. *P. americana* 'Fuerte' anthers appeared to be more adept at maintaining pollen health during cold periods, while *P. americana* 'Hass' performed better during warm periods, and the influence of a warm-front before anther collection in one of the sampling years may have improved overall pollen health. This suggests pollen health depends on sufficiently warm temperatures late in the flower development process if the pollen matures properly. A slight difference in the amount of pollen was also detected in the anthers of flowers sampled in the male and female phases, suggesting the overnight closure of these dichogamous flowers is physiologically important and potentially sensitive to cold temperatures.

Furthermore, analysis of the temperature trends for the sampling area showed the avocado trees are regularly exposed to sub-15 °C temperatures during the period of meiosis, a critical level in tropical plants. These findings suggest avocados grown in sub-tropical and temperate areas that experience low temperatures during and after the period of meiosis may result in less pollen and a higher degree of abnormalities. This will further compound the problem of low pollination in commercial avocado orchards, and yields will be compromised," she concluded.

Prof Mike Wingfield awarded an honorary doctorate from UFS

Prof Koos Albertyn (Head: Department of Microbiology and Biochemistry, UFS), Prof Corli Witthuhn (Deputy Vice-Chancellor, Research: UFS), Prof Mike Wingfield and Prof Brenda Wingfield.

Prof Mike Wingfield, an internationally renowned scientist and Advisor to the Executive of the University of Pretoria (UP), was recently awarded an honorary DSc degree from the University of the Free State (UFS) during their April graduation ceremonies.

During various opportunities that Prof Wingfield had to speak during the multiple events linked to the graduations, he highlighted that his academic career had been launched at the UFS. He thanked Prof Francis Petersen, Vice-Chancellor and Principal of the UFS, for receiving a DSc *honoris causa* from this great academic institution. More broadly, he recognised the role that the UFS had played in providing the empowering environment that led to the internationally recognised Tree Protection Co-operative Programme (TPCP), and that was the 'springboard" for the establishment of the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria.

Prof Bonang Mohale, Chancellor of the UFS, conferred the degree awarded in recognition of his exceptional contributions to science and education in South Africa and globally.

Prof Wingfield is the founding director of the Forestry and Agricultural Biotechnology Institute (FABI), established at UP in 1998, stepping down from this position at the end of 2017 after 20 years. Currently, he serves as an adviser to the UP Executive and conducts research locally and abroad.

Prof Wingfield's internationally recognised research is focused on insect and disease problems affecting trees established in plantations and those in natural woody ecosystems. He is particularly interested in tree pests' global movement pathways and strategies to manage their negative impact. He has published widely on this topic and has been included in the Clarivate list of approximately 6 000 most highly cited scientists globally. He has supervised more than a hundred PhD students.

Martin Mushomba walks away with best presentation award at SAAB

Mr Martin Mushomba, an MSc student in Medicinal Plant Sciences, recently won the Best MSc Presentation Award at the 47th Conference of the South African Association of Botanists (SAAB).

"Receiving the SAAB's best MSc presentation award was a great privilege and a testament to all the hard work we put into my MSc project," said Martin when asked how he felt about this Award.

"This was a project I conceived of on my own, then approached Prof Marion Meyer to be my supervisor. Prof Meyer has since been helping me on every step of my MSc journey. Many aspects of the project were unique, and we weren't sure if many of the experiments would work. After many pilot studies and experiments, we were able to identify and successfully isolate a key metabolite that became the key to the whole study."

"Presenting my MSc project at this symposium alongside some of the leading scientists in our country was an honour but also very daunting. With my supervisor's guidance, I went through my presentation and rehearsed my talk a fair number of times. When the moment finally came to present, I was interrupted by technical internet glitches halfway through. Fortunately, with the help of the SAAB symposium technical staff, I was able to get back on the saddle, hold steady amidst the disruptions and finish my presentation strong. I honestly didn't expect to win anything after all that, so it was quite a surprise when I received this award."

He concluded,

"My gratitude goes to my supervisor Prof Meyer and to Dr Emmanuel Tshikalange and the NRF for their support during this study. I would also like to acknowledge my colleagues, friends and family for their constant encouragement."

Martin explained "The focus of my project was antibiotic resistance. Antibiotic resistance is when bacteria evolve to a point where certain antibiotics can no longer treat them. It is currently a serious health crisis which could result in the inability to treat many infectious diseases. Plants are an important source of treatments and have been found to help re-establish antibiotic effectiveness. This study aimed to compare the metabolites of an originally susceptible Staphylococcus with its mutated strain, which had lost its antibiotic susceptibility. Staphyloxanthin, an orange pigment that protects bacteria, was partially isolated from the original strain but not the mutant. This comparative study could test the effectiveness of different plant treatments against different strains of bacteria and find new effective medicines in the fight against antibiotic resistance."

Martin Mushomba

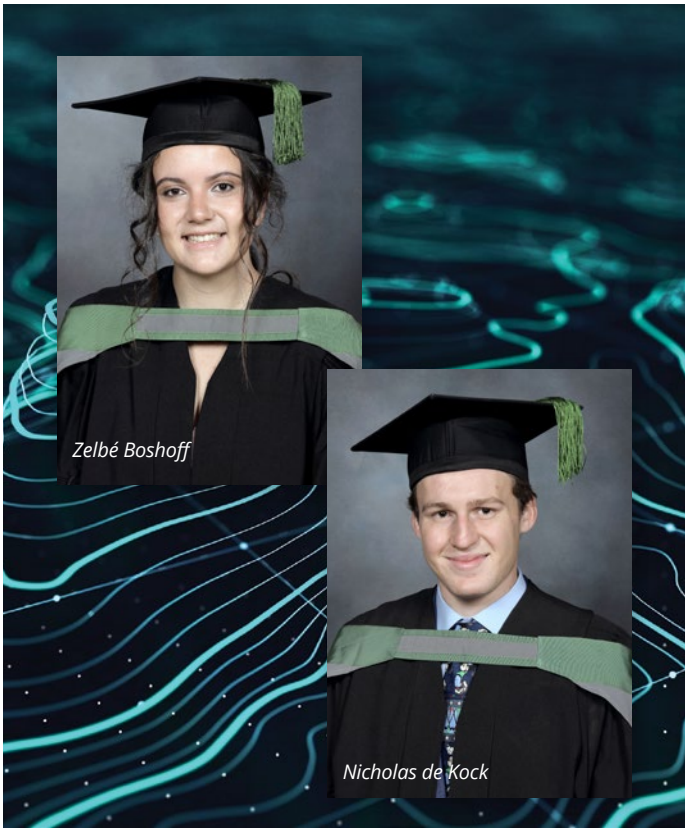
Two Geoinformatics honours students win at first GeoforAll student competition

Two former honours students in Geoinformatics, Zelbé Boshoff and Nicholas de Kock, entered their research projects in the first Geo for All competition for students in 2021 and did exceptionally well. Geo for All is the Open Source Geospatial Foundation's Committee for Educational outreach and works in close collaboration with international partners (ICA, ISPRS, UN-GIS, AGILE, UCGIS, IGU) in their mission of making geospatial education and opportunities accessible to all.

Zelbé was placed third in the English presentation category with her project An automated workflow for collecting and visualising daily rainfall in South Africa, supervised by Dr Victoria Rautenbach and Prof Liesl Dyson. The results of her project are available here. Zelbé is now employed as a Junior Spatial Economist (Research and Data Analyst) at S&P Global and is in the process of registering as a GISc Professional Candidate with the SAGC. She will be mentored by Dr Christel Hansen.

Nicholas de Kock won the prize for promising tools for his project autoESDA: An Open-Source Python Library for Automated Exploratory Spatial Data Analysis (ESDA). Nicholas is continuing with this project for his MSc Geoinformatics. He has published the library the official Python package repository(PyPI) and on conda forge, another popular Python data sciences platform. Furthermore, he hopes to publish it as a QGIS plugin. He is employed at the Geospatial Information Services in the Department and is also registering as a GISc Professional Candidate with the SAGC. He will be mentored by Mr Lourens Snyman.

Both students presented their work during the GeoforAll student conference.



Thuli Ntlatleng wins Esri Young Scholar Award


Thulaganyo (Thuli) Ntlatleng

Thulaganyo (Thuli) Ntlatleng, honours graduate in Geoinformatics from the Department of Geography, Geoinformatics and Meteorology (GGM), was announced the winner of the Esri Young Scholar Award for 2022.

She received the award for her honours project, Possible Wind Power in South Africa's Economic Hub: A GIS-Based Multi-Criteria Decision Analysis of the Potential of Wind Farm Development in the Gauteng Province of South Africa.

She joins previous winners from GGM, the most recent one being Azile Mdleleni, who won the award in 2020. The prize includes the potential in-person attendance at the Esri User Conference in San Diego, California, later this year. This, however, will depend on COVID-19 regulations.

For her project, Thuli utilised spatial Multi-Criteria Decision Analysis to identify suitable sites for wind power generation in the Gauteng Province. Sites were evaluated for wind factors, terrain gradient, electric gridlines, roads and railways, and proximity to urban areas. According to one of her supervisors, Dr Christel Hansen, "the Analytical Hierarchy Process (AHP) was used to assign weights to the criteria, to create a hierarchy in the decision model. AHP was completely modelled from literature instead of the common approach of a gathering of industry experts that assign importance score to the criteria. The thresholds, buffer zones, exclusionary areas and suitability scores were also sourced from various literature."

This study confirms the findings of the Council for Scientific Research , i.e., there is no potential for large-scale wind farms in the Gauteng Province. With the unique application of Multi-Criteria Decision Analysis, only small areas were deemed suitable for wind farm development.

Thuli was supervised by Dr Christel Hansen and Dr Adedayo Adeleke.

Prof Lise Korsten awarded MT Steyn medal for exceptional achievement

Prof Lise Korsten from the University of Pretoria (UP)'s Department of Plant and Soil Sciences was recently awarded the MT Steyn medal for exceptional natural sciences and technology achievement.

The South African Academy for Science and Arts (Suid-Afrikaanse Akademie vir Wetenskap en Kuns) awarded this medal as a 'once in a lifetime award' in honour of Prof Korsten's creative contributions to the exploitation, organisation and continued development of the natural sciences or technology and its successful application, in the national interest.

"This is an extraordinary special award for me personally since it provides a platform for recognition for all the people who supported me getting to this point. First and foremost, my mentor and role model Prof Jan M Kotze, a well-known plant pathologist who passed away just before COVID-19. This is truly a proudly South African moment for me to celebrate with all the people of our beautiful country and its amazing diversity and interesting people."

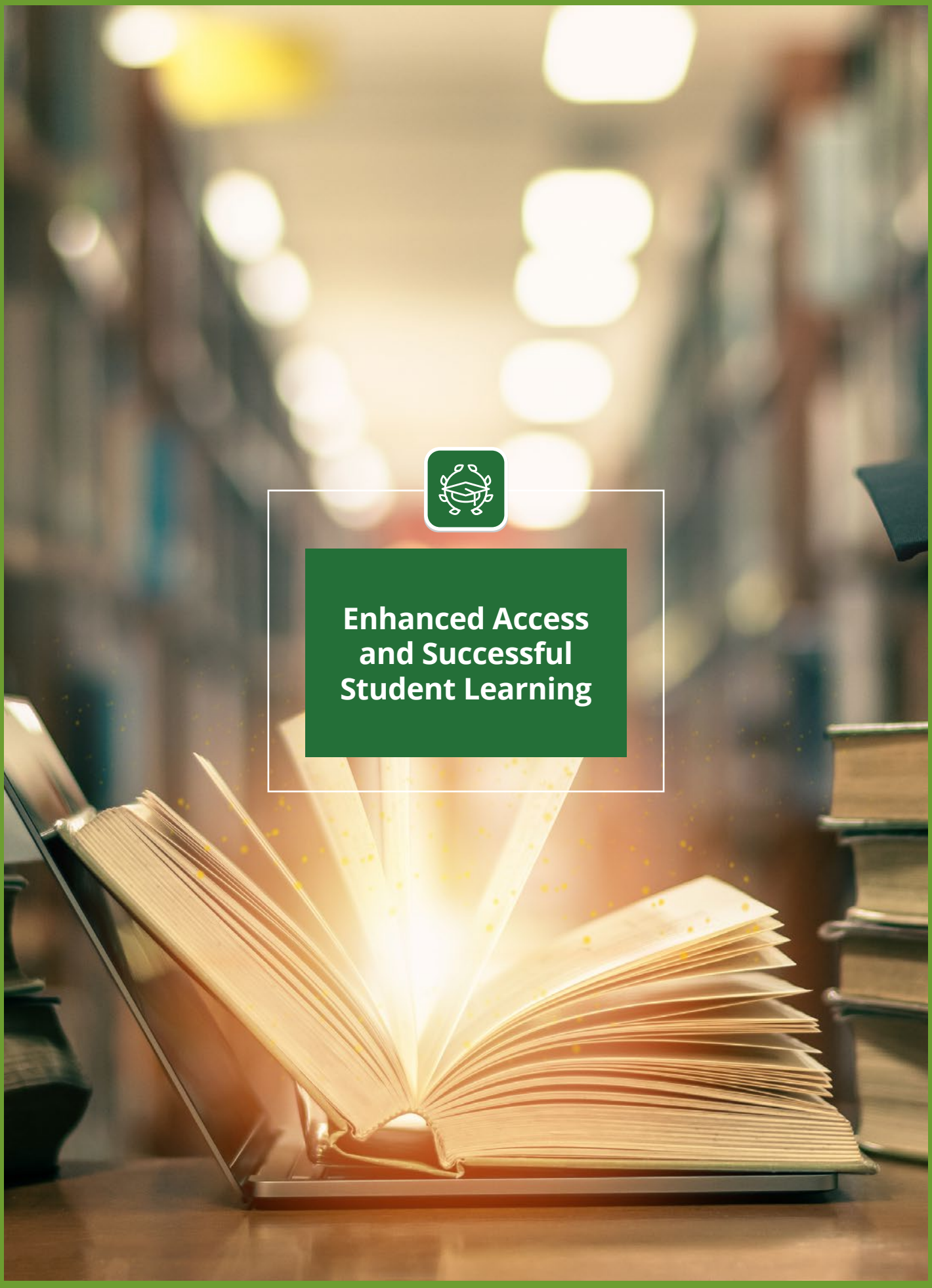
"We should never underestimate what these awards mean to people and their communities, and a country and its people still grappling with our history and the many challenges we have. May we build a better future for all,"

said Prof Korsten when asked how she felt about receiving such a prestigious award.

Prof Korsten is currently the Co-Director of the Department of Science and Innovation (DSI)-National Research Foundation (NRF) Centre of Excellence (CoE) in Food Security.

She developed South Africa's first biocontrol agent for fruit and established a biocontrol research group at UP in 1992. She has also established a fresh produce health group that focuses on food safety of fresh produce and Sanitary and Phytosanitary aspects related to international trade. Prof Korsten has focused her research on the complementary fields of postharvest technology and food safety related to international trade in fresh produce. As a team, the Plant Health and Safety research group has developed several innovative technologies to reduce disease and prevent product contamination.

Prof Lise Korsten



Enhanced Access and Successful Student Learning

NAS awards best lecturers of 2021

Praises sung by the students were the order of the day when the awards for best first-year lecturer and best lecturer for senior courses were made at the annual breakfast of the Faculty of Natural and Agricultural Sciences end of 2021.

The best first-year lecturer award was shared between Dr Markus Wilken (Department of Biochemistry, Genetics and Microbiology) and Dr Carel Oosthuizen (Department of Zoology and Entomology). Dr Rory Biggs from the Department of Mathematics and Applied Mathematics was awarded the best lecturer for senior courses.

These awards were initiated by the Faculty's student house, NATHouse, to recognise the extra effort that the lecturers put into their teaching and learning activities.

Students were very vocal with their compliments for **Dr Wilken**. Comments included:

"He is more than a lecturer; he is like a parent, an advisor, and a motivator. He not only focuses on the teaching and learning part of things but also on our social well-being and state of mind, especially during COVID-19. His teaching methods and techniques never cease to amaze."

Another student remarked: "Dr Wilken has taught me so much more than just chromosomes and DNA replication. He always makes sure that we are doing alright, always on time for lectures, marking our tests and ensuring we laugh now and then with Meme Monday."

The students equally lauded **Dr Oosthuizen** for his commitment to them.

"Dr Oosthuizen has an incredible passion for his work, which makes the module extraordinarily enjoyable. He never fails to make a lecture fun and entertaining whilst still informative. He takes the time to address questions presented by the students and is always willing to investigate new topics or ideas set forth by students."

Another student commented: The way he teaches the classes is always entertaining and grasps one's attention. Work that I never thought would interest me gains all my attention when he gives the lectures. I also do extra information around topics discussed in our classes, because the way he presents the classes get me so excited to know more."

Students voting for **Dr Biggs** as best lecturer for senior courses also expressed their gratitude in their nominations.

"Dr Biggs has gone the extra mile for students – from being available on a Discord server he made for students to being on the WhatsApp group with all the students and motivating us all to think critically about our degree paths and lives. He has proven to many students that although maths is hard when it is not your field of interest, it is super important as it does tie in with most things in life. The way he explains analysis, which is a difficult module, lets us learn from our mistakes and allows us to think abstractly to solve problems."

NAS Teaching and Learning Awards encourage passionate lecturers


Dr Nadine-Pienaar-Marx


Prof Matthys Dippenaar


Dr Lindo Magagula


Dr Miek Messerschmidt


Dr Carel Oosthuizen

Awards in four clusters for excellence in teaching and learning in the Faculty of Natural and Agricultural Sciences (NAS) were made at the end of 2021.

The cluster winners were: Dr Nadine-Pienaar-Marx (Agricultural Sciences), Prof Matthys Dippenaar (Physical Sciences), Dr Lindo Magagula and Dr Miek Messerschmidt (Mathematical Sciences) and Dr Carel Oosthuizen (Biological Sciences.

Dr Marx-Pienaar, a lecturer in the Department of Consumer and Food Sciences, said, "I am extremely honoured to be awarded the 2021 Teaching and Learning Cluster prize. This award is one of the highlights of my career at UP, and winning it during COVID-19 is extra special and humbling. I want to thank all of my colleagues who supported the nomination. Without their dedication and commitment to teaching excellence, this milestone would not have been possible. Teamwork makes the dream work!"

"To me, this award affirms that I am doing what I should be doing with my life. Not a lot of people are fortunate to get the fulfilment I get from my job (teaching). I count myself as blessed and to think I never worked for a day. I am just doing what I love," Dr Lindo Magagula, Lecturer in the Department of Statistics shared his sentiments on winning a cluster award.

"I have taught mathematics courses from high school and first-year through to master's and PhD level, both in South Africa and abroad. I enjoy teaching at all levels, but I find it extremely difficult. Maths is easy; people are hard. I am humbled that my colleagues in the Department deemed my efforts worthy of nomination. The real reward is not receiving any honour; it is seeing a lightbulb turn on," said Dr Messerschmidt, a senior lecturer in the Department of Mathematics and Applied Mathematics, on winning the cluster award.

Dr Oosthuizen is a Senior Lecturer in the Department of Zoology and Entomology and echoes other cluster winners' sentiments.

"Winning the Excellence in Teaching Award in the Biological Sciences cluster for 2021 is a great honour. I am excited that what is a true passion of mine is not only recognised by my students but also by the Faculty."

Eight NAS professors deliver their inaugural addresses in 2021

Eight senior academics from the Faculty of Natural and Agricultural Sciences (NAS) delivered their inaugural addresses in 2021. We are very proud of them, as this is a significant achievement in a researcher's career.

Prof Kwaku Gyebi Duodu
Department of Consumer and Food Sciences (18 August 2021)
Title: *Phenolics in African grains and their foods – a tale of their significance for health and food security*
Watch here

Prof Elna Buys, Prof Barend Erasmus, Prof Kwaku Gyebi Duodu and Prof Tawana Kupe

Prof Mohammad Naushad Emmambux
Department of Consumer and Food Sciences (7 September 2021)
Topic: *Technological innovation for food and nutrition security, and sustainability: A food biopolymer perspective*
Watch here

Prof Naushad Emmabux and Prof Tawana Kupe

Prof Serena Coetzee
Head of the Department of Geography, Geoinformatics and Meteorology (31 May)
Title: *The geospatial information ecosystem of the future*
Watch here

Prof Norman Duncan, Prof Serena Coetzee and Prof Barend Erasmus

Prof Sheryl Hendriks
Head of the Department of Agricultural Economics, Extension and Rural Development (5 August 2021)
Title: *Food systems approaches: Hope in a post-COVID world*
Watch here

Prof Barend Erasmus, Prof Sheryl Hendriks and Prof Tawana Kupe

Prof Patricia Forbes
Department of Chemistry (22 September 2021)
Title: *Understanding our environment one molecule at a time*
Watch here

Prof Norman Duncan, Prof Patrica Forbes and Prof Barend Erasmus

Prof Riëtte de Kock
Department of Consumer and Food Science (20 October 2021)
Topic: *The sensory properties of food: does it matter in Africa?*
Watch here

Prof Vinesh Maharaj, Prof Riëtte de Kock and Prof Elna Buys

Prof Anabella Gaspar
Department of Biochemistry, Genetics and Microbiology (3 November)
Title: *From basic biochemistry concepts to antimicrobial drug discovery*
Watch here

Prof Sanushka Naidoo, Prof Anabella Gaspar and Prof Barend Erasmus

Prof Oleg Reva
Department of Biochemistry, Genetics and Microbiology (30 November)
Watch here

Prof Vinesh Maharaj, Prof Oleg Reva and Prof Sanushka Naidoo

Remarkable in red – Four new PhDs leaving their mark on malaria drug discovery

The rapid emergence of malaria parasite resistance towards current antimalarial drugs threatens malaria elimination. There is a need for new antimalarial drugs with novel modes of action against all stages of the parasite, including the disease transmissible stage.

Four PhDs from the Malaria Parasite Molecular Laboratory (M²PL) research group in the Department of Biochemistry, Genetics and Microbiology were conveyed at the Autumn Faculty of Natural and Agricultural Sciences' graduation ceremony. Doctors Jessica Connacher, Janie Duvenhage, Rudi van Wyk and Hilde von Grüning, have made significant contributions to the parasite drug resistance challenge under the mentorship of Prof Lyn-Marie Birkholtz SARChI Chair in Sustainable Malaria Control. In addition, four MSc and six honours degrees were also conveyed.

Jessica explored the epigenetic mechanisms driving the development of transmissible stages of the human malaria parasite. The study substantially advances researchers' current understanding of epigenetic regulation in Plasmodium falciparum parasites and has broader implications for the potential development of transmission-blocking interventions for malaria.

Parasite-infected red blood cells can adhere to specific tissues and organs in the human host, causing the most severe and lethal malaria cases. **Janie** developed malaria-specific tracers that allow the parasites to be studied with positron emission tomography imaging, which could aid in investigating host-parasite mechanisms that govern malaria pathogenicity.

The process of antimalarial drug discovery is time-consuming and resource-intensive. **Rudi** used high throughput next-generation RNA-sequencing technology to explore the gametocytogenesis transcriptome of *P. falciparum*.

Through chromatin proteomics, **Hilde's** work fundamentally reshapes the understanding of gene regulation in *P. falciparum* by demonstrating that the parasite's histone "chemical barcode" is unique to different life cycle forms involved many unique regulatory proteins and can be drug targeted effectively.

The M²PL forms part of the Parasite Control Cluster of the University of Pretoria Institute for Sustainable Malaria Control (UP ISMC).

From left. Dr Janie Duvenhage, Dr Rudi van Wyk, Dr Hilde von Grüning, Prof Lyn-Marie Birkholtz (supervisor), and Dr Jessica Connacher.


Transformed
and Inclusive
Community

NAS and Facilities Management collaborate on UP's best-ever impact ranking on SDG15

The Faculty of Natural and Agricultural Sciences (NAS) has been instrumental in significantly improving the University of Pretoria (UP)'s national and international ranking in the Sustainable Development Goal (SDG) 15 – Life on Land.

In collaboration with UP's Department of Facilities Management, the Faculty made their submission for SDG 15. The outcome of this ranking was UP achieving position number 30 globally for SDG 15 and ranked first for the same SDG in South Africa in the latest Times Higher Education (THE) Impact Rankings (2022), released in May this year.

According to these rankings, UP has been named South Africa's second-best (joint second) and Africa's third-best (joint third) university. The rankings are based on all of the 17 SDGs designed to address the world's most severe and critical global challenges. The SDGs offer an integrated framework for ensuring that global development balances social, economic and environmental sustainability.

Prof Barend Erasmus, Dean of the Faculty of Natural and Agricultural Sciences, emphasised that UP and NAS proudly benchmark against the world's best. "SDG 15 is significant to NAS as this is our disciplinary domain. We conduct research, not only for our own sake but also for its impact."

Professors Nigel Barker and Wayne Truter (both from the Department of Plant and Soil Sciences in NAS) and Ms Ilze Ueckermann (Sustainability Specialist in the Department of Facilities Management) were part of the entire team of authors who were responsible for the UP submission.

The rankings assessed hundreds of quantitative and qualitative evidence that tangibly measure the impact of higher education institutions in addressing urgent global challenges.

Three metrics were used in the SDG15 submission requiring detailed information on how UP was active in each area.

The first metric used was **supporting land ecosystems through education, the second supporting land ecosystems through action and lastly land, sensitive waste disposal**.

In the **first metric**, one of the highlights of **supporting land ecosystems through education** included two UP researchers who were part of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) international series of assessments. These researchers were part of the entire team of authors nominated for the Nobel Peace Prize for the impact of their work at IPBES. Another example was UP leading an international consortium (several African countries, France, UN) at a discussion to produce a report on biodiversity, land and climate in support of policy at the UNFCCC COP26. In addition, UP researchers provided input to the Global Biodiversity Framework (GBF), which helps form the basis of international negotiations around biodiversity.

The sustainability of farmed food illustrated another way how UP supports land ecosystems - through education on campus on the Future Africa Campus. The gardens were designed and utilised for sustainable production of indigenous food and "orphan crops", the newest sub-collection in the Manie van der Schijff Botanical Gardens. This collection supports the on-campus catering and is a biodiversity showcase, especially indigenous African food plants.

In addition, a community urban gardening project (Moja Gabedi) was also developed on an abandoned lot within the broader university community, with food plant species supplied by the Cycad and Indigenous Plant Nursery and the Future Africa Gardens, and serves as a site for numerous student community engagement projects. Unfortunately, COVID-19 related regulations limited direct community engagement during the past two years. Still, the Department of Geography, Geoinformatics and Meteorology (GGM) utilised funds from the National Research Foundation Community Engagement project to provide more than 20 000 food plant seedlings to support the Moja Gabedi project.

In 2019, students from GGM were also involved in community engagement at UP's Reliable House project for the homeless, located on a plot of land close to the University. Students collaborated with residents to plan the design and layout of a food garden on the premises and planted more than 10 000 seedlings.

South Africa's Marion - and the Prince Edward Islands archipelago is another example of UP maintaining and extending existing ecosystems and biodiversity. These islands enjoy the highest protective status available under South African legislation - that of "Special Nature Reserve". They are set aside solely for the conservation of biodiversity and research purposes.

UP manages a long-term research programme on Marion Island.

Some of the activities to be proud of in the **second metric (supporting land ecosystems through action)** included the Manie van der Schijff Botanical Garden Collections, containing an Aloe and Cycad collection (International Union for Conservation of Nature Red Listed). In addition, UP is a Botanical Gardens Conservation International member and a Registered Scientific Institution at the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The University also does regular birding surveys on university property, using a standardised format to contribute to national bird atlas efforts, which contributed to this metric. Furthermore, UP's Environmental Policy has given birth to many environmental rehabilitation projects, such as the Strubenkop ecological rehabilitation and restoration project.

UP's support and expertise for Mothong African Heritage, where a traditional healer cultivates and protects locally important plants next to a large urban settlement, also contributed to this metric.

Regarding the **third metric, land sensitive waste disposal**, the University's Water Management Policy and Water Management Plan support many ongoing water management programmes on campuses. Ms Ueckermann, from UP's Department of Facilities Management, added that "the University adopts water discharge quality guidelines from the local enforcement agency (municipality), and UP will manage hazardous waste according to the hazardous waste disposal procedure."

She added that any new buildings constructed by the University would be built according to Waterwise regulations, such as utilising 'greywater'. UP prides itself in its Rainwater Harvesting Project on the Hatfield Campus.

The University's Waste Management Programme includes recycling various commodities, e.g. paper, cardboard, glass, plastics and cans. The University also contracted the services of a company that ensures the recycling of hazardous items such as fluorescent tubes, e-waste, printer cartridges and batteries are recycled and reused. In addition, waste reduction and recycling initiatives are made with local partners to support community development.

SUSTAINABLE DEVELOPMENT GOALS

UP staff and students in the Moja Gabedi gardens.

Zak Claassen overcomes sight impairment challenges to obtain master's

University of Pretoria (UP) graduate Zak Claassen recently received a master's degree from the Faculty of Natural and Agricultural Sciences in Bioinformatics *cum laude*, successfully overcoming accessibility challenges during his postgraduate studies as a result of him being blind.

His thesis focused on antibiotic resistance in the environment. "I chose this research topic because antibiotic resistance is one of the most significant challenges in healthcare," said the graduate who is studying towards a PhD. "Yet despite its importance, resistance is understudied in the environment."

Claassen studied the genomes (genetic information in an organism) of bacteria in different environments to determine whether they had antibiotic resistance genes. He then studied the patterns of those genes and whether they feature differences because of their environments. He also investigated bacteriophages (viruses that infect bacteria) to see if they carry resistance genes.

Speaking about why he chose this field of study, he said: "The genetic code underlies the functioning of every living thing on the planet. I chose to study it because it is a relatively new field that is still growing as new discoveries are being made, and I think it has the potential to become more important in future."

During his undergraduate studies, he relied on screen reader software – which is a text-to-speech application – and digital scans and print-outs in braille from UP's Disability Unit. The library also ensured that his textbooks were ordered in electronic format, which allowed him to read with the help of a screen reader.

UP graduate Zak Claassen

Zak Claassen's thesis focused on antibiotic resistance in the environment.

Conducting his postgraduate studies was no simple task. "It has been an interesting challenge," Claassen said. "Most of the available programmes are designed without considering accessibility." Many tools involved something visual or were not working on his screen reader, he added. "In some cases, I had to develop new scripts to do what most students could do easily with other available tools."

Claassen, who hails from Pretoria, said that while he had a fairly conventional upbringing, it was not without challenges. His sight was affected as a result of an accident that occurred at birth. "My sight went away gradually and then came to a point where I could not see any longer, but I accepted it," he said. He matriculated with seven distinctions from Prinshof School for the Visually Impaired in 2012.

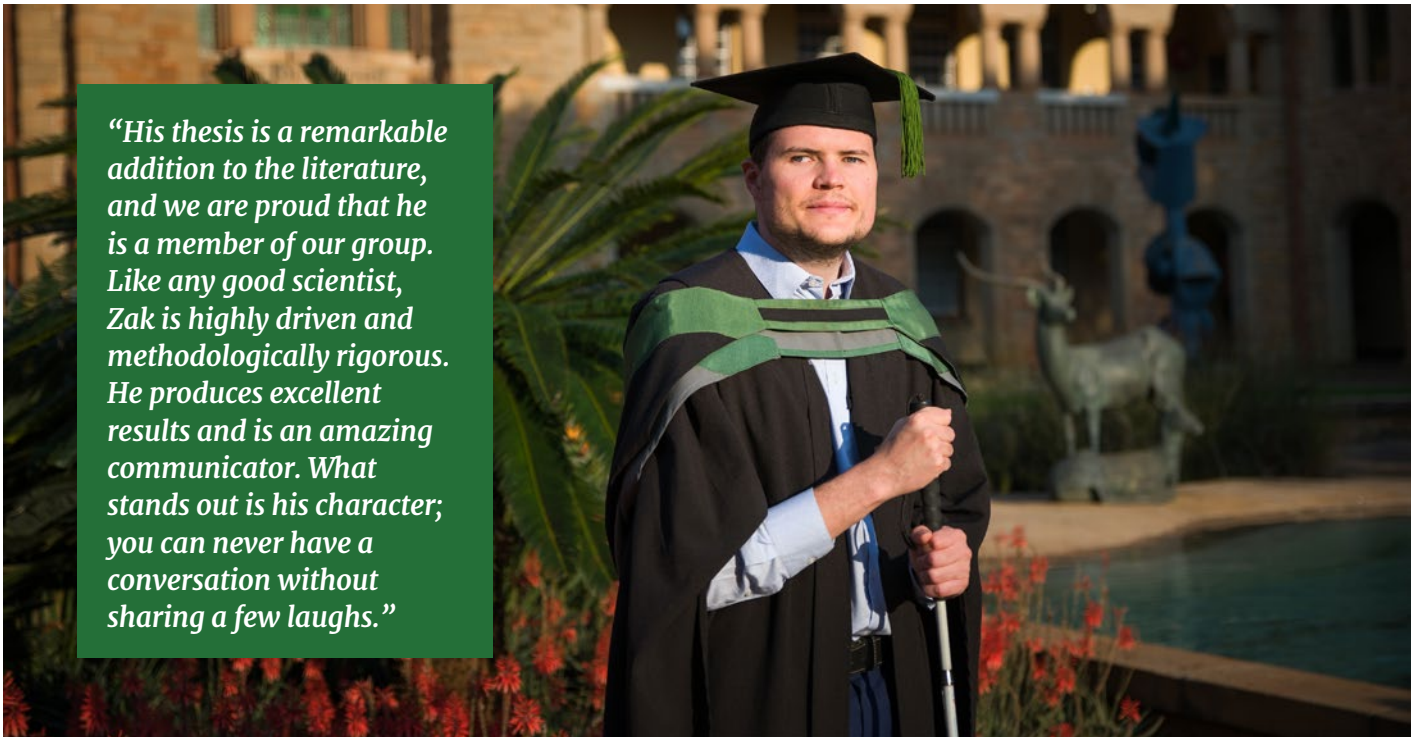
For Claassen, achieving his master's would not have been possible without the support of his supervisor and co-supervisor, Professor Thulani Makhalanyane,

Zak Claassen

Department of Science and Innovation-National Research Foundation SARChI Chair in Marine Microbiomes and Doctor Rian Pierneef, Senior Researcher at Agricultural Research Council.

"Dr Pierneef helped me to create visual representations of data [such as plots and graphs] because I had to demonstrate my research results. Prof Makhalanyane was also a great supervisor – he is incredibly organised and constantly tries to push his students. It also helps that he is well connected, so we are exposed to more opportunities."

"I am extremely proud of Zak and his growth as a researcher," Prof Makhalanyane said.



"His thesis is a remarkable addition to the literature, and we are proud that he is a member of our group. Like any good scientist, Zak is highly driven and methodologically rigorous. He produces excellent results and is an amazing communicator. What stands out is his character; you can never have a conversation without sharing a few laughs."

UP creates opportunity for talented student – funding studies of 14-year-old budding actuary

Mongiwa Ntuli

A 14-year-old actuarial science student has begun her academic journey at the University of Pretoria (UP) with the institution's financial support.

After passing matric with seven distinctions, Mongiwa Ntuli, who hails from Johannesburg, took to social media to express her frustration that she could not be considered for a bursary because of her age.

"Being turned down by bursaries frustrated me because I believe that I did my part by getting good results, and all I needed was financial assistance," she says. "But then I had a conversation with the Vice-Chancellor of UP, who ensured that I got funding. I will forever be grateful for that."

UP will cover Ntuli's tuition fees for three years. In congratulating the budding actuary, Vice-Chancellor and Principal Professor Tawana Kupe said one of the University's strategic goals is access and success, especially for learners who have done well. "Mongiwa fits everything that the University wants to promote," he says. "UP is a place of excellence and achievement; we aim to attract learners with distinctions worldwide."

In 2017 Hjalmar Rall, who was also 14, started his academic journey with the University. The young man, who registered for a BSc in physics, completed his initial degree *cum laude* and graduated cum laude with a BSc (Hons) Physics in the 2021 autumn graduation season.

"We are grateful that Mongiwa got funding," says Lifa Nkala, Ntuli's uncle. "These are tough times, but when someone opens their pockets this wide and is willing to assist a stranger, it means a lot to us. Thank you, Prof Kupe, for coming through for us."

Ntuli started school at an early age, having been enrolled for Grade 1 at the age of four. "When I was in Grade three, my teacher indicated that I would do better in Grade 5," Ntuli recalls. "After attending a few classes, he recommended that I skip Grade 6 and go to Grade 7, but my guardians were against me being promoted to upper grades. They decided that I should follow the sequence of grades."

Ntuli describes herself as a laid-back person who enjoys watching cartoons, reading books and cracking jokes, and nothing like the genius that many consider her to be. "I see myself as a problem-solver, and the type of person who thinks and does things differently from others," she says.
Unsurprisingly, graduating from high school to tertiary education has been challenging for Ntuli. "Transitioning to university and adjusting is difficult with COVID-19 playing a role. Not being able to attend physical classes meant I had to learn how to use a computer fully. Also , we got one-on-one time with teachers in high school, but here it is different. The best trick is to use what you have to the best of your ability."

She says choosing to study at UP was an easy decision because she wanted to be associated with a prestigious university. "At first, I wanted to study medicine, but everything changed when I read about actuarial science and realised that this profession is about problem-solving, which defines me," she explains.

"Actuarial science is about collecting complicated data and giving it out in its simplest forms; it is about maths, and I enjoy maths because it is precise and perfect. This course combines my love for maths, statistics and finance. If I can combine all of that and get one profession, why not actuarial science?"

Ntuli hopes to obtain her qualification in record time and eventually study towards a PhD. Her ultimate goal is to be an employer and create jobs.

Ntuli advises students who would like to enter the field of actuarial science to prepare themselves for the work ahead. "This profession and course comes with many responsibilities and sacrifices," she says. "One needs to be focused on being in this field because there will be fails and sleepless nights."

RETHINK@NAS shows commitment to transformation

Why RETHINK?

R – Respect
E – Empowerment
T – Thought leadership
H – Humanity
I – Inclusivity
N – Next Generation
K – Knowledge

Since the launch of RETHINK@NAS, the Faculty of Natural and Agricultural Sciences' transformation initiative has progressed steadily. The year plan was approved by the Institutional Transformation Committee, which is a compilation of all the subcommittee action plans.

This initiative is a holistic approach to transformation in NAS. It is a reminder to all staff and students to stop and assess their actions and words, the potential effect on others or perceptions and norms that impede change in NAS.

RETHINK@NAS will encompass ideological and socially driven aspects of transformation while still aiming to be inclusive and reflective of South Africa's demographic profile. Transformation activities will be inclusive of all staff (academic and professional) and students to establish initiatives with an impact that are aligned to the UP WAY, promoting excellence through diversity.

Chairpersons of RETHINK@NAS subcommittees:

- Anti-discrimination and Gender-based Violence: Dr Thando Ndarana and Dr Nolwazi Nombana (Co-chairs)
- Culture: Dr Thobela Nkukwana
- Outreach: Prof Mmantsae Diale
- Research: Prof Lise Korsten
- Teaching and Learning: Prof Paulette Bloomer
- Transformation and Employment Equity: Ms Jessika Samuels

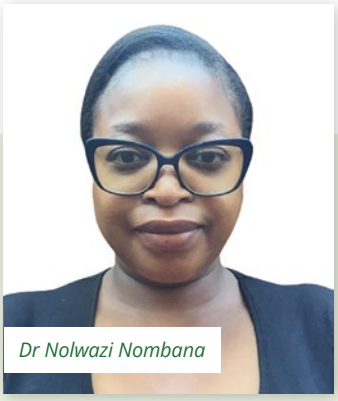
RETHINK@NAS launch video – watch here.

Visit www.up.ac.za/speakoutup for more information and help concerning sexual harassment and Gender-Based Violence (GBV).

UP Careline: 0800 747 747
Students and staff can access psychological support through the UP Careline.

www.up.ac.za/rethink@nas-transformation


Dr Thando Ndarana


Dr Nolwazi Nombana


Dr Thobela Nkukwana


Prof Mmantsae Diale


Prof Lise Korsten


Prof Paulette Bloomer


Ms Jessika Samuels

Institutional Sustainability

Oppenheimer Generations funds two research chairs at UP

The University of Pretoria (UP) has commemorated two research chairs being funded by the Oppenheimer Generations Research & Conservation and the Benjamin Raymond Oppenheimer Trust (BROT).

The University's partnership with Nicky, Strilli and Jonathan Oppenheimer to promote underfunded research areas, has resulted in one research chair in non-invasive wildlife research and another in molecular archaeology receiving funding. The launch and celebration of the chairs had to be postponed until recently due to restrictions necessitated by the COVID-19 pandemic.

The Oppenheimer donation agreement for the Oppenheimer Chair for Emerging African Scientists in Non-invasive Wildlife Research was finalised in 2021. It was awarded to Director of UP's Mammal Research Institute Professor André Ganswindt, the principal investigator. The Chair supports highly motivated postgraduate students from Africa to initiate, coordinate and conduct research that focuses on developing and promoting non-invasive approaches to wildlife research and management.

Funding for the BROT-supported Chair for Molecular Archaeology was granted in 2020, and was awarded to Dr Riaan Rifkin of the Department of Biochemistry, Genetics and Microbiology in UP's Centre for Microbial Ecology and Genomics. In his research, Dr Rifkin will look for evidence of pandemics in the southern African archaeological record.

Speaking at the launch, UP Vice-Chancellor and Principal Professor Tawana Kupe thanked the Oppenheimer family for supporting research in under-resourced fields.

"The impact of unlocking catalytic grants in underfunded areas such as the two chairs is inestimable," he said. "We thank you for your support in recognising the value of funding groundbreaking research and conservation efforts through the partnership with UP. It is people like you who contribute to UP becoming the top university it is today, and to our capacity to make a significant contribution to South Africa, our continent and the world."

Professor Barend Erasmus, Dean of the Faculty of Natural and Agricultural Sciences, where the two chairs reside, said this partnership is an example of important steps taken by universities, industry and society in supporting important change.

"The need for interdisciplinarity [has arisen] because of the existential crises that affect humanity," he said. "These include pandemics, food insecurity, disease and drought. None of these can be addressed by traditional disciplines; they are intersecting problems. That's why we need these new, interesting value propositions that emerges when academia and society start working together in novel ways, to tackle them. These novel partnerships give not only new perspectives from other sources of knowledge to contribute to the solution, but also due to the size of the problem. It's not that this particular partnership will change the world, but it is a step in the right direction, so that we can start shifting the needle."

From left: Faculty of Natural and Agricultural Sciences Dean Prof Barend Erasmus; Chairman of Oppenheimer Generations Nicky Oppenheimer; UP Vice-Chancellor and Principal Tawana Kupe; Oppenheimer Chair for Emerging African Scientists in Non-invasive Wildlife Research Prof André Ganswindt; Dr Duncan MacFayden, Oppenheimer Generations Head of Research and Conservation; and BROT-supported Chair for Molecular Archaeology Dr Riaan Rifkin at the launch of the research chairs.

Chairman of Oppenheimer Generations, Nicky Oppenheimer

Dr Duncan MacFadyen, Head of Oppenheimer Generations Research and Conservation said they were pleased to be in a partnership with UP, and that together we would develop the next generation of African scientists in these fields.

"The Oppenheimers have been funding research for decades and we run various research centres across our properties," he said. "The kind of research that we fund is key. We look for research that's innovative, and research that's new and has practical, impactful outcomes. I really believe that both these chairs and the students that they will train through the years will help us to achieve the goal of leaving the world in a better place than we found it in."

The Oppenheimer Chair for Emerging African Scientists in Non-invasive Wildlife Research currently supports one MSc, one PhD and one postdoctoral fellow as the first cohort. The envisaged studies will not only help to preserve species and ecosystem diversity and health, and supporting biodiversity stewardship, by generating much-needed information for decision support, but will also distinctively contribute to the much needed professional development of highly skilled, research orientated, young African academics.

The Chair for Molecular Archaeology supports the research of Dr Rifkin and his team. They are looking for evidence of pandemics in the southern African archaeological record, including human remains. This research requires searching for prehistoric or ancient pathogen DNA as this could inform us of the various diseases our African ancestors had. The results of this research hopes to offer new insight into whether pandemics like COVID-19 and the Black Death have occurred before, and how they spread and mutated; this could help us to anticipate potential future threats.

WWF and UP team up to keep watch on southern right whales

Dr Els Vermeulen, research manager at the Whale Unit.

Southern right whales rely heavily on their foraging success and stored energy supplies to support their reproduction and migration.

Warming oceans and consequent changes to ocean processes appear to be having a negative impact on the available food supply and are having a noticeable effect on the number of whales visiting South African shores.

The World Wide Fund for Nature (WWF) South Africa and the University of Pretoria's (UP) Mammal Research Institute Whale Unit are partnering up to support research on southern right whales, which are facing a variety of new threats, not least the impact of a warming climate on their food supply.

The Whale Unit, which falls under UP's Faculty of Natural and Agricultural Sciences, has been monitoring southern right whale populations since 1969. Using annual surveys, including photo-identification photography, their research is one of the longest continuous datasets for any marine mammal globally. It is an extremely valuable dataset that is of national and international importance.

Southern right whales rely heavily on their foraging success and stored energy supplies to support their reproduction and migration.

Until about a decade ago, southern right whales had made a remarkable recovery from commercial whaling. But now, warming oceans and consequent changes to ocean processes appear to negatively impact the available food supply. This has a noticeable effect on the number of whales visiting South African shores.

In partnering with UP's Whale Unit, WWF South Africa hopes to enable the facility to continue its vital research into the well-being of these iconic whales, which are at the heart of South Africa's coastal tourism industry, generating both direct and indirect income for the country.

"Since commercial whaling stopped, the recovery of the southern right whale population was a great conservation success story," said Dr Els Vermeulen, research manager at the Whale Unit. "But now, the science is telling us that these marine mammals are coming under renewed pressure from a more modern problem likely linked to climate change. Over the past decade, we have found that the whales are getting thinner, calving less often, and leave their breeding grounds earlier."

In October last year, a three-day aerial survey from Nature's Valley to Muizenberg counted some 414 whales, among them 191 mother-and-calf pairs, mainly between De Hoop Nature Reserve and Walker Bay near Hermanus. This number is higher than recorded in 2019 and 2020, but remains well below what is regarded as normal.

In addition, since 2009, the number of unaccompanied adults (males, resting females and receptive females) has been noticeably lower, indicating that non-calving right whales are still not migrating to the South African coast as readily as they used to in years gone by. A worrying trend is that whale mothers also appear to be leaving South African breeding areas earlier than usual, which could negatively affect the chances of calf survival.

Southern right whales rely heavily on their foraging success and stored energy supplies to support their reproduction and migration. Their body condition (or "fatness") is thus critical to ensure a successful pregnancy and calf rearing. Recent research has shown that right whale mothers have decreased in body condition by 24% since the late 1980s, indicating clearly that their feeding has been less successful.

"We strongly believe this lack of energy reserves lies at the basis of the increased calving intervals and a reduced migration towards our shores of the non-calving individuals," Dr Vermeulen said. "But to understand the dynamics behind this, we need to continue our ongoing research. We are deeply grateful to all the organisations and individuals who have supported this work over the years. It is now more important than ever for us to keep providing the information to promote the protection and conservation of this iconic whale species."

"There is no doubt that we are experiencing major changes in our oceans due to climate change, which in turn could have severe implications for marine species and livelihoods," said Craig Smith, senior manager of WWF South Africa's Marine Programme. "We need to understand these changes better to allow for improved forecasting and building of resilience for people and marine ecosystems. To this end, southern right whales may prove to be a useful indicator of our oceans' changes. The funding of a long-term southern right whale dataset is priceless in helping scientists to understand these changes, and to help advocate for reduced greenhouse-gas emissions so that the southern right whale can continue to thrive along our coastline."

What you can do to help

You can support the conservation of southern right whales by symbolically adopting a whale. In doing so, you will be supporting whale research and conservation in South Africa. All funds raised go towards covering the costs of whale fieldwork. Find out more.

Learn about the Whale Unit's research
Follow us on Twitter

One of the critical elements to ensure institutional sustainability is strengthening the Faculty's leadership capability – in this instance, the appointment of new heads of departments.

These leaders need to drive the change, and their actions need to reflect UP's and the Faculty's desired culture. This will ensure continuity and sustainability. These appointments also support our transformation plan.

Further to institutional sustainability, the Faculty will undergo a quinquennial review from 2017 to 2021 to determine how effectively it meets its teaching, learning, and research goals to further UP's strategic objectives. In addition, the review will assess the Faculty's strengths and weaknesses and identify areas for improvement in management structures. As a result, we will be able to build on our current strengths and improve our processes while systematically addressing challenges. We'll also determine which issues must be addressed for future faculty plans to be relevant, inclusive, and actionable.

Prof Samuel Manda leads the Department of Statistics

Prof Samuel Manda

"To strengthen the Department of Statistics' national and continent-wide standing in research, collaborative scientific activity, and teaching and learning, by innovatively adapting our core strengths."

This, in a nutshell, is what Prof Samuel Manda, who was appointed as the new Head of the Department (HoD) of Statistics on 1 March 2022, envisions for his term; with the mission that the "department serves the wider communities and focuses on the intellectual pursuit of the whole of the University of Pretoria."

In light of this backdrop, he added, "this requires the development of new methodologies and adequately trained statisticians and data scientists, with sophisticated and extensive technical skills, including computing and complex techniques to support statistically defensible results."Cognisant of the Fourth Industrial Revolution (4IR), Prof Manda aims to "concurrently apply and develop modern statistical methods for high-dimensional and big data analysis for practical applicability in a diversity of settings. This will steer the modernisation and innovation of the department." Moreover, by enhancing structures to strengthen collaborative research and training at both undergraduate and graduate levels, Prof Manda emphasises the "development of a collaborative postgraduate statistics programme and curriculum, whereby the words 'renewal' and 'faculty' complement."

Gearing towards the future and the need to strengthen information sharing, the objective is to "bolster consulting and academic statisticians — through comprehensive foundations and sources to embark on a transparent policy of collaboration and dialogue with various researchers at UP's numerous faculties." This co-operative effort will also include "government departments, and national and international research bodies." As a result, the Department of Statistics will "deliberately engage in developing generic, innovative, and rigorous statistical theory, methodology, and curriculum delivery that must keep pace with the dramatic changes in the data science landscape, teaching, and learning technologies."

Before he was appointed as HoD, Prof Manda was the Director of the Biostatistics Unit at the South African Medical Research Council (SAMRC) and an Extraordinary Professor in the Statistics Department. He obtained his PhD in Bayesian Statistics from the University of Waikato, New Zealand. He is a visiting Professor of Statistics at the University of Malawi; and an Extraordinary Professor at the Universities of Stellenbosch and North-West. He has previously served at the Universities of Auckland in New Zealand and Leeds in the United Kingdom.

His main research interests concentrate on: statistical methods for multivariate small area estimation and diseases mapping models; longitudinal and time-to-event models; and evidence and data combination. Prof Manda has developed and mastered many state-of-the-art Bayesian Methods and applications and is well known and recognised as a regional and international expert in statistical methods and applications for the many health problems in the Sub-Saharan African region. He has recently started working on multivariate small area estimation and causal effect estimation and has been involved in analysing coronavirus disease (COVID-19) transmission parameters and prediction in Sub-Saharan Africa.

Prof Manda has contributed more than one hundred and twenty-five (125) peer-reviewed publications and book chapters on statistical methods and health sciences applications. He has also co-edited several special issue journals and books on biostatistical methods and applications. He has presented well over 40 invited talks at national and international conferences. His science contributions also include sharing his knowledge and skills with postgraduate students. In that regard, he currently supervises five PhD and four master's students in Biostatistics. This emphasises Prof Manda's recognisable passion and dedication to learning, teaching, and developing the next generation of statistical minds.

His H-Index is 25, and he is a South Africa NRF C2 rated scientist.

Prof Duodu appointed as Head of Consumer and Food Sciences

"Creating a unique Africa-focused food, nutrition and well-being and consumer studies offering which meets the needs of its graduates and people of Africa in the 21st century".

This, in a nutshell, is what Prof Gyebi Duodu, the newly appointed Head of the Department of Consumer and Food Sciences at the University of Pretoria (UP), envisages for his term starting on 1 March 2022.

When asked about his appointment, he said, "I am incredibly excited about being the Head of the Department of Consumer and Food Sciences. I believe the Department is well placed and poised to become the leading research-intensive department of its kind in Africa. I am looking forward to this opportunity to lead it to attain this vision."

He has been a full Professor of Food Science since January 2020 and served a stint as Acting Deputy Dean: Research and Postgraduate Education in the Faculty of Natural and Agricultural Sciences from September 2020 to January 2021.

Prof Duodu is involved in undergraduate and postgraduate teaching in Food Chemistry and Food Engineering. His research focuses on the health-promoting properties of African grains and foods, and he investigates the metabolomic profiling, chemistry and bioactivity of phenolic compounds. In addition, Prof Duodu has a research interest in the nutritional aspects of African grain-based foods, focusing on mineral bioaccessibility and protein quality.

As an established researcher with a C1-rating from the National Research Foundation, he has supervised many MSc and PhD students and postdoctoral fellows. His current H-Index is 27 on Scopus and 25 on Web of Science.

Prof Duodu is a member of the South African Association for Food Science and Technology, Cereals and Grains Association (formerly American Association of Cereal Chemists International), Institute of Food Technologists, International Society of Food Engineering; and the International Society for Nutraceuticals and Functional Foods. He serves on the Bioactive Compounds Technical Committee of the Cereals and Grains Committee. He is also a member of the editorial boards of Journal of Food Composition and Analysis, Legume Science, and ACS Food Science and Technology.

Prof Gyebi Duodu

New Head of Department appointed for Chemistry

Prof Patrick Ndungu

A Professor in Physical and Materials Chemistry, Prof Patrick Ndungu, has been appointed to lead the Department of Chemistry from 1 March 2022.

Prof Ndungu, who was the former Deputy Departmental Head for Research and Postgraduate Matters in the departments of Applied Chemistry as well as Chemistry at the University of Johannesburg, believes "that the Department of Chemistry will grow and develop into a hub for solving local problems with innovative and dynamic technologies and systems that translate into solutions for the continent and the rest of the world."

"As a dynamic future hub for Chemistry Next, and a nexus for transdisciplinary research, innovation, learning, and teaching, I envisage the department playing a crucial role in providing the multi-cultural African perspective in developing Society 5.0," he concluded.

Prof Ndungu is an established researcher with a C2-rating from the National Research Foundation, and he has supervised many MSc and PhD students and postdoctoral fellows. His current H-Index is 24 on Scopus with 2087 citations. His research interests include the development of novel and functional nanosystems as integral components in low-cost water treatment technologies and renewable energy devices (such as, but not limited to, solar cells, fuel cells, hydrogen storage modules, photocatalytic systems, and electrochemical units for energy or fine chemical production).

Prof Ndungu also takes an interest in nanoscience and nanotechnology in the context of providing inexpensive solutions to problems unique to the developing world and the physical-chemical properties of nanocomposite materials.

Prof Ndungu has extensive teaching experience in Polymer Chemistry, Engineering Chemistry, Physical Chemistry, Environmental Chemistry, and many more. He served on the Water SA Editorial Board Member and was the Scientific Editor (Nanotechnology) for *The South African Journal of Chemistry*. He completed his PhD at Drexel University, Philadelphia, USA, in 2004.

Social Responsiveness and Societal Impact

First Conversations@NAS in 2022 focus on future of work in agriculture

"How does the future of work in agriculture affects higher education? What is the effect on horticulture, conservation agriculture, regenerative agriculture, producing and preserving food, including consumer sciences, retail and many other segments of agriculture?"

These were the opening remarks of Prof Barend Erasmus, Dean of the Faculty of Natural and Agricultural Sciences (NAS), at the first Conversations@NAS in March this year.

He explained that "A core part of re-imagining higher education is how universities work with broader society to tackle the global existential crises of our time. These collaborations need conversations, and events such as these provide a platform for the required thought leadership and solutions."

Prof Natasja Holtzhauzen, Director of the Centre for the Future of Work, was the panel leader and introduced the three panellists: Prof Gyebi Duodu (Head of the Department of Consumer and Food Sciences), Prof Sheryl Hendriks (Head of the Department of Agricultural Economics, Extension and Rural Development) and Ms Ayanda Ntshangase (Head of Communication and Centre of Excellence: Agri Gauteng).

Prof Duodu kicked off the conversation by referring to the food value chain, saying, "we need to train students over broad types of work – on the farm and off-farm types of jobs. We must focus more on the creation off-farm types due to urbanisation and development of countries." He also emphasised the importance of smallholder and subsistence farming in Africa.

Prof Hendriks explained that rapid advances in sciences would shape careers and work and things such as designer foods. "Targeted nutrition through specific crops and designer foods may exacerbate inequalities."

"The importance of export and import in the African context must be carefully considered. We must carefully consider the thin line between exporting to other African countries; we should not deplete our resources and not starve our own African people. Feed your nation before feeding the world," Ms Ntshangase said.

Prof Holtzhausen also added that we do not get the Africa we want but the one we deserve.

Ms Ntshangase emphasised that the growth in urbanisation and growing populations in Africa have a disruptive effect on the agricultural sector. "Areas that were used for farming are now used for business. But we must remember that the nation needs to eat. "Consumer patterns change, and we need to use technology to cut costs but produce enough volumes of food to eat."

Prof Hendriks reiterated the disruptive effects of megatrends, including climate change, COVID-19 and conflict, to mention but a few. "People need to connect across different disciplines."

"Disruptive megatrends also give us some opportunities and influence how we view agriculture. It informs us on how to train our students," explained Prof Duodu. Prof Hendriks corroborated this, "At NAS, we already introduced transdisciplinary programmes to bring postgraduate students in contact with solution-driven initiatives. We also need to give students hands-on experience - contextual knowledge is very important.

For the full conversation, click here.

Ms Ayanda Ntshangase

Prof Gyebi Duodu

Prof Sheryl Hendriks

Prof Natasja Holtzhausen

Two InspiringFifty SA winners hail from Plant and Soil Sciences

Two early-career scientists, Drs Jarishma Gokul and Khumbuzile Bophela from the University of Pretoria (UP)'s Department of Plant and Soil Sciences, were selected as InspiringFifty[1] South Africa winners for 2021.

This non-profit initiative benchmarks and awards the 50 most inspiring women in #STEM each year at an awards ceremony held on 23 March. The InspiringFifty are important role models for encouraging more girls and women in technology and inspiring future leaders and entrepreneurs to follow in their footsteps. It has chapters in Belgium, Canada, Italy, South Africa, and many more.

According to **Dr Gokul**, Lecturer and Microbiome Research Group Leader in Plant Pathology, "I am humbled and so very grateful to join this group of tenacious, inspiring women and leaders. I have been exposed to intelligent, strong and talented women, mentors and teammates, my whole life, and they have consistently inspired me to continue nurturing my curiosity and ambition in delivering impactful contributions in science."

"This is a collective win to each of these amazing unsung heroes who have supported, taught and cheered me on. The RAISE Project[2] has shown that women are persistently underrepresented in prizes and awards in fields like medicine and science."

"Yet, these are important indicators of professional achievement. Therefore, everyone must be treated fairly and invested in deserving and highly qualified women. While our roles are sometimes outside the limelight, it is a great honour to be recognised for the hard work, dedication and accomplishments in STEM by our peers and the young men and women we mentor," an elated Dr Gokul concluded.

Dr Gokul completed her PhD in 2017 in Polar Microbiology and Glaciology, Aberystwyth University, Wales, United Kingdom, through an NRF Study Abroad Scholarship. She has been awarded two sequential NRF Postdoctoral Fellowships (Innovation and Scarce Skills) since 2018 for her microbiome research at UP. She was also awarded a Food Systems Network Africa Fellowship (ARUA-UKRI) in 2021 for transdisciplinary research into the South African informal food system and a 2022 Africa-UniNet research award as Co-PI for cooperative research with Technical University Graz, Austria on "Wholesome Health through the Analysis of Microbiomes (WHAMi)". Furthermore, she has acted as an expedition leader for the Centre for Microbial Ecology and Genomics during the Southern oCean seAsonaL Experiment (SCALE) research voyage in 2019 and the Sub Antarctic Marion Island Relief voyage in 2018.

Dr Bophela, Lecturer and Soilborne Diseases Research Group Leader in Plant Pathology, is equally excited about this award.

"This is a reminder of the importance of representation in STEM fields, having just recently celebrated the International Day of Women and Girls in STEM in February. Being recognised nationally affirms my role as an academic and in my pursuit of mentoring young girls to take up STEM subjects at secondary and tertiary education levels."

"In addition, becoming a member of the InspiringFiftySA organisation will open several opportunities to build collaborative networks with like-minded women who occupy spaces in all parts of the STEM industry, such as the business sector, technology industries, and academia.

I am looking forward to this incredible experience in my academic journey, to forging lifelong relationships of support and community with these exceptional women and inspiring more young women to join us in this journey."

Dr Bophela added that "creativity and innovation are at its peak in a society that gives young girls and women equal opportunities in STEM, and inevitably this leads to growth and success. Therefore, having more female representation in STEM matters. It is by seeing more women occupying these spaces that young girls can envision themselves in such spaces too."

Dr Jarishma Gokul

Dr Khumbuzile Bophela

She graduated with a PhD in Microbiology in 2021 at the University of Pretoria. Her research has received some recognition, among others, the Whitehead Scientific (Pty) Ltd travel award in 2018 to attend the 51st Congress of the Southern African Society for Plant Pathology. In addition, she won first place for an oral presentation at the Inaugural meeting of the American Phytopathological Society - African Division in 2021 and the Australasian Plant Pathology Society early career researcher award to attend the 2021 APPS online conference. She is also an alumnus of the Black Women in Science (BWIS)[3] and an ASAPbio[4] 2021 fellow.

1. InspiringFifty is an initiative run by accelerateHER that aims to increase diversity in tech by making women role models more visible.
2. The RAISE project is a project that systematically tracks more than 2,750 awards and calculates the proportion of men and women who win them in the fields of science, engineering, technology, arts, mathematics and medicine.
3. Black Women in Science (BWIS) is a non-profit organisation supporting women of colour in STEM fields and promoting their visibility in South Africa.
4. ASAPbio is a scientist-driven non-profit organisation promoting transparency and innovation in life science communication.

Environmental change researcher gave guest lecture on soil health

The Geography, Geoinformatics and Meteorology Department and the Centre for Environmental Studies (CFES) had the privilege of hosting Professor Andy Dougill in March this year.

Prof Dougill gave a guest lecture on "Improving Soil Health through Climate-Smart Agriculture: A key to climate-resilient farming systems in sub-Saharan Africa". This was one of the department's and Centre's first opportunities to have a hybrid guest lecture. It worked very well, with some physically present in the lecture theatre and then about 40 attendees online, including colleagues and graduate students in other countries, including Zimbabwe and Zambia. The talk attracted a great deal of interest, including some lively discussions in the chat on the role of subsidies in Zambia, Zimbabwe and Malawi in driving agricultural practice.

Both students and staff immensely enjoyed the talk, and we look forward both to more hybrid lectures and to hosting Prof Dougill and his colleague, Prof Claire Quinn, again shortly.

Professor Dougill is currently the Dean for Global Development at the University of Leeds (he will be moving to the University of York in May 2022 to take up the Deanship of Science). He is a dryland environmental change researcher with significant experience in the SADC region, including substantive work in Malawi. He undertook his PhD in Botswana.

Key research areas and projects on which Professor Dougill works can be found below (several are in partnership with UP):

- Appraisal of Climate-Smart Agriculture interventions in terms of impacts on soil health and crop yields
- Agricultural and Food System Resilience, with specific emphasis on planning for climate change across southern and East Africa – https://africap.info/ and https://fsnetafrica.com/
- Climate change adaptation options for Malawi, based on appraisals of water resource management and agricultural adaptations – http://www.futureclimateafrica.org/project/umfula/
- Climate services and communications of weather information – https://africanswift.org/
- Dryland degradation monitoring and links to land policy, with a particular focus on the Kalahari region of Botswana

Prof Andy Dougill

Release of new population of biocontrol agents to control *Gonipterus*

A tiny egg parasitoid, *Anaphes nitens*, was released in the KwaZulu-Natal Midlands to control the eucalypt snout beetle, *Gonipterus* sp. 2, one of the most severe pests of eucalypts in the country. This is not the first release of this parasitoid in South Africa, which was first released in 1926! However, it does mark the first release since those original releases.

Notably, the first release of the wasp was collected from a region in Australia that is climatically similar to previous outbreak areas of Gonipterus in South Africa.

These releases form part of a collaborative effort between UP's Forestry and Agricultural Biotechnology Institute (FABI) and Biological Control of Eucalypt Pests (BiCEP), involving field collections in Australia, rearing of imported material in the FABI quarantine facility, and the eventual field release. It is not yet known whether introducing these wasps will increase the efficacy of biological control of *Gonipterus* sp. 2 in South Africa.

Still, the establishment and role of this introduction will be evaluated over time using molecular markers being developed by PhD student Harmen Barten. Mr Barten is also investigating phenotypic differences, with respect to climate tolerance, between the *A. nitens* populations already in South Africa and the new population.

Sci-Enza engages teachers in coding and robotics training

Not only is it Sci-Enza, the University of Pretoria's unique science centre's mission to make science accessible to people of all ages in a fun and entertaining way but also to raise awareness of science," says Tshepiso Maroga, Science Communicator at Sci-Enza.

According to Tshepiso, "The staff and volunteers at Sci-Enza are dedicated to creating a learning environment where science and imagination unite! Sci-Enza aims to foster public awareness and appreciation of science. As science advocates, they pride themselves on enormous community outreach projects that they get involved in. Science is relevant to everyone as they all practice it in their daily lives."

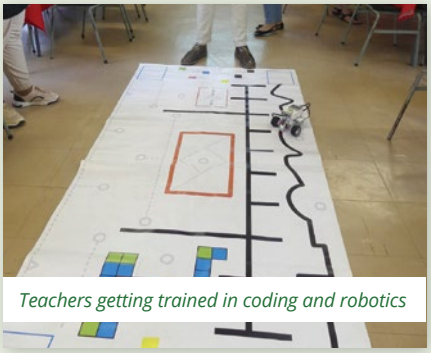
When Basic Education Minister Angie Motshekga called for comments to amend the Curriculum Assessment Policy Statement for Grade R to Grade 6, Sci-Enza took the initiative to be involved in the decision making by establishing a collaboration with the Department of Education, Tshwane district.

Tshepiso explained that "to prepare learners for the fourth industrial revolution, they trained teachers on coding and robotics within the district. The district chose Professional Learning Communities (PLC) teachers who teach Grade 0 to 6 as the ambassadors of coding and robotics from different schools within the district. In total, over four weeks, they trained 96 teachers."

"As an informal education entity, we believe that if you do not excite kids with science when they are still young (as young as Early Childhood Development), you are less likely to win them when they older. We intend to increase our reach; hence we invest in teachers. Our 'train a teacher/ trainer programme' expands our reach in the sense that if we train 96 teachers. Each teacher goes back to their respective schools and trains other teachers and the learners; more people will be equipped with coding and robotics skills, thus preparing them for the fourth industrial revolution.'

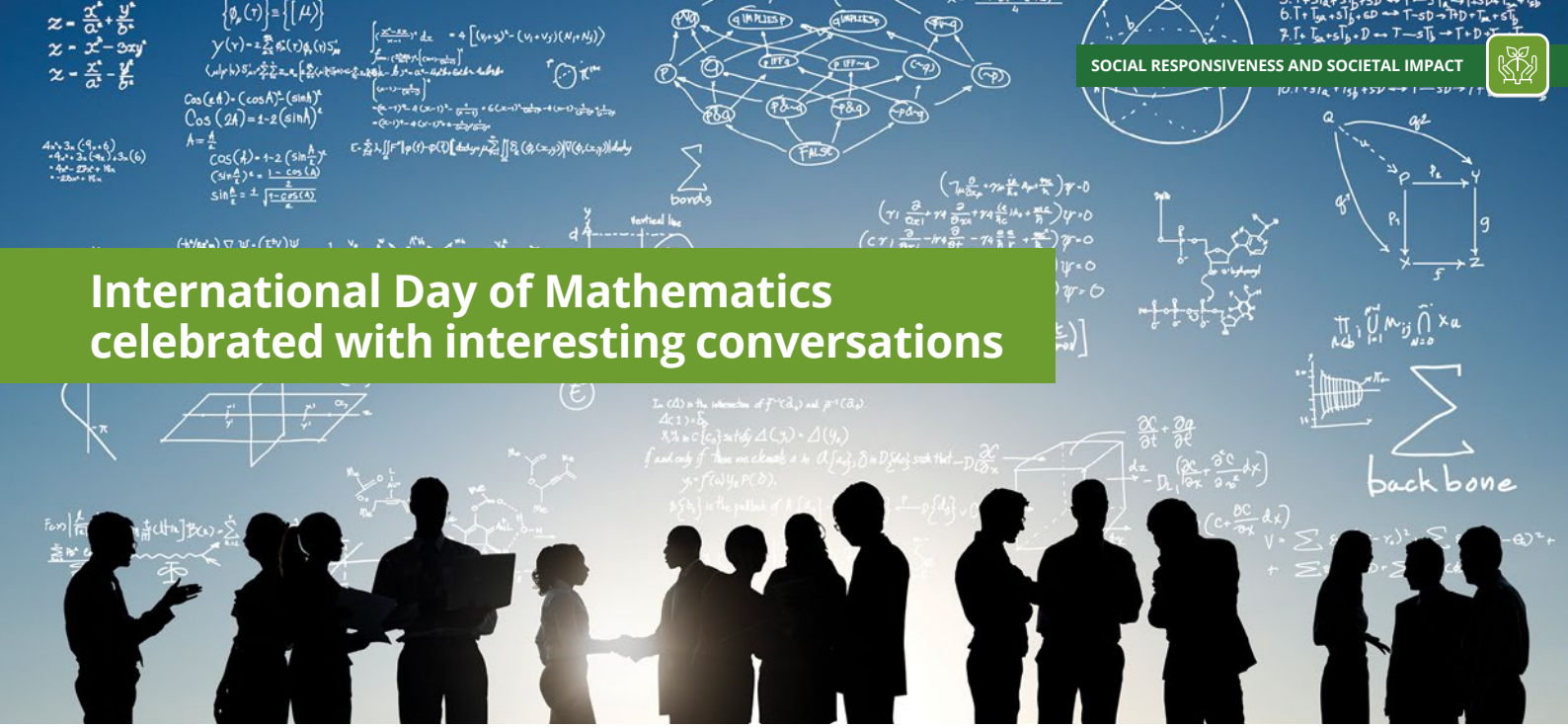
"To make it relevant to the teachers and the learners, we did our best to link coding and robotics to the school curriculum. We highlighted the benefits daily; we linked topics covered in coding with topics in mathematics, life sciences, physical sciences and English. To accommodate those that do not have the required equipment, we also trained them on how to teach coding without technology equipment."

The teachers who participated in the programme were allowed to rate the training, and overall, they were thrilled and eager to implement it in their respective schools.



Teachers getting trained in coding and robotics

International Day of Mathematics celebrated with interesting conversations



The Department of Mathematics and Applied Mathematics has celebrated the International Day of Mathematics (IDM) for the third consecutive year on 14 March, with some thought-provoking conversations.

The theme for this year's IDM was "Mathematics Unite", and the Department celebrated it online with a YouTube premiere of a conversation between Emeritus Professor Loyiso Nongxa (Vice-President of the International Mathematical Union) and two staff members from Mathematics and Applied Mathematics, Prof Bernardo Rodrigues and Dr Eder Kikianty.

Pi-Day is celebrated annually on March 14 (3.14) to celebrate the mathematical constant π. In November 2019, UNESCO designated Pi-Day as the International Day of Mathematics.

Prof Nongxa shared the stories from his youth as a black student in the days of apartheid. He completed his undergraduate and master's degree at the University of Fort Hare, later attended Oxford University and obtained his doctorate in Mathematics in 1982. He was the first black student who was awarded the Rhodes scholarship. However, due to the Bantu Homelands Citizenship Act, he was stripped of his South African citizenship and went to Oxford with a special permit which only allowed him to remain in the UK. This fact prevented him from travelling to other countries to attend conferences or conduct research visits in European countries, unlike the other South African Rhodes scholars who went to Oxford.

Despite these difficulties, he recalled some memorable moments during his time in Oxford, which inspired him to provide support and mentorship to the young mathematicians of South Africa. He highlighted the change in his career when the apartheid era ended, as he gained opportunities to travel abroad for research visits and conferences. Prof Nongxa talked about his conscious choice of focusing his university career on managerial positions over his research. With his experiences as Vice-Chancellor of the University of the Witwatersrand and the Vice-President of the International Mathematical Union, to name a few, Prof Nongxa has contributed immensely to the mathematical community of South Africa by fundraising projects, bringing about awareness to young researchers of the importance of mathematics, and the demystification of mathematics.

The three mathematicians also discussed the importance of mathematics and its applications in many areas and shared their views on the theme: "Mathematics Unite". Prof Bernardo shared his thoughts on the importance of celebrating mathematics not only on Pi-Day but also in the daily lives of mathematicians and doing mathematics with a great passion. He hoped to see more South African mathematics students embracing the subject as a valuable tool for their personal growth and influencing other people to change the course of their lives, as the subject has done to him:

"Being a mathematician has changed many perspectives, and has made me see the world in a different light". Prof Nongxa talked about an affinity he has always shared with fellow mathematicians worldwide, across different cultures, races, political leaning, etc. Despite the different languages and cultures, mathematicians share a common language and share the same passion: "[Mathematics] is a language that unifies strangers as long as they do mathematics."

Dr Kikianty shared her experiences living in different countries and how she always finds a home in the community of mathematicians. She also talked about the unity across genders, despite being a minority in the field: "Whenever there is a community of mathematicians, I always feel at home".

The full conversation can be found on the UPMaths YouTube channel: https://youtu.be/KPmmIotLuNw

Prof Nongxa interacted and answered some questions from UP students on the Discord server of UP's IDM celebration shortly after the premiere of the conversation on 14 March. The day concluded with a mathematics trivia quiz hosted by Mr Ben Victor, who is currently studying towards an honours degree in Mathematics.

Prof Loyiso Nongxa, Dr Eder Kikianty and Prof Bernardo Rodrigues

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