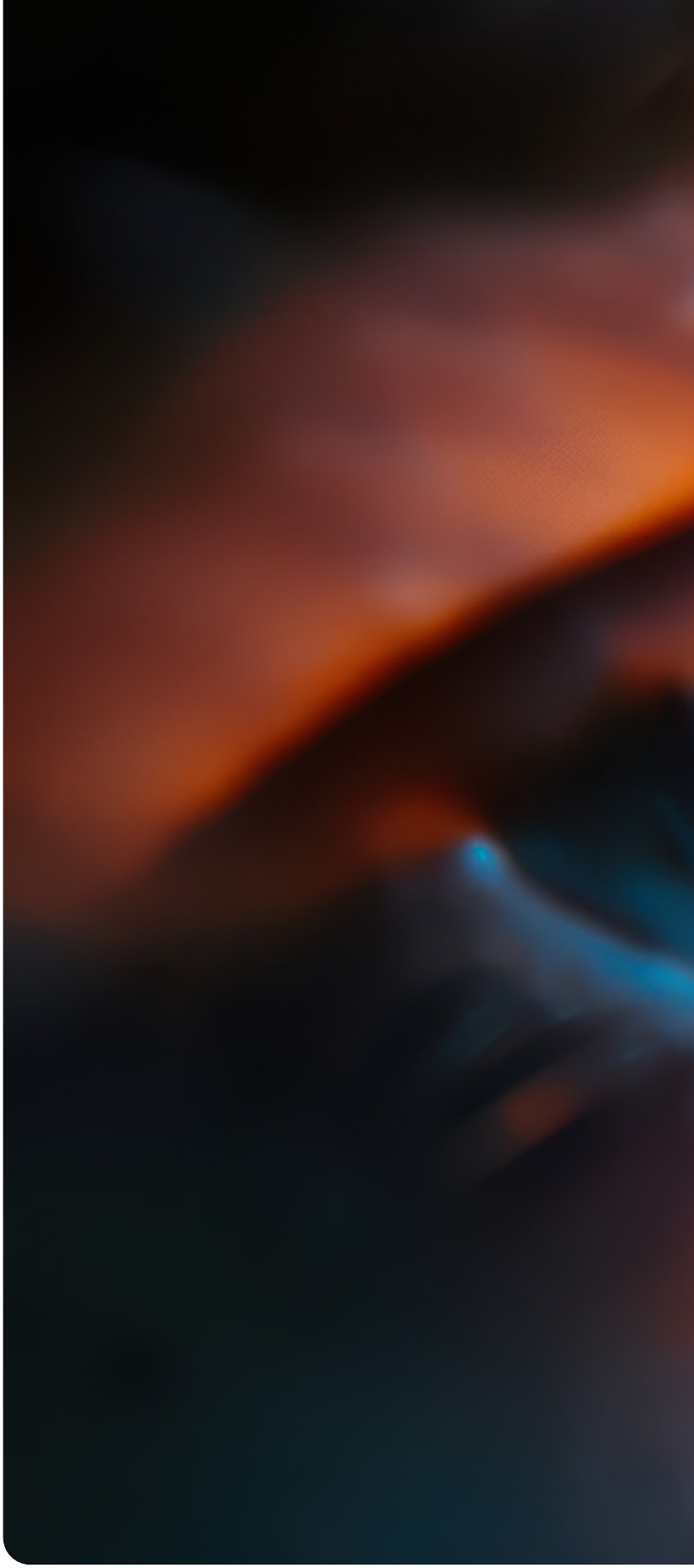
ANNUAL **REPORT** 2023

VISION 130
Renew and Reimagine for 2034

UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA

UFS
NATURAL AND
AGRICULTURAL SCIENCES



FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

ANNUAL **REPORT** 20**23**

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CONTENT

FROM THE **DEAN'S OFFICE**

PREFACE

Message from the Incoming Dean, Prof Paul Oberholster

Commencing the leadership role of Dean, against the background of increasing change and challenges experienced in the higher education sector, I enjoy a sense of accomplishment for the remarkable progress, innovation and achievements that the Faculty attained in 2023.

I am humbled by my predecessor, Prof Danie Vermeulen, for his concerted effort and guidance to ensure that ground-breaking research took precedence, that our graduates are competitive in the global arena and that our dedicated researchers enriched the academic community.

Evident from the report is the dedication of our academic staff to make a meaningful contribution to the academic domain, to promote community engagement and our staff's commitment, showcasing the talent and calibre of the next generation of researchers and leaders, our students.

Against the United Nations Agenda 2030 for Sustainable Development and the outline of the Sustainable Development Goals (SDGs), we find a strategic roadmap on how to make an impactful and lasting change on a global level. In line with the aims of the SDGs, the UFS Vision 130 articulates the aim to be a research-led, student-centered and regionally engaged university that contributes to development and social justice through the production of globally competitive graduates and knowledge. To realise Vision 130, we will be focusing on three key tenets:

- Academic excellence, quality and impact
- Maximum societal impact with sustainable relationships
- A diverse, inclusive, and equitable University

Against this backdrop, I look forward to contributing towards building the Faculty to make a continuous unwavering impact on global frontiers, to foster and cultivate a culture of interdisciplinary collaboration, and to strengthen our relationships with project partners and actively support the SDG and Vision 130 goals.

As a Faculty we are committed to excellence and together we can ensure a sustainable and prosperous future for all!

FOCUS ON TEACHING AND LEARNING

Message from the Vice-Dean for Teaching and Learning, Prof Liezel Herselman

The University of the Free State initiated the appointment of Vice-Deans in the different faculties during 2023. I was appointed as Vice-Dean: Teaching and Learning in the Faculty of Natural and Agricultural Sciences in September 2023. This new portfolio was mainly created to assist the Dean with the day-to-day activities of the Faculty, enabling the Dean to spend more time on the strategic aspects of running the Faculty. I am taking co-responsibility with the Dean to ensure the achievement of the mission of faculty-based programmes and initiatives. The focus of my portfolio is to lead the teaching and learning portfolio by providing guidance towards strategic teaching and learning or research matters. This will be done through ensuring compliance with General Rules and Regulations of the UFS and the Faculty and by continuously identifying new teaching and learning needs, based on related market, student, and government needs. I am also taking co-responsibility with the Faculty Manager for academic administration, Faculty rules, and standard operating teaching and learning procedures. I am also ensuring that the quality framework linked to teaching and learning matters in the Faculty is being implemented by engagement with Programme Directors of the Faculty on quality management aspects. I am furthermore spearheading curriculum renewal and innovation in the Faculty and am responsible for digitalisation and entrepreneurial projects and for coordinating the initiation of short learning programmes.

During the four months of being the Vice-Dean: Teaching and Learning, I familiarised myself with the various Faculty-related aspects of teaching and learning. I took over as chairperson of the Faculty Readmissions Appeals Committee (FRAC) and implemented a new working pipeline for members dealing with the appeal process. I was also involved in the planning for the 2024 registration process and played a major role in developing the 2024 Annual Performance Plan for the Faculty. The main priorities for my portfolio for 2024 are the recurriculation of all Agricultural programmes, in collaboration with Prof Johan van Niekerk, the Vice-Dean: Agriculture. I will also focus on investigating the establishment of a virtual laboratory within the Faculty and on implementing work integrated learning within certain programmes in the Faculty. These activities will focus on being student-centred with the aim of producing graduates who are globally competitive.

FROM THE **DEAN'S OFFICE**

FOCUS ON RESEARCH AND POSTGRADUATE STUDIES

Message from the Vice-Dean for Research and Postgraduate Studies, Prof Samuel Adelabu

The year 2023 has been transformative for our Research and Postgraduate Studies division, marked by remarkable achievements, strategic initiatives, and the relentless pursuit of excellence. I joined the Deanery as Vice-Dean of Research and Postgraduate Studies in September 2023 and I am proud of what we were able to achieve within the last four months of 2023 and the stage we have set for future endeavours.

In 2023, we increased our postgraduate admissions, especially in the Honours degree programmes and, most importantly, increased our graduations of Master's and PhD candidates. We also developed new standard operating procedures for postgraduate administration. In addition, we increased funding for postgraduate scholarships by approximately 20% through internal and external funding mechanisms, supporting our students financially and academically. In conjunction with Centre for Graduate Support, we organised several workshops and seminars to enhance research skills, academic writing, and career development.

Our publication output also increased with our outputs now exceeding 470 publication units. Of significance is that we observed a surge in quality publications in peer reviewed journals with a high-impact factor. This increase in quality publications has not only enhanced our academic reputation but also increased our citation index. Media coverage of several ground-breaking projects has further amplified our research impact.

Despite our successes, we faced challenges – particularly in securing sustained funding and translating research into commercial products. We recognise the need for stronger industry partnerships and are actively working to bridge this gap. Securing additional resources to support our growing postgraduate enrolments, remains a priority.

Looking ahead, we are committed to enhancing research quality by increasing publications in top-tier journals and encouraging interdisciplinary projects. Strengthening industry partnerships and establishing an innovation hub will be key to facilitating research commercialisation. We are also focused on implementing sustainability initiatives across all activities and fostering global engagement through international collaborations and conferences.

FOCUS ON AGRICULTURE

Message from the Vice-Dean for Agriculture, Prof Johan van Niekerk

The role of Vice-Dean for Agriculture at the University of the Free State presents a unique opportunity to drive innovation, excellence, and sustainability within our academic programmes and research initiatives.

My ultimate objective is to help establish UFS as the premier agricultural university in Sub-Saharan Africa, to not only lead in agricultural education and research but also to make a lasting impact on the agricultural sector in the region and beyond. By embracing a strategic approach to education and research, I aim to enhance our academic programmes, support cutting-edge research, and foster meaningful community engagement. Through collaboration with colleagues, students, and external stakeholders, I plan to develop and implement initiatives that align with the University's mission and strategic goals. This includes promoting interdisciplinary research, securing funding for key projects, and expanding our network of industry partnerships.

One of the most exciting aspects of my role is the establishment of the veterinary sciences programme and the development of a new agricultural curriculum at UFS. These initiatives represent significant advancements in our academic offerings. The turnaround strategy for our experimental farms presents a particularly demanding and exhilarating challenge. These farms are critical to our research and teaching missions, and transforming them into highly productive, financially sustainable, and innovative centres of excellence is a top priority. We will leverage the latest agricultural technologies and best practices to achieve this transformation, thereby enhancing both our research capabilities and our educational impact.

Another priority area is the establishment of agriculture-related research chairs within the Faculty. These positions are vital for attracting and retaining top-tier talent, driving cutting-edge research, and fostering collaborations with industry and other academic institutions. I am dedicated to supporting the creation of these chairs, which will significantly bolster our research profile and contribute to our strategic goals.

FOCUS ON QWAQWA CAMPUS

Message from the Assistant Dean for the Qwaqwa Campus, Prof Aliza le Roux

The Faculty of Natural and Agricultural Sciences on the Qwaqwa Campus (NAS-Qwaqwa) is a beacon shining in the Maluti mountains. We have a rich diversity of students and staff, with our leading researchers hailing from as far afield as Gabon, Nigeria, and Togo. The Faculty is maturing in terms of academic stature, as we received the excellent news at the end of 2023 that we now have five Associate Professors and three full Professors – including the first female full Professor in the history of the Campus! Prof Peter Taylor, won the Gold Medal of the Zoological Society of Southern Africa (ZSSA) this year for his lifetime of outstanding achievements. Sadly, in 2023 we bade farewell to Prof Geofrey Mukwada, a leading figure in the Department of Geography, who spearheaded numerous research and mentorship programmes. With our newest PhD-holder, Dr Michelle van As, completing her degree in 2023, 32 of the academic staff at Qwaqwa now hold PhD degrees – that is over 70% of the staff complement. This diversity, growth, and excellence in our staff, who also published 73 SCOPUS-listed papers in 2023, reflects the Faculty's commitment to research, equity, and quality, as encapsulated in the UFS Vision 130.

Being research-led, we welcomed the establishment of a new building, the Animal Research Facility, at the start of 2023, and the erection of a weather station on Campus, which was built with funding support from the US University Partnership Initiative in South Africa. Much-needed renovations also began in the Department of Plant Sciences, not only to support the researchers and students in this department, but also with a view to housing new gas chromatography and spectrometry equipment arriving in 2024. On the teaching and learning front, the Faculty is at the leading edge of digital innovations – we completed one 'mirror' classroom in 2023, enabling us to teach synchronously across campuses, and a number of our professors have been actively including Artificial Intelligence (AI) in the development of students' academic skills. This action research has resulted in popular media articles as well as conference presentations on research and teaching in the age of AI.

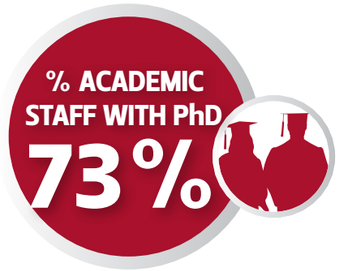
Our innovative technologies and facilities are nothing if we do not reach out to the broader academic and non-academic communities. In this, the NAS-Qwaqwa Faculty exemplifies a regionally-engaged unit with distinctive societal impact. We hosted two regional conferences in 2023 – the 40th Conference of the ZSSA, and the Society of South African Geographers' Student Conference. We also strive to engage our future young scientists in various ways. As an example, one of our new staff members, Dr Andronicus Akinyelu, is actively engaging high school learners with new technologies in a project on AI and robotics. The vast majority of our research projects are focused on addressing challenges in the Qwaqwa region.

We would of course be nothing without our students, both undergraduate and postgraduate. In 2023, 59% of our enrolments were postgraduate students (Honours, Master's and PhD students), with 23 of our successful graduates completing their Master's and PhD degrees. Our students excelled as much as our staff members, and in 2023 we boasted with a winner of the L'Oreal-UNESCO For Women in Science Award (Alexandra Howard), and at the 5th National Global Change Conference, two of our PhD students, Alexandra Howard and Veli Mdluli, won awards for their excellent presentations. Toka Mosikidi, similarly, won a prize for his sterling presentations at the ZSSA Conference and the Conservation Symposium.

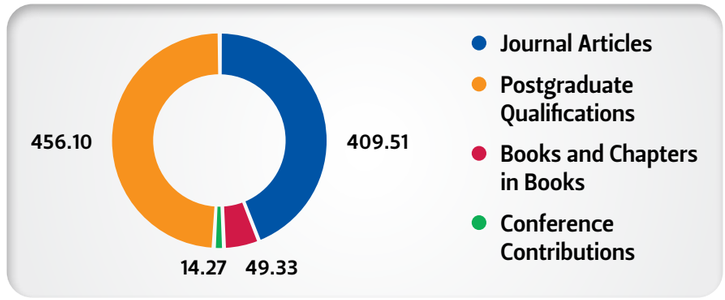
I look forward to what 2024 has in store for us. Our dedication to care and inclusivity, while driving innovation, will undoubtedly see the Faculty continue to shine.

FACULTY AT A GLANCE

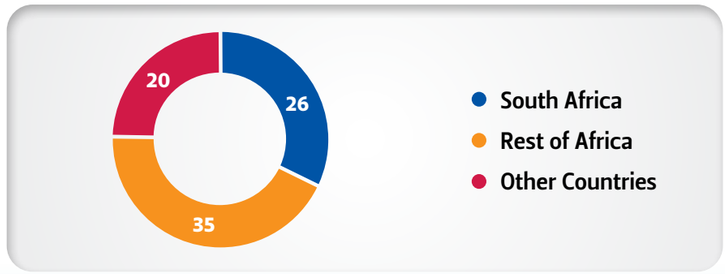
Research Profile



Research Output Units (2023)



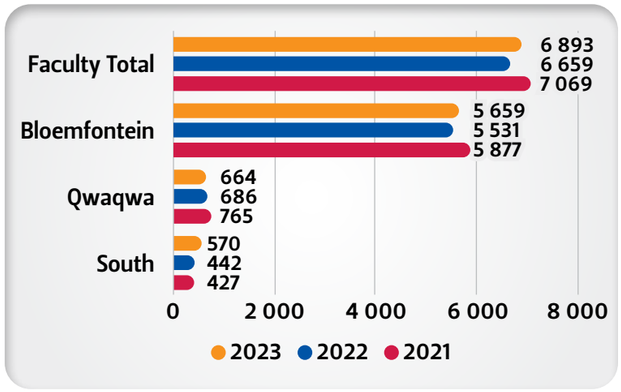
Postdoctoral Research Fellows by Nationality (2023)



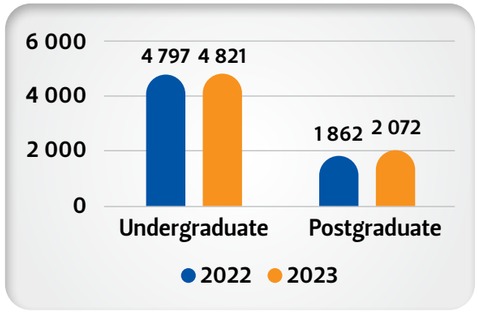
FACULTY AT A GLANCE

Student Profile

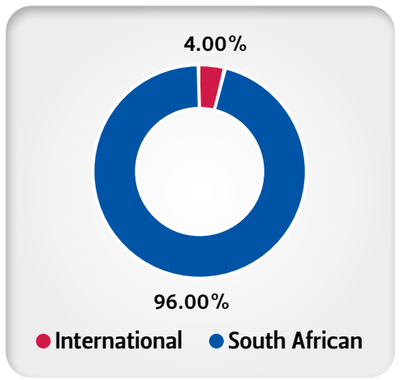
Total Registrations by Campus (2021–2023)



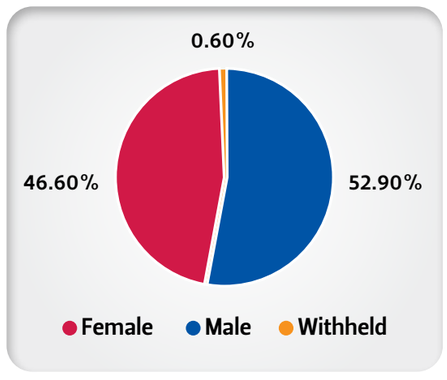
Student Numbers (2022 & 2023)



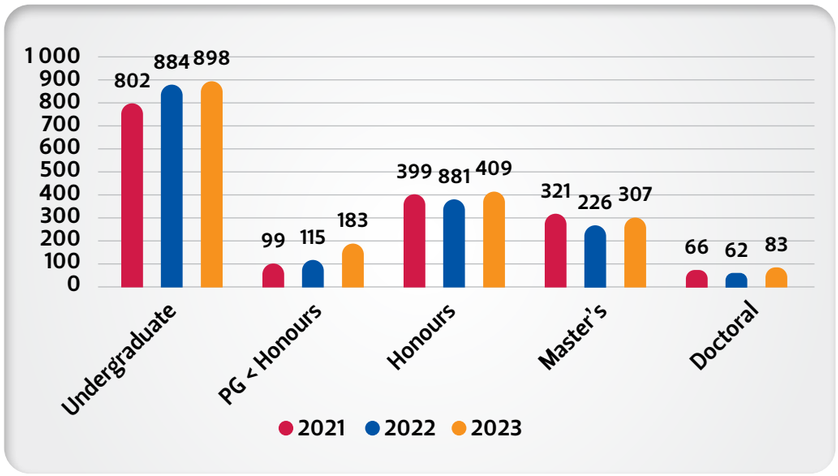
Registrations by International Indicator (2023)



Registrations by Gender (2023)



Graduates by Qualification Level (2021–2023)



AGRICULTURAL **SCIENCES**

DEPARTMENT OF

AGRICULTURAL ECONOMICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Agricultural Economics performed well during 2023 from an academic and engagement point of view, allowing us to enhance our academic and industry footprints. In total, we published 32 scientific papers in peer-reviewed journals and delivered six papers at local and international conferences. Staff members were also actively involved in the publication of articles in the popular press, participating in farmers' days and other industry engagements, as well as interviews on radio stations. Students from the Department also contributed to our academic and industry footprints by contributing to scientific publications, conference presentations, and participating in an international student case study competition, in which the team reached the finals.

From a staffing point of view, 2023 saw the resignation of one of our senior colleagues, Prof Wale, who was appointed as the Head of the Department of Agricultural Economics at the University of Pretoria. Dr Walter van Niekerk was promoted from Lecturer to Senior Lecturer.

Overall, 2023 was a good year for the Department.

ACHIEVEMENTS

Staff Achievements

One staff member in the Department was promoted in 2023. Dr HN van Niekerk was promoted from Lecturer to Senior Lecturer.

Dr WA Lombard was appointed as Editor of *Veeplaas* magazine, as from 1 November 2023.

Prof Frikkie Maré was the winner of the 'Agricultural Writer's Agriculturalist of the Year for the Free State in 2023. He was then one of the finalists for the national competition.

We are very proud of our staff members who received awards and prizes at our annual year-end function and prize-giving ceremony. These were:

- Best Achievement in Research: Prof YT Bahta
- Best Progress in Research: Dr WA Lombard
- Best Achievement in Teaching and Learning: Prof H Jordaan
- Best Progress in Teaching and Learning: Prof FA Maré
- Best Achievement in Engaged Scholarship: Prof FA Maré
- Best Progress in Engaged Scholarship: Prof YT Batha
- Best Achievement in Administration and Leadership: Prof FA Maré
- Best Progress in Administration and Leadership: Prof YT Bahta

Dr Walter van Niekerk

Dr WA Lombard

A manuscript published by colleagues from the Department, Prof Nicky Matthews and Prof Yonas Bahta, together with their PhD student, Lindikaya Myeki, received joint first prize for the award 'Best Publication in a Professional Journal or Best Published Book, other than Agrekon', at the 60th Annual Agricultural Economics Association of South Africa (AEASA) Conference, which was held as a joint conference with the 7th African Conference of Agricultural Economics (ACAE), from 18 to 21 September 2023.

Liza Bohlmann (Chairperson of Agricultural Writers SA), Dr Dirk Troskie (Western Cape and National Winner), Daniel Stevens (Head: Santam Agriculture – Crop Insurance), Corné Louw (Gauteng Winner) and Prof Frikkie Maré (Free State Winner)

From the left, Heinrich Kotzé, Danie Naudé, Ryno Schoeman, and Jan Daniël Strydom

Student Achievements

At the International Food and Agribusiness Management Association (IFAMA) Conference, held in Christchurch, New Zealand, from 17 to 20 June 2023, four of our Master's students participated in a case study competition and progressed to the semi-finals.

Danie Naudé

One of our Master's students, Danie Naudé, was part of a team of exceptional students from the University of the Free State (UFS) who claimed victory in the prestigious Sustainable Development Goals (SDGs) Challenge, South Africa, a global competition that unites students and organisations to address the United Nations (UN) SDGs. The competition was held in October at Innovation City, Cape Town.

The following students received awards and prizes at our annual year-end function and prize-giving ceremony:

- Service to the Department: Elené Wessels
- Student Ambassador: Danie Naudé

TEACHING AND LEARNING

The Department offers three undergraduate programmes – BSc Agricultural Economics, BAgric Agricultural Economics and BAgric Agricultural Management. At postgraduate level students can do Honours, Master's and Doctoral degrees in Agricultural Economics or Agricultural Management.

RESEARCH AND INNOVATION

Our research endeavours during 2023 continued around three broad themes:

(i) water-related research, mainly funded by the Water Research Commission (WRC),
(ii) research on livestock economics, mainly funded by the Red Meat Research and Development South Africa (RMRD SA) and industry partners, and
(iii) projects concerning drought and small-scale producers, mainly funded by the National Research Foundation (NRF).

The research team of Prof Yonas Bahta and Prof Henry Jordaan focuses on sustainable water use for food production. They are busy with a WRC-funded project, 'Assessing the social and economic impact of changed water use behaviour in food production in South Africa', which will run until 2025. Currently working with him on this project is one PhD student, two Master's students and one Honours student.

Prof Bahta delivered a paper on 'Smallholder livestock farmers coping and adaptation strategies to agricultural drought in South Africa' at the 11th Societá Italiana per le Scienze del Clima (SISC) Annual Conference, in Milan, Italy which took place from 22 to 24 November 2023. Prof Bahta was also the co-author of a number of papers delivered at international conferences in 2023 – 'Towards an automated, urban resilience, agile operational housing system framework. a case study of Khayalitjha in-situ informal settlement upgrading, South Africa' (co-authored with C Muhame and A Ncube) delivered at the Climate Change and Futures in Africa conference series (Maputo, Mozambique, 8 to 10 November), 'Export Competitiveness of Namibia's timber sector: implication for forestry sector (co-authored with S Mbai and EN Moses), presented at the Standard Bank Biomas Fair held at Okahandja, Namibia on 7 September, 'Competitiveness of Namibia's agri-food commodities: Implications for food security' (co-authored with S Mbai) presented at the IFAMA World Conference in Christchurch, New Zealand from 17 to 20 June 2023, and 'Transforming human settlement through an urban resilience agile operational model. A case study of Khayelitsha in-situ informal settlement upgrading; South Africa', co-authored with C Muhame and A Ncube, was delivered at the 5th National Global Change Conference (GCCS) held in Bloemfontein from 30 January to 2 February.

Prof Yonas Bahta

Prof Edilegnaw Wale Zegeye, Prof Henry Jordaan and Dr Janus Henning completed a WRC project in 2023, titled 'Entrepreneurial development for establishing small farming businesses and employment by youth in rain-fed crop farming'. The project aims to establish entrepreneurial development paths to facilitate the participation of rural youth in primary agriculture and value-adding activities along the food value chain. The project ran since 2018 and involved one PhD and three Master's students.

Prof Bennie Grové

Pascalina Pilane is currently busy with her PhD, in which she is exploring the use of social sustainability assessments within the scope of water footprint methodology to inform sustainable water use in the production of table grapes and wine.

Prof Bennie Grové's research focuses on modelling the water-energy-food nexus by combining mathematical programming, evolutionary algorithms and crop growth simulation for improved and sustainable water management. He completed a WRC project on 'Economic management of conjunctive use of irrigation water and root-accessible water tables'. At the same time, his research on the transfer of the custodianship of SAPWAT from PICWAT Consulting to the UFS is ongoing.

At the joint conference of AEASA and ACAE in September in Durban, he delivered a paper, co-authored with Prof Matthews and Jano Bezuidenhout, on 'Farm-level hydro-economic analysis of alternative water tariff charges using a hybrid solution method'. The paper is based on Jano's research for his Master's degree under the supervision of Prof Grové and Prof Matthews. He also presented two papers at the biannual symposium of the South African National Committee on Irrigation and Drainage (SANCID), which was held from 21 to 23 February 2023 in Tzaneen.

Dr Walter van Niekerk's primary research focus in 2023 was related to the livestock industry, especially factors influencing productivity in the livestock sector and related sectors on a macro-economic level. Due to his practical involvement in primary field crop production, he also has a growing interest in research related to the optimisation of production aspects. His research interests also include understanding the factors affecting lucerne hay production profitability within the industry and related sectors.

The Department of Agricultural Economics hosted a writing retreat funded by the UFS Centre for Graduate Support from 8 to 10 November 2023 at De Stijl Hotel, Gariep Dam. Dr Melissa van der Merwe and Lulama Traub, from the Department of Agricultural Economics at the Stellenbosch University, participated in the retreat to foster research collaboration with the UFS. Participants from the UFS

included Prof Bennie Grové, Prof Nicky Matthews, Dr Walter van Niekerk, Dr Lindie von Maltitz, Pascalina Pilane, Brent Jammer, and Ramigo Pfunzo.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

As our Department operates within a very diverse and dynamic agricultural sector, we are actively involved in a wide range of engagements within the sector to give back to the farming community at large. During 2023, this was done through participation in farmers' days, farmer-arranged conferences, and also through publications in popular media, such as *Farmer's Weekly*, *Veeplaas*, *Landbou Weekblad*, *Stock Farm* and *Farmbiz*. Our staff were also regular guests on radio programmes on OFM and RSG.

Walter van Niekerk remained actively involved with the National Lucerne Trust, which provides training days for lucerne producers and role players.

Markus Monteiro presented the South African Futures Exchange (SAFEX) (the Johannesburg Stock Exchange [JSE] Agricultural Derivative Market) course at Namib Mills in Windhoek, Namibia, in September 2023. The course is aimed at those who would like to learn more about the agricultural derivatives market (ADM) and how derivative instruments can be used to mitigate price risk. A total of four courses are normally presented, two in Afrikaans and two in English. The SAFEX course is a comprehensive course, primarily designed to assist individuals who want to write the SAFEX exam. The UFS is the only higher education institution that offers a course in this field to the industry.

Dr Lindie von Maltitz was invited to present at the strategic planning session for the National Department of Agriculture, Land Reform and Rural Development (DALRRD), held at The Capital Empire Hotel, Sandton, on 19 April 2023. The online presentation was titled 'Skills and competencies of agricultural extension professionals in South Africa'. She was also invited to present at the Africa International Sustainable Agriculture Production, Biotechnology & Engineering Conference, which was held in Cape Town in May 2023. Her presentation was titled 'Strengthening Skills and Competencies of Agricultural Extension Services in South Africa: Implications for Higher Education Curricula'. In addition, Dr Von Maltitz was invited to be the keynote speaker at two events – the Western Cape Government Extension and Advisory Services Symposium (19 to 21 July 2023), on 'Skills and competencies of agricultural extension professionals in South Africa: Implications for higher education curricula, and at the 56th Annual Conference of the South African Society of Agricultural Extension (28 to 31 August 2023), on 'Curricula Development to Address Critical Skills for 2030 Extensionists for Nutrition Security'.

Zimbine Coka was invited to be part of the Adjudication Committee for the DALRRD Female Entrepreneur Awards. On 10 August 2023, the adjudication team met with the district coordinators, who presented the profiles of the entrants at Glen College. Zimbine was one of the keynote speakers representing the adjudicators at the Provincial Female Entrepreneur Awards 2023 Gala Dinner and Award Ceremony, which was hosted on 24 August 2023 at Vulamasango Secondary School, Bloemfontein.

Participants at the DALRRD Female Entrepreneur Awards (from the left) Letshego Segwe, Sebopelo Segwe (farmer in both Thaba 'Nchu and Bloemfontein and one of the adjudicators), Zacharia Mokoena (MEC for Agriculture and Rural Development), Timothy Mosia (Agricultural economist for the Department of Agriculture and Rural Development and adjudicator), and Zimbine Coka (UFS and adjudicator)

Prof Frikkie Maré (sixth from left) and other participants at the Free State Agricultural Congress, with a leaf blower donated on behalf of the Agri Relief Foundation

Prof Frikkie Maré was a guest speaker on the Free State Agricultural Congress 2023, which was held on 2 and 3 August at Monte Bello Estate, Bloemfontein. At this event, on behalf of the Agri Relief Foundation (ARF), he donated leaf blowers to farmers' associations in the Free State. The leaf blowers will be used for help in the prevention of veld fires.

NATIONAL AND INTERNATIONAL COLLABORATION

Dr Lindie von Maltitz was involved in a project funded by the Michigan State University African Alliance Partnership that revolved around Agricultural Advisory Training in Africa: Process Skills and Competency Gaps in Undergraduate Curriculum. The research was done in selected countries, namely, South Africa, Kenya, Nigeria, Malawi, and Uganda. A workshop was held at Egerton University in Kenya from 14 to 18 May 2023. A paper on 'Strengthening Agricultural Extension Training in the MSU Alliance for African Partnership Consortium Partners in Africa – Process skills and competency gaps in undergraduate agricultural extension curriculum in South Africa', was presented at the workshop.

POSTGRADUATE STUDENTS

In 2023, a total of 47 students were registered for the three Honours programmes offered by the Department, 22 students for a Master's degree and 9 for the PhD degree. Forty-eight students graduated with an Honours degree, twelve with a Master's degree and one with a PhD degree.

Dr Lindie von Maltitz

One of our staff members, Dr Lindie von Maltitz, graduated with her PhD. The title of her thesis was 'Skills and Competencies of Agricultural Extension Professionals in South

Africa: Implications For Higher Education Curricula'. Her supervisors were Dr Kristin Davis, from the International Food Policy Research Institute, and Prof Johan van Niekerk.

STAFF MATTERS

Dr Christo Joubert joined the Department on 1 February 2023 as Senior Lecturer.

At the end of September 2023, after three years with the Department, Prof EW Zegeye joined the University of Pretoria as Head of the Departmen of: Agricultural Economics, Extension and Rural Development.

RESEARCH OUTPUTS

Research Articles

Abu Hatab, A., Owusu-Sekyere, E., Esmat, A-R. and Lagerkvist, C-J. 2023. In the midst of the COVID-19 pandemic: Perceived risks, management strategies and emerging opportunities for small and medium agri-food enterprises in a developing country. *International Journal of Disaster Risk Reduction* 97: 104045. DOI: 10.1016/j.ijdrr.2023.104045.

Adamie, A., Owusu-Sekyere, E., Lindberg, M., Agenäs, S., Nyman, A-K. & Hansson, H. 2023. Dairy cow longevity and farm economic performance: Evidence from Swedish dairy farms. *Journal of Dairy Science* 106(12): 8926-8941. DOI:10.3168/jds.2023-23436.

Bahta, Y.T & Lombard W.A. 2023. Nexus between Social Vulnerability and Resilience to Agricultural Drought amongst South African Smallholder Livestock Households. *Atmosphere* 14: 900. DOI:10.3390/atmos14050900.

Bahta, Y.T. & Mbai, S. 2023. Competitiveness of Namibia's Agri-Food Commodities: Implications for Food Security. *Resources* 12: 34. DOI:10.3390/resources12030034.

Bahta, Y.T. & Musara, J.P. 2023. Diversity of Food Insecurity Coping Strategies among Livestock Farmers in Northern Cape Province of South Africa. *Climate* 11: 82. DOI:10.3390/cli11040082.

Baloyi, R.J., Wale, E. & Chipfupa, U. 2023. Rural youth interest in economic activities along the agricultural value chain: Empirical evidence from South Africa. *International Food and Agribusiness Management Review* 26(1): 49-65. DOI:10.22434/IFAMR2021.0036.

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Ma, W., Vatsa, P., Owusu-Sekyere, E., Zhou, X & Owusu, V. 2023. Does income diversity really stimulate household consumption expenditure diversity? Evidence from mean-based and unconditional quantile regression. *Applied Economics* 55(55): 6567-6581. DOI:10.1080/00036846.2022.2159012.

Madende, P., Henning, J.I.F. & Jordaan, H. 2023. Accounting for Heterogeneity among Youth: A Missing Link in Enhancing Youth Participation in Agriculture – A South African Case Study. *Sustainability* 15(6): 4981. DOI:10.3390/su15064981.

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Mthethwa, S. & Wale, E. 2023. Household vulnerability to climate change: a multilevel regression model. *Development Southern Africa* 40(2): 466-481. DOI:10.1080/0376835X.2022.2085667.

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Owusu, V., Donkor, E., Owusu-Sekyere, E., Ogundeji, A.A. & Asante, B.O. 2023. Editorial: Climate change, variability and sustainable food systems. *Frontiers in Sustainable Food Systems* 6: 912811. DOI:10.3389/fsufs.2022.912811.

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Van den Heever, M.J.J., Lombard W.A., Bahta, Y.T. & Maré F.A. 2023. Cost-Effectiveness of Acaricide Application Methods Against Heartwater Disease in South Africa. *Agriculture* 13: 568. DOI:10.3390/agriculture13030568.

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Wale, E. & Mkuna, E. 2023. Smallholders' satisfaction with the quality of agricultural information and their preferences among the sources: empirical evidence from KwaZulu-Natal, South Africa. *Journal of Agriculture and Food Research* 14: 10015. DOI: 10.1016/j.jafr.2023.100715.

Conference Contributions

Conference Papers / Posters

Bahta, Y. & Mbai, S. 2023. *Competitiveness of Namibia's agri-food commodities: Implications for food security*. Paper delivered at 2023 IFAMA World Conference, Christchurch, New Zealand. 17-20 June 2023.

Bahta, Y.B. 2023. *Smallholder livestock farmers coping and adaptation strategies to agricultural drought in South Africa*. Paper delivered at the 11th Societá Italiana per le Scienze del Clima (SISC) conference, Milan, Italy. 22-24 November 2023.

Grové, B., Bezuidenthout, J.J. & Matthews, N. 2023. *Farm level hydro-economic analysis of alternative water tariff charges using a hybrid solution method.* Paper delivered at the 60th Annual Agricultural Economics Association of South Africa (AEASA) conference, Durban, South Africa. 18-21 September 2023.

Matthews, N., Grové, B. & Barnard, J.H. 2023. *Value of spatial differentiated irrigation informed by dynamic changes in matric and osmotic potential of soil water.* Paper delivered at the South African Commission on Irrigation and Drainage (SANCID) Symposium, Tzaneen, South Africa. 21-23 February 2023.

Mbai, S., Moses, E.N. & Bahta, Y.T. 2023. *Export competitiveness of Namibia's timber sector: Implications for forestry sector.* Paper delivered at the Standard Bank Biomass Fair 2023, Okahandja, Namibia. 7 September 2023.

Muhame, C., Ncube, A & Bahta, Y.T. 2023. *Transforming human settlement through an urban resilience agile operational model. A case study of Khayelitsha in-situ informal settlement upgrading, South Africa.* Paper delivered at the 5th National Conference on Global Change, Bloemfontein, South Africa. 30 January – 2 February 2023.

Muhame, C., Ncube, A & Bahta, Y.T. 2023. *Towards an automated, urban resilience, agile operational housing system framework. A case study of Khayalitjha in-situ informal settlement upgrading, South Africa.* Paper delivered at the Climate Change and Futures in Africa conference series, Maputo, Mozambique. 8-10 November 2023.

STAFF (2023)

Head of Department:
Prof FA Maré

Professor:	Prof EZ Wale
Associate Professors:	Prof YT Bahta, Prof B Grové, Prof H Jordaan, Prof FA Maré and Prof N Matthews
Senior Lecturers:	Dr JIF Henning, Dr JCN Joubert, Dr WA Lombard and Dr HN van Niekerk
Lecturers:	B Jammer, P Mokhatla, P Pilane and Dr L von Maltitz
Junior Lecturers:	Z Coka and MA Monteiro
Programme Director:	ES Jacobs
Researcher:	P Madende
Research Assistants:	FC Fourie, H Kotzé, E Moshugi, A Muller, D Naudé, M Qotoyi, R Schoeman, JD Strydom, H Venter and E Wessels
Research Associates:	Dr E Owusu-Sekyere, Dr B Riddout and Dr DB Strydom
Affiliated Researcher:	PL Oosthuizen
Officers:	I Combrinck and C van der Merwe

DEPARTMENT OF

ANIMAL **SCIENCE**

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The agricultural year started with positive prospects as good rains fell throughout the country before the onset of winter. Unfortunately, the El Niño phenomenon put a damper on the latter part of the year. Although excellent rains were recorded over parts of the country, certain areas remained dry. Also, the struggling economy and high interest rates led to lower product prices. All these factors placed severe strain on the profitability of the livestock industry.

The Department of Animal Science had an excellent year with several achievements and highlights. The first phase of the renovation of the Agricultural building was completed and greatly enhances the appearance of the building. The second phase started in November 2023 and will focus on laboratories and classrooms.

On the academic front, blended learning and teaching (BOB) was implemented for the practical Animal production module for third-year B Agric students. This new approach was very successful and led to improved exposure of students to practical training. Although the structured Master's for the M Agric students is still in its final stages of preparation, the first three students doing an M Agric by research, obtained their degrees. The popularity of the B Agric Hons in Animal Production is soaring, and the Department recorded the highest number of students since its implementation.

The Department managed to collaborate with various companies in 2023 and secure several research projects which led to either postgraduate studies for students or sponsorships for infrastructure on the UFS Paradys Experimental Farm. The farm is busy developing into a showcase for the University.

Construction to upgrade and enlarge the current meat processing facility started in November 2023. This upgrade will enable the Department to present Meat Science practical training to larger groups of undergraduate students and it will help to improve the quantity and quality of research.

The Dairy Processing Unit on the UFS Paradys Experimental Farm is operational and is producing excellent cheese, herb cheese, and yoghurt. It also started with the production of Amasi.

ACHIEVEMENTS

Staff Achievements

Dr Paul Malan served on the Forest and Range Forestry of South Africa Committee.

Jamie Paulse-Ross served on the organising committee for the Grassland Society of Southern Africa (GSSA) Conference for 2023 for the third consecutive year and was elected as Vice-Chair of the scientific committee of the GSSA.

Prof Errol Cason was awarded Mentor of the Year 2023 at the SAB Intervarsity Brewing and Tasting Challenge 2023. Prof Cason managed the UFS Brewing team that achieved third place in the India Pale Ale (IPA) category at the SAB Intervarsity Brewing and Tasting Challenge 2023. He was also invited to present a session on microbial diversity analysis during the University of the Free State Next Generation Sequencing (UFS-NGS) Unit Data and Bioinformatics Workshop 2023, an international workshop hosted by the UFS.

Leon Krüger obtained his PhD.

Student Achievements

Hendrik Human received the Animal Feed Manufacturers Association (AFMA) Koos van der Merwe award for the best undergraduate Animal Nutrition student from any South African university at the AFMA Forum held at Sun City from 5 to 7 September. The theme of the Forum was 'Feed & Food – The 4th Agricultural Revolution'.

Hendrik Human with the Koos van der Merwe AFMA student of the year

TEACHING AND LEARNING

The Department of Animal Science offers the BSc Agric and the BSc Agric Hons, as well as Master's and Doctorate qualifications (with various major options).

The final year Animal Breeding students, along with some members of the Faculty, attended the SIMBRA training course held on 23 and 24 May 2023. During this course, participants were exposed to basic genetic principles, breeding values and their use, and theoretical as well as practical appraisals of Simbra cattle.

Final year students for ANIG4864 practical

Dr Kobus Delport, Breed Director for Dohne Merino sheep, presented a judging course to the final year

Animal Breeding students on 6 and 7 September 2023.This was the first time the course was presented on the UFS Paradys Experimental Farm using the University's own sheep.

In August 2023, the final year BSc Agric Animal Science students went on two excursions to commercial dairy farms for teaching and learning purposes. Here they received first-hand training on how commercial farms apply technical skills for efficient milk production.

RESEARCH AND INNOVATION

Animal Science

Everyone in the Department, as well as industry, is extremely excited about the sheep and beef GrowSafe automated feeding units on the UFS Paradys Experimental Farm. Four MSc Agric students completed their research trials on the effect of different additives on the feed efficiency and growth of lamb and milk production of ewes, in collaboration with the formal feed industry. Research on the effect of additives in a beef ration on efficiency and production, is currently being conducted in collaboration with industry.

The newly acquired Daisy Invitro Incubator was also successfully installed and the first MSc Agric student will submit a dissertation using data generated with this unit.

Selection for survivability of Dexter cattle

A feral herd of Dexter cattle has survived in the Addo Elephant National Park for the last 40 years. Sixteen of these animals were captured and relocated to a commercial farm. Research is ongoing regarding the genetic components involved in the survival of these animals in these extreme environments. Prof Errol Cason and Prof Frikkie Neser spearhead the research and, thus far, genotyping has been performed on the feral animals as well as 400+ South African commercial Dexter cattle. The research has already attracted international interest, which resulted in receiving genotypes of Dexter's from Ireland. A popular article in *Farmers Weekly* (8 November 2023) was recently published, highlighting the research. https://www.farmersweekly.co.za/animals/cattle/dexters-survive-for-decades-in-national-park/.

Predation Management Centre

In 2021, the National Museum published Part 1 of a special predation issue of their journal, *Indago*. This special predation issue, which was the brainchild of Dr Nico Avenant (National Museum) and Prof HO de Waal (UFS), highlighted some of the latest research conducted on the impact of predators (particularly caracal and black-backed jackal) on, and their management in, the small livestock farming industry. This collaboration between the National Museum, the UFS, and various other tertiary and research institutions has been continued in Part 2, where authors will present advances in technology and methodologies aimed at finding workable and sustainable solutions to predation management in livestock farming areas of southern Africa. This work is also mentioned in the book *Simbamangu – through the eyes of caracal,* which was launched in November 2023.

Research linked to the Predation Management Centre, which will be included in *Indago* Vol 37, Part 2, involves:

- Social aspects of human-wildlife conflict management around the Square Kilometre Array core site in South Africa. Dr Quinette Kruger and Prof HO de Waal contributed historical and contextual background.
- Dr Quinette Kruger describes how a tool developed to facilitate recording of livestock losses and predator control may be used in efforts to standardise and co-ordinate research efforts in the predation management discipline.
- A study on the status of mesopredator management on livestock farms and wildlife ranches in southern Africa attempted to source all available scientific literature on black-backed jackal and caracal (earliest to recent). A comprehensive review of the literature is underway, with each author investigating specific aspects of the contributions of the literature to the way human-predator conflict management is practiced today to discuss the contribution of science to predation management in southern Africa so far, and the way forward for dealing with this highly contentious issue. Dr Quinette Kruger sourced and tabled the literature (over 500 peer-reviewed publications and scientific reports) and is investigating the legal aspects and sociology of human-predator conflict, while Prof HO de Waal is looking at the economic aspects and history.

Some of the contributors to the Indago special predation issue. From the left, Andries Strauss (Glen Agricultural College), Dr Nico Avenant (co-author of Simbamangu – National Museum), Dr Jurie du Plessis (formerly National Museum), and Dr Quinette Kruger (UFS) at the public lecture and book launch of Simbamangu – through the eyes of caracal

Reference population for Shorthorn cattle in South Africa

Genotyping of ~200 Shorthorn cattle is currently underway; the aim of the research is to set up a reference population for the breed using Single Step Blup analysis. Prof Errol Cason leads the research.

The molecular DNA lab in the Department has recently acquired new equipment for molecular DNA work. This state-of-the-art third generation DNA sequencer, Oxford Nanopore Minion, will allow the lab to perform analysis of rumen microbial diversity, variant discovery, and even low coverage genome sequencing. The new equipment represents an important step forward in its research capabilities. Researchers and students will be able to conduct a wide range of experiments in the field of molecular genetics, helping to advance our understanding of the complex biological processes that underlie animal production, development, and disease.

Centre of Meat and Dairy Science

The Centre of Meat and Dairy Science completed two contract research projects for Red Meat Research and Development – South Africa (RMRD-SA) during 2023.

The first project was titled 'The effect of different sodium reduction strategies on the chemical, microbial, and sensory quality of fresh and dried traditional South African processed beef products'. The research clearly indicated that the salt and

Salt and sodium reduced biltong

sodium content of fresh and dried traditional beef products can be reduced by 50% by the use of salt reduction and salt replacers. Several peer reviewed scientific articles were produced from this research. Rita Opperman also completed her PhD study on this topic and graduated in 2023.

The second research project, 'Can the meat (nutrient value) from rejected 'Wet Carcass Syndrome' lamb carcasses, be recovered for human consumption?', was completed. Wet lamb carcasses are rejected and condemned for human consumption at abattoirs, resulting in great financial losses for sheep farmers. This study confirmed the safety of wet carcass meat both for human and animal consumption, although the wet surface appearance, soft texture, and loose subcutaneous fat will deter consumers from purchasing such fresh meat cuts. Processing of wet carcass meat into products such as pet mince or other processed products, such as sausages and emulsion products suitable for human consumption, will support new commercial ventures and lessen the financial impact of the condition on the farming sector. Melissa Hatting completed this work for her MSc degree in 2023. She passed her degree with distinction.

Example of a wet carcass

Chop from wet carcass

Other postgraduate research projects completed during 2023 in the Meat and Dairy Science Section were:

- Prof Celia Hugo and Prof Arno Hugo supervised Ané Burger (MSc student) on a project titled 'The effect of plant extracts as natural preservatives on the chemical, microbial and sensory quality of Fresh Sausages', which she passed with distinction.
- Prof Celia Hugo and Prof Arno Hugo supervised Alicia Freitag (PhD student) on a project titled 'The effect of natural preservatives on the chemical, microbial and sensory quality of Fresh Sausages'. Alicia graduated in 2023.

Sausage with natural preservatives added

- Ndyebe Skele completed his MSc Agric study on 'The effect of castration age on meat quality of finishing Mutton Merino lambs'. This project was supervised by Dr Ockert Einkamerer, Dr Adri O'Neill, and Prof Arno Hugo. Ndyebo graduated in 2023. A manuscript from this research was accepted for publication in the international journal, *Small Ruminant Research.*
- Dr Koos Myburgh and Prof Arno Hugo supervised Niki Kretzman (MSc student) on a project titled 'To establish an indicator to confirm cold ultraviolet sterilization in milk'. Niki graduated in 2023.

Ongoing research projects being conducted in the Meat and Dairy Science Centre are:

- Dr Adri O'Neill, Dr Ockert Einkamerer, and Prof Arno Hugo are supervising MSc student, Temba Quankase, on a project titled 'Evaluating meat quality of wool and mutton type lambs produced on different production systems'.
- Prof Arno Hugo and Prof Celia Hugo are supervising MSc student, Rinus Behrens, on a project titled 'The effect of stunning methods on the quality of crocodile meat'.

Crocodile carcasses

Crocodile chop

Rangeland and Wildlife Science

Rangeland and Wildlife Science are mutually co-dependent and an integral part of Animal Science.

Prof Francois Deacon from Wildlife Science was part of the group which, for the first time ever, managed to place a GPS collar on the Himalayan Brown bear. The bears were successfully darted by Dr Willem Daffue in the Deosai National Park in Pakistan on 22 September 2023. These collars are novel and were manufactured by Martin Haupt from Africa Wildlife Tracking and sponsored by Dr Johan Marais from Saving the Survivors.https://www.ufs.ac.za/templates/news-archive/campus-news/2023/october/ufs-part-of-collaborative-efforts-to-collar-the-himalayan-brown-bear.

Animal Breeding – Genomics and Bioinformatics Unit (ABGB)

The Department of Animal Science, in collaboration with the UFS High-Performance Computing (HPC), presented a hands-on workshop with the aim to enable researchers to use Linux and the High-Performance Computing (HPC) resources at the UFS. Dr Louis du Preez, a postdoctoral researcher at the Department of Animal Science, presented the workshop.

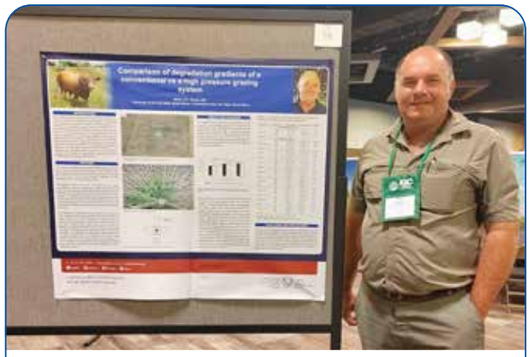
This is in line with the Bioinformatics Unit's dedication to hosting short training courses in biological bioinformatic analysis. The goal of the Unit is to provide students and researchers with the necessary skills to conduct advanced analyses in genomics, proteomics, and transcriptomics. In future the Unit will offer courses in a variety of topics, including genome-wide association studies, variant calling, and more.

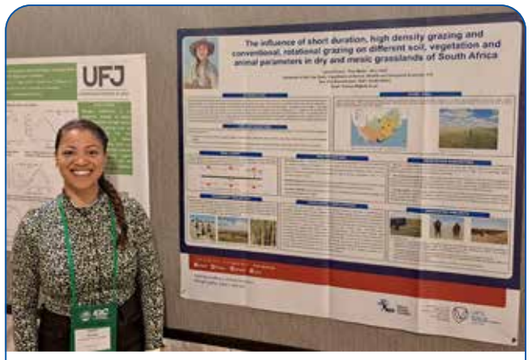
Throughout the year, members of the Department participated in national and international conferences where they presented their research results. These included, *inter alia:*

- Dr Lize van Wyngaard, Prof Arno Hugo, and Eileen Roodt participated in the 25th Biennial South African Association for Food Science and Technology (SAAFoST) Congress, which was held in Cape Town from 28 to 30 August 2023.

Attendees at the 25th Biennial SAAFoST congress in Cape Town. From the left, Lize van Wyngaard, Prof Arno Hugo, and Eileen Roodt

- Dr Ockert Einkamerer, Charne Josling, and Hanél Mans (postgraduate student) attended the AFMA Forum (with the theme 'Feed & Food'), held at Sun City from 5 to 7 September 2023.
- Dr Paul Malan and Jamie Paulse-Ross made presentations at the International Grassland Congress in May 2023, in Kentucky, USA.





Jamie Paulse-Ross

- Dr Adri O'Neill and Thabang Sako made presentations at the 8th All Africa Conference on Animal Agriculture held from 26 to 29 September in Gaborone, Botswana.

Thabang Sako (left) and Dr Adri O'Neill at the 8th All Africa Conference on Animal Agriculture

- Members of the Animal Breeding Group made six presentations at the European Association for Animal Science (EAAP) 2023 Conference in Lyon, France, held from 26 August to 1 September.

Attendees at the EAAP 2023 Conference in Lyon, France, from the left, Christopher Rothmann, Prof Frikkie Neser, Deidre Januarie, Prof Danie Vermeulen, and Prof Errol Cason

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

In the first semester of 2023, Leon Krüger presented three courses on faecal egg counts at the UFS Paradys Experimental Farm. The courses were booked to full capacity, confirming the need for such a course.

Short learning programmes in Animal Breeding, Disease Management, and Animal Handling were presented to farmers and representatives from industry on the UFS Paradys Experimental Farm.

Prof FWC Neser delivered an invited talk on 'True values of using performance-tested stud bulls' at the LRF Stockman School at Aldam.

All members of Grassland Section were part of the organising committee for the 58th GSSA Congress held in July 2023.

Prof Francois Deacon and Dr Beaneiri Janecke served on the organising committee of the South African Wildlife Management Association Conference, that was held from 10 to 15 September 2023 at the Golden Gate Highlands National Park.

POSTGRADUATE STUDENTS

The total number of postgraduate students at the various levels who were enrolled in 2023 in the Department of Animal Science was:

- Honours - total of 26 students
- MSc (total of 40)

Animal Breeding	3
Animal Nutrition	13
Wildlife	3
Grassland Science	2
Animal Physiology	5
Animal Production	5
Animal Science	5
Meat Science (Food Science)	4

- PhD (total of 19)

Animal Breeding	8
Animal Science General	4
Animal Nutrition	1
Animal Science Physiology	2
Wildlife Management	1
Wildlife	3

Eight candidates graduated with the MSc in 2023:

Kinghorn, MG	Animal Breeding (with distinction)
Potgieter, B	Animal Nutrition
Mavhungu, OM	Animal Nutrition (with distinction)
Augustyn, WC	Animal Nutrition
Jacobs, HL	Animal Nutrition
Coffee, BM	Animal Nutrition
Macdonald, EE	Animal Nutrition
Skele, N	Animal Science

The PhD was conferred on the following three candidates in 2023:

Boys, Jerome (Grassland Science)

Thesis: Sustainable wood harvesting principles with the aim to restore rangeland in the Thornbush Savanna of Namibia

Supervisor: Prof GN Smit

Kruger, Leon (Animal Science)

Thesis: The Effect of Temperament and Stress on Production and Immune Response in sheep

Supervisor: Prof FWC Neser

Opperman, Rita (Food Science)

Thesis: The chemical, microbial and sensory quality of South African biltong and dried sausage after the application of different sodium reduction strategies

Supervisor: Prof A Hugo

STAFF MATTERS

Dr Lindo Mhlongo was appointed as a Lecturer in the Department of Animal Science, and Jamie Paulse-Ross was promoted to Lecturer.

RESEARCH OUTPUTS

Research Articles

Abdulsalam, R., Ijabadeniyi, O., Cason, E.D., Sabiu, S. 2023. Characterization of Microbial Diversity of Two Tomato Cultivars through Targeted Next-Generation Sequencing 16S rRNA and ITS Techniques. *Microorganisms* 11(9): 2337-1 2337-23.

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Conference Contributions

Conference Papers / Posters

Cason, E.D., Van Wyk, J.B., Vermeulen, P.D. & Neser, F.W.C.2023. *Signature of selection in South African Dexter cattle reveal resistance genes and genetic variations.* Poster presented at the 74th EAAP Annual Meeting, Lyon, France. 26 August–1 September 2023.

Dalboc, A., Senekal, N., Bothma, C., Hugo, A. & Hugo, C.J. 2023. *The effect of sodium reduction and replacement by potassium chloride on the survival Of Escherichia coli ATCC 8739TM and Staphylococcus aureus ATCC 25923TM in Feta cheese.* Poster presented at the 25th Biennial South African Association of Food Science and Technology Congress. Cape Town, South Africa. 28-30 August 2023.

De Villiers, M., Janecke, B.B. & Müller, L.2023. *Mammal prey species and population of leopards in agriculture dominated farmlands, South Africa.* Poster presented at the Global Leopard Conference (Online). 13-17 March 2023.

Grobler, S.M., Scholtz, M.M., Neser, F.W.C., Greyling, J.P.C. & Morey, L.2023. *Effect of heat stress on extensive beef cattle's calving percentage in the Central Bushveld Bioregion.* Poster presented at the 74th EAAP Annual Meeting, Lyon, France. 26 August–1 September 2023.

January, D.A., Cason, E.D. & Neser, F.W.C. 2022. *Selection signatures of the indigenous Sanga cattle of Namibia.* Poster Presented at the 74th EAAP Annual Meeting, Lyon, France. 26 August–1 September 2023.

Kinghorn, M.G., Cason, E.D., Ducrocq, V. & Neser, F.W.C. 2023. *Comparison of Random Regression Test Day Models for Production Traits of South African Jersey Cattle.* Poster presented at the 74th EAAP Annual Meeting, Lyon, France. 26-August to 1 September 2023.

Malan, P.J. & Paulse-Ross, J.W. 2023. *Comparison of degradation gradients of a conventional vs a high pressure grazing system.* Poster presented at the XXV International Grassland Congress, Kentucky, USA. 14-19 May 2023.

O'Neill, H.A., Skele, N., Einkamerer, O.B., Hugo, A. & Neser, F.W.C. 2023. *Castration method affects the fatty acid profile of subcutaneous and intramuscular fat in sheep.* Poster presented at the 74th EAAP Annual Meeting, Lyon, France. 26 August–1 September 2023.

Opperman, R., Van Wyngaard, B.E., Roodt, E., Hugo, C.J., Bothma, C. & Hugo, A. 2023. *The effect of salt reduction and salt replacer combinations on the chemical, microbial and sensory quality of dry sausage.* Poster presented at the 25th Biennial South African Association of Food Science and Technology Congress, Cape Town, South Africa. 28-30 August 2023.

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Paulse-Ross, J.W., Malan, P.J. & Smit, G.N. 2023. *The influence of short duration, high density grazing and conventional, rotational grazing on different soil, vegetation and animal parameters in dry and mesic grasslands of South Africa.* Poster presented at the XXV International Grassland Congress, Kentucky, USA. 14-19 May 2023.

STAFF (2023)

Head of Department:
Prof FWC Neser

Professors:	Prof FWC Neser and Prof A Hugo
Associate Professors:	Prof ED Cason and Prof F Deacon
Affiliated Professors:	Prof VP Ducrocq, Prof JPC Greyling, Prof ML Makgahlela and Dr MM Scholtz
Senior Lecturers:	Dr OB Einkamerer, Dr MD Fair, Dr A Maqhashu Dr J Myburgh and Dr HA O'Neill
Lecturers:	Dr A Hattingh, Dr BB Janecke, GC Josling, Dr L Krüger and Dr PJ Malan
Junior Lecturers:	G Janse van Rensburg and J Paulse-Ross
Research Fellows:	Prof HO de Waal, Dr WJ Olivier, Prof HA Snyman and Prof JB van Wyk
Programme Director:	Dr MD Fair
Farm Manager:	J Barnard
Technicians:	E Roodt and JAM van der Merwe
Officers:	NAK Green and KR Moopelwa
Senior Assistant Officer:	Dr Q Kruger
Secretary:	I Auld
Technical Assistants:	NK Long and SA Rowles
Service Workers:	N de Bruin, TA Dumisi and VJ Lamle

DEPARTMENT OF

SOIL, CROP AND CLIMATE SCIENCES

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

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OVERVIEW OF 2023

The Department of Soil, Crop and Climate Sciences is currently implementing a set of curriculum revisions. In 2023, the third-year modules were thoroughly revised with a new Research Methodologies module for all BSc students and a new course on Micrometeorology for third-year students. In addition, two new horticulture modules in Fruit Production Science and Technology were started. Staff in the Department currently supervise 34 MSc students and 23 PhD students, which is an increase compared to previous years. These postgraduate students play an important role in the Department's research activities and generation of research outputs, which also increased in the last few years.

Major investments in new farm equipment and farm infrastructure were made in 2023, including the upgrading of the stores and the living quarters of a staff member.

Some changes in the staff composition occurred in 2023. Stefaans Erasmus was appointed as Irrigation Specialist and assumed duty in July 2023. Ronelle Etzebeth, Secretary in the Department, retired in March 2023.

In preparation for an external departmental review, the Department compiled a self-evaluation report with detailed information on the state of the Department. The review was expected to take place in 2023 but was eventually postponed to 2024.

In 2023 the Department expanded its portfolio of externally funded projects. This included research projects with funding from the private sector, the National Research Foundation (NRF) and the Water Research Commission (WRC). In addition, a large grant from the European Union (EU) for human capacity building in the field of climate change and sustainable food systems was obtained. The grant will facilitate extensive collaboration with other university partners in Africa.

ACHIEVEMENTS

Staff Achievements

Stefaans Erasmus was elected as Chairperson of the South African Institute of Agricultural Engineers (SAIAE) Free State Branch and as Chairperson of the South African Irrigation Institute (SABI) Orange Branch.

Prof Johan van Tol was elected as President of the Soil Science Society of South Africa (SSSSA).

Dr Elmarie van der Watt was elected as Vice-President of the South African Society of Crop Production (SASCP) and received a Fellowship award. She was also selected to be part of the Council of the South African Academy of Science and Art (Suid-Afrikaanse Akademie vir Wetenskap en Kuns [SAAWK]) to evaluate for the Junior Kaptein Scott-gedenkmedalje. The medal is awarded annually for the best dissertation submitted to a South African university for the MSc degree (alternately in the zoological and botanical sciences).

Student Achievements

Braam le Roux was awarded the SASCP Gold medal for the best Agronomy student as well as the Omnia award for the best final-year student.

Muthianzhele Ravuluma, a PhD student under the supervision of Dr Tharaga, attended the 12th International Workshop on Sap Flow held in Rotorua, New Zealand from 31 October to 3 November 2023, to present a research poster. Muthianzhele won the award for the best presentation.

From the left, Dr Phumudzo Tharaga and Muthianzhele Ravuluma (PhD student) at the International Conference in Rororua, New Zealand

TEACHING AND LEARNING

The Department is currently implementing a set of curriculum revisions. In 2023, the third-year modules were thoroughly revised with a new Research Methodologies module (SCC3724) for all BSc students and a new course on Micrometeorology (CLIM3734) for third-year students. Two new horticulture modules on Fruit Production Science and Technology were started (HORT3734 and HORT3724). A new module was introduced for third-year agrometeorology students (Introduction to Micrometeorology), which explores topics such as boundary layers in the lower atmosphere, turbulence, and microclimate manipulations.

Third-year agricultural engineering students visited the Maselspoort Water Treatment Works and Pump Station. The fourth-year class of agronomy students visited the facilities of Agraforum SA in May 2023 as part of one of their practicals.

The final-year BSc Agriculture and BSc Honours students gave presentations on their research projects

at the end of the year. At the end of the day, we held a small function for both the students and personnel.

All the final-year students of 2023

In 2023, for the first time, the Department organised a postgraduate student symposium at which students shared progress and interesting findings on their research. For other students the symposium served as preparation for conferences they intended to attend. The keynote address was delivered by the incoming Dean of Natural and Agricultural Sciences, Prof Paul Oberholster, and the symposium was chaired by Dr Steyn, a Lecturer in the Department.

Prof Paul Oberholster with the convenor of the SCCS Postgraduate Student Community, Neo Mathinya

The final-year students in the Crop and Soil divisions visited Omnia in Sasolburg for a site visit and

Final-year students at Omnia in Sasolburg

experienced their laboratory facilities as well as fertilizer manufacturing facilities.

The final-year Soil Science students were joined by Prof Johan van Tol and Prof Elmarie Kotze for a practical excursion to the eastern Free State.

Soil Science final-year students on their excursion to the eastern Free State

RESEARCH AND INNOVATION

Stefaans Erasmus conducted research as part of the Grid Related Research Group (GRRG) on the Qwaqwa Campus microgrid, the UFS smart grid and frequency dynamics, and pursued active research collaboration with the UFS Interdisciplinary Centre for Digital Futures (ICDF) on the role of social systems in energy usage.

Dr Phumudzo Tharaga started a project on water use of apricots under irrigation, which will run from 2023 to 2027 and will be funded by the WRC. The project includes a range of researchers from different institutions, including Dr Tharaga (as project leader), Dr Zanele Ntshidi (South African Environmental Observation Network [SAEON]), Dr Lindsay Banda (UFS), Dr Tinashe Dirwai (International Water Management Institute [IWMI]), Dr Nompumelelo Mobe (CSIR), Dr Jerry Dlamini (UFS/NWU), Dr Sajid Pareeth (IHEDelft-Netherlands), as well as several MSc students.

Dr Tharaga is also involved in another project with the Agricultural Research Council (ARC), which focuses on determining the water use of pomegranate orchards under irrigation. The study is led by the ARC researcher, Dr Theresa Volschenck, with team members from Stellenbosch University and Hortgro, and includes two UFS students. The project will be completed in 2025.

Dr Weldemichael Tesfuhuney and his team studied the utilisation of sunn hemp as cover crops in maize-based dryland farming systems. Over the past four years, this research culminated in the completion of a PhD thesis and five articles in peer-reviewed journals. Additionally, an MSc student undertook a two-year field trial and collected data to assess resource use efficiency, and two MSc students completed their studies on the impact of drought on dryland maize yield, and water quotes and irrigation requirements in selected water-stressed irrigation schemes. In addition, a study for a structured Master's degree involved a survey to assess smallholder livestock farmers' vulnerability and adaption strategies to climate in Thaba 'Nchu in the eastern Free State. Dr Tesfuhuney also spearheaded a new research project focused on pigeon pea evaluation to understand water and radiation utilisation by the crop, in collaboration with the ARC-Grain Crop Institute (ARC-GC) in Potchefstroom.

Prof Angelinus Franke and Nozi Radebe conducted research on resource use efficiencies of potato farmers in the Sandveld, Western Cape. This included the installation of eddy covariance systems in potato crops to assess evapotranspiration rates. These on-ground measurements will be compared against satellite data to assess the potential of remote sensing to estimate water use by the crop. The work is carried out together with the University of Pretoria and Stellenbosch University, with funding from Potatoes South Africa.

Prof Franke and Dr Elmarie van der Watt continued their research on agronomic practices to grow hybrid potato from seed. Greenhouse and field trials with biostimulants and different agronomic practices, were conducted. The work is supported by a grant from NRF and Solynta BV, a company in the Netherlands involved in hybrid potato breeding. They attended the Potato Symposium with Freedom Madzinwanzira (MSc student) to collaborate with Solynta BV and Potatoes SA regarding the research.

Dr Elmarie van der Watt, Freedom Madziwanzira, and Prof Linus Franke at the Potato Symposium

Dr Van der Watt and Adri Moffat conducted research on the effect of different biostimulants on various crops under glasshouse conditions. The work was supported by Agraforum SA.

Prof Johan van Tol and his team initiated a WRC-funded project focused on predicting the occurrence of landslides in KwaZulu-Natal and the Eastern Cape. This project utilises a combination of remote sensing and mechanistic hydrological modelling.

In addition, Prof Van Tol successfully concluded another WRC project that provides guidelines for incorporating hydropedological assessments into wetland delineation and management. These guidelines are intended to be implemented by consultants and decision-makers to ensure the sustainable management of wetlands when there is a change in land use.

Prof Van Tol and Prof Elmarie Kotze have embarked on a project funded by the German Department of Agriculture, in collaboration with the Technical University of Munich (TUM). This project is focused on assessing belowground carbon storage in various forest systems in the Vhembe district, Limpopo.

Several lecturers and postgraduate students from the Department participated in the Combined Congress held in Pretoria from 23 to 26 January 2023. The Combined Congress is an annual congress of three scientific societies - the Soil Science Society of South Africa (SSSSA), the Southern African Society for Horticultural Sciences (SASHS) and the South African Society of Crop Production (SASCP). The event thus attracted Horticulturists, Agronomists,

Weed Scientists, and Soil Scientists from both academic and industrial sectors.

A group of lecturers and students attended the Combined Congress in Pretoria in January 2023, from the left, Dr Stephan Steyn, Dr Elmarie van der Watt, Prof Linus Franke, Prof Elmarie Kotze, Prof Johan van Tol, Eddie Smit, Dr Isaac Gura, and Cowan McLean

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Stefaans Erasmus served on the SAIAE National Council. He was also the external examiner of three BEng (Mechanical) dissertations from North-West University and one MEng (Mechanical) from Stellenbosch University.

Prof Tesfay Weldeslassie served as an Associate Editor of the *South African Journal of Plant and Soil*.

In the course of 2023, Prof Franke handed over the duties as Editor-in-Chief of the *South African Journal of Plant and Soil* to Prof Michael Savage from the University of KwaZulu-Natal (UKZN). He continues to serve as an Associate Editor for the journal. Prof Van Tol is also an Associate Editor of the *South African Journal of Plant and Soil*.

Prof Weldeslassie is supervising a PhD student at Mekelle University, Ethiopia, and another PhD student at the University of Fort Hare. Prof Franke supervises PhD students in collaboration with the International Maize and Wheat Improvement Center (CIMMYT), Zimbabwe, the University of Namibia, the Mauritius Sugarcane Industry Research Institute, and Wageningen University.

NATIONAL AND INTERNATIONAL COLLABORATION

Dr Phumudzo Tharaga is involved in three international human capacity development projects. The first collaboration is with IHE Delft Institute for Water Education and is focused on giving opportunities to students to attend short courses on remote sensing and agricultural water management, and also on climate change- and QGIS-related short courses. Three students have attended the course at IHE Delft (Raesibe Kgaphola in 2022, and Dineo Siima and Katlego Mahlaba in 2023). Fanie Modukanele, Tshedza Mathidi, Mokotla Ntebaleng, Sihle Dlamini, and one staff member, Dr Lindsay Banda, have been awarded scholarships to attend training in 2024.

From the left, Dineo Siima, Prof Hans van der Kwast (IHE Delft), and Mahlaba Katlego attending a short course on water and climate change at IHE Delft Institute for Water Education, Netherlands

Dr Tharaga also collaborates with Dr Andrew Christopher Oishi of the United States Department of Agriculture (USDA) Forest Services and with other researchers from Georgia State University. The collaboration was initiated in 2019 and provides for an exchange of knowledge and skills. USDA-Forest Services provided support to Dr Tharaga to acquire an Equipment Travel Related Grant from the NRF. The funding was used to cover costs for Dr Tharaga and Nozindaba Radebe to attend training in North Carolina (USA) from 27 May to 17 June 2023 on how to manufacture sap flow sensors. The training included climate monitoring in complex terrains or ecosystems. This training helped the section develop a new module on advanced micrometeorology and instrumentation.

From the left Dr Andrew Oishi (USDA), Dr Phumudzo Tharaga (UFS), and Nozindaba Radebe (UFS)

Dr Tharaga started a collaboration with ICT International, which manufactures sap flow sensors, dendrometers, neutron probes, psychometers, soil moisture sensors, and low-cost weather station systems. The collaboration is based on exchange of knowledge and of instruments for teaching purposes. Dr Tharaga visited ICT International at Armidale, Australia, from 27 November to 15 December 2023.

Prof Weldeslassie, in collaboration with four universities in Africa and one in Germany, participated in a successful project proposal to the European Union Intra-Africa Academic Mobility Scheme – Transdisciplinary Training for Resource Efficiency and Climate Change Adaptation in Africa (TRECCAfrica).

Prof Franke visited Hochschule Weihenstephan Triesdorf (HSWT) as an initiative to strengthen collaboration between HSWT and African partners. HSWT is also the technical partner in the above-mentioned EU-funded project facilitating intra-Africa mobility between students and staff to build human capacity in the field of climate change and sustainable food systems. Prof Franke is leading this project, which is implemented with five partner universities in Africa (Maseno University in Kenya, the University of Eldoret in Kenya, Makarere University in Uganda, Universite Evangelique en Afrique in Democratic Republic of Congo, and Universite Abomey-Calavi in Benin). The project includes funding for scholarships for 12 PhD students and 24 MSc students. The funding (equivalent to ZAR 36M) was obtained in 2023 and the project will be implemented from 2024 to 2028.

In March 2023, Prof Franke organised a two-week postgraduate course on 'Land dynamics in an era of change', together with Wageningen University in the Netherlands. The course was held in the vicinity of Bergville in KwaZulu-Natal. There were 22 participants – eight from the UFS, and the others from Europe (mostly from Wageningen University in the Netherlands), as well as various other universities and countries.

OTHER ACTIVITIES

Agri Technovation, an international company that works in close partnerships with farmers and

A group of lecturers, postgraduate- and final-year students at the farmers' day near Bultfontein

producers on various crops, invited the Department to participate in a farmers' day near Bultfontein at which field trials and farming equipment were displayed.

POSTGRADUATE STUDENTS

Staff in the Department currently supervise 34 MSc students and 23 PhD students, which shows an increase compared to previous years. These postgraduate students play an important role in the Department's research activities and generation of research outputs.

In 2023 Jacobus Kotze, Qawekazi Mazwi, Nosihle Xulu, Masesabona Mathye, Albertus Momsen, Wesley Dickerson, Wian Visser, Jakobus Groenewald, Somila Dyabuza, Chumisa Silwana, Lerato Wood, Daniël van den Berg, and Zoyolo Somi graduated with an MSc degree.

PhD degrees were conferred in 2023 on:

Dzvene, Admire Rukudzo

Thesis: Effects of cover crop management on maize (Zea mays L.) productivity and resource use under in-field rainwater harvesting.

Supervisor: Dr WA Tesfuhuney

Co-supervisors: Prof S Walker and Prof GM Ceronio

Harrison, Rowena Louise

Thesis: Interact Interactions between dissolved organic carbon and hydropedology in Afromontane catchments.

Supervisor: Prof JJ van Tol

Co-supervisor: Prof P Amiotte-Suchet

Haumann, Eduard Johannes

Thesis: Refining of nitrogen fertilization guidelines for irrigated cotton (Gossypium Hirsutum L.) in South Africa

Supervisor: Prof CC du Preez

Malongweni, Siviwe Odwa

Thesis: Fire-Herbivore interactions in savanna ecosystems of the Kruger National Park, South Africa: Impact on Soil Quality

Supervisor: Prof JJ van Tol

Nemadodzi, Edzisani Albert

Thesis: Soil enzymes, root pathogens and yields under maize-legume rotations in a semi-arid area

Supervisor: Prof AC Franke

Co-supervisors: Dr N Mashingaidze, Dr E Kotze, and Dr Mavunganidze

POSTDOCTORAL RESEARCH FELLOWS

A Postdoctoral Fellow, Dr Achamyeleh Mengistu supervised by Dr Tesfuhuney, engaged in research focused on modelling the impact of climate change on the distribution of alien plant species. Additionally, Dr Mengistu analysed extreme weather events within the context of a changing climate.

STAFF MATTERS

Stefaans Erasmus was appointed as Irrigation Specialist and assumed duty on 1 July 2023. Ronelle Etzebeth, Secretary in the Department, retired on 31 March 2023.

RESEARCH OUTPUTS

Research Articles

Dlamini, J.C., Tesfamariam, E.H., Dunn, R., Evans, J., Hawkins, J., Blackwell, M., Collins, A. & Cardenas, L. 2023. Soil carbon dioxide (CO_2) fluxes in permanent upslope pasture and downslope riparian buffers with varying vegetation. *J. Plant Nutr. Soil Sci.* 2023: 1-11. doi.org/10.1002/jpln.202100292.

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Erasmus, S.J. & Maritz, J.M. 2023. A Carbon Reduction and Waste Heat Utilization Strategy for Generators in Scalable PV—Diesel Generator Campus Microgrids. *Energies* 16(18): 6749. doi.org/10.3390/en16186749.

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Franke, A.C., Mukiibi, A. & Steyn, J.M. 2023. Determination of Crop Coefficients and Evapotranspiration of Potato in a Semi-Arid Climate Using Canopy State Variables and Satellite-Based NDVI. *Remote Sens.* 15: 4579. doi.org/10.3390/rs15184579

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Mengistu, A.G., Tesfuhuney, W.A., Woyessa, Y.E., Steyn, S.A. & Lee, S.L. 2023. Assessing the impact of climate change on future extreme temperature events in major South African cities. *Theoretical and Applied Climatology* 155: 1807-1819. doi.org/10.1007/s00704-023-04712-w.

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Books/Chapters in Books

Dzvene, A.R., Tesfuhuney, W., Walker, S. & Ceronio, G. 2023. Managing cover crops in a maize-based cropping system with in-field rainwater harvesting in the semi-arid areas of South Africa. In: *Climate-Smart Agriculture: Evidence-based Case Studies in South Africa*. L Myeni, M. Moeletsi & T. Fyfield (Eds). Agricultural Research Council - Natural Resources and Engineering (ARC-NRE) and Department of Agriculture, Land Reform and Rural Development (DALRRD). pp 188-196.

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Weldeslassie, T., Haj Bouri, S. & Zied, A. 2023. Agroforestry as a tool for Climate change mitigation and agriculture sustainability: Experiences from Africa. In: *Agroforestry for Carbon and Ecosystem Management*. M.K. Jhariya, R.S. Meena, A. Banerjee, S. Kumar & A. Raj (Eds). ScienceDirect. pp. 245-256.

Conference Contributions

Conference Papers / Posters

Dickerson, W.P, Coetzer,G.M. & Van der Watt, E. 2023. *Effect of plant density and nitrogen on yield of Stevia (Stevia rebaudiana) in South Africa.* Poster presented at the Combined Congress, Pretoria, South Africa. 23-26 January 2023.

Makuya, V., Tesfuhuney, M., Moeletsi, M. & Bello, Z. 2023. *Assessing area-specific planting dates as an adaptation strategy for rainfed maize under climate change using AquaCrop model in Free State Province, South Africa.* Paper delivered at the Society of South African Geographers Student Conference (SSAG 2023), UFS Qwaqwa Campus, South Africa. 02-04 October 2023). (2nd prize).

Makuya, V., Tesfuhuney, W., Moeletsi, M. & Bello, Z. *Planting dates as an adaptation strategy for rainfed maize under climate change.* Poster presented at the Annual Early Career Researchers Conference: Perspectives of Climate Change in Africa, Cape Town, South Africa. 08-09 March 2023. (Best Poster award).

Mamabolo, L.K., Coetzer, G.M., Van der Watt, E. & Njom, H.A. *Antifungal properties of cactus pear (Opuntia ficus-indica) fruit pulp.* Poster presented at Combined Congress, Pretoria, South Africa. 23-26 January 2023.

Ravuluma, M., Tharaga, P.C., Volschenk, T., Dzikiti, S. & Walker, S. 2023. *Sap flow dynamics of young and mature pomegranate (Punica graatum L.) orchards under semi-arid conditions.* Poster presented at the 12th International Sap Flow Workshop, Rotorua, New Zealand. 31 October–3 November 2023. (Best poster award).

Tesfuhuney, W. 2023. *Innovative knowledge of rainwater harvesting techniques in semi-arid ecosystems. Maize-bean intercrop productivity and resource use efficiency*. Paper delivered at the 9th Global Workshop of the Agricultural Model Intercomparison and Improvement Project (AgMIP9), Columbia University, New York City, USA. 26-30 June 2023.

Tharaga, P.C. & Dlamini, L. 2023. *Determining water use of sweet cherry trees using remote Sensing.* Paper delivered at the ISHS Precision of Management of orchards and Vineyards Symposium, Tatura, Australia. 3-8 December 2023.

Tharaga, P.C. 2023. *Net ecosystem exchange of Sweet cherry Trees under rainfed conditions.* Paper delivered at the ISB-Conference, Arizona, USA. May 2023.

Tharaga, P.C. Tesfuhuney, W. & Coetzer, G.M. 2023. *Sap flow dynamics of sweet cherry trees during different growth stages.* Paper delivered at the 12th International Sap Flow Workshop, Rotorua, New Zealand. 31 October–3 November 2023.

STAFF (2023)

Head of Department:
Prof AC Franke

Professor:	Prof AC Franke
Associate Professors:	Prof GM Ceronio, Prof E Kotze, Prof JJ van Tol and Prof TA Weldeslassie
Affiliated Professors:	Prof CC du Preez, Prof R van Antwerpen, Prof CW van Huyssteen and Prof S Walker
Senior Lecturers:	Dr JH Barnard, Dr GM Coetzer and Dr E van der Watt
Lecturers:	Dr L Banda, L de Wet, Dr JC Dlamini, SJ Erasmus, VN Mathinya, CC Mc Lean, Dr AS Steyn, Dr PC Tharaga and Dr WA Tesfuhuney
Research Fellow:	Dr H Fouche
Programme Director:	L de Wet
Senior Officers:	L Henning, N Radebe and BE Tshabang
Senior Assistant Officers:	A Moffat and DE Terblanche
Technical Assistants:	DE Makara, TA Madito, T Mlobeli, TG Mokoena, ME Nthoba and ZE Yokwane

DEPARTMENT OF

SUSTAINABLE FOOD SYSTEMS AND DEVELOPMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

Against the complex and interconnected nature of sustainable food systems on a global scale, the Department of Sustainable Food Systems and Development's continued focus on making an impactful contribution, guided its cross-disciplinary approach in 2023. As we near the fifth year of presenting our new postgraduate qualifications, these qualifications have become synonymous with career advancement and developing policy influencers in the industry. The Postgraduate Diploma in Sustainable Agriculture (PGDipSA) and the Master of Sustainable Agriculture (MSA) contributed to the highest number of postgraduates (per programme) delivered in 2023. The number of students enrolled for the undergraduate Bachelor's degree in Agricultural Extension has also shown an upward curve, year on year. A new feeding stream of students has been added through incorporating an undergraduate Bachelor's degree in Food Systems, approved by the Council for Higher Education (CHE); student enrolments will commence in 2024. In addition, the first PhD student in our newly approved doctoral programme enrolled in 2024. We are proud of our continuous development and contributing to the success and growth of agriculture in South Africa.

ACHIEVEMENTS

Staff Achievements

Prof Maryna de Wit was appointed as a Board member of the newly formed International Cactus Pear Association (CactisMundis).

Prof Johan van Niekerk was appointed as Vice-Dean: Agriculture for the Faculty of Natural and Agricultural Sciences. He was also appointed as a member of the Directorate for Institutional Research and Academic Planning's (DIRAP's) Programme Advisory Committee (PAC) assisting with the development and accreditation of new programmes in line with UFS Vision 130. During the recent CHE meeting, Prof Van Niekerk was re-elected as a committee member for the Agricultural Extension Qualification Standard Working Group for assessment of national standards and reviews.

At the International Food and Agribusiness Management Association (IFAMA) conference, held on 17 June 2023 in New Zealand, Dr Anathi Makamane was re-elected as Treasurer for the Young Board.

From the left, Melissa van der Merwe (outgoing IFAMA Young Board Secretary), Jack Keys (incoming IFAMA Young Board President), Anathi Makamane (incoming IFAMA Young Board Treasurer) and Rebecca Bennett (IFAMA Young Board Member)

Prof Wilna Oldewage-Theron was re-elected as a member of the Editorial Committee for *Nutrients* and as Council Member for the Nutrition Society of South Africa. She also acted as guest editor for the *Nutrients* Special Edition on 'Interventions addressing risk factors contributing to cardiometabolic diseases among the elderly'.

Dr Brandon van Rooyen was elected to serve as the Free State representative on the Council of the South African Association for Food Science and Technology (SAAFoST) for 2023-2025.

Student Achievements

Ayanda Zulu and Onele Mpemba, both PhD students in Consumer Sciences, received a special mention at the SAAFost conference for their contribution to indigenous knowledge systems through their research. They were chosen to attend a workshop with Progress-Excellence and received a certificate for Food Professionals: An Introduction to Industry.

Axel Tarisse (PhD student in Food Science) placed the Department on an international platform through his research on the biogas and fodder potential of spineless cactus in Africa. His study focuses on its potential to act as complement supply for South Africa's existing industrial energy companies to produce sustainable jet fuel and diesel. His research contributes to biogas production, job creation and bio-product development for feedstock.

Axel Tarisse

Pieter Bruwer, together with Dr Brandon van Rooyen and Dr Anathi Makamane from the Department, as well as with other students from other departments at the University of the Free State (UFS), claimed victory in the prestigious Sustainable Development

Goal (SDG) Challenge – a global competition that unites students and organisations to address the United Nations Sustainable Development Goals (UNSDGs).

Pieter Bruwer

The students partnered with Ivanhoe Mines, a prominent mining company operating in the Democratic Republic of Congo, to develop a waste management strategy for the Kamoa-Kakula Copper Complex. The challenge addressed the limited waste management options and increasing environmental concerns in the area, together with the socioeconomic and biodiversity challenges stemming from the burgeoning population in the region. The UFS team innovatively conceived ÉcoFlotille, a solution that not only tackles essential waste management issues but also promotes biodiversity net gain. The plan extended its reach to support local agribusinesses and small and micro-enterprises through the repurposing and reuse of waste materials, while presenting a unique bio-financing opportunity. The EcoFlotille solution represents a distinctive aspect of their triumphant journey.

From the left, Dr Brandon van Rooyen, Dr Anathi Makamane, Dr Yolandi Schoeman and Daniel Naudé participated and won the SDG Challenge (Absent: Pieter Bruwer)

RESEARCH AND INNOVATION

With the support of the Centre for Graduate Studies, Kirsty Green and Heléne van der Merwe organised a three-day writing DYAD in May 2023 for all academic members in the Department. This prepared them for presenting and hosting a side event at the Science Forum South Africa (SFSA) 2023 conference, which took place on 5 December at the CSIR International Convention Centre in Pretoria. The title of the side event was 'Future Harvest: Scientific Perspectives on the Sustainability of Food Systems in the Next 10 Years'.

Nixtamalization / Grain SA research project

Building on a strong foundation, the nixtamalization project continued to flourish in 2023, which was the last year of phase 1 of the initial three-year commitment. Phase 1 of this project focused on developing and identifying innovative strategies to promote agro-processing in low-income communities in South Africa. Skills and awareness were developed and created towards improving maize agro-processing, encompassing diversified and nutritious diets among rural communities, empowering smallholder farmers, particularly female farmers, to add extra value to agricultural products. The objectives of phase 1 were achieved through the completion of the baseline survey and developing three consumer-acceptable products, namely convenient instant phuthu-pap, tempting maize chips, and delicious corn dogs. Phase 2 of the project starts in 2024 and aims to build on developing new products and training rural communities on nixtamalization and business model development, specifically to empower women in rural districts to start their own businesses.

In May 2023, Dr Alba du Toit (project leader), Prof JW Swanepoel, and students Taylon Colbert and Sandile Moagi, visited Grain SA's head office in Pretoria and delivered a presentation to representatives from Grain SA, the Department of Science and Innovation (DSI) and the Technology Innovation Agency (TIA) on past achievements and future planned prospects.

Front row, from the left, Dr Alba du Toit, Beatrix De Witt (Agri-manage solutions), Manseshree Jugmodan-Naidu (DSI), Sandile Moagi, Stefan Links, Vuyolwethu Gxotiwe, and Prof Jan Swanepoel. Back row, from the left, Petru Fourie (Agri-manage solutions), Miekie Human (Grain SA), Taylon Colbert, Liana Stroebel (Grain SA), and Godfrey Kgatle (Grain SA)

Cactus pear research

Ongoing from 2021, the current focus of the research is on the functionality of mucilage, a hydrocolloid extracted from the cladodes of the cactus pear plant *(Opuntia ficus-indica* and *O. robusta)*. The team has researched the development of innovative food solutions, including the investigation into all the human food applications of mucilage in food products, such as edible films. Benchmark development of cactus pear oil, extracted from the cactus pear fruit seeds, is being done in terms of its food, cosmetic and nutraceutical applications.

Nutritious, affordable soy-based products

A project on 'Nutritious snack multimix development for addressing under and overnutrition and promoting small, medium and micro-size enterprises (SMME's) in low-income countries' is led by Prof Wilna Oldewage Theron. It is funded by the Oilseeds Advisory Committee / Oil and Protein Seeds Development Trust (OAC/OPDT). The overall project currently consists of three sub-projects:

Nutritious, affordable snack foods

The project endeavours to develop ten nutritious snacks that are affordable and easy to prepare using locally available ingredients. A soy nut machine was procured for the snack food development and ten products – one soy rusk, muffin, granola bar, four trail mixes and three brittles – were formulated, biochemical and sensory analyses completed and shelf-life testing conducted. The ten developed snacks in this study were of higher nutritional quality than currently available in corresponding snacks in the South African market, with the protein content of the soy rusks, soy carrot muffin, and soy cookies being more than twice that of corresponding snacks in the market. Similarly, granola bars, nut brittles and trail mixes were at least 25% higher in protein than the corresponding snacks. The nutritional composition of the developed snacks also indicated that soy carrot muffins, soy cookies, granola bars, and brittles had dietary fibre content which was more than twice the corresponding snacks in the market. The South Africa National Department of Health stipulates that a food product containing ≥ 2.5g/100g of dietary fibre can be considered a source of fibre. At the same time, those with ≥ 5g/100g of dietary fibre can be claimed as high-fibre food products. Based on these guidelines, aside from soy rusks, as all our snacks provide >6g/100g of dietary fibre they can be regarded as high-fibre snacks. Furthermore, the developed snacks were lower in added sugar (200% lower), sodium (200% lower), and saturated fat than corresponding snacks in the market. The cost analysis of the raw ingredients for all ten snacks was between ZAR 3.13 and 3.63 per unit (35 to 40g) price. This price was below the ZAR

From the left, Dr Brandon van Rooyen, Ingrid Woodrow (SAAFoST), Prof Wilna Oldewage-Theron, and Prof JW Swanepoel with some of the soy alternative products developed by the Department

3.75 estimated cost of ingredients, ensuring that the snacks would be at least 20% cheaper than the average snacks in the South African market. This estimate was based on the analysis that 33 to 35% of the developed snacks' final production costs will be the ingredients' cost.

The consumer panel in this study included 143 panellists (81 children and 62 women). Among the developed snacks, soy rusks had the highest overall acceptability. Like the soy rusks, nine out of the ten developed snacks in this study were liked (with an average mean score of 4 out of a 5-point hedonic scale) by consumer panellists. The overall acceptability of the developed snacks was also evaluated based on ethnicity, educational status, income level, and among children and women. The acceptance of soy rusk and nut/seed brittle was lower among children and panellists who earned below the poverty line. In comparison, the overall acceptance of soy cookies was higher among blacks/Africans, however, there was no significant difference in the acceptability of most snacks. A possible reason for the indifference in acceptability among children and women is that children consume identical diets and have similar preferences to their mothers. Likewise, the fact that there were insignificant differences in the acceptability of most snacks based on income, ethnicity, and educational status, may translate into higher acceptability among the target population in South Africa, irrespective of racial/ethnic background, income level or academic status. Comparing purchase intent by ethnicity, income, and educational status, no significant differences in most snacks' purchase intent was observed. The microbial analysis of the snacks indicated the microbial stability of all the snacks after four months of storage, except the soy muffins. Overall, nine of the snacks we developed were dry, shelf-stable, microbial-safe products after three months of storage. Previous studies have shown that similar dry and baked products are safe for consumption for at least three to four months when stored correctly in an airtight container. This project was undertaken in collaboration with a PhD student from Texas Tech University.

Plant-based meat products

In addition to the soy snacks, an additional goal was added to the project in 2022, namely to meet the needs of consumers for plant-based meat products by developing an affordable, fresh soy-based, nutrient-rich (high-quality protein) mincemeat replacement, imitating the flavor, look, and texture of 'animal' mincemeat. Three soy meat analogues were developed in 2023 and a preliminary tasting was conducted with the President of the South African Association of Family Ecology and Consumer Sciences (SAAFECS) at UFS and teachers of a primary school in Gauteng during June 2023. Dr Brandon van Rooyen indicated that it ticks the boxes of affordability, nutrition, and being attractive to the consumer. The UFS Food and Innovation Laboratory also created a range of wholesome soy snacks.

UFS Food and Innovation Laboratory

Health and food security benefits of soy

Another objective of this study was to sensitise parents and children about the health benefits of soy for human health and increased soy consumption to address food insecurity and malnutrition of school children in Ironsyde, Vaal region. A baseline survey for the nutrition education programme was conducted during May 2022, and during June the nutrition education programme was implemented, and soy and soy recipe books distributed to the households. A refresher course was implemented and follow-up measures taken in June 2023. Soy nuts were distributed to the parents for informal tasting at the nutrition education during June 2023. The soy nuts were very popular, specifically the chutney flavor. In addition, the parents tasted the soy milk and soy yoghurt – produced from soybeans – at the nutrition education programme implementation and these were well-accepted. Furthermore, a generator and soy cow were installed and training provided to produce soy milk and yoghurt at the Best is Good Enough Academy in Ironsyde during March and May 2023. The soy yoghurt has been included in the menu of the learners at the school. During June 2023, our researchers visited the school for a soy cow demonstration and to brainstorm the way forward for commercialisation of the developed soy foods.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Prof Maryna de Wit and Dr Herman Fouché were invited to give a talk at the annual Cactus Pear festival held at the Willem Prinsloo Agriculture Museum in Rayton, Pretoria on 4 February 2023. This festival and talk featured on the *KykNet* (DSTV, Channel 144) programme 'Fiësta' on 17 February 2023.

UFS Food Tunnels

The UFS Food Tunnels project is entering its fourth year and produced a total of 927.2 kg of produce in 2023, which brings the total weight of vegetables harvested since 2020 to 3790.7 kg. Each residence on the Bloemfontein Campus continued to take care of their garden box. The Charitable Growth Organisation, a student-run foundation, assumed responsibility for caring for the gardens in 2023. During 2023, a worm farm was established for compost production and effective waste recycling, and the newly established herb garden is providing fresh herbs daily. The UFS Food Tunnels are used by various departments on the Bloemfontein Campus for practical classes, to increase practical knowledge, strengthen community bonds, and improve garden maintenance. To commemorate Mandela Day, an invitation was issued to staff and students, encouraging them to set aside 67 minutes of their day to join us in the food gardens. The response was truly heartwarming, with a remarkable turnout of enthusiastic participants who eagerly assisted with the harvest and garden maintenance.

On 20 May 2023, the UFS Chancellor, Prof Bonang Mohale, visited the gardens and addressed students, staff and volunteers involved in the gardens, saying "The project serves as a shining example of how universities can actively address food insecurity among students. By empowering students with access to nutritious food and promoting sustainable agriculture, these initiatives not only alleviate immediate hunger but also foster a sense of community, resilience, and self-sufficiency".

Prof Bonang Mohale (third from the left) with Megan Geduldt (Kovsie ACT – second from the right) and student representatives from Akasia residence

NATIONAL AND INTERNATIONAL COLLABORATION

Standard Bank Agri-business Transformation Programme

The Standard Bank Agribusiness Transformation Programme started in 2019 and after a period of five years, there are good examples indicative of the success of the programme. Against this background and its uniqueness, Standard Bank approved continuing the programme for another three years to 2026.

In the period spanning 2019 to 2023, a total of 141 farmers in the Free State and 34 farmers in the Northern Cape received extensive training in farm management and practical mix farming. The programme is currently being presented in Bloemfontein, Kroonstad, Bethlehem (which includes the Qwaqwa area), the Northern Cape (Vaalharts area), and in 2023 a total of 16 farmers in the Upington area were included, bringing the total of farmers in the programme to 175. During the sessions, each farmer develops her/his business plan applicable to her/his farm from the work done

in the sessions and submits the plan during the last session. The business plan showcases either the extension of current farm activities or adding one or more new farm activities to the current farming entities to ensure growth and becoming a larger commercial farmer.

Some participants in the Programme receiving their certificates, with representatives from Standard Bank and UFS. Front row, from the left, Masabatha Siwakwi, Nolwazi Nkaene (Standard Bank), Mirriam Vent, Prof Johan van Zyl (Project presenter), Johannes Pedi, Pauline Siwakwi, and Merriam Daka. Back row (from the left), Donald Khuma, Vincent Beans, Sabata Tsoanyane, Prof Jan Swanepoel (UFS – Project leader), Ben Daka, and James Mkhumla

RUFORUM

The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) wool project started in 2020. This project aims to elevate communal wool production in the Free State by transforming it into a commercially viable and sustainable venture. Driven by the global shift towards a competitive agricultural market, the project sought to empower communal wool growers, enhance their livelihoods, and contribute to the national economic development strategy. Since 2020 more than 1500 farmers and members of rural communities have attended various workshops and information days. Training for women in wool processing was provided, and farmers were trained in genetic improvement, nutrition, management, shearing, etc. Mentorship programmes were established to provide ongoing support and guidance. Various goods were developed and manufactured to provide value-added product development. The additional income stream developed from the project since 2022 employs seven ladies and one gentleman, who produce felt products, spun wool, specialised and corporate gifts, as well as conference bags. Demonstrations, team building, and small workshops have also been added to the services provided by the wool project. Small businesses, schools, and UFS departments visited the farm and attended demonstrations.

Learners from Jim Fouche Primary School Community Service Group (Landsdiens Groep) visiting the farm

The project involved students from different departments. Michelle Marais from the Department of Agricultural Economics and Ketshepileone Shiela Matlhoko from Consumer Science completed their Master's degrees and Alina Ntsiapane from Sustainable Agriculture graduated with her PhD. Andries Strauss, a PhD student, completed his South African Wool Classification Diploma instructor's Course and presented workshops in Bloemfontein, Botshabelo, and Thaba 'Nchu in collaboration with institutions like BKB, OVK, and the National Wool Growers Association (NGWA).

Mangaung Wool Commodity Group training day held in collaboration with the NGWA

POSTGRADUATE STUDENTS

During the 2023 academic year, 60 students obtained their Post Graduate Diploma in Sustainable Agriculture (five with distinction) and 12 students graduated with the Honours in Consumer Science, of whom four passed with distinction.

A total of 47 students graduated with the structured Master of Sustainable Agriculture (four with distinction). Taylon Colbert, Aninka de Jager and Maletsie Molapo graduated with the Master's in Consumer Science, while Niki Ann Kretzmann and Dembe Mushanganyisi obtained the MSc majoring in Food Science, and Elizabeth Oosthiuzen graduated with an MAgric in Food and Nutrition.

PhD degrees were conferred on the following twelve candidates in 2023:

Freitag, Alicia (Food Science)

Thesis: The effect of microbial and plant extract preservatives on the chemical, microbial and sensory quality of a traditional fresh South African sausage

Supervisors: Prof CJ Hugo, Prof A Hugo, Dr M Cluff and Dr S van der Merwe

Gavu, Masabata Lydia (Food Science)

Thesis: Taxonomy, spoilage, and virulence characteristics of Kaistella species isolated from fish

Supervisors: Prof CJ Hugo and Dr A Hitzeroth

Grobler, Hendrik Frederik (Sustainable Agriculture)

Thesis: Development of a toolkit for sustainable revitalization of smallholder irrigation schemes: Free State Province.

Supervisors: Prof JA van Niekerk and Dr CJ Botha

Hlatshwayo, Alois Sifelani (Sustainable Agriculture)

Thesis: Enhancing productivity and resilience of semi-arid rangelands of Southwestern Zimbabwe: A case of adaptation in extensive livestock production in a communal area.

Supervisor: Dr P Malan

Makamane, Anathi Siphesihle (Sustainable Agriculture)

Thesis: Capacity of extension and advisory services in supporting farmers to adapt to climate change in the Eastern Cape, South Africa.

Supervisors: Prof JW Swanepoel and Dr O Loki

Mathobo, David Nndineni (Sustainable Agriculture)

Thesis: Sustainability of vegetable production systems by small scale farmers of Limpopo Province in South Africa.

Supervisors: Dr ND Nthakheni and Prof E Zwane

Mavhungu, Tsumbedzo Jutas (Sustainable Agriculture)

Thesis: Development of a sustainable model for irrigated smallholder agricultural enterprises in Vhembe District, Limpopo province of South Africa.

Supervisors: Prof AE Nesamvuni, Dr KA Tshikolomo, Prof NS Mpandeli and Prof JA van Niekerk

Maziya, Mbongeni (Sustainable Agriculture)

Thesis: Smallholder farmers' perceptions and adaptation to climate change: a case of Umkhanyakude District in Kwazulu-Natal province of South Africa.

Supervisors: Prof B Nkonki-Mandleni and Prof JA van Niekerk

Nkoko, Nthabeleng (Consumer Science)

Thesis: Food and nutrition security among farming households in Lesotho: The role of commercial agriculture

Supervisors: Dr N Cronje and Prof JW Swanepoel

Ntsiapane, Alina Dimakatso (Sustainable Agriculture)

Thesis: Smallholder wool production for improved rural livelihoods in Thaba 'Nchu and Botshabelo in the Free State province of South Africa.

Supervisors: Prof JW Swanepoel and Prof E Nesamvuni

Olckers, Schae-Lee (Food Science)

Thesis: The influence of abiotic stress on gluten in wheat and its effect on bread baking quality.

Supervisors: Dr A van Biljon, Prof MT Labuschagne, Prof G Osthoff, and Dr C Guzman

Von Maltitz, Lindie (Sustainable Agriculture)

Thesis: Skills and competencies of agricultural extension professionals in South Africa: Implications for Higher education curricula.

Supervisors: Prof JA van Niekerk and Dr K Davis

STAFF MATTERS

Prof Johan van Niekerk was appointed as Vice-Dean: Agriculture for the Faculty of Natural and Agricultural Sciences.

RESEARCH OUTPUTS

Research Articles

Adelabu, D.B. & Franke, A.C. 2023. Response of soil fertilization and insect pollination on okra production: Prospect for optimizing underutilized crop management. *Journal of Agriculture and Food research* 114(100869): 1-9.

Chalwe, J.M., Grobler, C. & Oldewage-Theron, W. 2023. Development of a Structural Equation Model to Examine the Relationships between Genetic Polymorphisms and Cardiovascular Risk Factors. *South African Journal of Clinical Nutrition* 15: 2470.

Du Toit, A., MacDonald, R., Steyn, E., Mahlanza, Z., Zulu, A.B. & De Wit, M. 2023. Review of the Underutilized Indigenous Portulacaria afra (Spekboom) as a Sustainable Edible Food Source. *Agronomy* 13(5): 1206.

Kau, J. S., Mmbengwa, V. & Swanepoel, J. 202). The effect of selected macro-economic policies on citrus price volatility in South Africa: A reflection on experiences of farmer support. *Journal of Agribusiness and Rural Development* 67(1): 37-48.

Lee, H., Moyo, G.T., Theophilus, R.J. & Oldewage-Theron, W. 2023. Association of Dietary Changes with Risk Factors of Type 2 Diabetes among Older Adults in Sharpeville, South Africa, from 2004 to 2014. *Journal of Nutrients* 15(22): 4751.

Mahlanza, Z.P., De Wit, M., Hugo. A. & Du Toit,A. 2023. The Physicochemical and nutritional value of fresh and processed Prtulacaria afra (Spekboom) Leaves. *Agronomy* 13(3): 709.

Makamane, A., Van Niekerk, J.A., Loki, O. & Mdoda, L. 2023. Determinants of Climate-Smart Agriculture (CSA) Technologies Adoption by Smallholder Food Crop Farmers in Mangaung Metropolitan Municipality, Free State. *South African Extension Journal* 51(4): 52-74.

Manenzhe, T.D., Zwane, E.M. & Van Niekerk, J.A. 2023. Identifying the Causes of Failure in the Communal Property Associations (CPAs), State Owned and Household Farms. *South African Extension Journal* 51(3): 17-30.

Matlhoko, K.S., Vermaas. J.F. & Cronje. N. 2023. Assessing the effectiveness of traditional wool scouring for small-scale farmers in South Africa: a study on detergents and scouring time. *Research Journal of Textile and Apparel.* doi.org/10.1108/RJTA-02-2023-0017.

Mavhungu, T.J., Nesamvuni, A.E., Tshikolomo, K.A., Mpandeli, N.S. & Van Niekerk, J. 2023. Perception on Irrigated Smallholder Agricultural Enterprises led by Women and Youth (ISHAEs W-Y) towards climate extreme events variability for the selected field crop suitability potential at Vhembe district municipality in Limpopo Province of South Africa. *International Journal of Phytology Research* 3(3).

Mukherjee, U., Dawson, J.A., Chalwe, J.M. & Oldewage-Theron, W. 2023. Effectiveness of a short-term soy nutrition education intervention on nutrition knowledge and self-efficacy scores of rural elderly Zambian women. *Journal of Nutrition and Healthy Aging* 8: 97-108.

Najam, W., Ibiyemi, T., Aziz, S., Najam, R., Gichohi-Wainaina, W.N. & Oldewage-Theron, W. 2023. Social Determinants of Rural Household Food Insecurity under the Taliban Regime. *Journal of Nutrients* 15:1681.

Najam, W., Walsh, C. & Oldewage-Theron, W. 2023. Nutrition knowledge, attitudes, beliefs and practices: a comparison of urban and rural adults in the Free State province of South Africa. *South African Journal of Clinical Nutrition* 36(4): 154-161.

Nkoko, N., Cronje, N. & Swanepoel, J.W. 2023. Determinants of dietary diversity for women of reproductive age (WRA) and under-five children from small-holder farming households in Lesotho. *Cogent Food & Agriculture* 9:1.

Ntsiapane, A.D, Swanepoel, J.W. & Nesamvuni, A.E. 2023. Farmer's Perception on Asset-Based Approach in Agriculture: A Case Study of Smallholder Wool Farming in Thaba Nchu and Botshabelo, Free State Province, South Africa. *South African Extension Journal* 51(2): 188-206.

Ntsiapane, A.D., Swanepoel, J.W., Nesamvuni, A.E. & Ojo, T.O. 2023. Assessing the efficiency of smallholder wool farmers in the changing paradigms of the Free State province of South Africa. *South African Journal of Animal Science* 53(1): 125-132.

Orlu, K.N., Manasoe, B. & Swanepoel, J.W. 2003. Value Network Configuration and Competitiveness of Emerging Agricultural Cooperatives in the Central Free State of South Africa. *South African Business Review*, 14645. doi.org/10.25159/1998-8125/13564.

Thobejane, K., Swanepoel, J., Van Niekerk, J. & Van der Merwe, H. 2023. Measuring Women's Empowerment in Agriculture in the Gauteng Province of South Africa. *South African Extension Journal* 51(2): 161-185.

Tinta,N. & Kolanisi, U. 2023. Overcoming barriers for people with disabilities participating in income-generating activities: A proposed development framework. *African Journal of Disability* 12:1133. doi.org/10.4102.ajod.v12i0.1133.

Van Niekerk, J. A. & Conradie, B. 2023. Cereal Production in the Eastern Free State, 1981 – 2007: Can Agricultural Extension Deliver Food Security? *South African Extension Journal* 51(2): 68-88.

Van Rooyen, B., De Wit, M., Osthoff, G., Van Niekerk, J. & Hugo, A. 2023. Effect of Native Mucilage on the Mechanical Properties of Pectin-Based and Alginate-Based Polymeric Films. *Coatings* 13(9): 1611.

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Von Maltitz, L. & Van Niekerk, J.A. 2023. Undergraduate Agricultural Extension Qualifications in South Africa: Comparing Available Curricula to Desired Skills and Competencies. *South African Extension Journal* 51(4): 210-229.

Zulu, A.B., Bothma, C., De Wit, M. & Du Toit, A. 2023. Flavour profile, consumer acceptance and cooking methods of Portulacaria afra (spekboom) leaves. *International Journal of Gastronomy and Food Science* (33): 100784.

Books/Chapters in Books

Mahopo, T.C., Nesamvuni, N.C., Nesamvuni, A.E. & Van Niekerk, J.A. 2023. Value Chain Analysis of the Street Food Enterprises in the Rural Towns of Vhembe District, Limpopo Province. In: *Agricultural Value Chains - Some Selected Issues*. J. Stanton (Ed). IntechOpen. pp. 67-90.

STAFF (2023)

Head of Department: Prof JA van Niekerk

Associate Professors: Prof M de Wit, Prof JW Swanepoel and Prof JA van Niekerk

Lecturers/ Researchers: Dr C Bothma, Dr N Cronjé, Dr A du Toit, Dr A Makamane, Dr N Tinta, Dr I van der Merwe and Dr JF Vermaas

Affiliated Lecturers: Dr JH Barnard, M de Bruyn, K Green, Dr E Kotze, L Kruger, Dr P Malan, LL Marais-Lombard, OS Mpemba, Prof E Nesamvuni, Prof F Neser, VF Nkoi, Dr BD Nkosi, W Pretorius, PZ Swart, Dr K Thobejane, J van den Berg, H van der Merwe, BB van Rooyen, Prof CJ van Rooyen, AB Zulu and Prof EM Zwane

Junior Lecturers: Dr A Makamane and Z Swart

Research Fellows: Prof VM Mmbengwa, Prof W Oldewage-Theron and Prof HJH Steyn

Programme Director: Dr I van der Merwe

Senior Officers: A Calitz, G Green, D Jacobs and L van der Walt

Officers: R Coetzee and C Denner

Senior Assistant Officer: W van der Walt

Assistant Officers: S Mocwana and R Smith

NRF Intern: KS Matlhoko

BUILDING SCIENCES

DEPARTMENT OF

ARCHITECTURE

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Architecture hosted the 34th Sophia Gray memorial and exhibition, with Nadia Tromp of Ntsika Architects in Johannesburg.

Marie Herbst, supervised by Prof Noble, presented our first successful 'design led' PhD from the new programme at her exam and exhibition in September 2023, with a thesis titled 'The (S)Pace of Images: establishing a practice of the conscious abstraction of motion'.

Pieter Mathews, supervised by Dr Auret, presented the second successful 'practice-based' PhD at his exam and exhibition, with a thesis titled 'Towards an architecture of explorative divergence: an autoethnographic interrogation of explorative divergence as a mode of design and practice underpinning the oeuvre of Mathews and Associates Architects'.

Pieter Mathews' practice-based PhD exam – Towards an architecture of explorative divergence

Groundbreaking student work from the Department of Architecture was featured in the South African Pavilion at the 18th International Architecture Exhibition (Biennale) in Venice, Italy.

A special lecture series for all students and members of the profession was held during the course of the year focusing upon current research from practice and academia.

ACHIEVEMENTS

Staff Achievements

Dr Hendrik Auret was selected to be a participant in the Department of Higher Education and Training (DHET) Future Professors Programme Phase 1 (cohort 3).

Prof Gerhard Bosman received a Vice-Chancellors' Award for Teaching and Learning and was also selected to join the University of the Free State (UFS) Learning and Teaching Fellowship Programme, for advanced scholars.

Prof Jonathan Noble received a South African Institute of Architects Award of Merit for his peer-reviewed book, *The Architecture of Peter Rich: conversations with Africa* (Lund Humphries 2020).

Student Achievements

The following students won the annual Corobrik Student of the Year Award for the Free State in 2023:

1st prize:	Arran Wood
2nd prize:	Thomas Conradie
3rd prize:	Cara du Plessis
Brick Award:	Lize-Marie du Toit

TEACHING AND LEARNING

2023 Vertical studio

The 2023 Vertical studio, titled 'Architecture as Social Activism', was hosted by the award-winning South African architect Nadia Tromp. The vertical studio is a creative workshop that bridges the gap between education and practice, offering students the experience of practice by enabling them to interact with a leading architect. The week-long creative workshop exposed students of architecture to various methods and tactics of employing social activism in design, and thereafter students were expected to respond through creativity. The results were exhibited at the Sophia Gray Memorial exhibition at Oliewenhuis.

Architect Nadia Tromp (far right) conducts the History and Theory Vertical studio of 2023, titled 'Architecture as Social Activism'

Digital Fabrication

Teaching and learning in 2023 commenced with the Department's new digital fabrication lab, with student designs being fabricated by Orepa Mosidi, the lecturer in change, who has been trained to operate the machines. We hope to launch the lab for general student use in 2024, once all health and safety concerns are resolved.

RESEARCH AND INNOVATION

PhD with Design Programme

Two new PhD candidates joined the design-based PhD programme in 2023. Four PhD symposia were held for the new candidates, and two for the existing candidates. Thanks to blended-learning and our live streaming platform, the PhD symposia have developed an international character, with attendance in 2023 from Australia, Greece, India, Namibia, the Netherlands, New Zealand, and various parts of South Africa.

First Design-Led PhD Graduate

Marie Herbst presented our first successful 'design-led' PhD at her exam and exhibition in September, with a thesis titled 'The (S)Pace of Images: establishing a practice of the conscious abstraction of motion'. A design-led PhD is one in which the thesis is advanced by a new creative project, in contrast to a practice-based PhD, where the candidate explores their oeuvre of built works.

Young Researchers

Ntetleng Orepa Mosidi, our newest member of staff, produced two research papers in 2023, exploring African literature and questions of identity relating to architecture. The first paper was submitted to the *South African Journal of Art History (*SAJAH), while the second paper will be published in the conference proceedings from the International Conference of Architecture and Gender VI held in Valencia, Spain. Ntetleng was able to present at this prestigious conference with various well-known international female architects.

Phadi Mabe was invited to take part in the first edition of the Biennale College Architecture in Venice, Italy.

A floating platform device, designed and assembled as contribution to the first edition of the Biennale College Architecture in Venice, Italy, produced by Phadi Mabe and his team

Marie Herbst presenting her design-led PhD exam – 'The (S)Pace of Images'

The conference was a month-long experimental lab during which he collaborated with world-renowned architects and academics in the field of architecture, on the themes of decolonisation and decarbonisation. The purpose of the engagements is toward charting new paths for the future of architectural education and practice. During the conference Phadi Mabe and his team creatively engaged and researched the topic of decarbonisation, producing a floating platform device to counteract the sinking of the city of Venice due to climate change.

SAJAH hosted a conference at the University of KwaZulu-Natal in Pietermaritzburg and Phadi Mabe presented a paper on an award-winning architect, Mphethi Morojele. The paper drew from Mphethi Morojele's Sophia Gray Memorial Lecture which was held in 2022. The paper focused on how African indigenous knowledge and mythology are a creative inspiration for the architecture of Mphethi Morojele.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

34th Sophia Gray Memorial Lecture

The Department hosted the 34th Sophia Gray Memorial Lecture and exhibition, titled 'Shifting Perceptions: Designing Dignity', by architect Nadia Tromp of Ntsika Architects in Johannesburg. During her lecture, Nadia spoke about how practice-based teaching builds a bridge between industry and academia. The lecture included a personal interview, conducted on stage by Phadi Mabe.

Architect Nadia Tromp presents the 34th Sophia Gray Memorial Lecture and exhibition, titled 'Shifting Perceptions: Designing Dignity'

Public Lectures

On 1 April 2023, Prof Jonathan Noble delivered a book launch and public lecture at David Krut bookshop in Johannesburg, on his peer-reviewed book, *The Architecture of Peter Rich: conversations with Africa* (Lund Humphries 2020).

Prof Noble's book launch at David Krut bookshop, in Johannesburg

He also delivered a public lecture, on 2 November, at the School of Explorative Architecture (SEA) in Cape Town, concerning his book. In addition, Prof Noble presented a SAISshare streamed webinar, hosted by the South African Institute of Architects (SAIA), on 6 October 2023, titled 'What is design-research? And why it matters'.

Service-learning

From September to October, the Earth Unit and the Centre for Development Support (CDS) conducted three service- learning tours to farms in the eastern Free State. Prof Gerhard Bosman, Dr Karen Venter, Annemarie Wagener, and Hein Raubenheimer accompanied 43 CONS2606 students on these tours. The student groups visited and participated for two days in different parts of an assignment that included organising tasks, collecting raw materials, and the

preparation of wall surfaces and plaster panels. Twenty-four women and men were asked to teach the art of traditional Basotho *litema* and *marela* wall decoration skills to the second-year students.

Service-learning student tour to farms in the eastern Free State, led by the Earth Unit and the Centre for Development Support

Heritage Month at the First Raadsaal

During Heritage Month in September, an exhibition was hosted in the First Raadsaal in the Bloemfontein CBD. The exhibition honoured various aspects of Sesotho material and visual culture, placed alongside historical artifacts from the Free State Republic.

NATIONAL AND INTERNATIONAL COLLABORATION

Adjunct Professor Jeremy Smith

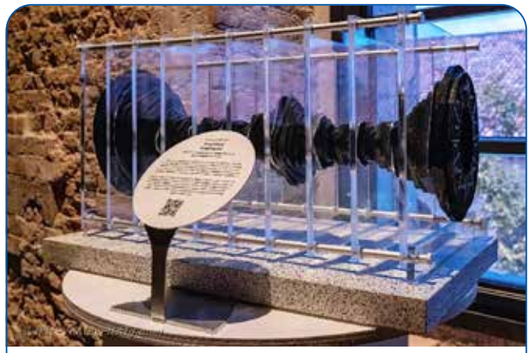
Multi-award winning, New Zealand based architect, Dr Jeremy Smith, joined the Department as an Adjunct Professor in 2023, primarily to assist with the practice-based PhD programme and to serve as a guest critic in our professional programme.

Dr Smith has an impressive design portfolio and CV. He completed his PhD with creative practice in Architecture at the University of Auckland in 2019. Formerly, he was an Adjunct Associate Professor at the University of Auckland and has extensive experience as an examiner for the University of Auckland and Victoria University of Wellington. Since 2020, he has served as an international adviser to the Saveetha College of Architecture and Design in Chennai, India. Dr Smith's design work has received international acclaim via numerous awards. We anticipate that Dr Smith will make a valuable contribution to the future success of our design-based research programme, will boost the Department's international profile, and will prove to be a worthy ambassador for the University of the Free State.

Adjunct Professor Jeremy Smith appointed in 2023

South African Pavilion at the 18th International Architecture Exhibition (Biennale) in Venice

Groundbreaking student work from the Department of Architecture was featured from 1 May to 30 September 2023 in the South African Pavilion at the 18th International Architecture Exhibition (Biennale) in Venice, Italy. The Biennale showcases transformative and innovative work in the field of architecture from various countries around the world. The creative contribution was made by the UFS team – Phadi Mabe (lecturer), Yamkelwa Simelane, Jan Truter, Khalipha Radebe, and Anya Strydom – with an exhibition titled 'Amplified Voices'. The exhibited architectural artefact captured student critique and 'design voices', represented by a 3D-printed 'data object of sound', that encapsulates the language of architectural form.



'Amplified Voices' exhibited in the South African Pavilion at the 18th International Architecture Biennale 2023

Baçeşehir University, Istanbul

In May 2023, Prof Jonathan Noble was invited to participate in design studio sessions, to discuss future collaboration and to give a keynote address at the Faculty of Architecture and Design, at Baçeşehir University (BAU), in Istanbul. He also presented a public lecture on his book *The Architecture of Peter Rich: conversations with Africa.*

International Union of Architects World Congress of Architects

On behalf of the Earth Unit, Gerhard Bosman attended the International Union of Architects (UIA) World Congress of Architects from 2 to 6 July in Copenhagen, where he co-presented the findings of the Architecture of Care and Engagement Research Project, funded by the Central Research Fund of the UFS.

COIL Exchange

As part of the last year of the iKUDU Project, 36 BArch Hons students shared in a Collaborative Online International Learning (COIL) exchange during March and April 2023. Gerhard Bosman facilitated the UFS students while collaborating online with students from Akita International University in Japan, and the University of Siena in Italy.

Architecture Winter School, 12 and 13 July 2023

Winter School

The Architecture Winter School took place on 12 and 13 July 2023 and was presented at the Department of Architecture. The student representative body of the Department – the A5 led by their chairperson, Nazif Alam – helped to facilitate the Winter School, which was attended by about 30 scholars from different backgrounds and schools. The event consisted of a good mix of theory and practical sessions and scholars were given the opportunity to engage with various creative exercises, including designing, drawing, model building, computer aided drawings, and 3D modelling. The feedback we received from the scholars who attended was extremely positive.

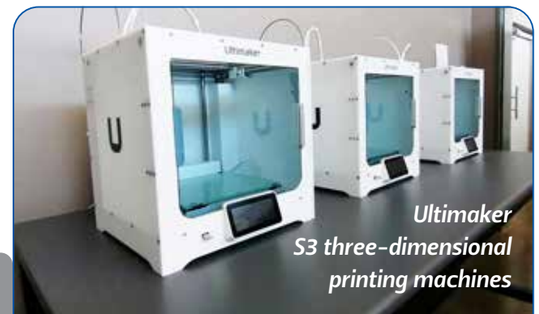
Special lectures

The special lecture series this year – coordinated by Orepa Moisidi – concerned research with a dual focus, from practise and academia. The research that is conducted by practicing architects, encompassed presentations from various established architectural practices. The research within academia included that of our departmental staff who are involved with doctoral study and research papers. This allowed our students to see how research unfolds within both spheres, blurring the boundaries between academia and practice. The talks occurred on Thursday mornings, and began with the fascinating presentation by Nhlamulo Ngobeni on his travels across 13 African countries. They ended with Phadi Mabe, who described his research endeavours as well as his recent involvement in the Venice Biennale – 'Laboratory of the Future.' We look forward to continuing this momentum next year.

OTHER ACTIVITIES

Digital Fabrication

The Department acquired three Ultimaker S3 3D



Ultimaker S3 three-dimensional printing machines

printing machines, supplementing our laser cutting machine in the digital fabrication facility.

HS-T1390, 80W flatbed laser cutting machine

The new digital fabrication lab has undergone inspection to ensure that the facility is safe to be accessed by students when necessary. A workflow document is in preparation, which aims at ensuring that students and staff are aware of the terms of engagement within the facility and its machinery. We hope to launch the facility to general use in 2024.

Daughters of Litema Exhibition

During the Annual Free State Art Festival on the UFS Bloemfontein Campus, the Earth Unit presented the 'Daughters of Litema' exhibition to showcase service-learning combined with a COIL exchange with Art History students during the previous years. A duplicate research exhibition was exhibited in May at the Gregory Allicar Museum of Art at Colorado State University.

STAFF MATTERS

Orepa Mosidi attended the international conference for Gender and Architecture in Valencia, Spain. The conference explores the various manners in which women have been left out in architectural records and research initiatives that explore the lost histories of women in architecture, in a number of contexts and countries. Mosidi presented a paper from the perspective of a black and African woman in architecture. Many well-known female architects and researchers were present at the conference, including Anna Sokolina, Anna Bofill, Dolores Hayden, and others.

RESEARCH OUTPUTS

Research Articles

Bosman, G., Venter, A. & Mabe, P. 2023. Litema artivism: Community engaged scholarship with international online learning. *Acta Structilia* 30(1): 185-211.

Mabe, P. 2023. Transposed African myths in the works of Mphethi Morojele. *South African Journal of Art History: Myth, religion and the sacred*. 17(1).

Mosidi, N. 2023. NERVOUS Conditions: missionary myths and misconceptions, religion and the sacredness of space. *South African Journal of Art History: Myth, religion and the sacred*. 17, 1 (Jun 2023).

Books/Chapters in Books

Peters, W. 2023. Die Otavibahn in Deutsch-Südwestafrika. Die längste Schmalspurbahn der Welt (1905). In: *Deutsch-koloniale Baukulturen*. M. Falser (Ed). Munich: Zwntralinstiut fur Kunstgeschichte. pp. 178-181.

Peters, W. 2023. Eine Stadt an einem der unwirtlichsten Küstenstreifen der Welt? Die Bebauungspläne zu lüderitzbucht in Deutsch-Südwestafrika (1898). In: *Deutsch-koloniale Baukulturen*. M. Falser (Ed). Munich: Zwntralinstiut fur Kunstgeschichte. pp. 126-129.

Peters, W. 2023. Neues Bauen in den Kolonien. Das Wohnhaus auf Farm Dordabis/Namibia von Hellmut stauch (1929) In: *Deutsch-koloniale Baukulturen*. M. Falser (Ed). Munich: Zwntralinstiut fur Kunstgeschichte. pp. 70-73.

Peters, W. 2023. Water, its presence and absence in settlements and placemaking in colonial Namibia. In: *German colonialism in Africa and its legacies: architecture, arts & urbanism*. I. Osayimwese (Ed). London: Bloomsbury. pp. 69-88.

Conference Contributions

Conference Papers / Posters

Bosman, G., Mabe, P. & Venter, A. 2023. *Litema rural art and architecture: global acts of care*. Paper delivered at the 5th National Global Change Conference, Bloemfontein, South Africa, 30 January–2 February 2023.

Bosman, G. & Riep, D. 2023. *International Student Collaboration: Transformation for Vernacular Art and Architecture Teaching and Learning, Free State Province, South Africa*. Paper delivered at the UIA World Congress of Architects Copenhagen 2023, Copenhagen, Denmark. 2-6 July 2023.

Conference Proceedings

Bosman, G. & Riep, D. 2023. International Student Collaboration: Transformation for Vernacular Art and Architecture Teaching and Learning, Free State Province, South Africa. In: *Sustainable Development Goals Series. Design for Resilient Communities, Proceedings of the UIA World Congress of Architects Copenhagen 2023*. A. Rubbo, A (Eds). Springer Nature: Switzerland. DOI: 10.1007/978-3-031-36640-6.

STAFF (2023)

Head of Department:
Prof JA Noble

Professor:	Prof JA Noble
Associate Professor:	Prof G Bosman
Adjunct Professor:	Dr J Smith
Adjunct Associate Professor:	Dr T Hardman
Senior Lecturers:	Dr HA Auret, MM Bitzer, JL du Preez and A Wagener
Lecturers:	P Mabe, O Mosidi, JH Nel, H Raubenheimer and DPG van der Merwe
Lecturers (Contract):	K Salzmann-McDonald, JD Smit and P Smit
Junior Lecturer:	JI Olivier
Research Fellow:	Prof WH Peters
Senior Assistant Officers:	Z Bronkhorst and Y Nienerber
Assistant Officer:	LT Keswa
Assistant Officer – Professional Services:	MQ Myeni
Messenger:	TJ Mohatlane

DEPARTMENT OF

QUANTITY SURVEYING AND CONSTRUCTION MANAGEMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

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OVERVIEW OF 2023

The Department of Quantity Surveying and Construction Management, housed in the Faculty of Natural and Agricultural Sciences (NAS) at the University of the Free State (UFS), forms one of the pillars of the Building Sciences cluster along with Architecture and Urban and Regional Planning. It plays a significant role in advancing the training of future built environment professionals, thereby making meaningful contributions to institutional and national imperatives of developing much-needed scarce skills. The professionally accredited programmes offered by the Department are listed on the Department of Labour's critical skills list – in the areas of construction management, quantity surveying, and property.

In 2023, the Department was invovled in two accreditation visits. The South African Council for Project and Construction Management Professionals (SACPCMP) hosted the first in March 2023 and in November 2023, the Royal Institute of Chartered Surveyors (RICS) carried out an international accreditation. The Department is happy to report that all of the programmes under examination received full accreditation.

This marks the end of an era for Prof Kahilu Kajimo-Shakantu as she concludes her extraordinary spell as the Head of the Department of Quantity Surveying and Construction Management. She has devoted ten years of nonstop effort to the Department's expansion and success, creating a lasting impression on both staff and students. We say goodbye to her with mixed emotions, since we know that her departure marks the start of a new chapter for the Department.

The Department is grateful for the team who ensured that we delivered without compromising standards and moved closer to realising its vision of becoming the go-to department in the built environment discipline.

Prof Kahilu Kajimo-Shakantu

Mart-Mari Els

ACHIEVEMENTS

Staff Achievements

Dr Christopher Amoah was recognised and awarded for his excellent performance in the Research, Future Professoriate Programme at the UFS. He was also awarded the best response letter for paper review at the CIB W070 Conference on Facility Management and Maintenance in Trondheim, Norway, in May 2023.

Hendri du Plessis successfully completed the UFS Learning and Teaching Fellowship Programme and Academic Leadership Programme which were both presented by the Centre for Teaching and Learning (CTL).

The following staff members won best conference presentation awards:

- Mart-Mari Els won the Best Paper at the South African Council for the Quantity Surveying Profession (SACQSP) Annual Conference in Teaching and Learning Pedagogy 2023 in Johannesburg.
- Liezl Le Roux won the Best Paper Presentation by Female Youth at the SACQSP Annual Conference 2023 in Johannesburg.
- Tascha Bremer won the Best Paper Presentation at the Development and Investment in Infrastructure International Conference 2023 in Zambia.
- Prof Kajimo Kajimo-Shakantu, Prof Theo Haupt, and PhD student Mohlomi Raliile won the Best Paper at the International Council for Research and Innovation in Building and Construction (CIB) W099 Annual International Conference: Digital Transformation of Health & Safety in Construction in Portugal.

Student Achievements

The Department is pleased to congratulate the following students, who received recognition at the annual Faculty prize-giving:

- Reynard Otto won the Association of South African Quantity Surveyors prize for Best first-year student in the BSc Construction Economics & Management (Quantity Surveying) programme.
- Johannes Calitz won the Association of South African Quantity Surveyors prize for the Best second-year student in the BSc (Quantity Surveying) programme.
- Milne Botha won the Association of South

African Quantity Surveyors prize for Best third-year student in the BSc (Quantity Surveying) programme.

- Yolandi de Beer won the Association of South African Quantity Surveyors prize for Best fourth-year student in the BSc Honours (Quantity Surveying) programme.
- Reynard Otto won the Bell John prize for Best all-round student in any year of study (Quantity Surveying).
- Adam Vermaak won the Department of Quantity Surveying and Construction Management Prize for Best Student in Construction Finance.
- Chrisjan Terblanche and Deon Louw won the Department of Quantity Surveying and Construction Management Prize for Best Student Research Project in the Honours programme.
- Chantelle Foster and Lungisa Nakin won the Department of Quantity Surveying and Construction Management Prize for Best Student Research Mini Dissertation in the MLPM Programme.

As mentioned above, Mohlomi Raliile. (PhD student), together with Prof Kajimo-Shakantu and Prof Haupt, won the award for the best paper at the International CIB W099 & W123 Annual International Conference: Digital Transformation of Health and Safety in Construction, held in Porto, Portugal, on 21 and 22 June 2023.

TEACHING AND LEARNING

The Department offers several built environment-related programmes in Quantity Surveying, Construction Management, and Real Estate Management (Property Studies). Within each of these main areas, numerous professional and career opportunities can be followed in both the public and private sectors, and not limited to the construction sector. The developments in teaching and learning highlight the Department's commitment to delivering an innovative and robust curriculum, which prepares students for the challenges and opportunities of the modern workforce, particularly considering the imperatives of the Fourth Industrial Revolution (4IR).

Quantity Surveying and Construction Management students on site visit

In 2023, 47 students were enrolled for the BSc Construction Economics and Management, and 48 were enrolled for the BSc Construction Management and BSc Quantity Surveying compact learning (part-time).

During the year, several site visits around Bloemfontein were undertaken to provide students with exposure to construction activities aimed at enhancing their classroom learning experiences.

RESEARCH AND INNOVATION

Hendri du Plessis's research group continued its research under the umbrella topic of 'An evaluation of the Fourth Industrial Revolution (4IR) readiness of learning institutions and various professionals in the South African Construction Industry: An exploratory study'. The group presented a paper at the International South African Council for the Quantity Surveying Profession (SACQSP) conference. Hendri du Plessis also delivered a paper on his work at the Scholarship of Teaching and Learning 4 the South Conference (SOTL4 the South), in November 2023.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Dr Christopher Amoah was appointed as an editorial board member for the journal *Acta Structilia* and served as a reviewer for a number of international journals, including *Urban, Planning and Transport Research, International Journal of Managing Projects in Business, Journal of Management and Research, Construction Management and Economics, Journal of Innovative Digital Transformations, Journal of Responsible Production and Consumption, International Journal of Strategic Property Management, Cogent Business and Management, Canadian Journal of Civil Engineering* and the *International Journal of Public Sector Management.* Additionally, Dr Amoah was appointed as an external examiner for the PhD and Master's dissertations at the University of Johannesburg (UJ) Faculty of Engineering and the Built Environment, as well as an external moderator for the Research Methodology Module at Cape Peninsula University of Technology (CPUT).

Dr Christopher Amoah

Prof Kahilu Kajimo-Shakantu was invited as a Keynote Speaker at the International Conference on Development and Investment in Infrastructure, held in July 2023 in Livingstone, Zambia.

NATIONAL AND INTERNATIONAL COLLABORATION

Dr Amoah collaborated with other academics at Cape Coast University Technology in Ghana on a number of publications.

POSTGRADUATE STUDENTS

The Department offers postgraduate degrees at Honours, Master's, and Doctoral levels, majoring in Quantity Surveying and Construction Management. It also offers a Master's by research and a PhD in Property Science. Included by our postgraduate programmes is a Master's by coursework degree in Land and Property Development Management (MLPM), specialising in either Project Management or Property Valuation.

The total number of postgraduate students enrolled in the various programmes in 2023 was:

BSc Hons:	92
MLPM:	53 (for both specialisations)
MSc:	11
PhD:	10

At the 2023 graduation ceremonies, the following degrees were conferred:

BSc Hons (Construction Management):	2
BSc Hons (Quantity Surveying):	28
MLPM (Project Management):	5
MLPM (Property Valuation):	13

In our Master's programme, the MSc (majoring in Construction Management) was conferred on Liané Labuschagne with distinction.

Two candidates graduated with a PhD in Construction Management in 2023. These were:

Moyo, Lovemore

Thesis:	Developing a Theoretical Framework for the Assessment of Practical Completion in Standard Construction Contracts in South Africa
Supervisor:	Prof Kahilu Kajimo-Shakantu

Raliile, Mohlomi Terah

Thesis:	Occupational Stress Management Model for the Construction Workforce in South Africa
Supervisor:	Prof Theo C Haupt

STAFF MATTERS

The Department was pleased to welcome Barend duToit and Liezl Roux as Lecturers. Alfred Deacon resigned as a full-time Lecturer in 2023 and was retained by the Department as a contract lecturer.

We bid farewell to our Head of Department, Prof Kahilu Kajimo-Shakantu, who served the Department with exceptional leadership for 10 years.

RESEARCH OUTPUTS

Research Articles

Amoah C. 2023. Quality Management Framework for Government Social Housing Construction in South Africa. *International Journal of Building Pathology and Adaptation* 41(6): 217-236.

Amoah, C. 2023. The impact of the Black Economic Empowerment (BEE) concept in the South African public procurement systems on black construction professionals. *Journal of Procurement Management* 16(1): 115-135.

Amoah, C. & Nkosazana, H. 2023. Effective management strategies for construction contract disputes, *International Journal of Building Pathology and Adaptation* 41(6): 70-84.

Amoah, C. & Steyn, D. 2023. Barriers to unethical and corrupt practices avoidance in the construction industry. *International Journal of Building Pathology and Adaptation* 41(6): 85-101.

Amoah, C., Bamfo-Agyei, E. & Simpeh, F. 2023. Disable access compliance to university infrastructure: Built environment students' perceptions. *Property Management* 41(5): 681-697.

Blessing, M. & Amoah, C. 2023. Barriers to the Uptake of Technology in the Quantity Surveying Industry. *International Journal of Computer and Information Engineering* 17(8): 474-479.

Deacon, H. & Kajimo-Shakantu, K. 2023. Project performance affecting claim events under the JBCC Principal Building Agreement in South Africa. *Journal of Construction Project Management and Innovation* 13(1): 58-73.

Deacon, H.A. & Amoah, C. 2023. COVID-19: Lessons learned on reactive crisis management for project managers. *Journal of Construction* 16(1): 5-18.

Deacon, H.A., Kajimo-Shakantu, K. & Le Roux, J.C. 2023. Contract administrators' perspective on claim events under the JBCC Principal Building Agreement in South Africa. *Acta Structilia* 30(2): 124-160.

Muleya, F., Tembo, C. K., Phiri, E. & Zulu, S. 2023. Deciphering cultural differences between local and foreign contracting firms using Hofstede's national culture model in the construction industry. *Social Sciences & Humanities Open* 8(1): 100728.

Nene, M., Ayesu-Koranteng, M., Amoah, C. & Adeniran, A. 2023. Factors Influencing the Use of Green Building Practices in the South African. *International Journal of Architectural and Environmental Engineering* 17(12): 490-497.

Simpeh, F. & Amoah, C. 2023. Assessment of measures instituted to curb the spread of COVID-19 on construction site. *International Journal of Construction Management* 23(3): 383-391.

Conference Contributions

Conference Papers / Posters

Du Plessis, H. 2023. The evaluation of Construction 4.0 attributes of the South African construction Built Environment Students using activity theory – an Institutional perspective. Paper delivered at the Fourth SOTL Conference (SOTL 4 the South). 21-23 November 2023.

Conference Proceedings

Amoah, C., Venter, P.V. & Ayesu-Koranteng, E. 2023. Critical factors for the successful delivery of construction projects: emerging contractor's perspectives. In: *Proceedings of the Towards a Sustainable Construction Industry: The Role of Innovation and Digitalisation. 12th Construction Industry Development Board (CIDB) Postgraduate Research Conference*. East London, South Africa. 10-12 July 2022. C. Aigbavboa (Ed). pp.356-369.

Amoah, C. 2023. Sustainability of the government policy on social housing construction in South Africa: the emerging issues. In: *Proceedings of the CIB W070 Conference on Facility Management and Maintenance*. Trondheim, Norway. 8-12 May 2023. pp. 1-10.

Amoah, C. 2023. The BEE concept in the South African Public procurement system: the perspective of construction professionals. In: *Proceedings of the 12th International Structural Engineering and Construction Conference (ISEC-12)*. University of Chicago, USA. 14-18 August 2023. pp. 7-13.

Amoah, C. & Kajimo-Shakantu, K. 2023. Challenges Confronting Social Housing Dwellers in Bloemfontein, South Africa. In: *Proceedings of the 12th International Structural Engineering and Construction Conference (ISEC-12)*. University of Chicago, USA. 14-18 August 2023. pp. 1-6.

Arendt, H.R. & Amoah, C. 2023. Work readiness attributes in the quantity surveying profession: the perspective of employers. In: *Proceedings of the SACQSP International Research Conference*. Johannesburg, South Africa. 22-23 October 2023. C. Aigbavboa (Ed). pp.235-245.

Bremer, T. & Monoametsi, S.C. 2023. A framework for sustainable human settlement building methods for low-cost housing in Northern Cape Province. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 233-241.

Du Plessis, H.B. & Kubheka, S.T. 2023. Enhancing the Significance of Quantity Surveying in the South African Construction Industry – A Diffusion of Innovation Perspective. In: *Proceedings of the SACQSP International Research Conference*. Johannesburg, South Africa. 22-23 October 2023. C. Aigbavboa (Ed). pp. 1-9.

Els, M-M. 2023. Pedagogical challenges in the first-year building measurement module: An exploratory study. In: *Proceedings of the SACQSP International Research Conference*. Johannesburg, South Africa. 22-23 October 2023. C. Aigbavboa (Ed). pp. 108-115.

Kajimo-Shakantu, K. 2023. Quantity surveying practices and competences in a transforming construction industry. In: *Proceedings of the SACQSP International Research Conference*. Johannesburg, South Africa. 22-23 October 2023. C. Aigbavboa (Ed). pp.342-350.

Le Roux, L. 2023. A Critical Review of the Cost Implications of Sustainable Construction. In: *Proceedings of the 17th Built Environment conference*. Muldersdrift, South Africa. 26-28 September 2023. (ASOCSA). (Eds). pp. 199-208.

Le Roux, L. & Ferreira, C. 2023. *A Critical Review of Women in Construction: Quantity Surveying. In. Proceedings of the SACQSP International Research Conference*. Johannesburg, South Africa. 22-23 October 2023. pp. 82-92.

Le Roux, L. & Kajimo-Shakantu, K. 2023. An Assessment of Cost and Socio-Economic Implications of Applying Innovative Active Design Principles in Construction. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 213-221.

Mntu, A., Kajimo-Shakantu, K. & Du Toit B, A. 2023. Influence of public sector built environment professionals on infrastructure delivery in the Eastern Cape. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 125-133.

Mntu, A., Kajimo-Shakantu, K. & Mogorosi T,H. 2023. Factors affecting public sector infrastructure delivery in the Eastern Cape, South Africa. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 134-142.

Mukumba, C.P. & Kajimo-Shakantu, K. 2023. Public procurement: Driver for achieving a circular economy among SME housing developers. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 152-160.

Mukumba, C.P., Kajimo-Shakantu, K., Raliile, M.T. & Haupt, T.C. 2023. Occupational Stressors Among Small and Medium Sized Enterprises in the Zambian Construction Industry: A Preliminary Study. In: *Proceedings of the Towards a Sustainable Construction Industry: The Role of Innovation and Digitalisation. 12th Construction Industry Development Board (CIDB) Postgraduate Research Conference*. East London, South Africa. 10-12 July 2022. C. Aigbavboa (Ed). pp.727-734.

Muleya, F., Kajimo-Shakantu, K. & Tembo C.K. 2023. An exploratory and comparative assessment of cost estimates on infrastructure projects: A client's perspective. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 203-212.

Muleya, F., Kajimo-Shakantu, K. & Tembo, C.K. 2023. Investigation of cost management factors influencing poor cost performance on large to medium-sized projects in the construction industry. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 213-221.

Muleya, F., Nengovhela, H. & Kajimo-Shakantu, K. 2023. Implementing construction risk management methods on private sector projects in South Africa. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Smart and resilient infrastructure for emerging economies: perspectives on building better*. Livingstone, Zambia. 19-21 July 2023. I. Musonda (Ed). pp. 182-190.

Nyangiwe, T., Amoah, C. & Mukumba, C.P. 2023. The Emergence of Construction Mafia in South Africa: The Implication on the Construction Industry. In: *Proceedings of International Conference on Sustainable Built Environment*. Cape Town, South Africa. 6-7 November 2023. pp. 1-6.

Oosthuizen P.M. & Barnard W. 2023. An inquisition into the quantity surveyor's apprehension of ecology and its relation to the South African built environment. In: *Proceedings of the SACQSP International Research Conference*. Johannesburg, South Africa. 22-23 October 2023. C. Aigbavboa (Ed). pp.297-305.

Van Niekerk, L. & Amoah, C. 2023. Workforce motivational factors in the South African construction industry. In: *Proceedings of the 12th International Structural Engineering and Construction Conference (ISEC-12)*. University of Chicago, USA. 14-18 August 2023. pp.1-6.

STAFF (2023)

Head of Department:
Prof K Kajimo-Shakantu

Associate Professor:	Prof K Kajimo-Shakantu
Senior Lecturer:	Dr C Amoah
Lecturers:	T Bremer, AH Deacon, H du Plessis, B du Toit, M-M Els, C Ferreira, PM Oosthuizen and L Roux
Lecturers (Contract):	D Huggett, C Mukumba, MT Raliile, R Schaaf, R Seedat, C Skibbe, L Spencer, L Stott, W Strydom and J Swartz
Programme Directors:	H du Plessis and C Ferreira
Affiliated Research Fellows:	Prof T Haupt, Dr K Ibrahim, Dr F Muleya and Dr A Opawole
Officers:	A Beukes, TH Mogorosi and A Mosimanegape
Senior Assistant Officers:	AB Madiehe and R Runkel
Secretary:	E van der Walt
Messenger / Service Worker:	N Mohapi

DEPARTMENT OF

URBAN AND REGIONAL PLANNING

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

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OVERVIEW OF 2023

The Department of Urban and Regional Planning is one of 11 planning schools that was established country-wide in 1975. As a postgraduate department, it offers two honours, three masters, two PhD programmes, and eight Short Learning Programs (SLPs). In 2023 the Department enrolled students from neighbouring countries such as Lesotho, Namibia, and Zimbabwe.

TEACHING AND LEARNING

Each year the students doing their Honours in Spatial Planning and specialisation in Human Settlements are taken on field trips to enhance their learning experience. Dr Kgosi Mocwagae led a visit to the informal settlement of Phomolong in Bloemfontein. The students must assess the spatial planning, or the absence thereof, and the social circumstances of the inhabitants of these settlements.

Students conducting an interview with the residents of the Phomolong informal settlement

In May 2023, an SLP was concluded with Human Settlement officials from departments and local municipalities from around the Free State. The SLP consisted of four modules, namely Human Settlements Administration and Development, Human Settlements Upgrading Programme, Human Settlements Strategies and Institutional Frameworks, and Sustainable Human Settlements Development.

Participants in Human Settlements training at Rooi Dam in Bloemfontein

On 30 October 2023, a certification ceremony was held for the 42 students who participated in the SLP.

Attending the graduation ceremony for the Free State Provincial Department of Human Settlements, from the left, Thomas Stewart, Caren Somiah, Dr Kgosi Mocwagae, Adv Moferefere Dhlamini, Kagisho Motlhanke, Sello Senoge, and Cyril Monyela

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Dr Kgosi Mocwagae served as a member of the Pixley ka Seme District Municipal Planning Tribunal in the North Cape pertaining to development applications for eight local municipalities in the district. He also served as Deputy Chairperson for the Matjhabeng Local Municipal Planning Tribunal where development applications for the towns of Allanridge, Hennenman, Odendaalsrus, Ventersburg, Virginia, and Welkom were considered. In addition, he facilitated the Basic Practice in Urban and Regional Planning – Land Use Survey of the Phomolong Informal Settlement in Bloemfontein.

Dr Mocwagae accompanied 14 Master of Urban and Regional Planning Students on a service-learning field trip to the Thabo Mofutsanyana District Municipality. This forms part of the Applied Regional Planning Project on 'Planning for a Sustainable District Development Model for the Thabo Mofutsanyana District Municipality'. They visited Senekal, Bethlehem, Reitz, and Phuthaditjhaba, where they interacted with municipal officials, local businesses, and some community members.

Applied Regional Planning students at the Nketoana Local Municipality offices in Reitz

Applied Regional Planning students at the Thabo Mofutsanyana District Municipality offices in Phuthaditjhaba

NATIONAL AND INTERNATIONAL COLLABORATION

From 27 February to 3 March 2023, our Department participated in a Joint Teaching and Learning, Research, and Collaborative Workshop at North-West University (NWU), which was attended by four PhD candidates, a Postdoctoral Fellow, and a staff member.

Urban and Regional Planning participants at the NWU Joint Teaching and Learning, Research, and Collaborative Workshop, from the left, Timothy Lehobo, Abongile Mgwele, Mareli Hugo, and Johannes Bhanye

On 26 July 2023, the National Department of Transport approached our Department to seek assistance with the professionalisation of transportation planning in South Africa. This collaboration may result in the Department offering a professional qualification in this regard.

POSTGRADUATE STUDENTS

In 2023, a total of 82 postgraduate students were enrolled in the Department of Urban and Regional Planning. In terms of the breakdown in the individual degrees, this translated to:

- Bachelor of Spatial Planning Honours: 18
- Bachelor of Spatial Planning Honours specialising in Human Settlements: 12
- Master of Urban and Regional Planning (Professional): 15
- Master of Urban and Regional Planning (Research): 5
- Master of Human Settlements: 6
- PhD in Urban and Regional Planning: 24
- PhD in Human Settlements: 2

Twenty-one (21) students graduated with the Bachelor of Spatial Planning Honours in 2023. Relebogile Gontse Goitsemodimo, Tinda Samson Motsoeneng, and Kirsten Toni Storm passed with distinction. A further five students graduated with a Bachelor of Spatial Planning Honours specialising in Human Settlements.

Relebogile Gotsemodimo, the top Bachelor of Spatial Planning Honours graduate, with Dr Kgosi Mocwagae

In the Master of Urban and Regional Planning (Professional), 14 students graduated. Pilisiwe Zamafaku Masiba, Ntombizodwa Fransina Modisakeng, and Bhelinda Mtamo graduated with distinction – the latter receiving the award for best-performing graduate.

Top Master of Urban and Regional Planning (Professional) graduate, Bhelinda Mtamo, with Dr Kgosi Mocwagae

On 7 December 2023, the Department graduated a record number of five PhD candidates, supervised by Dr Abraham Matamanda, Prof Verna Nel, and Prof Maléne Campbell.

Bingle, Rouve Velma

Thesis: Boiphilic Considerations for Urban Planners: Exploring the perceptions of the Value of Trees within the Built Environment in Bloemfontein, South Africa

Supervisors: Prof VJ Nel and Prof MM Campbell

Buthelezi, Natal

Thesis: Morphological Characterisation of Informal Settlements and their Adaptation to Natural Disasters in the Face of Climate Change: A Case Study of the Buffalo City, South Africa

Supervisors: Dr A Matamanda and Prof VJ Nel

Goliath, Michellé Lillian-May

Thesis: Urban Pacification Strategies and Solutions Towards a Contested Space Theory of Artisanal Mining

Supervisor: Prof MM Campbell

Leboto, Lucia

Thesis: Local Economic Development in South Africa Through Collaborative Housing Revitalization

Supervisor: Dr A Scheba

Zimunya, Willoughby

Thesis: A Critical Analysis of Planning and Policy Frameworks in the Mapping of the Urban Liveability of Mutare City, Zimbabwe

Supervisors: Dr AR Matamanda, Prof MM Campbell and Prof I Chirisa

Our PhD graduates and their supervisors, from the left, Rouvé Bingle, Abraham Matamanda, Michellé Goliath, Verna Nel, Maléne Campbell, Natal Buthelezi, Lucia Leboto-Khetsi, and Willoughby Zimunya

POSTDOCTORAL RESEARCH FELLOWS

Dr Johannes Bhanye was hosted as a Postdoctoral Fellow in the Department in 2023. He has 10 peer-reviewed publications in journals and book chapters and presented at seven conferences.

RESEARCH OUTPUTS

Research Articles

Bhanye J. 2023. Emerging forms of spatialised and socialized authority among tenure-insecure peri-urbanites in African peri-urban spaces: A review study. *Pan-African Conversations: An International Journal* 1(2). doi.org/10.36615/pac.v1i2.2734.

Bhanye, J. 2023. "Strategic, dual sense of place" among middle-aged migrants in the diaspora. *International Journal of Migration, Health and Social Care* 19(3). doi.org/10.1108/IJMHSC-07-2022-0075.

Bhanye, J., Shayamunda. R, H., Mpahlo, R. I., Matamanda. A. & Kachena. L. 2023. Land politics and settlers' responses to land tenure under threat in emerging peri-urban spaces in Zimbabwe. *Land Use Policy* 135: 106945. doi.org/10.1016/j.landusepol.2023.106945.

Buttner, D.P., Campbell, M. & Kruger, W. 2023. The Impact of Studentification on the Sustainable Planning and Development of an Established City. *Sketch: Journal of City and Regional Planning* 4(01-02): 88-110.

Chirisa, I. & Nel, V. 2023. Conflicts, Confrontations and Conduits in Rural Environments: Is Resilience at Work in Gokwe South Rural District?. *International Journal of Rural Management* 19(1): 149-164.

Dunn, M; Nel V; Van der Berg, H. & Van Huyssteen, E. 2023. The application of constructivist grounded theory methodology in an urban planning doctoral thesis. *International Journal of Qualitative Methods* 22: 1-10. doi-org.ufs.idm.oclc.org/10.1177/16094069231153594.

Leboto-Khetsi, L., Mangara, F., Dunn, M., Manana, K.S., Matamanda, A.R. & Chirisa, I. 2023. Off-campus housing supply and utilization: perspectives of landlords and students in Chinhoyi. *South African Geographical Journal* 106(2): 127-143.

Moloise, S.D., Matamanda, A.R. & Bhanye, J.I. (2023). Traditional ecological knowledge and practices for ecosystem conservation and management: the case of savanna ecosystem services in Limpopo, South Africa. *International Journal of Sustainable Development & World Ecology* 31(1): 29-42. doi.org/10.1080/13504509.2023.2249856.

Mocwagae, K. 2023. Enkele Suid-Afrikaanse beplanningsvraagstukke/Some South African planning issues by Das Steÿn. Book review. *Town and Regional Planning* 83: 71-72.

Stewart, T. 2023. Does community development work? Stories and practice for reconstructed community development in South Africa by Peter Westoby and Lucius Botes. Book review. *Town and Regional Planning* 82: 125-125.

Books/Chapters in Books

Bhanye, J. 2023. "Emerging Forms of Authority in Land Access?": The Occult and Witchcraft Among Malawian Migrants in Peri-urban Zimbabwe. In: *Debating Religion and Forced Migration Entanglements*. E. Goździak & I. Main (Eds). Cham: Springer International Publishing. pp. 89-107.

Bhanye, J. 2023. "Nimble Sociality and Belonging": an Ethnography of Migrants' Responses to Bans on Associational Life During the COVID-19 Pandemic. In: *Urban Forum*. Dordrecht: Springer Netherlands. pp. 1-27. doi.org/10.1007/s12132-023-09503-0.

Bhanye J. 2023. Temporality, Translocality, and Sedentariness: 'Complex and Varied' Perceptions for the Future Among African Migrants on the Margins. In: *The Palgrave Handbook of Global Social Change*. Palgrave Macmillan Cham. doi.org/10.1007/978-3-030-87624-1_396-1.

Bhanye J. & Bhanye A. 2023. A Blessing or a Curse: The Role of Social Media during the COVID-19 Pandemic in Africa. In: *The Palgrave Handbook of Global Social Problems*. Palgrave Macmillan Cham. pp. 1-23. doi.org/10.1007/978-3-030-68127-2_367-1.

Bhanye, J. & Maisiri, M. 2023. Environmental Communication (EC) and the New Media: An African Context Perspective. In : *The Palgrave Handbook of Global Social Change* Cham: Springer International Publishing. pp. 1-23. doi.org/10.1007/978-3-030-87624-1_397-1.

Bhanye, J., Shayamunda, R. & Tavirai, R.C. 2023. Social Media in the African Context. In: *The Palgrave Handbook of Global Social Problems*. Palgrave Macmillan, Cham. pp. 1-32. doi.org/10.1007/978-3-030-68127-2_366-1.

Chirisa, H. & Campbell, M. 2023. Spatial Demography as the Shaper of Urban and Regional Planning Under the Impact of Rapid Urbanization: Reconnoitering the Future. In: *The Palgrave Encyclopedia of Urban and Regional Futures*. Cham: Springer International Publishing. pp. 1618-1626.

Chirisa, I., Nyevera, T. & Moyo, T. 2023. Challenges surounding climate resilience on transportation infrastructures. In: *Adapting the Built Environment for Climate Change*. F. Panchero-Torgal & C-G. Granqvist (Eds). Woodhead Publishing. pp. 161-181.

Denoon-Stevens, S.P., Andres, L., Lewis, M., Melgaço, L., Nel, V. & Van Huyssteen, E. 2023. Engaged pedagogy, informality, and collaborative governance, in South Africa. In: *Engaged Urban Pedagogy: Participatory practices in planning and place-making*. L. Natarajan & M. Short (Eds). University College London. pp. 85-102.

Mocwagae, K. & Mphambukeli, T. 2023. Planning for Effective and Sustainable Water Access and Provision in QwaQwa Through the UN Sustainable Development Goals. In: *Sustainable Futures in Southern Africa's Mountains: Multiple Perspectives on an Emerging City*. A. Membretti, S.J. Taylor & J.L. Delves (Eds). Cham: Springer International Publishing. pp. 105-126.

Mocwagae, K., & Nel, V. 2023. Planning for the Expansion of Phuthaditjhaba CBD Through UN Sustainable Development Goals. In: *Sustainable Futures in Southern Africa's Mountains: Multiple Perspectives on an Emerging City*. A. Membretti, S.J. Taylor & J.L. Delves (Eds). Cham: Springer International Publishing. pp. 17-35.

Nel, V. & Denoon-Stevens, S.P. 2023. *Land-use management to support sustainable settlements in South Africa*. 1st Ed. Routledge.

Conference Contributions

Conference Papers / Posters

Bhanye, J. 2023. *African Democracy under Siege: Decoding the Surge in Military Coups*. Paper delivered at the Journal of Peasant Studies (JPS) 50th Anniversary Conference: Critical Agrarian Studies in the 21st Century, COHD, China Agricultural University,Beijing, China. 10-12 October 2023.

Bhanye, J. 2023. *African Democracy under Siege: Decoding the Surge in Military Coups*. Paper delivered at the Workshop on Elections and Democracy In Africa, Senegal, Dakar. 29 November–3 December 2023.

Bhanye, J. 2023. *Decentralized Water-Energy-Food (WEF) Systems in Africa: Space Analysis, Least-cost Modelling of Sack Farming and Establishment of Renewable Energy Technologies in the Diepsloot Slums of Johannesburg, South Africa*. Paper delivered at the 5th National Global Change Conference (GCC5), University of the Free State, Bloemfontein, South Africa. 30 January 2023–2 February 2023.

Bhanye, J. 2023. *"Nimble Sociality and Belonging": an Ethnography of Migrants' Responses to Bans on Associational Life During the COVID-19 Pandemic*. Paper delivered at Conference on Rethinking the Regional Development Opportunities and Challenges in Southern Africa, University of Zimbabwe, Zimbabwe.5-7 July 2023.

Bhanye, J. 2023. *Regional migration challenges and opportunities in Southern Africa. A Review Study*. Paper delivered at Early Career Researchers Conference: Perspectives on Climate Change in Africa, African Climate & Development Initiative (ACDI), Cape Town, South Africa. 9-10 March 2023.

Bhanye, J. 2023. *Research assistants as brokers and mediators in knowledge production: Reflections from ethnographic fieldwork among Malawian migrants at Lydiate informal settlement in Zimbabwe*. Paper delivered at 6th Neuchâtel Graduate Conference of Migration and Mobility Studies, University of Neuchâtel, Seitzerland.11-12 July 2023.

Bhanye, J. 2023. *'This is God's land': Land seizures as a mechanism of land access for peri-urban farming among insurgent Malawian migrants in Zimbabwe*. Paper delivered at the Journal of Southern African Studies Conference, Centering African Agency: Co-Producing- Science, Technology and Medicine, Lusaka, Zambia. 16-18 August 2023.

STAFF (2023)

Head of Department:
Dr K Mocwagae

Emeritus Professor (Contract):	Prof M Campbell
Professor:	Prof V Nel
Associate Professor:	Prof Y Mashalaba
Senior Lecturers:	Dr K Mocwagae and T Stewart
Senior Lecturers (Contract):	Dr H Booysen and Dr A Venter
Lecturers:	A Mgwele and S Rammile
Lecturers (Contract):	M Hugo, L Leboto-Khetsi, T Lehobo, L Matooane, O Mhobo and Dr M Mokoena
Research Fellows:	Prof I Chirisa, Dr S Denoon-Stevens and Prof D Steÿn
Programme Director:	Prof Y Mashalaba
Senior Assistant Officer:	T Ntsiu
Secretary:	R Hugo
Student Assistant:	N Malatji

NATURAL SCIENCES

DEPARTMENT OF

CHEMISTRY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Chemistry focused on the strategic priorities of the University of the Free State (UFS) and the Faculty of Natural and Agricultural Sciences. The Department is spread over the three UFS campuses, with the South Campus concentrating on the extended BSc programme, with 265 students in total. The Qwaqwa Campus caters for 230 local residential students and specialises in Polymer Science research, while the Bloemfontein Campus teaches approximately 700 undergraduate students and conducts research in all four classic divisions in Chemistry, namely Analytical, Inorganic, Organic, and Physical Chemistry. In 2023, the postgraduate students on the Bloemfontein Campus included 11 Honours, 23 MSc, and 30 PhD students. One intern was involved in the Department, as well as 12 Postdoctoral Fellows from India, Nigeria, Sudan, Ethiopia, Morocco, Spain, Cameroon, Ghana, Iran, and South Africa. The Qwaqwa Campus hosted 3 Honours, 13 MSc, and 2 PhD students, and one Postdoctoral Fellow.

Regarding research outputs, the Department maintained its high level with the assistance of three affiliate professors, namely Roodt, Conradie, and Swarts. The outputs of the Qwaqwa Campus improved when compared with last year.

I would like to acknowledge our personnel for their sacrifice, commitment, and loyalty, which ensured the successful completion of the 2023 academic year. During this period, we also succeeded in producing 113 accepted publications in internationally accredited journals, while five PhD and nine MSc students graduated from the Department. The continued contribution and support of all personnel in the Department of Chemistry, the Dean's Office, and the Faculty are gratefully acknowledged.

ACHIEVEMENTS

Staff Achievements

Prof Alice Brink and three UFS PhD students (Christo van Staden, Francois Jacobs, and Hannah van Dyk) were awarded Bruker Advanced Crystallographic Application training at Bruker Headquarters in Karlsruhe, Germany, during July in association with the National Research Foundation (NRF) National Equipment Programme Grant. Prof Brink was a Fellow of the Future Professors Programme (Cohort 1) – a flagship programme of the Department of Higher Education and training (DHET), which is a national, collaborative initiative aimed at developing the qualities of academic excellence and leadership in university scholarship to contribute to the development of a future South African professoriate. Prof Brink presented an invited lecture at the 44th SACI National Convention in Stellenbosch, and a seminar lecture at Zürich University, Switzerland. She was the invited Session Chair for the 26th Congress and General Assembly of the International Union of Crystallography held in Melbourne, Australia, in August 2023.

Dr Marietjie Schutte-Smith was invited to be part of the Industrial Mentorship Programme, an initiative of the Vice-Chancellor. The UFS also nominated her for the Department of Science and Innovation (DSI) South African Women in Science Awards (SAWiSA) in the Distinguished Young Women Researchers category.

Prof Jeanet Conradie delivered an invited Plenary talk at the 6th International Symposium on Electrochemistry, held at the University of Johannesburg in April 2023, She also delivered an invited Keynote talk at the 53rd Heyrovský Discussion, at Castle Třešť, Czech Republic in June 2023.

Prof Lyudmila Moskaleva delivered a Keynote Lecture at the Chem4Energy Conference, held at North-West University, Potchefstroom, in March 2023. She was also invited to present a Colloquium for the National Institute for Theoretical and Computational Science (NITheCS) in Stellenbosch, in November 2023.

Two staff members, Dr Moipone Malimabe and Dr Puseletso Mofokeng received awards for 20 or more years of service at the UFS.

Mothepane Mbongo received the Khothatso student nomination.

Student Achievements

Hannah van Dyk (PhD) and Lerato Bosman (PhD) within Inorganic Chemistry were awarded first- and second prizes for the Best PhD Poster presentation

Dr Susanna Bonnet and Prof Lyudmila Moskaleva at the 2023 Research Awards

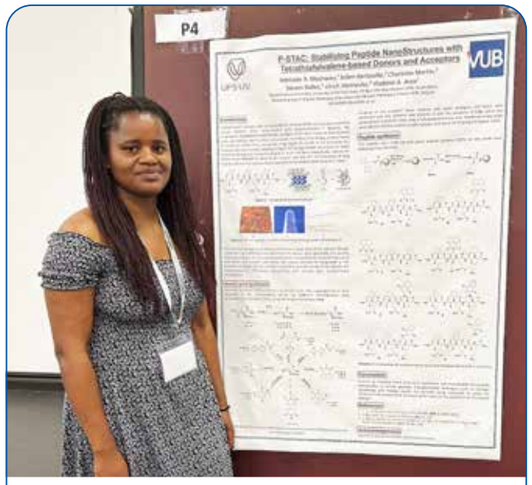
Hannah van Dyk with her UFS Dean's Medal

at the South African Chemical Institute (SACI). Young Chemists Symposium (24 November 2023). Hannah was also awarded the UFS Dean's Medal, which is awarded to a student who achieved the best results for a Master's degree in the Faculty of Natural and Agricultural Sciences.

Leandri Liebenberg (PhD) received the third prize at the Studentesimposium in die Natuurwetenskappe in Pretoria for her oral presentation. At the same symposium, Janine Blignaut (PhD) received an Afrikaans spell-check software prize valid for one year.

PhD student Lenard Carroll (Moskaleva research group) was selected to deliver an oral presentation at the prestigious 4th International Symposium on Nanoporous Materials by Alloy Corrosion, held in Nohfelden, Germany, in April 2023. Lenard and a fellow PhD student, Kgalaletso Otukile (also from the Moskaleva research group), visited the Institute of Materials Chemistry at the Vienna University of Technology, Austria, in June 2023, during which they gave oral presentations at a Workshop of the UFS Department of Chemistry and the Institute of Materials Chemistry, Vienna, Austria. They also participated in the 17th International Congress of Quantum Chemistry (ICQC)in Bratilava, Slovakia. Kgalaletso received the best poster prize at SACI in Stellenbosch in January 2023.

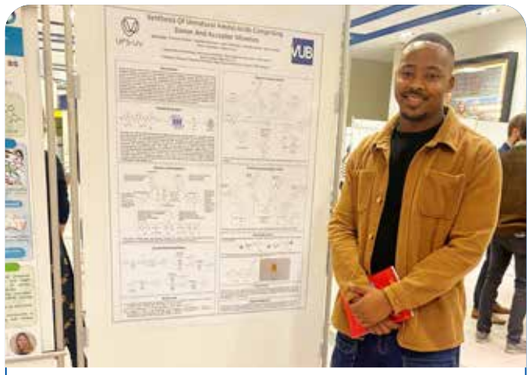
Lenard Carroll (left) and Kgalaletso Otukile at the 17th International Congress of Quantum Chemistry held in Bratislava, Slovakia



Adelaide Mashweu at the 16th Frank Warren Conference in Organic Chemistry held at Polokwane Resort

Adelaide Mashweu presented a flash presentation and a poster on her research synthesising novel functional peptide nanostructures for targeted drug delivery at the 16th Frank Warren Conference in Organic Chemistry in December 2023.

Akho Ntsila spent several weeks from October to December 2023 as a research exchange student at Vrije Universiteit Brussel in Belgium. His project was focused on integrating custom-designed unnatural donor- / acceptor-modified amino acids into hydrogelator peptide sequences. Additionally, Akho participated in the Merck Organic Chemistry Symposium (MOCS 2023), held in Blankenberge, Belgium, from 30 November to 1 December 2023 and presented a poster showcasing his work synthesising unnatural amino acids.



Akho Ntsila at the Merck Organic Chemistry Symposium held in Blankenberge, Belgium

Londiwe N Khumalo (MSc) and Lebohang Seromo (PhD) represented the Department at the Faculty level in the Flash Fact competition on the Bloemfontein Campus. Lindiwe received the Academic Student Tutorial and Excellence Programme (A-Step) award for the best collaborative team (CHEM 2613 and CHEM 2633) at the Qwaqwa Campus.

TEACHING AND LEARNING

The BSc Extended Programmes are offered on the South Campus (theory and practical modules) and the Qwaqwa Campus (theory modules).

The BSc Hons curriculum for Physical Chemistry was revised and updated. New themes included Nanochemistry, Medicinal Chemistry, Energy, and Porosity Analysis

Dr Ernie Langner presented a theme (Nano-sized Metal-Organic Frameworks) as part of the Advanced Nanochemistry module for the Master's in Nanoscience students at the University of the Western Cape (UWC). These lectures were delivered virtually.

The pass rate in the Department on the Qwaqwa Campus was, in most modules, above 50%, except for the first-year module, which is cause for concern. Thus, the Department will engage with Centre for Teaching and Learning (CTL) to explore avenues to improve performance in that module. In contrast, the success rate at the Honours level on that Campus continues to be exceptional.

RESEARCH AND INNOVATION

Analytical Chemistry Division

Prof Karel von Eschwege

Prof Karel von Eschwege (NRF C2-rated) traditionally specialises in photochromic and photo-catalytic research, with potential applications in sensors of diverse kinds and in the renewable energy sector, where these dye compounds are used as photocatalysts in the electrophotoreduction of H_2O or CO_2 to H_2 or CO. He also started working on commercial projects involving the strengthening of wood for material and construction applications and modified activated carbon in water filtration systems. He supervised a PhD project in collaboration with the University of Pretoria, investigating particulate matter pollution in Bloemfontein and the larger Free State area, while a Master's project entails new approaches in the use of activated carbon in water filtration. A full-time Postdoctoral Fellow is researching local abundant wood species' potential for conversion into super-strong materials.

Prof Walter Purcell manages the other part of the Analytical Chemistry Division. His group focused on several analytical and hydrometallurgical projects. The analytical projects relate to method development and validation of analytical processes of target elements. The hydrometallurgical studies include the dissolution, quantification, separation, and isolation of target elements of economic value. The group also investigated the recovery of valuable elements from mine tailings, auto catalysts and, more recently, the recovery of Co and Li from spent batteries.

Dr Rebotsamang Shago focuses on analysing and characterising nanomaterials conjugated with porphyrin macrocycles for the adsorption of heavy metals in wastewater. Dr Mpho Mathebula serves as co-researcher.

Litheko Nkabiti was awarded his PhD at UWC. during this period. He continued his research on

photocatalytic hydrogen production via ammonia splitting using photocatalysts.

Inorganic Chemistry Division

The Inorganic Chemistry Division consists of several research groups, which are independently managed by Prof Deon Visser (C2-rated), Prof Johan Venter, Prof Alice Brink (Y1-rated), and Dr Marietjie Schutte-Smith (Y2-rated). The research is supported by Dr Mpho Mathebula, Officer – Professional Services.

Prof Visser's research group consists of five PhD and four MSc students. The research focuses on materials chemistry with applications in agriculture and health. He also manages a special unit that synthesises small molecules with high value.

Dr Schutte-Smith's research can be grouped into three topics. One is menstrual health management, where four projects are driven toward technological readiness. These are reusable sanitary pads with special photocatalytic properties that kill germs in normal light (inside a building), disposable sanitary pads that do not harm the environment, menstrual cups with antibacterial coatings, and super absorbent polymers from waste cardboard boxes that can be used in sanitary materials. The second research area focuses on the search for molecules with anti-cancer properties, while the third research area is antibacterial paints and coatings for use in frequent-touch areas like hospitals.

Prof Venter's research focuses on fundamental organometallic studies of mainly the platinum group metals with catalytic application. His studies provide a better insight into the intricate role of ancillary ligands by modelling their effects on the progress and outcome of the catalytic reaction. This, combined with mechanistic elucidation, contributes to the knowledge base to improve the design and working of catalysts. In September, he paid a research visit to Prof Muller's group at the University of Johannesburg. Collaboration with the group of Prof Belay at the University of Bahir Dar in Ethiopia continued.

Prof Brink's research focuses on radiopharmaceutical drug development, incorporating the interoperable usage of chemical and macromolecular crystallography and research within the field of homogeneous catalysis. During 2023, the research was supported by grants from the NRF Competitive Support for Y-rated Researchers, and the UFS-CUT Interdisciplinary Grant in collaboration with the Central University of Technology (CUT). The research group was generously provided with synchrotron beam time at the DIAMOND Light Source, UK, in association with the SA Bag Time within the South African Structural Biology Consortium, as well as at the Italian Synchrotron: Elettra Sincrotrone Trieste in collaboration with the University of Warsaw, Poland. In January, the research group hosted a global leader in inorganic chemistry, Prof Roger Alberto (Zürich University, Switzerland). A seminar lecture was presented at UFS titled, 'Photocatalytic H2 formation / CO2 reduction and π-aromatic ligands, piano-stools and sandwiches of rhenium and technetium with underivatized pharmaceuticals'.

Physical Chemistry Division

Dr Ernie Langner's research group comprised one PhD student and one MSc student. The group's research focused on applying Metal-Organic Framework nanoparticles in drug delivery and the recovery of Cobalt and Nickel from spent Li-Ion batteries. As part of a shared project with Prof Karel von Eschwege, the densification of wood after the removal of its lignin, was investigated. This could lead to wood that is stronger than steel.

Prof Alice Brink

Prof Elizabeth Erasmus's group consisted of four PhD students, seven MSc students, and three Postdoctoral Fellows. The research in the Erasmus Group focuses on materials science and heterogeneous catalysis. Projects during 2023 included (i) optimisation of cross-metathesis reactions mediated by Grubbs II catalyst, (ii) phthalocyanine derivatives to be used as light harvesters for solar cells, (iii) Pristine and doped Titanium dioxide as photocatalysts for anti-bacterial application in paint, hygiene products and catheters, (iv) superabsorbent polymers for agricultural and hygiene sectors, (v) Rh-containing oximes and cyanoximes with biomedical application, and (vi) valorisation of phthalates in nappies and hygiene products. Prof Erasmus, Prof Visser, and Dr Schutte-Smith acquired Technology Innovation Agency (TIA) SEED Funding in 2023.

Prof Elizabeth Erasmus

Dr Eleanor Müller

Dr Eleanor Müller's research concentrates on anti-cancer agents and synthesising possible chemotherapeutic drugs and drug carriers. Possible anti-cancer drugs include synthetic organometallic compounds and complexes containing natural compound fragments. Drug carriers in the form of polymers, nanoparticles, and organometallic compounds are also being investigated. Her research includes a cell-culture lab, where all newly synthesised compounds are tested in-house for anti-cancer activity. She is included in the UFS Industrial Mentorship programme, in which she is mentored by Prof Natalie Schellack, the head of the Pharmacology Department at the University of Pretoria. Several other collaborative projects within the UFS Department of Chemistry also exist through cell-line testing. She publishes under her maiden name, Eleanor Fourie.

Prof Lyudmila Moskaleva participated in two NRF-funded projects in 2023 – the International Research Grant (IRG) - China / South Africa Research Cooperation Programme on 'The development of efficient Cu-based catalysts for CO2 (photo-)electro reduction' in collaboration with the group of Prof Z-J Zhao from Tianjin University, China, and in the South Africa / India Joint Science and Research Collaboration Programme on 'Extremely Large Scale Modeling of Elementary Processes in Hydrocarbon Combustion Using High-Throughput Atomistic Simulations and Data Science'. She also continued a collaborative project within the Research Unit Nanoporous Gold Catalyst (NAGOCAT) funded by the German Research Foundation (DFG), which was completed in 2023. Prof Moskaleva's group currently consists of two PhD students and one Postdoctoral Fellow. The research focus is the surface reactivity of solids at the atomic level using first-principles quantum-chemical methods, molecular dynamics, statistical theory, microkinetic modelling, and thermodynamics. Currently, computational studies are directed to chemocatalysis with gold-based alloys, rare-earth oxides, and electrocatalysis (oxygen reduction reaction and CO2 reduction). Additionally, the group is working on mechanistic studies and modelling of rate constants of reactions relevant to hydrocarbon combustion.

Prof Jeanet Conradie's group consisted of one PhD student, two Postdoctoral Fellows, and one MSc student. The research in the Conradie Group focuses on the synthesis, characterisation, computational chemistry, electrochemistry, kinetics, etc., of ligands, transition metal complexes, transition states, and reaction-intermediates for application in drugs, dye-sensitized solar cells (DSSC), catalysis, etc. Research by the Conradie research group resulted in 52 high-quality publications in 2023. This list includes invited publications. Prof Conradie held an NRF Competitive Grant for Rated Researchers (CPRR) research grant and is a C1 NRF-rated researcher.

Organic Chemistry Division

The Organic Chemistry division consists of four distinct research directions – Phytochemistry and Tannin Extract research (Dr Susanna Bonnet and Prof Anke Wilhelm), Homogenous catalysis (Dr Charlene Marais), Nuclear Magnetic Resonance (NMR) reaction progression (Dr Rudi Swart), and supramolecular chemistry (Prof Vladimir Azov).

In the Phytochemistry Group, Dr Bonnet and Prof Wilhelm investigated the development of commercial drugs and phytomedicines from

indigenous knowledge to treat and sedate patients suffering from psychotic diseases, cancer, and diabetes. Dr Bonnet collaborates with the University of Vienna to access bioassays to identify GABA(A) modulators in the central nervous system. This offers an ideal opportunity to investigate African traditional medicine used to treat psychosis, provide scientific explanations for their efficacy, identify the active molecules involved, and develop phytomedicines and commercial antipsychotic drugs. In addition, investigations into groups of synthetic compounds with GABAergic and other biological activities are underway. The cancer research includes both phytochemical and synthetic compounds. Testing is done in collaboration with Palacky University in the Czech Republic, and the antidiabetic project tests all substances in collaboration with Dr Chika Chukwuma at the CUT. Dr Bonnet also runs projects investigating black and green wattle bark extract (phytochemical analysis, aminomethylation, carboxylation, etc.).

Prof Wilhelm's registration at the South African Veterinary Council was successful, and she is authorised to possess and administer scheduled drugs to zebrafish larvae in terms of her approved ethical clearance. Prof Wilhelm manages the zebrafish bioassay in the Department of Chemistry. She developed a complete business plan for the zebrafish bioassay with the guidance of Dr Henriette van den Berg and Dr Nico Walters through the Industry Engagement Mentoring Programme. The bioassay provides third-stream income by performing toxicity and activity assessments to outside institutions. Her main research focuses on isolating active GABAergic compounds using a larval zebrafish locomotor bioassay. The established collaboration with the University of Vienna investigates the GABAergic activity of South African botanicals in searching for novel anti-epileptic drugs. Prof Wilhelm collaborated with Environmental Management and Uptown Trading to extract vetiver oil from dried vetiver roots and Afrikelp, performing toxicity and activity screenings on seaweed.

The Marais group focuses on homogeneous catalysis (e.g. olefin metathesis, transfer hydrogenation, the Sonogashira reaction, Heck reaction, and carbonylation) in the synthesis of pharmaceutical targets. The current focus is the synthesis of flavonoids, stilbenoids, and analogues with confirmed or potential anti-cancer and antidiabetic activity. An NRF-Thuthuka grant with joint contributions from the NRF and the UFS supports the research group. The Marais group published four papers in international peer-reviewed journals in 2023. Dr Marais also presented some of the group's research in July at the 22nd European Symposium on Organic Chemistry (ESOC 2023) in Ghent, Belgium. In June, MSc student Bathabile Makhathini presented her work at the International Organic Chemistry Symposium at the UFS. The Marais group comprised two PhD students and four MSc students in 2023. Two MSc students graduated.

Prof Azov's group conducts projects that cover the broad area of supramolecular chemistry, molecular self-organisation, and redox- and light-controllable molecular receptors, devices, and materials. The current project involves the synthesis of redox-active tetrathiafulvalene derivatives and non-canonical amino acids with donor and acceptor groups. Prof Azov is also involved in collaborative projects to study weak interactions in molecular crystals, investigate complex formation and gas phase reactivity using mass spectrometry methods, and develop stereoselective heterogeneous catalysts.

Dr Rudi Swart employs various NMR. techniques to better monitor and investigate reaction progression to understand organic reaction pathways.

Other Research Activities

Dr Rudi Swart, as Manager of the NMR facility, contributes to the research within all the groups in the Department of Chemistry by implementing new NMR. techniques to advance their research. He assisted more than 20 postgraduate students from different research groups with delicate and advanced multi-nuclear NMR experiments.

To inculcate the research culture in the Department of Chemistry on the Qwaqwa Campus, we organised bi-weekly presentation sessions for Honours and other postgraduate students. For the first time, the Department participated in a Flash Fact competition. The Department received both the University (UV) and Internal Recognition (IR), courtesy of the Sasol Foundation.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Analytical Chemistry

Dr Shago was a reviewer and moderator in several NRF funding instruments. Prof Von Eschwege was a reviewer for various international journals and an examiner of local and overseas MSc and PhD theses. Due to his expertise, he constantly advises companies in the renewable energy sector, including solar, wind, H2-production, and latest technologies in battery energy storage systems.

The Analytical Chemistry Division, headed by Dr Refilwe Matshitse, also started offering professional analytical services to local and outside clients. Instruments include the following:

- ASAP porosity analyser
- Thermogravimetric analyser
- Differential scanning calorimetry
- X-ray powder diffraction
- Opus microscope optical imaging
- Inductively coupled plasma-optical emission spectrometry
- Malvern analytical
- Fourier transform infrared spectroscopy.

Clients typically include:

- University of the Free State: Chemistry, Physics, Genetics, Pharmacology
- Durban University of Technology: Chemistry
- Central University of Technology: Mechanical and Mechatronics Engineering, Faculty of Engineering, Built Environment and Information Technology
- University of Zululand: Communication Science
- Unisa: Science, Engineering and Technology
- Sefako Makgatho Health Science University: Pharmaceutical Sciences
- Walter Sisulu University: Chemical & Physical Sciences
- Rhodes University: Pharmacy
- North-West University: Chemical Engineering
- Council for Scientific and Industrial Research (CSIR)
- Redstone Concentrated Solar Power Plant.

Inorganic Chemistry

Prof Brink serves the scientific community as a member of the International Union of Crystallography (IUCr) Committee on Data (CommDat) and the South African National Committee of the IUCr. She also serves on the editorial board of *Crystallography Reviews*.

Dr Schutte-Smith acts as an external moderator for the University of KwaZulu-Nata (UKZN) and as a reviewer for *Metallomics*.

During May 2023, Prof Johan Venter (Inorganic Chemistry) and Dr Ernie Langner (Physical Chemistry) facilitated two workshops at the Creative Clubs school outreach initiative, hosted at the South Campus. Many learners from several schools in underprivileged communities attended the interactive Chemistry-stimulating learning experience.

Creative Clubs High School learners launch rockets propelled by a chemical reaction under the supervision of Prof Johan Venter and Dr Ernie Langner

Physical Chemistry

All the lecturers of Physical Chemistry were reviewers for the NRF (Grant, Rating, and Bursary applications)

Dr Langner reviewed articles for *Materials Today Communications*, *Process Safety and Environmental Protection* and *ACS Applied Nano Material*. He was on a team presenting the Chemagic Show at two schools, and Prof Johan Venter also presented an activity at the Creative Club for High School learners at the South Campus in May.

Dr Müller reviewed articles for *Inorganica Chimica Acta*, *Inorganic Chemistry*, *Transition Metal Chemistry*, and the *Journal of Electroanalytical Chemistry*. She also contributed as an external examiner for other universities at postgraduate levels.

Prof Moskaleva frequently acted as a reviewer for reputed international journals, including *Nature Communications*, *Nature Chemistry*, *Chem*, *Applied Surface Science*, *P.C.C.P.*, *The Journal of Physical Chemistry C*, and *the New Journal of Chemistry*. She serves on the Editorial Board of Scientific Reports. In 2023, she was a Guest Editor of a Special Collection on 'Multiscale Modeling for Heterogeneous Catalysis'.

Prof Moskaleva and Dr Ernie Langner were members of the European COST Action CA21101 COSY https://cost-cosy.eu/ with currently ~300 members (mainly from EU countries, where South Africa acts as a partner country). Prof Moskaleva is currently a co-leader of Working Group 3, 'Confined Metal and Metal-Oxide Nanoparticles and Clusters Down to the Subnanometer Scale'. She co-organised and co-chaired the second virtual Symposium of WG3 ('Control on the Nanoscale') on 27 November 2023.

Prof Conradie acted as a reviewer for several international journals. She is the Physical Chemistry Editor for the South African Journal of Chemistry. She is a member of SACI, the Academy of Science of South Africa (ASSAf), International Society of Electrochemistry (ISE), and Society of Porphyrins and Phthalocyanines (SPP).

Organic Chemistry

Dr Bonnet served on the SACI Organic Division Committee and Prof Wilhelm acted as external examiner for two PhD theses. She was appointed Organic Editor for the *South African Journal of Chemistry*. Dr Marais reviewed articles for Arkivoc and was a reviewer/moderator of NRF scholarship proposals.

Prof Azov regularly acts as a reviewer for international journals, such as the *Journal of Organic Chemistry*, *Chemistry - A European Journal*, *European Journal of Organic Chemistry*, *Chemical Communications*, *Chemical Physics Letters*, *Molecules*, *Tetrahedron Letters*, *Molecular Liquids*, *Materials*, *International Journal of Molecular Sciences*, *Mendeleev Communications*, and others.

The Organic Chemistry staff also acted as reviewers for the following internationally acclaimed journals: *Journal of Natural Products*, *Journal of Organic Chemistry*, *Phytochemistry*, *Phytochemistry Letters*, *Natural Product Communications*, *Chemical Engineering Journal*, and *Russian Chemical Reviews*.

Qwaqwa Campus

Members of the Department on the Qwaqwa Campus visited Kgola-Thuto Secondary School in Phuthaditjhaba (June 2023) and Moteka Secondary School in Slovo Park (September 2023) for motivational and exhibition sessions.

Dr Mfiso Mngomezulu was a peer reviewer for *Carbohydrate Polymers*.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Von Eschwege continued his collaboration on femtosecond laser spectroscopy with the Laser Research Institute at the Department of Physics at Stellenbosch University and with the University of Pretoria Medical Faculty on fine particulate matter in atmospheric pollution, together with universities in Sweden. He also started collaborations with the Universities of Gaborone in Botswana, the Ain Shams University in Cairo, Egypt, and the University of Yaoundé, Cameroon.

Dr Refilwe Matshitse collaborated with researchers at Rhodes University, Sefako Makgatho Health Sciences University, Unisa, North-West University, and the University of Lesotho.

Prof Brink collaborates with Prof John Helliwell from the University of Manchester with generous support from the Manchester Institute of Biotechnology, Prof Dirk Opperman (UFS Department of Microbiology and Biochemistry), and the South African Structural Biology Consortium. She also collaborated with Prof T Makhafola (CUT), Prof N Gerasimchuk (Missouri State University), and Prof R Kamiński and KN Jarzembska (Warsaw University of Technology).

Dr Schutte-Smith collaborates nationally with Dr Amanda-Lee Manicum (Tshwane University of Technology), Dr Frikkie Malan (University of Pretoria), and Prof Katinka de Wet (UFS Department of Sociology). Internationally she collaborates with Prof Gilles Gasser and Dr Kallol Purkait (PSL University, Chimie ParisTech), Prof Bruno Goud (PSL University, Institut Curie), Prof Fabio Zobi (Fribourg University), Dr Lucie Rárová (Palacky University), Prof Justin Wilson (Cornell University), and Prof Roger Alberto (University of Zurich).

Dr Marais collaborated with Chemical Process Technologies, Pretoria, and has established a collaboration with the South African Medical Research Council.

Dr Bonnet and Prof Wilhelm continued their collaboration with Prof Sophia Khom-Steinkellner from the University of Vienna and Dr Lucie Rarova from Palacky University in the Czech Republic. Dr Bonnet also collaborates with Dr Chika Chukwuma from the CUT and Prof Wilhelm collaborates with Prof Carine Smith from Stellenbosch University on the breeding and management of the zebrafish facility. Prof Smith also acts as a mentor to Prof Wilhelm through the UFS Mentorship Programme.

Prof Wilhelm hosted Dr Joseph Tchamgoue from Cameroon between October and December 2023. Dr Tchamgoue received a fellowship from the Alexander von Humboldt Research Hub-CECANAPROF (3.4-CMR-Hub). He will return for another visit in 2024.

Prof Erasmus, Prof Wilhelm, and Dr Swart collaborated with Dr Zolili Dlamini from CUT and Prof VS Vallabhapurapu from Unisa to identify plant extracts that can be utilised in memory devices. Prof Erasmus also collaborated with Prof JW Niemantsverdriet from SynCat@DIFFER in the Netherlands on gold and iridium complexes.

Prof Azov continued his collaboration with Prof Hennecke at Vrije Universiteit Brussel in Belgium. The project pursues the synthesis of unnatural amino acids containing donor and acceptor groups that can be used to create new hydrogelators for materials and biomedical applications. Prof Azov also collaborates with Dr Warneke at the University of Leipzig in Germany, investigating gas phase reaction mechanisms and the application of methods of mass spectrometry for the synthesis of new compounds and materials on the nanoscale. This collaboration involves scientists from Purdue University and Pacific Northwest National Laboratory (PNNL).

Dr Ernie Langner

Dr Langner collaborated with Dr Kobus van der Walt from CUT on developing polypropylene powders for laser sintering as well as with members of the COST Action CA21101 COSY – Workgroup 3: A European Collaborative Project.

Dr Müller collaborated with researchers from the Pharmacology Department at the University of Pretoria.

Prof Moskaleva collaborated with a range of internationally-based researchers, including Prof R Ramakrishnan from Tata Institute of Fundamental Research in Hyderabad, India, on combustion chemistry and

data science (funded jointly by NRF and the Indian Department of Science and Technology), with Prof Zhi-Jian Zhao from Tianjin University, China, on developing efficient Cu-based catalysts for CO2 (photo-) electro reduction (funded jointly by NRF and the Chinese Ministry of Science and Technology), and with Prof María-Pilar de Lara Castells from the Spanish National Research Council (CISC) on a Spanish National Research project focusing on the computational studies supported by subnanometric clusters of coinage metals.

She also continued her collaboration with researchers from from the NAGOCAT research unit funded by the DFG, until the project's completion, after which Prof Moskaleva continued a bilateral collaboration with the group of Prof Tholmas Risse from the Freie Universität Berlin, Germany.

Prof Conradie continued her collaboration with Prof M Landman and Dr F Malan (University of Pretoria). She also worked with international collaborators such as Prof Abhik Ghosh (Department of Chemistry and Centre for Theoretical and Computational Chemistry at the University of Tromsø), Prof JH Potgieter (University of the Witwatersrand and Manchester Metropolitan University), Karl M Kadish (University of Houston), Carl Wamser (Portland State University), Prof Elisa Tomat (University of Arizona), Prof Sanjib Kar (National Institute of Science Education and Research, India), Dr Jean Jules (Fifen University of Ngaoundere, Cameroon), and Prof Fridolin Nya Tchangnwa (University of Maroua, Cameroon).

Dr Puseletso Mofokeng

A five-year research collaboration was established between Dr Nagi Greesh of the Libyan Advanced Centre for Chemical Analysis and Dr Puseletso Mofokeng from the Department of Chemistry on the Qwaqwa Campus. Dr Mofokeng also established a research collaboration on the project 'Dielectric properties polymer nanocomposites' with Prof Blanka Škipina at the Faculty of Technology at the University of Banja Luka in Serbia. The project will commence in January 2024.

OTHER ACTIVITIES

On behalf of the University, the SA Precious Metal Permit is managed by Eleanor Andrews and supported by the Inorganic Division

Some members of the Department of Chemistry were active members of Faculty committees. Dr Langner served on the Environmental and Biosafety Ethics Committee and was Chairman of the Chemistry Scientific Committee, Prof Erasmus on the Faculty Research Committee, and Prof Moskaleva on the NRF Rating Evaluation Committee.

Prof Visser, Prof Schutte-Smith, Prof Azov, and Prof Wilhelm drive the Small Molecule Unit with the aim of commercialising various molecules ranging from pesticides to pharmaceuticals, and Prof Von Eschwege assists with the commercialisation.

POSTGRADUATE STUDENTS

In 2023 six students graduated with the BSc Honours, majoring in Chemistry.

At Master's level, C Jacobs *(cum laude)* and V Mzinjani graduated with the structured/taught MSc in nanoscience. Eight candidates graduated with the MSc (by research) with specialisation in Chemistry, namely, F De Beer *(cum laude)*, H van Dyk *(cum laude)*, Z Mtshali *(cum laude)*, DIH Maier *(cum laude)*, MM Sebotsa *(cum laude)*, W Smith **(***cum laude)*, M Chukwuma, and K de Jager.

The following candidates completed their Doctoral degrees and graduated:

Abraha, Yuel W

Thesis: Mixed-Linker Zeolitic Imidazolate Frameworks (ML-ZIFS) with applications in the storage and conversion of CO2 to cyclic carbonates

Supervisor: Dr EHG Langner

Chiyindiko, E

Thesis: Synthesis, electrochemistry, and DFT study of benzophenones, hydroxybenzophenones and their Cu complexes

Supervisor: Prof J Conradie

Co-supervisor: Dr EHG Langner

Enslin, Lucy

Thesis: Synthesis, Characterisation, and Cytotoxicity of Rhenium(I) complexes bearing N,N' bidentate ligand scaffolds

Supervisor: Dr M Schutte-Smith

Co-supervisor: Prof HG Visser

Faber, Jani

Thesis: Anticancer and antidiabetic activity of glucosylated benzophenone and xanthone scaffolds.

Supervisor: Prof A Wilhelm

Co-supervisor: Dr SL Bonnet

Motente, Mokete A

Thesis: Hydroxamic Acid N, O Rhodium(I) Complexes As Model Carbonylation Catalysts

Supervisor: Prof A Brink

Co-supervisor: Prof JA Venter

MSc and PhD graduates at the December 2023 graduation – from the left, Dr Jani Faber (PhD), Wilma Smith (MSc with distinction), and Prof Anke Wilhelm (supervisor)

POSTDOCTORAL RESEARCH FELLOWS

The Department of Chemistry hosted 11 Postdoctoral Fellows in 2023, from nine different countries:

- Ajiboye, Timothy — Nigeria
- Elmakki, Mohammed — Sudan
- El Mansouri, Az-eddine — Morocco
- Gomez-Arias, Alba — Spain
- Issahaku, Abdul — Ghana
- Jalali, Elham — Iran
- Malloum, Alhadji — Cameroon
- Matthews, Cameron — South Africa
- Mogale, Refilwe — South Africa
- Naghizadeh, Matin — Iran
- Yahya, Faqir — Pakistan

Okikiola Olaniyan (Moskaleva research group) was selected to deliver an oral presentation at the 44th National Convention of the South African Chemical Institute (SACI) held in Stellenbosch from 8 to 13 January 2023.

Refilwe Mogale was a finalist at Falling Walls in Johannesburg and a Keynote Speaker at the Free State Department of Education Science Quiz.

STAFF MATTERS

Associate Professor Anke Wilhelm

Dr Pennie Mokolokolo accepted a Lecturer's post on the Qwaqwa Campus in June 2023, and Dr Dumisani Kama was appointed as a Senior Lecturer in October 2023.

Dr Anke Wilhelm and Dr Marietjie Schutte-Smith were promoted from Senior Lecturer to Associate Professor.

Dr Kovo Akpomie was appointed as an Affiliated Researcher at the end of 2023

At the end of August 2023, Dr MFT Mosoabisane resigned from the Department and was replaced by Sipho Nyawo. Bernadette van Tonder resigned as a facilitator on the South Campus at the end of June 2023.

Four staff members are pursuing their higher degrees – Mothepane Mbongo and Sipho Nyawo for Master's and Tsietsi Tsotetsi and Rantooa Moji for the PhD.

Associate Professor Marietjie Schutte-Smith

RESEARCH OUTPUTS

Research Articles

Abraha, Y.W., Jacobs, F.J.F., Brink, A. & Langner, E.H.G. 2023. Effect of Solvent Assisted Linker Exchange (SALE) and De Novo Synthetic Routes on CO2 Uptake and Fixation by Mixed Linker Zeolitic Imidazolate Frameworks. *Journal of Inorganic and Organometallic Polymers and Materials* 33: 2058-2074. doi.org/10.1007/s10904-023-02653-5.

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Van Jaarsveldt, J., Marais, C., Van Tonder, J.H. & Bezuidenhoudt, B.C.B. 2023. Synthesis and epoxidation of flav-3-enes as methodology for the biomimetic preparation of flavan-3,4-diols. *Synthesis* 55(17): 2742-2756. doi:10.1055/s-0041-1738441.

Van Tonder, J.H., Marais, C. & Bezuidenhoudt, B.C.B. 2023. The synthesis of symmetrical peripheral and non-peripheral octa-substituted metal-free phthalocyanines: simpler, better, faster, cheaper. *Arkivoc* vii: 202311976. doi.org/10.24820/ark.5550190.p011.976.

Wittstock, G., Bäumer, M., Dononelli, W., Klüner, T., Lührs, L., C. Mahr, C., Moskaleva, L.V., Oezaslan, M., Risse, T., Rosenauer, A., Staubitz, A., Weissmüller, J. & Wittstock, A. 2023. Nanoporous Gold: From Structure Evolution to Functional Properties in Catalysis and Electrochemistry. *Chem. Rev*. 123: 6716-6792. doi.org/ 10.1021/acs.chemrev.2c00751.

Conference Contributions

Conference Papers / Posters

Azov, V.A., De Beer, F., Mashweu, A.R., Hennecke, U., Martin, C. & Ballet, S. 2023. *Stabilizing peptide nanostructures using non-canonical amino acids with donors and acceptors.* Paper delivered at the 44th (SACI) National Convention, Stellenbosch, South Africa. 08-13 January 2023.

Azov, V.A., De Beer, F.J & Ntsila, A. 2023. *Negishi Pd-catalyzed Cross-coupling Reaction in the Synthesis of Unnatural Amino Acids.* Paper delivered at C.A.T.S.A. 2022, Mossel Bay, South Africa. 05-08 November 2023.

Blignaut, J., Visser, H.G. & Schutte-Smith, M. 2023. *Rutenium(II) Komplekse Met Fosfien Knyperligande: Karakterisering en Teenkankertoetse.* Paper delivered at the Studentesimposium in die Natuurwetenskappe 2023, Pretoria, South Africa. 23-24 October 2023.

Bosman, L., Brink, A. & Kama, D.V. 2023. *Rhodium (I) Complexes as greener Model Catalysts for Homogeneous Catalysis.* Poster presented at the SACI National Young Chemists' Symposium, Online. 24 November 2023. (2nd prize for PhD poster presentation).

Brink, A. 2023. *Fragments & Clusters: [Re (CO)3] + on the interface between small molecules & proteins.* Seminar Lecture delivered at Zurich University, Switzerland. 13 July 2023.

Brink, A., Jacobs, F.J.F., Helliwell, J.R., Roodt, A. & Alberto, R. 2023. *The Wonderland of Multinuclear Mn, Tc & Re Complexes in Small Molecule and Macromolecular Drug Development.* Invited Lecture delivered at the 44th SACI. National Convention, Stellenbosch, South Africa. 8-13 January 2023.

Carroll, L. & Moskaleva, L. 2023. *Computational Modelling of Catalysis on Nanoporous Gold: Studying the Self-Organization of Oxygen Atoms, Surface Restructuring and Reactivity with A.I.M.D. Simulations.* Paper delivered at the Joint Workshop of the Department of Chemistry, University of the Free State (UFS), South Africa, and the Institute of Materials Chemistry, Vienna, Austria. 2 June 2023.

Carroll, L. & Moskaleva, L. 2023. *Investigating the catalysis on nanoporous gold surfaces using A.I.M.D. simulations: Self-organization, reactivity and restructuring.* Paper delivered at the 4th International Symposium on Nanoporous Materials by Alloy Corrosion, Nohfelden, Germany. 23-26 April 2023.

Carroll, L. & Moskaleva, L. 2023. *Investigating the self-organization of oxygen atoms on top of nanoporous gold surfaces with and without the effect of additional adsorbates.* Poster presented at the 44th South African Chemical Institute (SACI) Convention, Stellenbosch, South Africa. 08-13 January 2023.

Carroll, L. & Moskaleva, L. 2023. *Self-organization, Restructuring and Reactivity: Computational Modelling of Catalysis on Nanoporous Gold using A.I.M.D. Simulations.* Poster presented at the 17th International Congress of Quantum Chemistry (I.C.Q.C.), Bratislava, Slovakia. 26 June– 01 July 2023.

Cele, S.A., Matthews, C. & Moskaleva, L.V. 2023. *Computational modelling of a prototypical photocatalyst: a zeolite encapsulated TiO_2-supported Cu_5 cluster.* Poster presented at the 44th South African Chemical Institute (SACI) National Convention, Stellenbosch, South Africa. 08-13 January 2023.

Cele, S.A., Matthews, C. & Moskaleva, L.V. 2023. *Computational modelling of a prototypical photocatalyst: a zeolite encapsulated TiO_2-supported Cu_5 cluster.* Paper delivered at the Chem4Energy Conference, Potchefstroom, South Africa. 29 March–02 April 2023.

Conradie. J. 2023. *Ruthenium(II) complexes containing substituted 2,2′:6′,2″-terpyridines: is it possible to predict accurate redox potentials with density functional theory methods?* Keynote address delivered at the 53rd Heyrovský Discussion, Castle Třešť, Czech Republic. 18-22 June 2023.

Conradie. J. 2023. *The redox chemistry of bidentate ligands and their metal complexes: Electronic influence of substituent groups.* Invited Plenary address delivered at the 6th International Symposium on Electrochemistry, ElectrochemSA, University of Johannesburg, South Africa. 03-06 April 2023.

Conradie J., Conradie, M.M. & Mateyise, N.G.S. 2023. *Redox Chemistry of substituted 2,2′:6,2″-terpyridines and their Ru(II) complexes.* Poster presented at the 6th International Symposium on Electrochemistry, ElectrochemSA, University of Johannesburg, South Africa. 03-06 April 2023.

Du Plessis, U., Visser, H.G. & Schutte-Smith, M. 2023. *Die studie van renium en goud metaalverbindings as anti-kanker en anti-mikrobiale middels.* Paper delivered at the Studentesimposium in die Natuurwetenskappe 2023, Pretoria, South Africa. 23-24 October 2023.

Łaski, P., Bosman, L., Drapała, J., Kamiński, R., Brink, A., Szarejko, D., Borowski, P., Roodt, A. & Jarzembska, K.N, 2023 , *Observation of a light-induced short-lived excimer in a crystal of a fluorescent rhodium complex via time-resolved Laue photocrystallography.* Paper delivered at the 26th Congress and General Assembly of the International Union of Crystallography, Melbourne, Australia. 22-29 August 2023.

Liebenberg, L., Schutte-Smith, M. & Visser, H.H. 2023. *Die sintese en evaluasie van 'n reeks amino-ouroonderivate en hul renium(I) trikarbonielkomplekse as moontlike antikankermiddels.* Paper delivered at the Studentesimposium in die Natuurwetenskappe 2023, Pretoria, South Africa. 23-24 October 2023. (3rd prize in session 3C).

Malloum, A. & Conradie, J. 2023. *Method to Calculate the Adsorption Free Energy of a Pollutant as Function of Temperature.* Poster presented at the 4th Commonwealth Chemistry Posters, Online. 4-5 October 2023.

Malloum, A. & Conradie, J. 2023. *Quantum Cluster Equilibrium Prediction of Liquid Ethanol* Poster presented at the 3rd African Conference on Fundamental and Applied Physics (ACP2023), Nelson Mandela University, South Africa. 25-29 September 2023.

Mashweu, A.R, De Beer, F., Bertouille, J., Martin, C., Ballet, S., Hennecke, U. & Azov, V.A. 2023. *Non-canonical amino acids with donors and acceptors for the stabilization of gel-forming peptide nanostructures.* Poster and Flash oral presentation at the 16th Frank Warren Organic Chemistry Conference, Polokwane, South Africa. 03-07 December 2023.

Mateyise, N.G.S, Conradie, M.M. & Conradie, J. 2023. *CV and U.V. of bis(2,2′:6′,2″-terpyridine)ruthenium – application in dye-sensitized solar cell (D.S.S.C.).* Poster presented at the 4th Commonwealth Chemistry Posters, Online. 4-5 October 2023.

Matthews, C. 2023. *A Python script for evaluating 3D 'Tolman cone angle'-based steric descriptors of N-substituents and their modulation of the dimer Au..Au distance.* Poster presented at the 44th South African Chemical Institute (SACI) National Convention, Stellenbosch, South Africa. 08-13 January 2023.

Moskaleva, L. 2023. *What Makes Nanoporous Gold a Unique Catalyst? Insights from Modelling Studies of its Surface Chemistry.* Invited Lecture delivered at the NITheCS Colloquium, Stellenbosch, South Africa. 6 November 2023.

Moskaleva, L., Carroll, L., Li, Y., Dononelli, W. & Bäumer, M. 2023. *Insight into surface chemistry and catalysis on nanoporous gold from modelling studies.* Keynote address delivered at the Chem4Energy Conference, Potchefstroom, South Africa. 29 March–2April 2023.

Ntsila, A., De Beer, F., Mashweu, A.R., Bertouille, J., Martin, C., Ballet, S., Hennecke, U. & Azov, V.A. 2023. *Synthesis of unnatural amino acid comprising donor and acceptor substituents.* Poster presented at the 25th Merck Organic Chemistry Symposium (MOCS), Blankenberge, Belgium. 30 November–12 December 2023.

Olaniyan, O. & Moskaleva, L. 2023. *Ab initio study of the mechano-chemical coupling of Au(221) with chemisorbed oxygen atoms.* Paper delivered at the 44th South African Chemical Institute (SACI) National Convention, Stellenbosch, South Africa. 08-13 January 2023.

Otukile, K.P., Kandpal, S.C., Matthews, C., Chakraborty, S., Moskaleva, L.V., Ramakrishnan, R. 2023. *A Comprehensive Theoretical Investigation of Selected Low-Temperature Hydrocarbon Combustion Reactions.* Paper delivered at the Joint Workshop of the Department of Chemistry, University of the Free State (UFS), South Africa, and the Institute of Materials Chemistry, Vienna, Austria. 2 June 2023.

Otukile, K.P., Kandpal, S.C., Matthews, C., Chakraborty, S., Moskaleva, L.V. & Ramakrishnan, R. 2023. *First-principles based evaluation of rate constants for R + O_2 reactions with R = ethyl, isopropyl, isobutyl, t-butyl and neopentyl.* Poster presented at the 44th South African Chemical Institute (SACI) National Convention, Stellenbosch, South Africa. 08-13 January 2023.

Otukile, K.P., Moskaleva, L.V., Kandpal, S.C., Ramakrishnan, R., Matthews, C. 2023. *A Comprehensive Theoretical Investigation of Selected Low-Temperature Hydrocarbon Combustion Reactions.* Poster presented at the 17th International Congress of Quantum Chemistry (I.C.Q.C.), Bratislava, Slovakia. 26 June–01 July 2023.

Pieterse, T., Marais, C. & Bezuidenhout, B.C.B. 2023. *Natural Product Mimics via Metathesis.* Poster presented at the 22nd European Symposium on Organic Chemistry (ESOC 2023), Ghent, Belgium. 9-13 July 2023.

Roodt, A. 2023. *Appreciating Swiss SA Collaboration: 1994 - 2023+.* Invited lecture presented at the (Goodbye Lecture Symposium: Prof Dr Roger Alberto, University of Zürich, Zürich, Switzerland. 24 August 2023.

Roodt, A. 2023. *Structure/ (Re)activity Relationships in Radiopharmaceutical Coordination Chemistry: Is it Necessary?* Invited Lecture delivered at the 6th EuChemS Inorganic Chemistry Conference, Technical University Vienna, Vienna, Austria. 03-07 September 2023.

Teimouri, S., Potgieter, J.H., Billing, C., Conradie, J., Lundström, M. &Wilson, B.P. 2023. *Indium and Gallium Extraction using Ionic liquids: Experimental and Theoretical Study*. Paper delivered at

E.M.C. 2023, Duesseldorf, Germany. 11-14 June 2023.

Ugwu, D. & Conradie, J. 2023. *Recent Advances in Cancer Drug Discovery using Bidentate ligand complexes.* Poster presented at the 4th Commonwealth Chemistry Posters, Online. 4-5 October 2023.

Van Dyk, H., Brink, A., Mokolokolo P.P. & Erasmus, E. 2023. *A Structural and Electronic Study of Rhodium Cyanoxime Complexes.* Poster presented at the SACI National Young Chemists' Symposium, Online. 24 November 2023. (1st prize for PhD poster presentation).

Van Staden, C., Moskaleva, L.V., Kama, D.V., Schutte-Smith, M., Visser, H.G. & Kroon, R.E. 2023. *Die sintese van bis(difenielfosfien)amien goud(I) en silwer(I) komplekse en die vergelyking van die fotoluminesensiedata.* Paper delivered at the Studentesimposium in die Natuurwetenskappe 2023, Pretoria, South Africa. 23-24 October 2023.

Patents

The P.C.T. Patent titled *"Multinuclear Complexes and their Preparation"* with co-inventors Roodt, A., Alberto, R.A., Frei, A., Mokolokolo, P.P., Bolliger, R., Brink, A. & Kama, D.V. was granted National Phase Filing in South Africa, Denmark, Europe, Japan and U.S.A. during 2023.

STAFF (2023)

Head of Department:
Prof HG Visser

BLOEMFONTEIN CAMPUS:

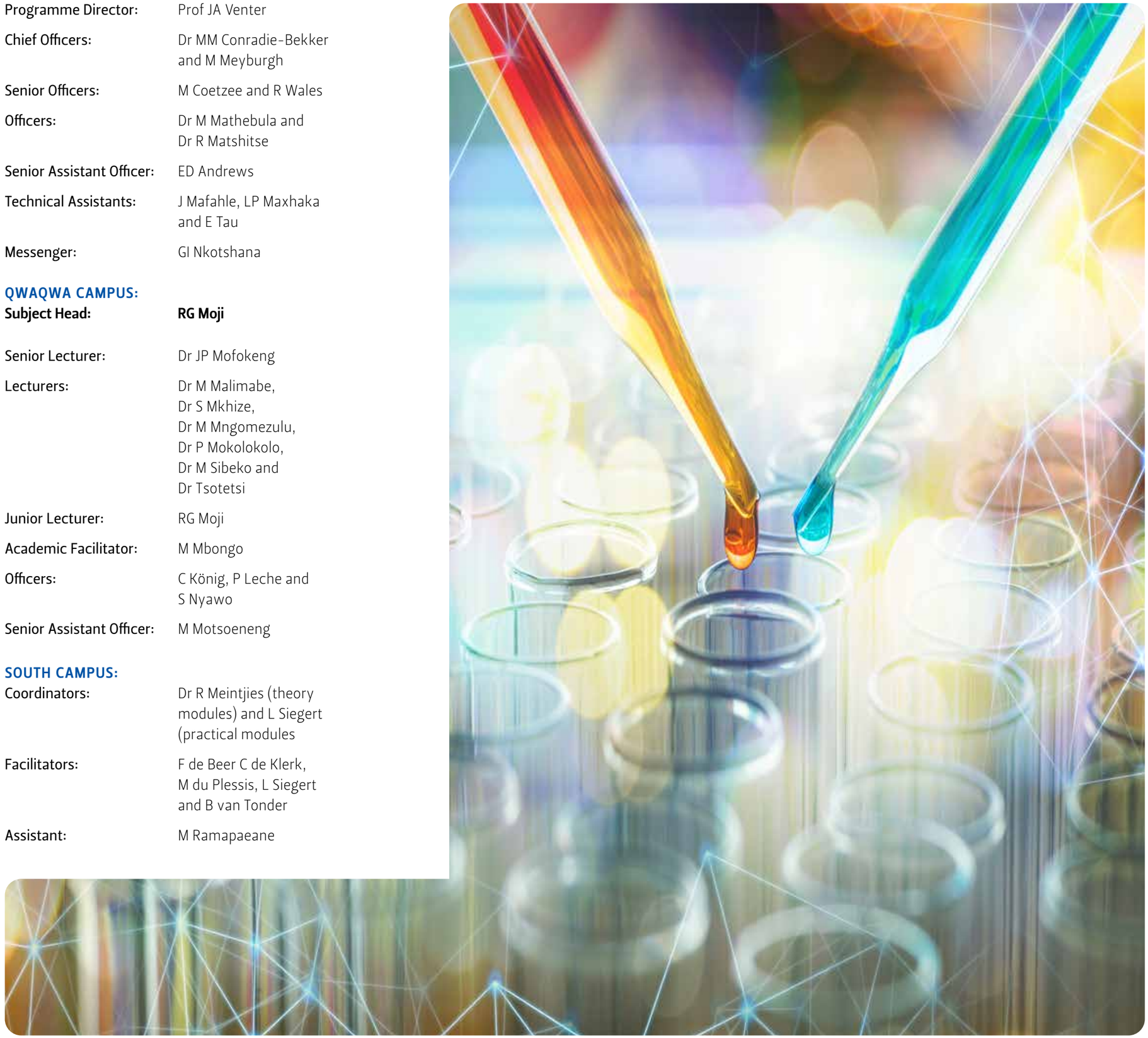
Professors:	Prof VA Azov, Prof W Purcell and Prof HG Visser
Associate Professors:	Prof A Brink, Prof E Erasmus, Prof L Moskaleva, Prof KG von Eschwege and Prof JA Venter
Senior Lecturers:	Dr S Bonnet, Dr DV Kama, Dr EHG Langner, Dr C Marais, Dr E Müller, Dr M Schutte-Smith and Dr A Wilhelm
Lecturers:	N Litheko, Dr R Shago and Dr MR Swart
Researcher:	Dr A Noreljaleel
Research Fellows:	Prof BCB Bezuidenhoudt, Prof J Conradie and Prof A Roodt
Programme Director:	Prof JA Venter
Chief Officers:	Dr MM Conradie-Bekker and M Meyburgh
Senior Officers:	M Coetzee and R Wales
Officers:	Dr M Mathebula and Dr R Matshitse
Senior Assistant Officer:	ED Andrews
Technical Assistants:	J Mafahle, LP Maxhaka and E Tau
Messenger:	GI Nkotshana

QWAQWA CAMPUS:

Subject Head:	**RG Moji**
Senior Lecturer:	Dr JP Mofokeng
Lecturers:	Dr M Malimabe, Dr S Mkhize, Dr M Mngomezulu, Dr P Mokolokolo, Dr M Sibeko and Dr Tsotetsi
Junior Lecturer:	RG Moji
Academic Facilitator:	M Mbongo
Officers:	C König, P Leche and S Nyawo
Senior Assistant Officer:	M Motsoeneng

SOUTH CAMPUS:

Coordinators:	Dr R Meintjies (theory modules) and L Siegert (practical modules
Facilitators:	F de Beer C de Klerk, M du Plessis, L Siegert and B van Tonder
Assistant:	M Ramapaeane



DEPARTMENT OF

COMPUTER SCIENCE AND INFORMATICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

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OVERVIEW OF 2023

The Department of Computer Science and Informatics continues to grow with the increase in undergraduate and postgraduate students. This results in our laboratories being utilised to their total capacity. We completed the upgrade of our new postgraduate laboratory (WWG223) to a hybrid laboratory. As soon as the corresponding venue on the Qwaqwa Campus is completed, real-time Honours lectures will be facilitated between the two campuses. Successful Advisory Board meetings were held in 2023, and valuable input from industry members was implemented where possible. Third-year and Honours students also participated in a week-long work-integrated-learning pilot project with one of our Advisory Board members, BBD Software Development, in Sandton, Johannesburg.

ACHIEVEMENTS

Staff Achievements

Prof Lizette de Wet was appointed as Review Editor on the Editorial Board of *Brain-Computer Interfaces,* a speciality section of *Frontiers in Human Neuroscience.*

Prof Eduan Kotzé was appointed to the Editorial Board of the *African Journal of Information and Communication.*

Student Achievements

Ricus Krause, an Honours student supervised by Dr Wynand Nel and Dr Rouxan Fouché, presented at the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (SAAWK) Student Symposium in Pretoria. His contribution, titled *Blokskakel Fluitjieblaser-Stelsel,* was awarded first prize for being the best project and presentation in his session. He was also awarded the Eureka Prize for Outstanding Contribution to Computer Sciences and Mathematical Sciences.

Ricus Krause with his SAAWK presentation

A paper by one of our Honours students, Jan-Louis du Toit, co-authored by Prof Eduan Kotzé, was accepted for oral presentation at the 2024 International Conference on Artificial Intelligence, Computer, Data Sciences and Applications (ACDSA) at the University of Seychelles.

The South African Centre for High-Performance Computing (CHPC) invited applications from suitably qualified candidates to enter the annual CHPC Student Cluster Competition. The CHPC Student Cluster Competition exposes undergraduate students at South African universities to the High-Performance Computing (HPC) industry. At the CHPC 2023 National Meeting, teams built small HPC clusters on the exhibition floor from hardware provided by the CHPC and industrial partners. We entered two teams from the University of the Free State (UFS) in the competition, one of which came third overall.

The winning team is entered into the International Supercomputing Conference (ISC) Student Cluster Competition hosted at the 2024 International Supercomputing Conference in Germany. Two of our students, Itumeleng Khaka and Nhlonipho Shezi, were selected for the national team and will be competing and training in Germany and the USA in 2024. One of our participating students, Limpho Senatla, was selected as the female student with the most potential in this competition.

Team 5 members, from the left, Nhlonipho Shezi, Kgoboketso Mphahlele, Albert van Eck (mentor), Bophelo Pharasi, and Itumeleng Khaka

TEACHING AND LEARNING

The Electronic Computer Literacy Assessment (ECLA) program is used across the three UFS campuses to assess the first-year computer literacy modules. Usually, four to five thousand students are registered for these modules in an academic year. Continuous expansions and updates are being applied to improve and expand functionality.

RESEARCH AND INNOVATION

Blockchain Technology

The Blockchain Technology research area falls in the 4IR domain and is led by Dr Wynand Nel, assisted by Dr Rouxan Fouché. The research group continued its research on alternative consensus algorithms for blockchain systems. This group focuses on the proof-of-work consensus algorithm of Bitcoin and on creating alternative algorithms that can dramatically reduce the energy requirement of

the Bitcoin network. Furthermore, the group investigates the practical application of Blockchain Technology in the areas of Whistleblowing and NGO financial sustainability. Three Honours students completed their projects with a focus on Blockchain Technology. One PhD student graduated with a thesis focusing on an efficient consensus for permissionless blockchain systems. Currently, one PhD and two Master's students contribute to Blockchain-related projects.

Business Intelligence and Text Mining

The Business Intelligence and Text Mining (BITM) research group, led by Prof Eduan Kotzé, continued working on natural language processing problems, including general text classification, stylometry (authorship), and conversational agents. Prof Kotzé also worked on a machine learning solution for genre classification in an archival context, specifically referring to the National Afrikaans Literary Museum and Research Centre (NALN). The project investigates neural language models to automatically classify documents. Prof Kotzé also worked on a scholarly book with Dr Susan Brokensha and Dr Burgert Senekal. The book, *AI in and for Africa: A Humanistic Perspective*, explores the convoluted intersection of Artificial Intelligence (AI) with Africa's unique socio-economic realities and should provide its readers with a comprehensive overview of how AI is currently being deployed on the African continent. The book was published by CRC Press (Taylor & Francis Group) in 2023.

From the left, Dr Burgert Senekal, Dr Susan Brokensha, and Prof Eduan Kotzé at the launch of their book, 'AI in and for Africa: A Humanistic Perspective'

Computer Science Education

The Computer Science Education (CSE) research group, led by Prof Liezel Nel, continued investigating strategies to enhance student understanding of fundamental concepts in the field of computer science. Prof Nel presented some of this research internationally at the Decoding the Disciplines (DtD) conference in Aachen, Germany and the 19th Conference of the International Society for the Scholarship of Teaching and Learning (ISSOTL) in Utrecht, the Netherlands, during November 2023. These engagements fostered global collaborations and highlighted the group's innovative approaches, including the 'Disciplinary Dream-Drawing' methodology. Currently, two Master's and two PhD students contribute to CSE-related projects.

Eye-Tracking

Prof Tanya Stott continued the collaborative eye-tracking research. The current project investigates gaze movements in both source code and narrative text while reading. Research fellow, Dr Luna Bergh, joined the Department in 2023 and works closely with Prof Stott.

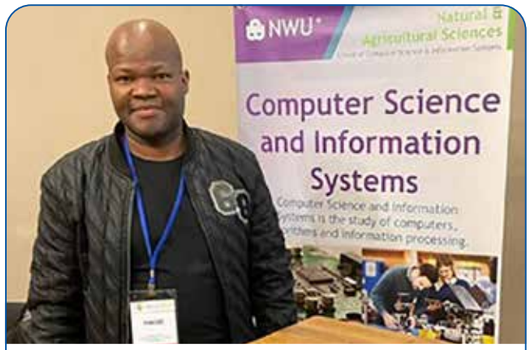
Human-Computer Interaction

The research interest of Prof Lizette de Wet falls within the discipline of Human-Computer Interaction (HCI). The main focus is on evaluating usability and user experience of applications in various disciplines. These evaluations use more traditional evaluation methods, such as observation, questionnaires, and interviews, conducted in a controlled environment (such as a laboratory) or at the venue or environment where the application is used. Evaluation is also undertaken while incorporating physiological methods, such as brain-computer interfaces, of which the Department has a few different versions.

Prof De Wet incorporated virtual reality (VR) into her research area a few years ago. VR environments are created on Honours level as possible additional teaching methods. These environments are subsequently evaluated in terms of their usability and user experience.

Mobile and Digital Technologies

Dr Pakiso Khomokhoana's research focuses on Mobile and Digital Technologies. Using these technologies, he aims to develop interventions/solutions to address topical challenges related to, among others, business activities/operations, by incorporating other relevant technologies, including the Internet of Things (IoT), mobile internet, mobile edge, and cloud computing.



Dr Pakiso Khomokhoana at Southern African Computer Lecturers' Association (SACLA) 2023

Research on Qwaqwa Campus

Dr Andronicus Akinyelu's research interests encompass deep learning, machine learning, medical diagnosis, sustainable agriculture, computer vision, and ethics in artificial intelligence. He developed deep learning-based techniques for COVID-19 diagnosis, crop disease diagnosis, and gaze estimation on mobile devices. He also developed machine learning techniques for electronic fraud detection and Efficient Characterisation of Schottky Barrier Photodiode Internal Parameters. Moreover, he has worked on several medical-related projects covering areas such as brain tumour diagnosis, breast cancer diagnosis, lung cancer diagnosis, and malaria parasite detection.

Gavin Dollman developed a deep learning-based drone ortho mosaic land cover classifier to develop a predictive model for prospecting new fossil sites from the Elliot Formation in South Africa.

Ben Mase is continuing with his PhD project which focuses on exploring how the development of novices' basic programming skills can be advanced using a meta-cognitive scaffolding model.

Adebola Musa's major research interests include machine learning, deep learning, and artificial intelligence.

Dr Ruth Wario's research focus areas are HCI and Information and Communications Technologies for Development (ICT4D). Through ICT4D research, Dr Wario has explored ways in which ICTs can be used to enhance development in the areas of health, agriculture, and education.

merSETA Grant

The Manufacturing, Engineering and Related Services Skills Education Training Authority (merSETA) funds the Research Capacity Building project for postgraduate students in the Department. The purpose of the first project (R7.4 million over three years) was to build the Department's research capacity by expanding our postgraduate programme. We met all the deadlines and delivered our final commitment of ten Honours students and two Master's students at the end of 2023. The merSETA project was successful, and we received a commendation from merSETA for the achievement.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Information Technology Service Learning (ITSL) Project

The CSIS2642 service-learning students provided computer literacy training to participating community members through the annual ITSL project. The ITSL project was organised and implemented for the tenth year by Dr Rouxan Fouché, assisted by Dr Wynand Nel. Individuals from Mangaung and surrounding communities were recruited with the help of our community partner organisations (Mangaung Concerned Residents Organisation, the South African Red Cross, and loveLife) who are responsible for the selection process. The ITSL project included computer literacy training in Microsoft (MS) Word and MS Excel. The training was presented over ten weeks, with classes each Friday from 10:00 to 13:00 in a UFS computer laboratory (the first time since COVID-19), and in Botshabelo, as we did in the past few years.

There are two implementations of the project each year, one at the loveLife Youth Development Centre in Botshabelo and the other at the UFS Bloemfontein Campus of the UFS. The certificate handover ceremony was held on 24 November 2023 and 60 Bloemfontein and 84 Botshabelo participants received certificates. Various stakeholder group speakers addressed and congratulated the project participants during this ceremony.

ITSL Certificate Function held on the Bloemfontein Campus on 24 November 2023.

Robotics Programme

The Department initiated a community project to introduce school learners to logical, computational, and programmatic thinking, thereby nurturing problem-solving abilities. This initiative commenced before the onset of the COVID-19 pandemic and consists of two distinct programmes: Robotics (in which participants engage in the construction and programming of robots employing LEGO EV3 Mindstorms), and Python (which focuses on teaching coding skills using the widely used programming language Python).

The project was revitalised in 2022 and carried forward into the current year. Remarkably, we witnessed an unprecedented turnout, with 25 learners currently enrolled in the Robotics programme and 46 individuals, including learners and UFS students, participating in the Python programme.

The Robotics programme achieved a significant milestone in 2023 when, on 17 August 2023, students organised and participated in their inaugural informal competition. This competition entailed the design and construction of slow-moving car robots. The challenge stretched the boundaries of critical thinking beyond mere coding, as the participants needed to ensure that the car robot's mechanical design deliberately limited its speed. Their efforts culminated in a 'slow car race', effectively determining the winner – or, more precisely, the last participant to cross the finish line. The participants enjoyed the experience and it provided them with valuable opportunities to refine their problem-solving skills along the way.

Participants in the Robotics Competition

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Eduan Kotzé continued to work with Prof Walter Daelemans at the Computational Linguistics and Psycholinguistics (CLiPS) research centre at the University of Antwerp, Belgium. They are jointly working on natural language processing research projects, investigating methods and algorithms to automatically detect abusive language online in South Africa and conversational agents.

Dr Burgert Senekal and Dr Oluwafemi Oriola, from Nigeria, continued their fellowship with Prof Eduan Kotzé's research group. Dr Christa van Staden continued her fellowship with Prof Liezel Nel's research group. Dr Luna Bergh joined the Department as a research fellow, working with Prof Tanya Stott.

Dr Bennie Botha visited higher education institutions in Malawi as part of the 'Digitalisation project for advancing Infection Prevention and Control through the use of Virtual Reality'. As part of the visits, a needs analysis is done, and partnership-building events are organised where the institution can voice its needs and concerns while we seek to foster collaboration and build partnerships for the project and other postgraduate initiatives.

Dr Bennie Botha's virtual reality research

OTHER ACTIVITIES

Ten of our students visited BBD Software Development, for a week-long work-integrated-learning experience before lectures commenced for the second semester. The students enjoyed the experience, although it was challenging. They were joined by other students who were bursary or internship students at BBD. Only our students attended in a work-integrated learning capacity.

During the UFS Career Fair in May 2023, BBD Software Development went above and beyond to engage students in a specialised event. Geared toward third-year and Honours students, this initiative offered advanced insights into BBD's graduate programme and vacation work opportunities. The event featured customised sessions for each group, enabling impactful interactions between students and BBD representatives. Notably, an Honours student session facilitated connections between peers and company representatives, bridging academia and industry while addressing inquiries about BBD's culture and growth prospects.

The collaborative effort between the Department of Computer Science and Informatics and BBD showcased their dedication to equipping students for their professional paths. As the event unfolded, it established a bridge between aspirations and opportunities, linking young minds' ambitions with the promising avenues that await them.

The BBD initiative at the UFS Career Fair, held in May 2023

The Information Technology Student Association (ITSA) played an important role in the opening event of the Sasol Makerspace. Makerspaces are hubs for creativity, collaboration and learning, aiming to bring together a diverse group of makers, thinkers, and enthusiasts who share a passion for innovation and hands-on learning.

Preparing for the Makerspace opening event

POSTGRADUATE STUDENTS

The Department of Computer Science and Informatics staff supervises Honours, Master's, and PhD students at postgraduate level.

We accommodated nine registered PhD students and 15 Master's students. The cohort of Honours students included a record number of 37 students, of whom 25 were first-time Honours registrations in 2023. Of the 37 registered students, 24 were enrolled for the Honours programme in Computer Science and Informatics (CSI), five for Data Science (DS) and eight for our BCIS (B-degree in Computer Information Systems) programme.

Honours students can complete their degree over two years. They must pass an Honours project (year module) in which they are required to identify, plan, analyse, and design either a working system (CSI and DS projects) or a horizontal prototype (BCIS projects). In 2023, there were 19 CSI, five DS, and three BCIS projects.

A record number of 27 Honours project students completed their projects successfully and presented and defended their projects at the annual Honours Project Day, that took place over three days in November 2023. All the registered DS and BCIS students passed their project modules. The average final mark for the projects was 70%, which demonstrated an increase in the quality of the projects delivered.

The increase in the number of project students annually involves a heavier workload for each project supervisor in the Department, as supervision takes place one-on-one. As project supervision is very 'labour intensive' and involves many hours dedicated to the project students, the staff must be commended for their efforts.

Thobani Mhlongo, a Master's student, passed his degree *cum laude* with the dissertation titled 'Determining the Usability, User Experience and Continuance Use of a Mobile Application and Online Portal: A Comparative Case Study'.

Three PhD candidates obtained their Doctoral degrees in Computer Science and Informatics at the 2023 UFS graduation ceremonies. They were:

Bezuidenhout, R

Thesis: Generalised non-linear proof-of-work: Addressing high energy use in decentralised proof-of-work blockchain systems

Supervisor: Dr W Nel

Co-supervisor: Dr Jacques Maritz

Botha, Benjamin S

Thesis: A framework to prevent or minimise cybersickness during immersive virtual clinical simulation

Supervisor: Prof L de Wet

Fouché, Rouxan C

Thesis: Addressing the South African digital divide through a community-informed strategy for service-learning: A critical Utopian action research

Supervisor: Prof L Nel

STAFF MATTERS

Lereko Mohlomi joined the Department as the Technical Assistant on the South Campus, and Dr Bennie Botha joined the Department as a Lecturer on the Bloemfontein Campus. Prof Paul Kogeda and Thabiso Raleteng resigned.

RESEARCH OUTPUTS

Research Articles

Akinyelu, A.A. & Bah, B. 2023. COVID-19 diagnosis in computerised tomography (CT) and X-ray scans using capsule neural network. *Diagnostics* 13(8): 1484-1 - 1484-28. doi.org/:10.3390/diagnostics13081484.

Atsa'am, D.D., Gbaden, T. & Wario, R.D. 2023. A machine learning approach to the formation of earthquake categories using hierarchies of magnitude and consequence to guide emergency management. *Data Science and Management* 6: 208-213. doi.org/10.1016/j.dsm.2023.06.005.

Atsa'am, D.D., Gbaden, T. & Wario, R.D. 2023. Association rules on attributes of illicit drugs, suspect's demographics and offence categories. *Journal of Drug Issues* 53(4): 637-646. doi.org/10.1177/00220426221140010.

Atsa'am, D.D. & Wario, R.D. 2023. Adopting the divide-and-conquer strategy for use of terrorists in counterterrorism through the stag hunt game-theoretic environment. *Journal of Applied Security Research* 18(1): 128-136. doi.org/10.1080/19361610.021.1908814.

Atsa'am, D.D. & Wario, R.D. 2023. Class prediction of the prevalent transmission mode of COVID-19 within a geographic area. *International Journal of Medical Engineering and Informatics* 15(2): 120-130. doi.org/10.1504/IJMEI.2023.129346.

Beelders, T. 2023. Visual search patterns for multilingual word searches puzzles, a pilot study. *Journal of Eye Movement* 16(1): 1-12. doi.org/10.16910/jemr.16.1.6.

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Bezuidenhout, R., Nel, W. & Maritz, J. 2023. Permissionless blockchain systems as pseudo-random number generators for decentralised consensus. *IEEE Access* 11: 14587-14611. doi.org/10.1109/ACCESS.2023.3244403.

Botha, B.S., Hugo-van Dyk, L. & Nyoni, C.N. 2023, Simulating infection prevention and control through virtual reality: a vehicle for equity, diversity, and inclusivity in Africa. *Frontiers in Education* 8(1214321): 1-5. doi.org/10.3389/feduc.2023.1214321.

Bothma, J.D.P., Nel, W. & Fouché, R.C. 2023. 'n Ondersteunende stelsel vir die toets van konsensus-algoritmes. *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 41(1): 115 (Referaatopsomming in joernaal)

Khomokhoana, P.J. 2023. Understanding elements, strengths and challenges of explicit instruction for the teaching of computer programming (to post-graduate students). *Independent Journal of Teaching and Learning* 18(1): 59-80.

Kotzé, E. & Senekal, B. 2023. 'n Pyplyn vir die versameling, ontsluiting en beskikbaarstelling van materiaal vir die Nasionale Afrikaanse Letterkundige Museum en -Navorsingsentrum (NALN) se knipselversameling. *Stilet*, 35(2):38-62. doi.org/10.59507/stilet.2023.35.1.1.

Ocaya, R.O., Akinyelu, A.A., Al-Sehemi, A.G., Dere, A., Al-Ghamdi, A.A. & Yakuphanoglu, F. 2023. Machine learning models for efficient characterisation of Schottky barrier photodiode internal parameters. *Scientific Reports*, 13 (13990): 1-10. doi.org/10.1038/s41598-023-41111-7.

Oriola, O. & Kotzé, E. 2023. Improving the detection of multilingual South African abusive language via Skipgram using joint multilevel domain adaptation. *ACM Transactions on Asian and Low-Resource Language Information Processing* 23(2): 1-28. doi.org/10.1145/3638759.

Senekal, B. 2023. Die neerslag van Russiese propaganda in kommentare op Maroela Media se nuusberigte oor die oorlog in die Oekraïne. *Litnet Akademies* 20(2): 40-67. doi.org/10.56273/1995-5928/2023/j20n2b2.

Senekal, B. 2023. Samesweringsteorieë en vals nuus in leserskommentaar op nuusberigte van Maroela Media tydens die COVID-19-pandemie. *Tydskrif vir Geestewetenskappe* 63(4): 921-945. doi.org/10.17159/2224-7912/2023v63n4a9.

Senekal, B. 2023. The depiction of Orania in print media (2013-2022): A quantitative analysis using natural language processing (NLP). *Communitas* (28): 1-19. doi.org/10.38140/com.v28i.7280.

Senekal, B. & Brokensha, S. 2023. Is ChatGPT a friend or foe in the war on misinformation? A South African perspective. *Communicare: Journal for Communication Sciences in South Africa* 42(2): 3-16. doi.org/10.36615/jcsa.v42i2437.

Van Staden, C. 2023. ChatGPT: Vriend of vyand in die Geografie-vakdidaktiek-klaskamer? Implikasies vir die praktyk. *Litnet Akademies* 21(2): 498-546. doi.org/10.56273/1995-5928/2023/j20n2d5.

Van Staden, C. 2023. 'n Proaktiewe strategie om plagiaat met behulp van ChatGPT-3.51 te bekamp – 'n verkennende ondersoek. *Litnet Akademies* 20(3): 327-366. doi.org/10.56273/1995-5928/2023/j20n3b7.

Van Staden, C. & Nel, L. 2023. Using WhatsApp-based mobile learning environments during abrupt switches to online learning: A duoethnographic account. *Perspectives in Education* 41(1): 195-210. doi.org/10.38140/pie.v41i1.6294.

Books/Chapters in Books

Atsa'am, D.D. & Wario, R.D. 2023. Segmentation of pregnant women to guide how intervention programs are formulated and implemented to ensure positive pregnancy outcomes. In: *Handbook of Research on Quality and Competitiveness in the Healthcare Services Sector*. U. Akkucuk (Ed). Hershey PA, United States of America: IGI Global. pp 304-317.

Brokensha, SI., Kotzé, E. & Senekal, B.A. 2023. *AI in and for Africa: A Humanistic Perspective. (Artificial Intelligence and Robotics Series).* Chapman & Hall/CRC, Boca Raton.

Combrinck, H., Knedik, T., De Villiers, A., Brokensha, S. & Kotzé, E. 2023. Basic digital education and the digital divide in South Africa. A Free State perspective. In: *African Development Perspective 2022/2023: Business Opportunities, Start-ups and Digital Transformation in Africa*. H. Combrinck, T. Knedik, S. Nour, U Schuerkens, K. de Wet & K. Wohlmuth (Eds). Berlin, Germany: Lit Verlag. pp. 391-416.

Mathonsi, T.E., Kogeda, O.P. & Olwal, T.O. 2023. Intelligent intersystem handover delay reduction algorithm for heterogeneous wireless networks. In: *Comprehensive Guide to Heterogeneous Networks*. A. Kiran, A. Nayyar & K. Sharma (Eds). London, United Kingdom: Elsevier. pp. 271-313.

Conference Contributions

Conference Papers / Posters

Bergh, L. 2023. *Holding with hope: A spatiotemporal perspective on Isaiah 41:10*. Poster presented at the 2023 South African Society of Near Eastern Studies (SASNES), Pretoria, South Africa. 3-7 July 2023.

Bezuidenhout, R. & Nel, W. 2023. *Exponentially distributed non-linear proof-of-work saving energy while preserving decentralisation in Bitcoin mining.* Paper delivered at the International Conference on Electrical, Computer and Energy Technology (ICECET) 2023, Cape Town, South Africa. 16-17 November 2023.

Krause, R., Nel, W. & Fouché, R.C. 2023. *Blockchain Whistleblower*. Poster presented at the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (SAAWK), Pretoria, South Africa. 23-24 October 2023.

Nel, W. & Bezuidenhout, R. 2023. *Smart resource trading using blockchain technology*. Poster presented at the 5th National

Global Change Conference. Bloemfontein, South Africa. 30 January 2023-02 February 2023.

Nyaga, C.N. & Wario, R.D. 2023. *Towards Kenyan sign language hand gesture recognition dataset*. Paper delivered at Applied Human Factors and Ergonomics (AHFE) 2023, California, USA. 20-24 July 2023.

Conference Proceedings

Ahishakiye, E., Mwangi, W., Murithi, P., Wario, R., Kanobe, F. & Danison, T. 2023. An ensemble model based on learning vector quantisation algorithms for early detection of Casava diseases using spectral data. In: *Proceedings of International Development Informatics Association (IDIA) 2022*. Mbombela, South Africa. 23-25 November 2022. Communications in Computer and Information Science (CCIS) 2023. P. Ndayizigamiye, H. Twinomurinzi, B. Kalema, K. Bwalya & M. Bembe (Eds). SpringerLink. pp. 320-328.

Khomokhoana, P.J. & Nel, L. 2023. A Framework to assist instructors help novice programmers to better comprehend source code- a decoding perspective. In: *Proceedings of 23rd International Conference in Computational Science and its Applications (ICCSA) 2023*. Athens, Greece and online. 3-6 July 2023. Lecture Notes in Computer Science (LNCS). O. Gervasi, B. Murgante, D. Taniar, B. Apduhan, a. Braga, C Garau & A Stratigea (Eds). Springer. pp. 677-693.

Khomokhoana, P.J. & Wario, R. 2023. Value of explicit instruction in teaching computer programming to post-graduate students: The Kirkpatrick training evaluation model. In: *Proceedings of Annual Conference of the Southern African Computer Lecturers' Association (SACLA) 2023*. Johannesburg, South Africa. 19-21 July 2021. Communications in Computer and Information Science (CCIS). H.E. van Rensburg, D.P. Snyman, L. Drevin & G.R. Drevin (Eds). Springer. pp. 18-33.

Mhlongu, T., De Wet, L. & Verkijika, S. 2023. Determining the user experience and continuance use of a mobile application and an online portal: A comparative case study. In: *Proceedings of International Human Interaction and Emerging Technologies (IHIET) 2023*. Nice, France. 22-24 August 2023. Applied Human Factors and Ergonomics (AHFE). T. Ahram & R. Taiar (Eds.) AHFE Open Access. pp. 419-429

Oriola, O. & Kotzé, E. 2023. A feature selection method based on rough set attribute reduction and classical filter-based feature selection for categorical data classification. In: *Proceedings of International Conference on Applied Informatics (ICAI) 2023*. Guayaquil, Ecuador, 26-28 October 2023. Communications in Computer and Information Systems (CCIS). H Florez & M. Leon (Eds). Springer. pp. 3-15.

STAFF (2023)

Head of Department:
Prof JE Kotzé

BLOEMFONTEIN CAMPUS:

Professor:	Prof P Blignaut (Contract)
Associate Professors:	Prof L de Wet, Prof P Kogeda, Prof E Kotzé, Prof L Nel and Prof T Stott
Senior Lecturer:	Dr W Nel
Lecturers:	Dr B Botha, A Deacon (Contract), Dr R Fouché, L Grobbelaar (Contract), Dr P Khomokhoana, J Marais and T Nkalai
Junior Lecturers:	J Bothma (Contract), C Cilliers, G le Roux (Contract), R Phuthi (Contract) and J Vieira (Contract)
Research Fellows:	Dr L Bergh, Dr O Oriola, Dr B Senekal and Dr C van Staden
Senior Assistant Officers:	S Mocwana, S Radebe (Technical Assistant) and J Stallenberg (Technical Assistant)
Assistant Officer:	R Smith
Officer:	S Opperman

QWAQWA CAMPUS:

Subject Head:	**B Mase**
Senior Lecturer:	Dr R Wario
Lecturers:	Dr A Akinyelu, G Dollman, B Mase and A Musa
Junior Lecturers:	T Lesesa and B Sebastian
Assistant Officers:	M Mahakoe and M Makhanya (Technical Assistant)
Secretary:	P van der Merwe

SOUTH CAMPUS:

Junior Lecturer:	M Thakaso
Senior Assistant Officers:	L Mohlomi (Technical Assistant) and T Raleteng (Technical Assistant)
Assistant Officer:	S de Klerk

DEPARTMENT OF

ENGINEERING SCIENCES

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

Engineering Sciences (EnSci) continued their expansion into research related to the circular economy, energy efficiency, smart grids, and green concrete in 2023, culminating in a total of 33 publications from five staff members.

EnSci expanded the formal number of collaborating universities to accept UFS EnSci graduates to include the University of Pretoria.

The Department received two additional contracts for third stream work on the Circular Economy and Candidate Engineers training and completed all other third stream contracts successfully. Several other research initiatives at EnSci are continuously expanding.

EnSci obtained endorsement from the Engineering Council of South Africa (ECSA), South African Institute for Agricultural Engineers (SAIAE), the Department of Higher Education and Training (DHET), and the Council of Higher Education (CHE) to start a full new engineering programme, BEng (Agricultural and Biosystems Engineering). The final programme number from SAQA is in process and infrastructural and module development plans are underway to start presenting the programme in 2025, upon approval from SAQA.

ACHIEVEMENTS

Staff Achievements

Dr Jacques Maritz was selected for the UFS Future Professoriate programme.

Dr Sogo Abolarin was awarded Professional Engineer (PrEng) status by the Engineering Council of South Africa.

TEACHING AND LEARNING

Students successfully returned to face-to-face (F2F) and blended learning and teaching and benefited from the training of lecturers to be more skilled facilitators on blended learning methodologies.

The annual Bridge-Building competition was held in November 2023 between classes of the Strength of Materials modules, during which participants constructed and tested bridges in front of an audience until they collapsed. This activity was a fun way for the students to supplement theory and develop practical skills.

EnSci student, Nhlanlhla Hlanyane, testing bridges during the annual EnSci Bridge Building competition

Lebohang Mashego and Siyabonga Khumalo loading bridges during the annual EnSci Bridge Building competition

The winners of the annual EnSci Bridge Building competition – Damund de Klerk, Casper Engelbrecht, Tiaan Esterhuizen, and Antonia Ndlovu (photo below) with Dr Abdolhossein Naghizadeh

Gelalelo Monyaki, a second-year EnSci student, and her supervisor, Dr SM Abolarin, presented a keynote address at the UNESCO 9th Africa Engineering Week and 7th Africa Engineering Conference, held at the CSIR from 25 to 29 September 2023, on the topic 'An Approach to Resolving the Integrative Conflicts of Renewable Energy in South Africa: A Technical Overview'. This paper discusses the attainment of

relevant Sustainable Development Goals (SDGs) and determines the renewable energy infrastructure, particularly with regards to the required solar photovoltaic size, for South Africa to meet the clean energy transition based on the variation of solar sun hours of the nine provinces and average national solar sun hours.

Dr Sogo Abolarin and Gelalelo Monyaki at the Africa Engineering Conference

RESEARCH AND INNOVATION

Engineering Sciences opened a new laboratory for circular economy-related research projects in green cement and concrete. The research focuses on advanced concrete technology, specifically on green concrete and eco-friendly cementitious systems. The laboratory facility was expanded to include thermal property tests of 3D printed and other brick walls and is also being used by several outside companies for tests and research purposes. Dr Abdolhossein Naghizadeh was a team member for the project on 3D printing additive technologies for sustainable human settlements in South Africa, conducted by the University of Johannesburg and the Department of Science and Innovation (DSI).

Green concrete testing laboratory at EnSci

Full-scale thermal property testing unit designed and fabricated in the Green Concrete Lab

Dr Naghizadeh, in collaboration with researchers from other local and international universities, including the University of Johannesburg, Nelson Mandela University, and the University of Yaounde in Cameroon, is researching the production of green cement and concrete based on locally available industrial wastes. The aim of this research project is to formulate user-friendly green concrete that can be employed in the construction industry on a large scale.

The UFS Grid Related Research Group (GRRG) continued to be aligned with the UFS Vision 130 by increasing research infrastructure, people, and aligning with the UFS digitalisation plan. The mandate of the GRRG is to contribute to international interdisciplinary open science while growing local academic capacity and research infrastructure. The latter maximises epistemic diversity and inclusive research.

A major achievement in 2023 was the commissioning of the UFS Qwaqwa microgrid, which was conceptualised in 2021. The Qwaqwa microgrid frequency DataStream was successfully integrated into the UFS GRRG and UFS High-performance Computing (HPC) cloud infrastructure for further research and collaborations. This will serve several international research groups with data which is logged on millisecond scale with microsecond time stamping.

Phase 2 of the research on High-performance Engineering Materials (HPEM) commenced with the testing and determination of the financial feasibility of additional passive energy materials.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

The GGRG has synchronised with the UFS Engaged Scholarship vision for the next few years, specifically integrating their outcomes in the GRRG research strategy. We assisted in building and growing a Community of Practice for Engaged Scholarship (CoPES), by providing leadership for engaged scholarship in various departments, schools, and units, as well as in cross- and transdisciplinary initiatives.

Dr Jacques Maritz delivered a number of invited lectures at the UFS on, *inter alia,* the UFS Carbon Report for 2023, interdisciplinary research, the role of physics in power grids, and the Qwaqwa Campus microgrid. He also contributed a number of articles to the popular press, such as to the South African Research Chair in Cities, Law and Environmental Sustainability (CLES) at North-West University on 'Universities as living labs to infer policies to aid the energy crisis', to *University World News* on 'Institution's carbon reporting feeds into its work on SDGs', *Cape Times* on 'Using physics to control and improve our power grid', and *African Physics Newsletter* on 'Exploring the useful stochastic layer of power grids'.

Louis Lagrange served on a number of national bodies, including:

- National Board member of the South African Institute for Agricultural Engineers (SAIAE) and Free State Branch Chairman of the SAIAE;
- National Board member for training of the South African Energy Efficiency Confederation (SAEEC); and
- National Cleaner Production Council of South Africa (NCPC-SA) and Energy and Water SETA team member for the development of the curriculum for a new Quality Council for Trades and Occupations (QCTO) qualification: Energy Management Specialist.

His expertise was also drawn on with regards to developing and presenting training courses, such as the NCPC-SA Resource Efficiency and Cleaner Production (RECP) train the trainer as a team member on expert level courses and presenter of the NCPC training course on 'Eco-industrial parks renewable energy'. He developed and recorded the 'Training on Demand' video sets for the Energy Performance Certificates (EPC) and the Energy Efficiency Technician (EET) training courses. He also served as the International Board member representing Africa for the Certified Lighting Efficiency Professional (CLEP) training and for the Certified Business Efficiency Professional (BEP) training – both for the Association of Energy Engineers (AEE).

Dr Abdolhossein Naghizadeh undertook a study tour in Europe comprising presentations of two research papers, attending three conferences and workshops, as well as several technical meetings and lab visits in the Netherlands, France, Austria, and the Czech Republic. He also presented a workshop on Green Concrete in collaboration with South African Institute of Civil Engineering (SAICE).

GRRG, in conjunction with the UFS HPC, hosted the prestigious National Institute for Theoretical and Computational Sciences (NITHeCS) Summer School in 2023. The 13th CHPC Coding Summer School and the 5th NITheCS Summer School on the Foundations of Theoretical and Computational Science was held at various university campuses from 30 January to 10 February. This was done in collaboration with the CHPC.

Louis Lagrange, Dr Sogo Abolarin and Galeleko

Monyaki, participated in the review process for the Free State Climate Change Adaptation Responses and assisted with identification of future actions with the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs.

EnSci team participating in the Free State Climate Change Adaptation Review

NATIONAL AND INTERNATIONAL COLLABORATION

Engineering Sciences, through Dr Naghizadeh, is leading a collaboration of researchers from the Universities of Johannesburg, KwaZulu-Natal, Nelson Mandela, Central University of Technology, and the University of Yaoundé (Cameroon), and Erzurum Technical University (Turkey), to formulate an eco-friendly construction material called 'green concrete'. The project is aimed to reduce the impact of cement and cement production on the environment.

Dr Naghizadeh also collaborates in a research project on 3D printing additive technologies for sustainable human settlements in South Africa.

An international academic collaboration for joint research was rekindled with the Department of Electrical Engineering, Faculty of Khorramabad, Technical and Vocational University (TVU), Iran. This collaboration focuses on grid protection techniques that encompass an interdisciplinary approach.

The international industry Research and Development collaboration was reconfirmed with Schweitzer Engineering Labs (SEL) in the USA – specifically their grid protection department. This collaboration also focuses on grid protection techniques that encompass an interdisciplinary approach.

Collaborations between the GRRG and KU Leuven and between GRRG and the Norwegian University of Life Sciences were strengthened in co-authored papers submitted to *Heliyon* and the *Journal of Physics: Complexity*.

GRRG students are exposed to international collaborations, open data, and high-performance research groups in order to facilitate long-term strategies to enable graduation with UFS Doctoral degrees.

POSTGRADUATE STUDENTS

Riaan Bezuidenhout graduated with a PhD in Computer Science. The title of his thesis was 'Verifiable Proof of Randomness: Efficient Consensus for Permissionless Blockchain Systems', supervised by Dr Wynand Nel (Department of Computer Science and Informatics) with Dr Jacques Maritz (EnSci) as co-supervisor

As part of our collaboration agreements with other universities, a number of postgraduate students were co-supervised by members of EnSci. Three MEng students, Ntebaleng Lekhera (Central University of Technology, supervised by Dr Rakesh Gopinath), Damund de Klerk (Nelson Mandela University, supervised by Prof Stephen Ekolu), and Johnnie Haefele (University of Johannesburg, supervised Prof Jeffrey Mahachi) are pursuing their studies under the co-supervision of Dr Naghizadeh.

In addition, Dr Abolarin co-supervised an Honours student in Mechanical Engineering at the Department of Mechanical and Aeronautical Engineering at the University of Pretoria. The research is on extended surfaces.

STAFF MATTERS

GRRG staff members without PhDs are on track for obtaining PhDs by the end of 2025.

Sandile Dladla, an EnSci Lecturer, started with his PhD studies in 2023.

RESEARCH OUTPUTS

Research Articles

Abomo, T., Kaze, R.C., Cengiz, O., Alomayri, T., Wilson, T.P., Robert, M.E., Naghizadeh, A. & Kamseu, E. 2023. Impact of the depth of a lateritic profile on the physicochemical, mechanical and microstructural properties of geopolymer binders. *Construction and Building Materials* 403: 133138.

Bezuidenhout, R., Nel, W. & Maritz, J. 2023. Permissionless blockchain systems as pseudo-random number generators for decentralized consensus. *IEEE Access* 11: 14587-14611.

Dladla, S.S. & Workneh, T.S. 2023. Evaluation of the effects of different packaging materials on the quality attributes of the tomato fruit. *Applied Sciences* 13(4): 2100. doi.org/10.3390/app13042100.

Erasmus, S., Esterhuysen, N. & Maritz, J. 2023. Campus Microgrids within the South African Context: A Case Study to Illustrate Unique Design, Control Challenges, and Hybrid Dispatch Strategies. *Energies* 16: 1519. doi.org/10.3390/en16031519.

Erasmus, S. & Maritz, J. 2023. A Carbon Reduction and Waste Heat Utilization Strategy for Generators in Scalable PV-Diesel Generator Campus Microgrids. *Energies* 16: 6749. doi.org/10.3390/en16186749.

Ewim, D.R.E., Abolarin, S.M., Scott, T.O. & Anyanwu, C.S. 2023. A survey on the understanding and viewpoints of renewable energy among South African school students. *The Journal of Engineering and Exact Sciences* 9(2):15575-01e. 1-14. doi:10.18540/jcecvl9iss2pp15375-01e.

Ewim, D.R.E, Abolarin, S.M., Scott, T.O., Opateye, J.A., Uduafemhe, M.E. & Olatunji, O.O. 2023. Experiences of engineering thermodynamics students during online learning: Lessons for post-pandemic. *The Journal of Engineering and Exact Sciences* 9(9): 1-14 16497–01e. doi.org/10.18540/jcecvl9iss9pp16497-01e.

Ewim, D.R.E, Nundlal, Y., Govender, K., Nzuke, N.L., Mbatha, M.V., Gwexa, N., Naido, K., Laseinde, O.T. & Abolarin, S.M. 2023. Knowledge, Awareness and Perception of Senior High School Learners Towards Nuclear Energy: A South African Case Study. *African Journal of Science, Technology, Innovation and Development* 15(7): 1-19. doi.org/10.1080/20421338.2023.2213965.

Fetuga, I.A., Olakoyejo, O.T., Abolarin, S.M., Adelaja, A.O., Ologunoba, S.O., Oluwatusin, O., Fetuata, O., Adewumi, O.O., Robinson, U.D. & Siqueira, A.M.O. 2023. Eulerian-Lagrangian fluid dynamics study on the effects of inlet radial angle on the performance and flow pattern of multi-inlet cyclone separator. *Alexandria Engineering Journal* Q1(78): 453-468. doi.org/10.1016/j.aej.2023.07.058.

Fetuga, I.A., Olakoyejo, O.T., Abolarin, S.M., Adelaja, A.O., Oluwatusin, O., Gbegudu, J.K., Onwuegbusi, A.U., Shitta-Bey, O.T., Meyer, J.P. & Siqueira, A.M.O. Thermohydraulic performance of a semi-alternated twisted tape insert and cylindrical baffles in a tube with ternary nanofluid under sinusoidal wall temperature. *Alexandria Engineering Journal* Q1(73): 607-623. doi.org/10.1016/j.aej.2023.05.005.

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Conference Contributions

Conference Papers / Posters

Abolarin, S.M., Everts, M., Ewim, D.R.E., Adelaja, A.O., Olakoyejo, O.T &, Meyer, J.P. 2023. *Study on the heat transfer and pressure drop power curves for entropy generation in the laminar, transitional and turbulent flow regimes.* Paper delivered at the 8th Thermal and Fluids Engineering Conference (TFEC), American Society of Thermal and Fluids Engineers (ASTFE). Virtual and at University of Maryland, USA. 26-31 March 2023.

Abolarin, S.M., Everts, M., Ewim, D.R.E., Olakoyejo, O.T., Adelaja, A.O. & Meyer, J.P. 2023. *Evaluation of the irreversibility distribution ratio and pumping power using heat transfer and pressure drop power curves of a smooth circular tube with laminar, transitional, and turbulent flows.* Paper delivered at the 17th International Heat Transfer Conference, IHTC-17. Cape Town, South Africa. 14-18 August 2023.

Adewumi, O.O., Adio, S., Olakoyejo, O.T., Abolarin, S.M. & Akinpelu, A. 2023. *Effect of porosity and nanofluid concentration on thermal transfer performance of microchannel heat sink inserted with porous substrate.* Paper delivered at the 17th International Heat Transfer Conference, IHTC-17. Cape Town, South Africa. 14-18 August 2023.

Fetuga, I.A., Olakoyejo, O.T., Abolarin, S.M., Adelaja, A.O., Ewim, D.R.E, Sobamowo, G.M., Gbegudu, J.K., Onwuegbusi, A.U. & Meyer, J.P. 2023. *Numerical investigation of ternary nanofluid flow with combined stent, torus-ring, and grooved twisted tape inserts under a non-uniform temperature wall profile.* Paper delivered at the 17th International Heat Transfer Conference, IHTC-17. Cape Town, South Africa. 14-18 August 2023.

Magugu, K., Ekolu, S.O., Naghizadeh, A. & Quainoo, H. 2023. *Influence of Ferrochrome Slag Co-Binder on Mechanical Behaviour of Fly Ash Geopolymer Mortars.* Paper delivered at the 7th Non-traditional Cement and Concrete Conference, Brno, Czech Republic. 25-28 June 2023.

Monyaki, G.O., Abolarin, S.M. & Lagrange, L. 2023. *An Approach to Resolving the Integrative Conflicts of Renewable Energy in South Africa: A Technical Overview*. Paper delivered at the UNESCO 9th Africa Engineering Week and the 7th Africa Engineering Conference, CSIR, Pretoria, South Africa. 25-28 September 2023.

Ohemeng, E.A., Naghizadeh, A. & Ramabodu, M.C. 2024. *Empirical Model for Predicting Elastic Modulus of CRCA Concrete: An Approach towards Sustainable Concrete Design.* Paper delivered at the 7th Non-traditional Cement and Concrete Conference, Brno, Czech Republic. 25-28 June 2023.

Onyiriuka, E.J., Ewim, D.R.E. & Abolarin, S.M. 2023. *An optimization technique to identify simulation assumptions for various nanofluids using machine learning.* Paper delivered at the 17th International Heat Transfer Conference, IHTC-17. Cape Town, South Africa. 14-18 August 2023.

Conference Proceedings

Tshimpumpu, M. L., Naghizadeh, A. & Mahachi, J. 2023. Structural Performance of Metal Sheeting versus Tiled Roofs under Extreme Winds. In: *Advances in Information Technology in Civil and Building Engineering: Proceedings of ICCCBE 2022* Vol 357. S. Skatulla, & H. Beushausen (Eds). Springer, Cham. pp. 289-306.

STAFF (2023)

Head of Department:
LF Lagrange

Senior Lecturers:	LF Lagrange, Dr J Maritz and Dr A Naghizadeh
Lecturers:	Dr SM Abolarin and SS Dladla
Affiliated Lecturers:	EP Boje, JA Calitz, JJ Haefele and JC Potgieter
Junior Lecturers:	GE Ehlers, SJ Erasmus and S Nel
Affiliated Junior Lecturers:	GD le Roux and IP Scott
Researcher:	C Bornmann
Senior Technician:	HJD Lubbe
Senior Administrative Assistants:	C Du Toit and ZV Mngomezulu

DEPARTMENT OF

GENETICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Genetics underwent an External Review in October 2023, overseen by a panel of three external reviewers, and received a positive review outcome. The Department was commended for having a clear vision, the uniqueness of the programme, and the number of staff members with PhDs.

Teaching and Learning was conducted in 33 modules at undergraduate and Honours levels. One entirely new third-year Genetics module was introduced and the format of several other modules was adapted along with a new approach, with third-year practicals now treated as a distinct module. A total of 24 students were enrolled for MSc and PhD studies in 2023, with a new interdisciplinary combination introduced for the first time. A total of ten MSc and two PhD degrees were awarded in 2023. Research and postgraduate training were conducted in 10 broad fields and this yielded 40 publications, including two papers in the prestigious Nature group. Research also involved a considerable number of collaborations, both locally and internationally. Department of Genetics staff demonstrated notable engagement, participating actively in professional societies, and also collaborating with local organisations relevant to their fields. Additionally, they attended multiple conferences, including one hosted by a staff member. Regarding staffing updates, one member resigned, a new Nurturing Emerging Scholars Programme (NESP) intern was hired, three staff members completed their MSc or PhD degrees, and another received a teaching award. In terms of infrastructure, two new offices were added to the Genetics Building.

ACHIEVEMENTS

Staff Achievements

Prof Renate Rebello received the Khothatsa UFS Teaching & Learning award.

Three staff members submitted their theses at the end of 2023 – Letecia Wessels (PhD in Forensic Genetics), Sue-Rica Schneider (PhD in Genetics), and Mthe Manqana (MSc in Forensic Genetics).

Student Achievements

JC Botha started a two-year term as NESP scholar in the Department. He assists with various aspects of training in Forensic Science, while also working on his MSc.

Ruan Jacobs

Ruan Jacobs (PhD student) received an award for his presentation at the annual Southern African Wildlife Management Association (SAWMA) meeting.

TEACHING AND LEARNING

A total of 15 modules was presented at undergraduate level and 18 modules at Honours level in 2023. Student numbers per module at undergraduate level ranged from 337 in first-year Biology to between 104 and 186 in Genetics modules, and from 40 to 54 in Forensics modules. At Honours level, class sizes per module ranged from 7 to 22 students, with the whole group of 33 taking the Techniques, Literature Review, and Year Project modules. Pass rates in undergraduate modules ranged from 81 to 100%, with a 100% pass rate in all Honours modules for the 2023 period.

A completely new module in third-year Genetics (GENE3703) was completed (developed, taught, and assessed) for the first time, with newly appointed Dr Morné du Plessis as Lecturer. Along with this, three existing Genetics modules (GENE3714, GENE3734, and GENE3744) were presented in a new format with the practical components moved to the new GENE3703. New tutorials were introduced, and credits were reduced from 16 to 12, with the modules now presented as GENE3713, GENE3733, and GENE3743.

The first two interdisciplinary MSc students in Forensic Science, shared with the Department of Anatomy in the Faculty of Health Sciences, were registered for study under Dr Sonja Brink in 2023.

RESEARCH AND INNOVATION

Research in the Department of Genetics is conducted under ten broad themes, which include Behavioural Genetics, Conservation and Population Genetics, Human Genetics, Fungal Systematics, Plant Molecular Genetics and Genomics, Forensic Genetics, Forensic Sciences, Forensic Entomology, Forensic Chemistry, and Wastewater Monitoring.

A total of 40 research papers were published by members of the Department in 2023, compared to 35 in 2022. A highlight for 2023 was that two researchers were co-authors on papers published

or accepted in the *Nature* portfolio of journals. Dr Morné du Plessis was co-author on a paper in *Nature Reviews Microbiology* (with an Impact Factor [IF] of 78), titled 'African microbiomes matter'. Postdoctoral Research Fellow, Dr Soumya Ghosh co-authored a paper in *Nature Climate Change* (IF=28), titled 'Funding African-led Climate Initiative'.

Dr Karen Ehlers and Letecia Wessels attended and presented posters at the 23rd European Forensic DNA Working Group Meeting held in Malta (10 to12 October 2023). They presented on their research which focused on the use of insects to determine the post-mortem interval (i.e. time since dearth) during forensic investigations.

From the left, Dr Letecia Wessels, Dr Karen Ehlers, and Dr John Butler (National Institute of Standards and Technology, USA) at the 23rd European Forensic DNA Working Group Meeting, Malta

Collaborative work performed by Dr Gerda Marx and several collaborators on kidney disease was presented at the XXIIIrd International Congress of Genetics (16-21 July) in Melbourne, Australia.

Prof Paul Grobler received a grant from the International Rhino Foundation for research on white rhino in the Munywane Conservancy in KwaZulu-Natal.

Dr Frank Maleka, with new PhD student Palesa Naidoo, started a project that will entail sequencing the very large nuclear genome of *Clivia miniata*, which has been estimated to be ~19 Gbp. Research agreements in relation to the necessary sequencing resources have already been made with the genomics facility at the South African Medical Research Council (SAMRC) and Diplomics, a Department of Science and Innovation (DSI)-funded entity that promotes omics-research in South Africa. In September, Dr Frank Maleka attended a training workshop at the Diplomics facility in Cape Town that was organised in collaboration with the SAMRC genomics facility. The workshop entailed teaching participants on the use of a high-throughput sequencer that uses the long-read technology. In addition, all university partners were awarded several pieces of equipment (including an ONT Mk1c sequencer) to facilitate the establishment of next-generation sequencing facilities at all partner laboratories.

The wastewater project, involving Prof Grobler, Dr Maleka, and Dr Marx, continues to generate data that is relevant to the Bloemfontein Campus and the greater Mangaung Metro Municipality in terms of tracking the viral load being shed into the wastewater.

The Department acquired a Pippin size fractionator which is an essential tool in the growing genomics research component. This will be utilised to develop workflows that will allow for the characterisation of wildlife populations (particularly non-model organisms) at a genome-wide scale. The significance of this is that it will provide researchers with a cost-effective way to identify genetic variants underlining complex traits and diseases, while also allowing for the detection of fine-scale population structure.

Mushrooms studied by the fungal systematics research group

An application to the South African Health and Products Regulatory Authority (SAHPRA) for a special permit to cultivate psilocybin containing mushrooms for research in human pharmaceutical applications, was successful and the permit awarded. This project is driven by Dr Marieka Gryzenhout, with Zurika Murray and Dr Tinus Viljoen also participating.

Staff involved in the Zebrafish unit and associated research (Prof Paul Grobler, Sue-Rica Schneider, and Alistair Naidoo) are working closely with a new veterinarian (Dr Marieke Badenhorst). These staff members undergo regular training and testing to maintain competency and registration with the South African Veterinary Council (SAVC) to perform restricted activities, such as euthanising fish.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Zurika Murray continued her good collaboration with the Jimmie Roos Special School for Boys. One new MSc project started in 2023 in collaboration with the school. Behavioural Genetics was a topic of interest to social workers and psychologists and during 2023 Zurika Murray co-presented two Continuing Professional Development (CPD) workshops on aspects of aggressive behaviour and substance dependence and abuse.

In March 2023 the first Hogsback Mushroom Festival was presented in Hogsback, Eastern Cape. The day included talks by professional mycologists from across South Africa to citizen scientists, while Dr Gryzenhout gave a general introduction to fungi and the state of fungal biodiversity research in South Africa. The day proved to be thoroughly enjoyed by participants from across South Africa.

Dr Karen Ehlers continued to serve on the National DNA Board, an oversight board tasked with monitoring forensic matters conducted by the SAPS. As part of the DNA Board duties, an oversight report based on visits to all the SAPS forensic laboratories was submitted to the Minister of Police in 2023.

Two staff members, Dr Karen Ehlers and Dr Marieka Gryzenhout, participated in the UFS Industry Engagement Mentoring Programme. Dr Ehlers is now continuing with the Academic Leadership programme.

Prof Paul Grobler was re-elected to the council of SAWMA and was the host for the 2023 annual SAWMA symposium, with co-hosts from the Department of Zoology and Entomology (Dr Hennie Butler) and the Department of Animal Science (Prof Francois Deacon and Dr Beaneiri Janecke). The symposium, held at the Golden Gate Highlands National Park from 10 to 15 September 2023, attracted 170 delegates. Staff members from the Department of Genetics contributed four papers to the programme.

Prof Grobler also served as subject editor for the journals *Mammalian Biology* (Springer) and *African Journal of Aquatic Sciences* (Francis & Taylor).

Dr Morné du Plessis participated as presenter and contributor to two workshops organised by the South African National Biodiversity Institute (SANBI), in the developing field of biodiversity informatics. His role entailed familiarising participants and facilitating the development of an improved understanding of a number of concepts, which included eDNA, metabarcoding, and metagenomics. These workshops were co-presented by international scholars from Spain and Norway as part of a growing partnership in the Global Biodiversity Information Facility.

The Forensic Division of the SAPS visited the Department and Faculty and agreed to a Memorandum of Understanding (MOU) between the UFS and SAPS regarding research and development as well as the development of short courses to address SAPS needs.

Forty (40) Grade 12 learners and two teachers from Dr Viljoen School visited the Department and were hosted by Prof Grobler and Prof Rebello.

Visiting group from Dr Viljoen School

NATIONAL AND INTERNATIONAL COLLABORATION

Staff collaborated with a large number of institutional, national, and international units and scientists in 2023. These included Stéfan Burger (Clinical Psychologist, Jimmie Roos School, Dewetsdorp), Dr Angelique Lewies (UFS Department of Cardiothoracic Surgery), Prof Frank Zachos (Natural History Museum, Vienna), Prof Brian Reilly (Tshwane University of Technology), Prof Jess Jones (Virginia Tech University, USA), Free State Psychiatric Complex, Femspes infertility clinic, UFS Department of Internal Medicine, Pelonomi Hospital, Dr M van der Vyver (Department of Medicine, University of Stellenbosch), Dr D Goedhals and PA Bester (UFS Department of Virology), Dr W Janse van Rensburg (UFS Department of Haematology), South African Doping Control Laboratory (SADoCoL), Prof Errol Cason (UFS Department of Animal Science), Dr Gesine Coetzer (UFS Department of Soil, Crop and Climate Sciences), Prof Rabia Johnson (BRIP Unit, SAMRC), Dr Renee Street (SAMRC), Municipal Health Services of the Mangaung Municipal Metro, Prof Che Weldon (Department of Zoology, North-West University), Dr Riana Jacobs-Venter (Agricultural Research Council), Prof John Wilson (University of Stellenbosch), the Suez Canal University in Egypt, the Global Soil Mycobiome Consortium based in Estonia, Col. Anton Lucassen, Marli de Bruyn (SANBI), and Dr Petra Maas (UFS Department of Anatomy).

POSTGRADUATE STUDENTS

There was a total of 33 Honours, 24 MSc, and 11 PhD students registered in 2023 in the Department of Genetics. The students who graduated in 2023 with the MSc in Genetics were:

- De Jager, JLCE
- Herselman, M (with distinction)
- Hughes, KA (with distinction)
- Janse van Vuuren, H
- Kloppers, GAE
- Maloka, OO
- Magagula, NV
- Marais, J
- Myburgh, MM
- Naidoo, P

The following candidates graduated with the PhD:

Diseko, LG (Genetics)

Thesis: The relationship between host genetic make-up and human immunodeficiency virus in a South African population

Supervisor: Dr G Marx

Dr Gerda Marx with PhD graduate, Lerato Diseko

Komakech, CO (Conservation Biology)

Thesis: Economically viable Eucalyptus species and hybrid clones for commercial afforestation of mined sand dunes in the Richards Bay area of KwaZulu-Natal

Supervisor: Prof A Fossey

Co-supervisor: Prof P Grobler

Dr Komakech at his graduation, with Prof Grobler (left) and Prof Fossey (right)

POSTDOCTORAL RESEARCH FELLOWS

Four postdoctoral fellows conducted research in the Department of Genetics in 2023.

- Dr Z Zhao (from China) continued working in the Evolutionary Generics Group under Prof Grobler.
- Dr M Azeez (from Sudan) joined the Wastewater Monitoring group with Prof Grobler, Dr Maleka, and Dr Marx.
- Dr S Ghosh (from India) and Dr S Ahmed (from Sudan) continued work in the Fungal Systematics Group of Dr Gryzenhout.

STAFF MATTERS

Boipelo Segoje resigned as secretary. Rather than replacing her, the part-time position of Laboratory Manager, held by Bontle Radise, was converted to a full-time position and she now shares her time between lab management and secretarial support to the Department.

RESEARCH OUTPUTS

Research Articles

Achilonu, C.C., Gryzenhout, M., Ghosh, S. & Marais, G.J. 2023. In vitro evaluation of azoxystrobin, boscalid, fentin-hydroxide, propiconazole, pyraclostrobin fungicides against *Alternaria alternata* pathogen isolated from Carya illinoinensis in South Africa. *Microorganisms* 11: 1691. doi.org/10.3390/microorganisms11071691.

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Conix, S., Cuypers, V., Zachos, F.E., Artois, T. & Monnens, M. 2023. A plea for preregistration in taxonomy. *Megataxa* 010(1): 001-014. doi.org/10.11646/megataxa.10.1.1.

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Conference Contributions

Conference Papers / Posters

Cronje, H.P., Reilly, B. & Grobler, J.P. 2023. *The genetic status of fragmented gemsbok populations in the Northern Cape Province, South Africa.* Paper delivered at the Annual symposium of the South African Wildlife Management Association, Golden Gate Highlands National Park, South Africa. 10-15 September 2023.

Ehlers, K. & Wessels, L. 2023. *Forensic Sciences: Education vs. Industry*. Poster presented at the 23rd European Forensic DNA working group meeting, St George's Bay, Malta. 10-12 October 2023.

Jacobs, R., Zachos, F.E., Reily, B. & Grobler, J.P. 2023. *A phylogeographic assessment of the greater kudu (Tragelaphus strepsiceros) across South Africa.* Paper delivered at the Annual symposium of the South African Wildlife Management Association, Golden Gate Highlands National Park, South Africa. 10-15 September 2023.

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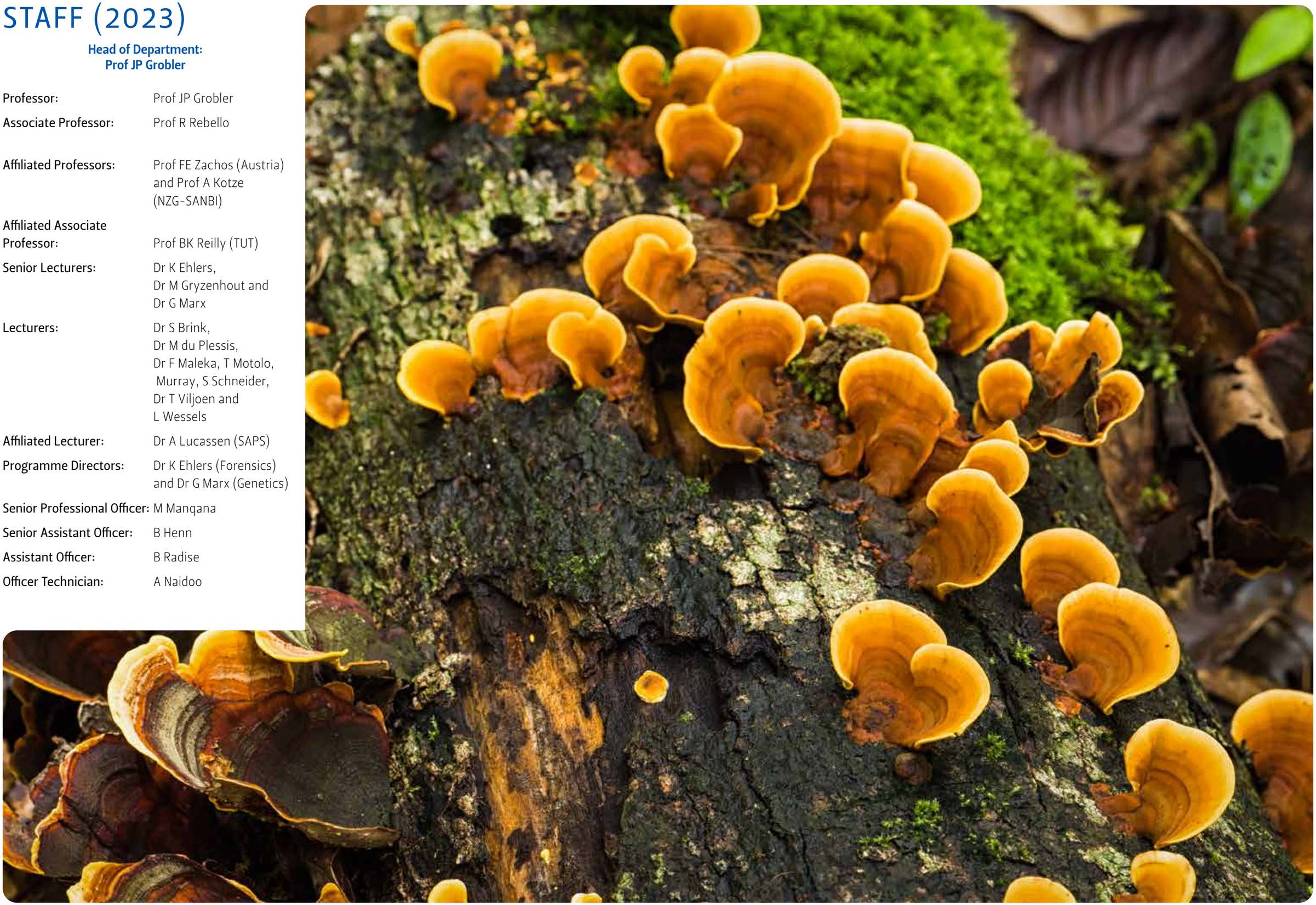
Zachos, F.E. 2023. *Genetics of a common species – diversity, phylogeography and conservation of the European red deer (Cervus elaphus).* Plenary speech delivered at the XIII European Vertebrate Pest Management Conference (XIII EVPMC), Florence, Italy. 28 August-01 September 2023.

STAFF (2023)

Head of Department:
Prof JP Grobler

Professor:	Prof JP Grobler
Associate Professor:	Prof R Rebello
Affiliated Professors:	Prof FE Zachos (Austria) and Prof A Kotze (NZG-SANBI)
Affiliated Associate Professor:	Prof BK Reilly (TUT)
Senior Lecturers:	Dr K Ehlers, Dr M Gryzenhout and Dr G Marx
Lecturers:	Dr S Brink, Dr M du Plessis, Dr F Maleka, T Motolo, Murray, S Schneider, Dr T Viljoen and L Wessels
Affiliated Lecturer:	Dr A Lucassen (SAPS)
Programme Directors:	Dr K Ehlers (Forensics) and Dr G Marx (Genetics)
Senior Professional Officer:	M Manqana
Senior Assistant Officer:	B Henn
Assistant Officer:	B Radise
Officer Technician:	A Naidoo



DEPARTMENT OF

GEOGRAPHY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

Over the past year, the Department of Geography has undergone significant developments and achievements that reflect our commitment to academic excellence and innovation. Firstly, we are excited to announce that the Department of Geography now operates across all three campuses, marking a pivotal expansion with the introduction of an extended programme on the South Campus. This expansion signifies our dedication to providing accessible and inclusive educational opportunities to a broader student demographic. Furthermore, we are delighted to share that our Head of Department has been appointed as the Vice-Dean for Research and Postgraduate Studies in the Faculty of Natural and Agricultural Sciences.

As we celebrate new beginnings, it is also a time of reflection and gratitude. We extend our heartfelt appreciation to Prof Geofrey Mukwada, who retired after a long-standing career as an esteemed academic and mentor within our Department. Prof Mukwada's dedication and guidance have left an indelible mark on the Department's legacy and we wish him a fulfilling retirement.

In line with our commitment to continuous improvement, the Department successfully started a new curriculum and is currently phasing in and restructuring modules. The response to these changes has been overwhelmingly positive, with many Geography students benefiting from an essential skills module early in their first year. This proactive approach ensures that our students have a strong foundation of knowledge to excel in their further studies and future careers.

In conclusion, the Department of Geography remains steadfast in its pursuit of excellence, innovation, and inclusivity. We look forward to the continued growth and success of our Department and the invaluable contributions of our Faculty, students, and stakeholders.

ACHIEVEMENTS

Staff Achievements

Prof Samuel Adelabu was appointed as Vice-Dean for Research and Postgraduate Studies in the Faculty. His portfolio includes promoting impactful research and postgraduate initiatives in line with the University's Vision 130, with a special focus on visibility, renewal, and reimagination. Prof Adelabu's leadership is anticipated to foster a thriving research culture and enrich the postgraduate experience at the UFS.

Dr Katlego Mashiane was awarded his Doctorate during the April graduation, whilst Marike Stander graduated with her PhD in December 2023.

Dr Abraham Matamanda's book, titled *Housing and technology: A special focus on Zimbabwe,* was nominated for the UFS book prize award.

During the XXI INQUA Congress in Rome, Dr Elizabeth Rudolph was nominated to be the early career researcher (ECR) representative for southern Africa on a steering committee for a research group investigating 'Quaternary warm intervals in the Southern Hemisphere'. During the Southern African Association of Geomorphologists (SAAG) biennial conference in Hogsback in October 2023, she took up her role as President of the Association and Marike Stander was elected as the new President-Elect for the 2023 to 2025 term.

Dr Melissa Hansen was selected for the Emerging Scholar Accelerator Programme (ESAP) at the University. Her fellowship of the programme runs from January 2023 until December 2024.

Tobeka Mehlomakhulu chaired the Human Geography session at the Society for South African Geographers (SSAG) student conference that was held on Qwaqwa Campus from 2 to 4 October 2023.

Eldalize Kruger was elected as chair of the International Association for Impact Assessment South Africa (IAIAsa) Free State Branch. She successfully re-established the branch after it disbanded in 2019.

Participants at the IAIAsa National Conference held in Skukuza, (from the left) Izelque Botha (University of Limpopo), Eldalize Kruger (UFS), and Lorato Tigedi (NSVT Consultants)

Dr Adriaan van der Walt was appointed as a member of the Editorial Board of the *African Journal of Climate Studies*.

Student Achievements

Moleboheng Pherane won the award for the best Master's presentation at the SSAG Annual Student Conference, held on the UFS Qwaqwa Campus (from 2 to 4 October 2023). At this conference, Sherylyn Mashabale won the first prize for best Honours presentation, whilst Motselisi Mohanoe won third prize.

On the Qwaqwa Campus, Nthabiseng Sibande and Nhlanhla Nkosi tied for first place in the Geography stream for the Faculty Excellence Award for first-year students in 2023. Tshokolo Dhlamini won the award for second-year students, whilst Tsepo Tsotetsi won the award for third-year students, and Siyanda Shabalala won the Faculty Excellence Award (Geography stream) for Honours students.

TEACHING AND LEARNING

In 2023 the Bloemfontein and Qwaqwa Campuses offered a new course in the first semester, GEOG 1512, Essential Skills for Geography, at first-year level. The module aims to equip students with the skills and knowledge used in Geography. The outcomes include to be able to read and interpret a topographic map, to understand the concept of space through distance, and the orientation of objects and their relation to one another and to express this understanding on a map, to visualise a 3D landscape from 2D map/image, and to be familiar with the basic data types, as well as how to collect/create and store data. The module is team-taught, allowing the first-year students to be systematically introduced to all the staff in the Department. This model worked well and the course received good reviews from students.

Dr Jay le Roux developed and lectured a new first year module GERS1624, titled 'Introduction to GIS & Remote Sensing'.

As part of the Genus Accelerator Programme (GAP), Dr Rudolph, together with colleagues from the UFS Department of Geology and the University of Cape Town's Department of Geology, took interested third-year students on an excursion to Graaff-Reinet and surrounds. The purpose of the excursion was to introduce students to opportunities in palaeoscience and to illustrate the importance of science and development within a community context. This was made possible with the collaboration of Prof Bruce Rubidge and the work he has done on the Karoo's fossil record.

Prof Bruce Rubidge (centre) sharing invaluable knowledge on Karoo fossils

Geomorphology Honours students from the Bloemfontein Campus attended a field excursion and workshop in the Elandsberg, near Hogsback, as part of the SAAG Biennial Conference, funded by the International Association of Geomorphologists (IAG). The workshop aimed to train students in field techniques related to wetland research and studying geomorphic features that are related to slope processes.

Students and lecturers during the SAAG Conference field trip

Tobeka Mehlomakhulu attended the UFS Curriculum Renewal Programme workshop to advance her teaching styles.

Dr Martin Snow and Jucelle Ontong from the South African National Space Agency (SANSA) visited the University on 17 August 2023 to elaborate on the research they are currently undertaking, as well as all the opportunities they offer students.

Prof Adelabu (left) introducing Dr Snow (right) from SANSA, during his visit to the University

The Department of Geography on the Qwaqwa Campus organised a fieldtrip to the Vredefort Dome on 12 May 2023. Seventy (70) students at second-, third-, Honours, and Master's levels participated in the fieldtrip. The Vredefort Dome is a representative part of a larger meteorite impact structure, or astrobleme. With a radius of 190 km, it is also the largest and the most deeply eroded. The Dome bears witness to the world's greatest known single energy release event, which had devastating global effects including, according to some scientists, major evolutionary changes. The Dome was declared a UNESCO World Heritage Site in 2005.

The Department of Geography, Qwaqwa Campus, hosted a fieldtrip to Cathedral Peak in the Drakensberg on 25 October 2023 for second- and third-year students. The third-year Rural Geography students were asked to complete a practical about route tourism and local economic development.

RESEARCH AND INNOVATION

Dr Jay le Roux undertakes research for the Water Research Commission (WRC) project running from April 2022 to March 2024. The research relates to the development of a hydrological soil (HYDROSOIL) map of South Africa. Prof George van Zijl (North-West University) is the project leader. The lack of a detailed and accurate hydrological soil map was identified as hindering progress in hydrological modelling. The current best national soil information dataset, the land type survey, is widely being used for such purposes, but is considered inadequate for various reasons. This study created hydrological soil maps of six ecologically and/or economically priority catchment areas in South Africa, including the Tsitsa River Catchment. Comparing the results and accuracies of the two input datasets (Land Type input versus HYDROSOIL input) allows appraisal of the performance of the data.

Dr Le Roux is also actively involved in another WRC project on a landslide early warning system for South Africa (LEWSSA), running from April 2023 to March 2025. The project leader is Prof Johan van Tol (UFS Department of Soil, Crop and Climate Sciences). South Africa does not have a Landslide Early Warning System (LEWS) and relies only on forecasted rainfall to speculate on the potential of landslides occurring. Historic landslides will be mapped from satellite imagery and groundtruthed to improve and establish an inventory of landslides in coastal areas of KwaZulu-Natal and the Eastern Cape, followed by the creation of a landslide susceptibility map depicting site specific sensitivity to landslides. Rainfall thresholds and soil moisture contents derived from satellite imagery will be downscaled to local scales as surrogate for *in situ* measurements. Finally, cloud-based computing will be used to access open-source satellite imagery, compute antecedent soil moisture, and, together with rainfall forecasts, determine if the thresholds for landslide will be exceeded.

Dr Adriaan van der Walt is one of the collaborators and researchers who received funding from the WRC for a proposed project titled 'Development of climate and water availability indices app to support decision-making across South African water management areas'.

Dr Elizabeth Rudolph's main research activities revolve around reconstructing the palaeo-climate of the Southern Hemisphere through landscape reconstruction of sub-Antarctic islands. She collaborates with national and international researchers and laboratories from the UK and Europe to apply a range of techniques. She is continuously involved with first-hand fieldwork and sample processing to understand landscape-climate interactions and to answer questions related to the rates of landscape and climate change. This research is predominantly funded by the NRF's South African National Antarctic Programme (SANAP) and SA-France bilateral PROTEA frameworks and is affiliated with the Afromontane Research Unit (ARU).

Dr Abraham Matamanda and Dr Andreas Scheba (UFS Centre for Development Support), together with postgraduate students from the Department of Urban and Regional Planning, conducted fieldwork on small scale rental housing in Maseru, Lesotho.

Dr Matamanda (front), Dr Scheba (left), and postgraduate students conducting fieldwork in Lesotho

Dr Melissa Hansen conducted research in 2023 on the social constructions of space in the Maloti-Drakensberg Transfrontier Conservation Area (MDTFCA) and the implications for social justice. The research, which is associated with the ARU, aims to explore the production of space in the MDTFCA, through an analysis of spatial conflict. With inspiration from Henri Lefebvre's theory on the production of space, the research examines dialectical processes of the production of conservation space empirically. The research contrasts top-down processes of spatial production in the MDTFCA, with bottom-up processes of spatial appropriation, which often lead to spatial conflict.

Dr Katlego Mashiane is conducting research on the fire dynamics of the Maloti mountains, a sub-alpine environment located at the foothills of the Drakensberg. Fire is still a predominant land feature in the mountains during the dry season and the prevalence and implications of fire are not well understood in the area. There are concerns that fire and climate change might cause phylogeographic and pyro-diversity shifts. These theories can be tested using remote sensing. In addition, Dr Mashiane conducts research on biodiversity conservation in the Maloti Mountains, developing remote sensing for monitoring and measuring the quantity and quality of natural resources in the area.

Ntebohiseng Sekhele's PhD research looks at the management challenges of protected areas that are associated with surrounding communities resulting from the displacement and economic disenfranchisement of local people. Communities bordered by protected areas, often impoverished, are relocated against their will, yet they depend on conservation areas for food and firewood. Alternatively, these communities are kept out with electric fences. As reported in many developing countries, the conditions of these communities may be worsened by climate change, affecting the main source of communities' livelihoods from primary activities such as agriculture and farming. Two central questions guide the research study. First, what form have park-community conflicts taken in and around the Golden Gate Highlands National Park (GGHNP) and are resulting conflicts because of depleting natural resources in the park, or are communities denied harvesting despite the abundance of firewood, freshwater, non-timber products, medicinal plants, hunting, and healthy grazing land? And more importantly, to what extent has climate change heightened these conflicts?

Solomon Zondo conducted his PhD research in 2023 on climate change in the mountain environments of the Maloti-Drakensberg in South Africa. Located in the rural former Qwaqwa homeland villages and the Witsieshoek Community Conservation Area (CCA), the study assesses the resilience of transhumance grazing systems in the wake of climate change in the Namahadi Catchment Area. The study found that there are emerging methodologies employed by herders in combating challenges brought about by climate change. The study identifies the concept of "emergent resilience" behind the survival of transhumance in the Namahadi Catchment Area.

Solomon Zondo (left) with a transhumance herder near Masaleng Village, Qwaqwa

These findings necessitate in-depth ethnographic research to supplement the historical data to fully understand the societal aspects of transhumance.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Dr Abraham Matamanda was invited to be a guest presenter at the inaugural workshop for the UFS Department of Public Health and Administration, on 23 August 2023. He presented on how postgraduate students can integrate the Sustainable Development Goals in their research.

Dr Adriaan van der Walt published three articles in the public media, shedding light on extreme climate events in South Africa:

- 'Heat stress is rising in southern Africa – climate experts show where and when it's worst, in *The Conversation*, 26 January 2023.
- 'South Africa's cold weather has arrived – some tips on how to stay warm and safe', in *The Conversation*, 10 May 2023.
- 'Weather Bureau warns of another cold front', in *The Sowetan* 19 July 2023.

Dr Adriaan van der Walt

He also formed part of a panel discussion titled 'The future of water in agriculture: access, quality and climate change' at the Bloem Show on 4 May 2023, hosted by the North-West University's Business School in association with AgriConnect and the Bloem Show.

Dr Stander and Dr Rudolph were both part of the organising committee for the Southern African Association of Geomorphologists' Biennial Conference which was held in Hogsback form 27 to 30 September 2023. Dr Rudolph joined collaborators from the University of Fort Hare and Unisa to exhibit their research at the SA Agulhas II Open Day, which was hosted by Department of Fisheries, Forestry and Environment at the V&A Waterfront, Cape Town from 8 to 12 June 2023. The public audience was estimated to be more than 500 school pupils and over 2 000 members of the public.

From the left, Bjorn Boyes (MSc student), Febe Jansen van Vuuren (MSc student), Marike Stander, Dr Elizabeth Rudolph, Zovuyo Yekane (Honours student), Colby Weiss (Honours student), and Dr Jay le Roux in Hogsback during the SAAG Biennial Conference field trip

Prof Geofrey Mukwada, together with Prof Ralph Clark, Director of the ARU and Research Fellow in the Department of Geography, presented in a Land-use Dynamics Postgraduate Course from 6 to 15 March 2023, in the Northern Maloti-Drakensberg. The course was held together with Wageningen University in the Netherlands, and brought together 22 participants, eight from the UFS and others from various European universities, mostly Wageningen. The title of the course was 'Land Dynamics in an Era of Change: Learning from the past to face the future'. The course takes an interdisciplinary perspective to study the complex issues related to the dynamics of the landscape and the development of sustainable systems.

The Department of Geography on the Qwaqwa Campus hosted a community engagement workshop at the GGHNP from 17 to 19 April 2023. The workshop was part of the University Staff Doctoral Programme (USDP) and brought together stakeholders from the University of Venda, Appalachian State

University (ASU), University of Montana, Colorado State University, Department of Higher Education and Training (DHET), the University Capacity Development Programme (funded by DHET), as well as representatives from the Batlokoa Traditional Authority and local community members.

The Qwaqwa Campus also hosted 80 learners from Tsebo Secondary School in Phuthaditjhaba, on the 24 August 2023. The purpose of their visit was to expose them to the automatic weather station and GIS techniques through lectures, observation, and demonstrations. The Department also hosted an Automatic Weather Station (AWS) project workshop on 28 and 29 August 2023 at the Witsieshoek Mountain Lodge. The AWS project is part of the Mountain-to-Mountain Project between the UFS Qwaqwa Campus and ASU in Boone, North Carolina, USA. The theme of the workshop was 'Utilising Automatic Weather Stations in Mountainous Regions: A Workshop on Best Practices and Applications'.

The Qwaqwa Campus attended and participated as exhibitors in an Environmental Awareness and Career Exhibition event that was hosted by the Free State Wetland Forum and other stakeholders, which took place on 1 September 2023 at Mookodi Secondary School, in Maluti-A-Phofung Municipality. The event was attended by learners from various schools in the Municipality, government officials, and traditional leaders.

The Department of Geography, Qwaqwa Campus, hosted the annual SSAG Student Conference, from 2 to 4 October 2023. The conference brought together 112 Honours, Master's, and PhD candidates from universities across South Africa. Dr Felicia Akinyemi (Institute of Geography, University of Bern, Switzerland) and Dr Ernest Daemane (SANParks) were the invited keynote speakers at the conference. The main objective of the SSAG is to advance the research and educational activities of all South African Geographers. One of the ways in which it achieves this objective is through the annual Student Conferences, held annually for the postgraduate student community The conference provides postgraduate students from South African universities with the opportunity to experience a conference environment, network with other students and academics, and present their research. The conference is intended as a nurturing environment with students presenting to their peers and providing a platform to begin a career in research.

Attendees at the SSAG Student Conference, 2 to 4 October 2023, UFS Qwaqwa Campus

The National Focal Point (NFP) nominated Prof Geofrey Mukwada to attend meeting sessions at the United Nations Climate Change Conference 28 (COP28), held in Dubai, United Arab Emirates, from 24 November to 12 December 2023.

Prof Geofrey Mukwada at COP28

NATIONAL AND INTERNATIONAL COLLABORATION

In July, Prof Samuel Adelabu visited the Qwaqwa Campus meteorological stations project set up in the Maloti-Drakensberg to monitor the climate of the highly fragile environment. This project forms part of a joint project between the Department and the ASU in the USA.

From the left, Dr Melissa Hansen, Zandile Mncube, Prof Samuel Adelabu, Prof Geofrey Mukwada, and Dr Efosa Adagbasa, visiting the meteorological stations

Prof Adelabu also led the Department of Geography on a visit to the Appalachian Geography and Planning Department in Boone, North Carolina, from 4 to 15 September 2023, as part of the Mountain-to-Mountain project between UFS and ASU.

From the left, Dr Efosa Adagbasa (UFS) Prof Saskia van de Gevel (ASU), Prof Samuel Adelabu (UFS), and Prof Geofrey Mukwada (UFS) during their visit to the Appalachian State University

Dr Matamanda collaborated on several projects with researchers from Brazil and the United Kingdom on a project on 'Adaptations of young people from monetary poor households to COVID19 pandemic'.

From the left, Dr Stuart Denoon-Stevens (Birmingham University, UK) and Dr Abraham Matamanda (UFS) conducting fieldwork in favelas in Sao Paulo, Brazil

Dr Abraham Matamanda also collaborated with Dr Andreas Scheba (UFS Centre for Development Support) and researchers from the University of Botswana on a project on 'Small-scale rental housing'.

Dr Abraham Matamanda and Dr Andreas Scheba after a collaboration meeting with lecturers from BA ISAGO University and the University of Botswana in Gaborone, Botswana

Dr Adriaan van der Walt is a collaborator and researcher who received funding from the NRF's South African and Japan Joint Collaboration for the project titled, 'Analysis of climate influences on medical conditions and diseases'. As part of this project and to further strengthen collaborations, Dr Van der Walt and 11 other delegates visited Japan from 27 November to 2 December 2023. During the visit the delegates met with Prof Hashizume Masahiro and his research group at the University of Tokyo Graduate School of Medicine's Department of Global

Health Policy, Prof Swadhin Behera and his research group at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) Applications Laboratory, and attended a joint workshop on climate and health at JAMSTEC Yokohama on 29 and 30 November, together with colleagues from the University of Nagasaki and the University of Bologna.

As part of an NRF-PROTEA grant, Dr Elizabeth Rudolph is collaborating with a French laboratory, LN2C - CEREGE, in Marseille, and a research group working in the sub-Antarctic and French Alpine regions. They are working towards palaeo-glacial modelling and palaeo-climate reconstruction of the sub-Antarctic with the application of cosmogenic nuclides.

As part of an interdisciplinary research project, Drs Elizabeth Rudolph and Jay le Roux collaborate with colleagues from the Humanities' Departments of Linguistics and Language Practice, and Art History and Image Studies. This year the project entered its third phase with a fieldwork excursion to the Golden Gate Highlands National Park.

Dr Elizabeth Rudolph continued to collaborate with colleagues from the University of Fort Hare and UNISA on their earth science research on sub-Antarctic Marion Island. Dr Stander joined the team in April on the annual research expedition to Marion Island with the purpose of exploring the suitability of applying new dating and tracing techniques in landscape reconstruction studies.

Marike Stander and Elizabeth Rudolph expanded their expertise in the realm of geochronology at the International Geochronology Summer School hosted by the University of Zürich in Morteratsch, Switzerland. From 27 August to 2 September 2023, they immersed themselves in an enriching academic environment, in which they shared insights from their own research and also delved into the latest advancements in the field. Their participation not only contributed to the exchange of knowledge but also provided them with invaluable opportunities to enhance their skill set.

Marike Stander (left) and Dr Elizabeth Rudolph in front of the Morteratsch Glacier in Switzerland during the International Geochronology Summer School

Prof Ralph Clark, together with L Malekana, Dr Ona Gwate, and M Bereng (PhD candidate in the Department of Geography) participated in the 7th Plant Functional Traits Course (PFTC7), held at the Witsieshoek Mountain Lodge from 1 to 19 December 2023 with online pre-course preparatory work in September and November 2023. This was co-organised by the University of Arizona, University of British Columbia, University of Pretoria, University of Bergen, Norges Miljø og Biovitenskaplige Universitet, Institute for Mountain Hazards and Environment at the Chinese Academy of Sciences, and Oxford University. It was the seventh event in this series and the first in South Africa (and perhaps Africa). It included around 50 people (students, postdocs, early career and established professionals) from around the world, focusing on various ecological and physiological aspects of vegetation and abiotic interactions with elevation at Witsieshoek (2 000 - 3,000 m). It is the first detailed intense elevation sampling activity like this in the Maloti-Drakensberg. It included an overlap with 'RangeX' (an international study of non-native plant invasions in mountains in which the ARU is a participant), which was also the top-most site for the PFTC. The data will go a long way to understanding elevation gradient from various variables and complements existing elevation work at Witsieshoek, such as the Mountain Invasion Research Network (MIREN), Witsieshoek BioBlitz, pollination studies, RangeX and Prof Pete le Roux's (University of Pretoria) fine-scale drivers of biodiversity.

In 2023, Dr Melissa Hansen collaborated with Dr Stefan Schneiderbauer, Jessica Delves, and Dr Stefano Terzi from the United Nations University – Institute for Environment and Human Security (UNU-EHS) Global Mountain Safeguard Research (GLOMOS). The project aims to estimate the population of Qwaqwa using a combination of remote sensing and ground data collection. The most up-to-date population numbers for Phuthaditjhaba provided by Statistics South Africa from the 2011 census are ca. 275,000. However, unofficial estimates put the population as much higher. Using remote sensing to estimate populations in data-scarce or data-poor areas – where *in situ* data collection is unreliable or unsystematic – has been carried out in many settings; however, no such methodology has been applied in Phuthaditjhaba.

POSTGRADUATE STUDENTS

The Bloemfontein and Qwaqwa Campuses had 25 enrolled Honours students (with 20 students graduating), 28 enrolled Master's students and 24 enrolled Doctorate students in 2023.

Three students graduated with the MSc Geography (L Mofokeng, JM Tavener, and J Theunissen), and one student graduated with the MSc Geoinformations (BE Lefulebe).

Seven PhD candidates graduated in 2023. They were:

Collins, Nacelle Berne

Thesis: An alternative approach for large-scale wetland mapping in South Africa

Supervisor: Prof S Adelabu

Daemane, Ernest

Thesis: The spatial distribution of the woodland and grassland communities in the Golden Gate Highlands National Park, Free State, South Africa

Supervisor: Prof S Adelabu

Hadebe, Patronella Emah

Thesis: A comparative assessment of spatial planning of the city of Johannesburg Metropolitan Municipality and the City of Tshwane Metropolitan Municipality in Gauteng, South Africa

Supervisor: Prof S Adelabu

Mararakanye, Ndifelani

Thesis: Quantifying eutrophication from agricultural sources under changing land use and climate in a semi-arid and data poor catchment

Supervisor: Dr J le Roux

Mashiane, Katlego

Thesis: Grass nutrients estimation as an indicator of rangeland quality using satellite remote sensing

Supervisor: Prof S Adelabu

Nhlapho, Mveli Stephen

Thesis: Towards an integrated municipal environmental planning tool for the Thabo Mofutsanyana district of South Africa

Supervisor: Prof G Mukwada

Stander, Marike

Thesis: Sediment source provenance by means of composite fingerprinting technology: towards identifying tracers associated with erodible soils

Supervisor: Dr J le Roux

POSTDOCTORAL RESEARCH FELLOWS

Dr Efosa Adagbasa worked closely with Prof Mukwada on the installation of the weather station project and on research around climate change in the Maloti-Drakensberg.

Dr Colbert Jackson and Dr Femi Durowoju joined the Department in September 2023. They are led by Prof Adelabu and are actively involved in the geospatial lab.

STAFF MATTERS

Dr Adriaan van der Walt was appointed as the new Programme Director on the Bloemfontein Campus and Dr Pululu Mahasa for the Qwaqwa Campus.

Dr Jay le Roux was promoted to Associate Professor, whilst Dr Melissa Hansen and Dr Elizabeth Rudolph were promoted to Senior Lecturers. These positions commence in 2024.

Kholeka Sikhosana was appointed as a Human Geography Lecturer on the Bloemfontein Campus. Her duties commenced on 1 July 2023. Dr Katlego Mashiane joined the Department as a Lecturer in Geoinformatics. He conducts research on biodiversity and conservation in the Maloti-Drakensberg.

Zandile Mncube joined the Department on the Qwaqwa Campus as a Professional Officer. Zandile is responsible for the smooth functioning and transmission of data from each of the five weather stations installed in 2023, to disseminate the data, and to be part of the planning and execution of workshops and presentations pertaining the stations. She also conducts practicals for certain modules in the Department and is responsible for the effectiveness and functionality of the GIS lab and the postgraduate lab.

Prof Geofrey Mukwada retired at the end of 2023, after being at the Department since 2010. Prof Mukwada's contribution to the Department was remarkable as he spearheaded the USDP, the Mountain-to-Mountain project, and the installation of five weather stations at different elevations in the Maloti-Drakensberg.

RESEARCH OUTPUTS

Research Articles

Adams L.D., Giovannoni D., Clark V.R., Steenhuisen, S. & Martin G.D. 2023 Reproductive Ecology of the Invasive Alien Shrub Pyracantha angustifolia in the Grassland Biome, South Africa. *Plants* 12: 1308.

Anderson, R.L., Le Roux, J.J., Van der Waal, B., Rowntree, K.M. & Hedding, D.W. 2023. Assessing the short-term inter-annual growth of the largest documented gully network in South Africa using UAV and SfM methodology. *Physical Geography* 45(3): 284-306. doi.org/10.1080/02723646.2023.2234178.

Bhanye, J., Shayamunda RH, Mpahlo RI, Matamanda, A.R. & Kachena L. 2023. *Land Use Policy* 135. doi.org/10.1016/j.landusepol.2023.106945.

Clark V.R., Hickman A., Szarzynski J., Lombard C. & Hill T. 2023. Guest Editorial for the Special Issue: Southern African mountains – their value and vulnerabilities. *Transactions of the Royal Society of South Africa* 78(1-2): 1-4.

Gwate O., Canavan K., Martin G. D., Richardson D. M. & Clark V.R. 2023. Assessing habitat suitability for selected woody range-expanding plant species in African mountains under climate change. *Transactions of the Royal Society of South Africa* 78: 101-116.

Hořák D., Clark V.R., Njabo K.Y. & Fjeldså J. 2023. Biodiversity across Afromontane environments. *Frontiers in Ecology and Evolution*, 10: 1080119.

Kotzé J., Van Tol J. & Clark V.R. 2023. Africa's First Alpine and Transboundary Long-Term Socioecological Research Platform. *Mountain Research & Development* 43: 1-5.

Leboto-Khetsi L, Mangara F, Dunn M, Manana K, Matamanda, A.R. & Chirisa I. 2023. Off-campus student housing supply and utilization: perspectives of landlords and students in Chinhoyi, Zimbabwe. *South African Geographical Journal* 106(2): 127-143. doi.org/10.1080/03736245.2023.2227150.

Loader, N., Roffe, S. & Van der Walt, A.J. 2023. Spatiotemporal analysis of heavy summer rainfall events across the Free State Province, South Africa: 1981–2022. *South African Geographical Journal*. doi.org/10.1080/03736245.2023.2272894.

Manyuchi, T., Taru, P. & Mukwada, G. 2023. The Role of Spatial Data Infrastructure in Disaster Management: A Review. *SSRN* 4608792. dx.doi.org/10.2139/ssrn.4608792.

Mashiane, K.K., Adelabu, S.A. & Ramoelo, A. 2023. Comparative Analysis of Single Bands, Vegetation Indices, and Their Combination in Predicting Grass Species Nitrogen in a Protected Mountainous Area. *Applied Sciences* 13: 7960.

Mashiane, K.K., Romoelo A., Adelabu, S.A. & Daemane, E. 2023. Assessing environmental factors contributing to plant species richness in mountainous mesic grasslands. *Koedoe - African Protected Area Conservation and Science* 65(1): 1-7.

Mashiane, K.K., Ramoelo, A., Adelabu, S.A. & Daemane, E. 2023. Estimating mountainous plant species richness and diversity for monitoring global change in a protected grassland park. *African Journal of Ecology* 61(3): 636-644.

Matamanda, A.R., Kalaoane R.C.& Chakwizira J. 2023. "Leave us alone": 'Right to the city' of street vendors along Main North 1 Road, Maseru, Lesotho. *GeoJournal* 88: 4473-4491. doi.org/10.1007/s10708-023-10881-y.

Mishra, H., Pandey, B.W., Mukwada, G., De Los Rios, P., Nigam, N. & Sahu, N. 2023. Trapped within nature: climatic variability and its impact on traditional livelihood of Gaddi transhumance of Indian Himalayas. *Local Environment* 28(5): 547-563.

Moloise, S.D., Matamanda, A.R. & Bhanye, J.I. 2023. Traditional ecological knowledge and practices for conservation and management of Savanna ecosystem services in Capricorn District, Limpopo, South Africa. *International Journal of Sustainable Development and World Ecology* 31(1): 29-42. doi.org/10.1080/13504509.2023.2249856.

Mosikidi, T., Le Maitre, N., Steenhuisen, S., Clark, V.R., Lloyd, K.S. & Le Roux, A. 2023. Passive acoustic monitoring detects new records of globally threatened birds in a high-elevation wetland (Free State, South Africa). *Bird Conservation International* 33(e80): 1-8.

Nel, W., Hedding, D. W. & Rudolph, E.M. 2023. The sub-Antarctic islands are increasingly warming in the 21st Century. *Antarctic Science* 35(2): 124-126. Doi.org/10.1017/S0954102023000056.

Nyama, V. & Mukwada, G. 2023. Factors Affecting Citizen Participation in Local Development Planning in Murewa District, Zimbabwe. *Journal of Asian and African Studies* 58(3): 421-437.

Nyama, V. & Mukwada, G. 2023. Role of citizen participation in local development planning in Murewa district. *South African Geographical Journal* 105(3): 329-345.

Nyama, V. & Mukwada, G. 2023. Role of Local Authorities and Public Officials in Encouraging Citizen Participation in Development Planning in Murewa District. *International Journal of Social Science Research and Review* 6(7): 168-181.

Payne, S., Alexander, J.M., Bjorkman, A.D., Clark, V.R., Gwate, O., Huntsaar, M., Iseli, E., Lenoir, J., Mann, H.M.R., Steenhuisen, S. & Høye, T.T. 2023. Deep learning to extract the meteorological by-catch of wildlife cameras. *Global Change Biology* 30: e17078.

Roffe, S. & Van der Walt, A.J. 2023. Representation and evaluation of southern Africa's seasonal mean and extreme temperatures in the ERA5-based reanalysis products. *Atmospheric Research* 284: 106591. doi.org/10.1016/j.atmosres.2022.106591.

Roffe, S., Van der Walt, A.J. & Fitchett, J. 2023. Spatiotemporal characteristics of human thermal comfort across southern Africa: an analysis of the Universal Thermal Climate Index (UTCI) for 1971-2021. *International Journal of Climatology* 1-23. doi.org/10.1002/joc.8009.

Sibanda, W., Hansen, M. & Mukwada, G. 2023. Grappling with Gendered Crises: Women's Access and Participation in Water, Sanitation and Hygiene Activities at Tongogara Refugee Camp, Zimbabwe. *International Journal of Social Science Research and Review* 6(7): 212-228. doi.org/10.47814/ijssrr.v6i7.1462.

Van der Walt, A.J., Kruger, J.A. & Roffe, S.J. 2023 High-resolution analysis of heatwave trends in the Maloti-Drakensberg region, southern Africa: 1979-2021. *Transactions of the Royal Society of South Africa* 78(1-2): 5-15. doi.org/10.1080/003591 9X.2023.2175075.

Vilakazi, B.S. & Mukwada, G. 2023. Curbing land degradation and mitigating climate change in mountainous regions: a systemic review. *Environmental Monitoring and Assessment* 195(2): 275.

Books/Chapters in Books

Dzvimbo, M.A., Matamanda, A.R., Adelabu, S., Van der Walt, A.J. & Mawonde, A. 2023. Understanding the Politics of Climate Change in Zimbabwe. In: *Climate Change Strategies: Handling the Challenges of Adapting to a Changing Climate. Climate Change Management*. Leal Filho, W., Kovaleva, M., Alves, F., Abubakar, I.R. (Eds). Springer, Cham.

Mukwada, G. & Mutana, S. 2023. Surviving the Limits Imposed by a Changing Climate: The Case of Urban Drought and Water Supply Sustainability in Phuthaditjhaba. In: *Sustainable Futures in Southern Africa's Mountains: Multiple Perspectives on an Emerging City*. Cham: Springer International Publishing. pp. 75-89.

Mutana, S. & Mukwada, G. 2023. SDGs as Indicators of Holistic Small Town Tourism Development. A Case for Phuthaditjhaba South Africa. In: *Sustainable Futures in Southern Africa's Mountains: Multiple Perspectives on an Emerging City*. Cham: Springer International Publishing. pp. 141-152.

Sekhele, N. & Otomo, P.V. 2023. Afromontane community's dependence on the water and climate change nexus of the Maloti-Drakensberg mountain range: The case of Phuthaditjhaba. In: *Sustainable Futures in Southern Africa's Mountains.* A Membretti et al. (Eds). Sustainable Development Goals Series.

Conference Contributions

Conference Papers / Posters

Boyes, B. & Rudolph, E.M. 2023. *Constructing a digital Marion Island using Unreal Engine 5 to examine its use for virtual tourism and geo-conservation.* Paper delivered at the Southern African Association of Geomorphologists (SAAG) Biennial, Hogsback, South Africa. 28-30 September 2023.

Canavan, K., Canavan, S., Clark, V.R., Gwate, O., Mapaura, A., Richardson, D.M., Steenhuisen, S.L., Sutton, G. & Martin, G.D. 2023. *Invasive alien plants in South Africa's mountains.* Paper delivered at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Chionwa-Gaza, M. & Matamanda, A.R. 2023. *The place of Civil society organisations in community infrastructure and regional development.* Paper delivered at the Conference on Rethinking the Regional Development Opportunities and Challenges in Southern Africa, University of Zimbabwe, Harare, Zimbabwe. 5-7 July 2023.

Clark, V.R., et al. 2023. *Phuthaditjhaba – Informing the Future for a Sustainable African Mountain City: Perspectives from the UFS-QQ Risk & Vulnerability Science Centre Programme.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Clark, V.R., Burrows, J., Turpin, B., Lotter, M., Balkwill, K. & Siebert, S. 2023. *The Limpopo–Mpumalanga–Eswatini Escarpment: Extra-ordinary endemic plant richness and extinction risk in a summer rainfall montane region of southern Africa.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Gwate, O., Payne, S., Steenhuisen, S., Martin, G.D. & Clark, V.R. 2023. *Exploring mechanisms underlying the success of range expanding plant species in Maloti-Drakensberg mountains, South Africa.* Paper delivered at the Grassland Society of Southern Africa Congress, Rustenburg, South Africa. 24–28 July 2023.

Hansen, M. 2023. *Producing space: Human-mountain relationships in the Maloti-Drakensberg Transfrontier Conservation Area.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Hansen, M., Kudo, S. & Matsuyama, K. 2023. *Trans-local learning – An approach for forming collective learning for sustainability*. Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Hugo, M., Bhanye, J. & Matamanda, A.R. 2023. *Spatial inequalities in transport systems and implications for regional development. A South African perspective.* Paper delivered at the Conference on Rethinking the Regional Development Opportunities and Challenges in Southern Africa, University of Zimbabwe, Harare, Zimbabwe. 5-7 July 2023.

Hugo, M., Bhanye, J. & Matamanda, A.R. 2023. *Urban planning and public transportation: a historical overview of South Africa.* Paper delivered at the International Conference Paradigm Shifts in Local and Urban Governance, IGU Commission Geography of Governance Annual Conference – 2023, Budapest, Hungary. 4-6 September 2023.

Le Roux, J.J., Mararakanye, N., Mudaly, L., Weepener, H.L, van Tol, J.J. & Van der Laan, M. 2023. *Southern African soil, land cover*

and weather generator file databases for SWAT applications. Paper delivered at the International SWAT Conference, Aarhus University and Texas A&M University, Aarhus, Denmark. 28-30 June 2023.

Le Roux, J.J., Morake L., Anderson R.L., Van der Waal, B. & Hedding, D.W. 2023. *How large can gullies be?* Paper delivered at the American Society of Agricultural and Biological Engineers (ASABE) decadal soil erosion symposium, Punta Borinquen Resort, Aguadilla, Puerto Rico. 8 -13 January 2023.

Le Roux, J.J., Van Tol, J.J., Mararakanye, N., Mudaly, L., Weepener, H.L. & Van der Laan, M. 2023. *South African soil, land cover and weather generator file databases for SWAT applications.* Paper delivered at the Southern African Association of Geomorphology Biennual Conference, Hogsback, South Africa. 28-30 September 2023.

Malekana, L., Clark, V.R., Steenhuisen, S., Martin, G.D. & Alexander, J. 2023. *Impact and management of range expanding Rosaceae species along elevational gradients in the Maloti Drakensberg.* Poster presented at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI). Pucón, Chile. 23-25 October 2023.

Malekana, L., Martin, G.D., Steenhuisen, S. & Clark, V.R. 2023. *Impact and management of range expanding Rosaceae species along elevational gradients in the Maloti Drakensberg.* Paper delivered at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Malekana, L., Martin, G.D., Steenhuisen, S. & Clark, V.R. 2023. *Impact and management of range expanding Rosaceae species along elevational gradients in the Maloti Drakensberg.* Paper delivered at the South African Association of Botanists (SAAB) Student Online Symposium. 28 September 2023.

Matamanda, A.R., Dzvimbo, MA, & Paradza, P. 2023. *Universities As Nodes For Regional Development? Insights From Chinhoyi University of Technology, Zimbabwe.* Paper delivered at the Conference on Rethinking the Regional Development Opportunities and Challenges in Southern Africa, University of Zimbabwe, Harare, Zimbabwe. 5-7 July 2023.

Matamanda, A.R., Selemani, W. & Mugumbate, H. 2023. *Urban governance and food systems in secondary cities: contestations and struggles from Chitungwiza, Zimbabwe.* Paper delivered at the International Conference Paradigm Shifts in Local and Urban Governance, IGU Commission Geography of Governance Annual Conference – 2023, Budapest, Hungary. 4-6 September 2023.

Mboyi, L., Clark, V.R., Mapaura, A., Steenhuisen, S. & Canavan, K. 2023. *Invasion patterns and impacts of the grass Nassella tenuissima in the Eastern Cape Drakensberg, South Africa.* Poster presented at the Grassland Society of Southern Africa Congress, Rustenburg, South Africa, 24-28 July 2023.

Mgwele, A. & Matamanda, A.R. 2023. *'Democracy spatial legacies': Implications on South African spatial governance and planning.* Paper delivered at the International Conference Paradigm Shifts in Local and Urban Governance, IGU Commission Geography of Governance Annual Conference – 2023, Budapest, Hungary. 4-6 September 2023.

Nel, W., Rudolph, E.M. & Hedding, D.W. 2023. *A call for geoconservation in the sub-Antarctic: An illustration from the Prince Edward Islands in a South African context.* Paper delivered at the XXI International Quaternary Association (INQUA) Congress 2023, Rome, Italy. 13-20 July 2023.

O'Leary, G., O'Leary, K., Mota, Morena e Moholo M. & Clark, V.R. 2023. *How mountain science is helping mountain tourism & rural communities: A case study of the Batlokoa Community, Witsieshoek Mountain Lodge, Transfrontier Parks Destinations & ARU.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Pherane, M., Matamanda, A.R. & Rudolph, E.M. 2023. *Anthropogenic activities and the sustainability of urban wetland ecosystems.* Paper delivered at the International Conference on Sustainable Development, Online. 18-20 September 2023.

Pherane, M., Matamanda, A.R. & Rudolph, E.M. 2023. *Legislative Framework for Managing Urban Wetlands in South Africa.* Paper delivered at the Society of South African Geography (SSAG) Student Conference, QwaQwa, South Africa. 2-4 October 2023.

Pherane, M., Matamanda, A.R. & Rudolph, E.M. 2023. *Urban wetlands and human environmental footprint and conflict: Case of the Seven Dams Conservancy, Bloemfontein.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Ramasar, V., Caretta, M.A. & Hansen M. 2023. *Envisioning social transformations for a just society: Methodologies for community participation in futures work.* Workshop presented at the South Africa Sweden University Forum (SASUF) Sustainability Forum, University of the Western Cape, Cape Town, South Africa. 29-31 March 2023.

Roffe, S., Van der Walt, A.J. & Fitchett, J.M. 2023. *Spatiotemporal characteristics of human thermal comfort across southern Africa: an analysis of the Universal Thermal Climate Index (UTCI) for 1971-2021.* Paper delivered at the 23rd International Conference of Biometeorology, Arizona State University, Tempe, Arizona, USA. 11-17 May 2023.

Rudolph, E.M. 2023. *Old scopes to new goggles: implementing virtual reality in the South African lecture room.* Paper delivered at the Southern African Association of Geomorphologists (SAAG) Biennial Conference, Hogsback, South Africa. 28-30 September 2023.

Rudolph, E.M., Hedding, D. W. & Nel, W. 2023. *A glacial chronology from sub-Antarctic Marion Island for MIS 3 and MIS 2.* Paper delivered at the XXI International Quaternary Association (INQUA) Congress 2023, Rome, Italy. 13-20 July 2023.

Rudolph, E.M., Hedding, D.W. & Nel, W. 2023. *Approaches to reconstruct the timing and nature of glaciation(s) at sub-Antarctic Marion Island.* Paper delivered at the XXI International Quaternary Association (INQUA) Congress 2023, Rome, Italy. 13-20 July 2023.

Rudolph, E.M., Hedding, D. W., & Nel, W. 2023. *The deglaciation of sub-Antarctic Marion Island.* Paper delivered at the South African National Antarctic Program (SANAP) Symposium, Grabouw, South Africa. 27 November–1 December 2023.

Sekhele, N.M. 2023. *Assessing the impact of climate change on natural resources in the Golden Gate Highlands National Park and adjacent rural communities.* Paper delivered at the 5th National Global Change Conference, Bloemfontein, South Africa. 30 January–2 February 2023.

Stander, M.H., Rudolph, E.M. Treasure, A.M., Lavery, C., Olivier, R. & Rossouw, M. 2023. *Proposed project: Digitisation and preservation of Marion Island's hut books.* Paper delivered at the South African National Antarctic Program (SANAP) PI Symposium, Grabouw, South Africa. 27 November–1 December 2023.

Steenhuisen, S., Martin, G., Moloi, K., Adams, L.D., Gwate, O., Payne, S., Masole, P., Malekana, L., Downs, C. & Clark, V.R. 2023. *When roses go rogue: Expanding ranges of invasive Rosaceae in South Africa.* Paper delivered at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Van der Walt, A.J. & Fitchett, J.M. 2023. *Exploring extreme warm temperature trends in South Africa: 1960-2016.* Paper delivered at the 23rd International Conference of Biometeorology, Arizona State University, Tempe Arizona, USA. 11-17 May 2023.

Research Reports

Andres, L., Moawad, P., Kraftl, P., Denoon-Stevens, S., Marais, L., Matamanda, A., Bizzotto, L., Giatti, L. 2023. *The Impact of COVID-19 on Education, Food & Play-Leisure and Related Adaptations for Children and Young People: International and National Overviews.* PANEX-Youth WP2 Full Report, London. https://panexyouth.com/.

Andres, L., Moawad, P., Kraftl, P., Denoon-Stevens, S., Marais, L., Matamanda, A., Bizzotto, L., Giatti, L. 2023. *The Impact of COVID-19 on Education, Food & Play-Leisure and Related Adaptations for Children and Young People: International Overview.* PANEX-Youth WP2 Short Report, London; https://panexyouth.com/.

STAFF (2023)

Head of Department:
Prof SA Adelabu

BLOEMFONTEIN CAMPUS:

Associate Professors:	Prof SA Adelabu and Prof JJ le Roux
Senior Lecturers:	Dr A Matamanda and Dr AJ van der Walt
Lecturers:	E Kruger, T Mehlomakulu, Dr EM Rudolph, K Sikhosana and MH Stander
Research Fellows:	Prof J Boardman, Prof K Chatiza, Dr R Massey, Dr A Ramoelo, Dr R Rapolaki and Dr S Roffe
Senior Officer:	N van Dyk
Officers:	S Brits and Dr K Mashiane

QWAQWA CAMPUS:

Subject Head:	**Dr MM Hansen**
Professors:	Prof G Mukwada
Lecturers:	Dr MM Hansen, Dr P Mahasa, Dr K Mashiane, N Sekhele and S Zondo
Research Fellows:	Prof VR Clark, Prof S Kudo, Dr S Schneiderbauer and Dr M Tongwane
Academic Facilitators:	K Mhlanga, S Ngwenya and N Radebe
Officer:	Z Mncube
Senior Assistant Officer:	M Lebeko

SOUTH CAMPUS:

Facilitator:	R Mukwevo

DEPARTMENT OF

GEOLOGY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Geology is responsible for teaching and research in the geological sciences at the University of the Free State (UFS). The Department offers five undergraduate, three Honours, and four MSc programmes (Geology, Geochemistry, Environmental Geology, and Mineral Resource Management [MRM]), as well as the PhD by research. The Department offers 19 undergraduate modules, 10 Honours, and 12 structured MSc (MRM) modules.

2023 has been a very busy and productive year for the Department in all areas of activities.

In 2023, the Department enrolled a total of 206 students (111 undergraduate (for BSc), 17 for BSc Honours, 66 for MSc (47 in MRM, 19 in Geology, Geochemistry and Environmental Geology), and 12 for PhD. A total of 50 students completed their studies (26 BSc, 17 BSc Honours, 3 MSc [MRM], and 4 PhDs).

The conferment of PhD degrees on four candidates of which two are the staff of the Department – Jarlen Keet and Megan Welman-Purchase – was the highlight of the 2023 teaching and learning project. The Department has also performed well in terms of research outputs by publishing 41 peer-reviewed articles and delivering 22 conference papers and three posters at various international and national conferences.

In terms of expanding the research endeavours of the Department, 2023 saw the establishment of the Centre for Advanced Orebody Knowledge (AOK) under the South African Mineral Resource Development Initiative (SAMERDI) project funded by the Council for Scientific and Industrial Research (CSIR). The Centre's computing facility, which is equipped with high-performance computers for postgraduate students (MSc, PhD) and Postdoctoral Research Fellows, has become fully functional.

ACHIEVEMENTS

Staff Achievements

Doctoral degrees were conferred on Jarlen Keet and Megan Welman-Purchase. Prof Frederick Roelofse obtained an NRF C2-rating, having previously held a Y2-rating. Justin Wayne Nel was promoted to a Lecturer position.

Prof John Carranza delivered a keynote lecture on 'Exploration Information System – linking of mineral systems and mineral prospectivity mapping' at the 29th Colloquium of African Geology, held from 26 to 29 September 2023, in Windhoek, Namibia.

Dr Jarlen Keet (left) and Dr Megan Welman-Purchase (right) after the conferral of their doctoral degrees

Student Achievements

The Department of Geology annually recognises the best-performing students in first-, second-, and third-year categories by awarding prizes and financial incentives, sponsored by the Department and supporters. The best and second-best student prize-winners in 2023 were Bonginkosi Mofokeng, and Marius Smit (first-year), Praise Ngwenya and Abulele Marwanqa (second-year), and Seeabi Molato and Tshireletso Khasuli (third-year). The Department would like to thank our loyal and generous sponsors of the annual Best Geology Student awards, namely Kumba Resources Ltd, Philip Fouche, Wiley Publishers, and the Professional Provident Society (PPS) Insurance Company Ltd.

Recipients of the 2023 Best Geology Student awards at the Faculty prize-giving, top left, Abulele Marwanqa, top right, Praise Ngwenya, below left, Seeabi Molato, and below right, Tshireletso Khasuli

Doctoral candidate Samkelo Radebe won an award in the Faculty Flash Facts competition

TEACHING AND LEARNING

The Department offers five undergraduate programmes for the BSc, majoring in Geology, Environmental Geology, Geochemistry, Geology and Chemistry, and Geology and Physics. The modules presented by the Department attempt to integrate theory, laboratory, and geological field investigations, and most include visits to mines and mineral processing plants, geoscientific laboratories, or research centres. At the undergraduate level, the first-, second, and third-year students visited various geological sites to study the different geological aspects pertinent to the respective modules.

Second-year sedimentary geology students on the field trip to Fouriesburg, eastern Free State, led by Dr Robert Muir

Second-year field excursion to Austin's Post accompanied by Justin W Nel

Third-year students, accompanied by Prof Freddie Roelofse, visited the Big Hole Museum in Kimberley and were introduced to the geology of diamonds and the town's mining history

Honours sedimentary geology students busy with stratigraphic correlation and subsurface geology interpretation

Exploration and Economic Geology class with Prof John Carranza

Students from Advanced Structural Geology (Hons) participating in the yearly field mapping excursion to the Vredefort Impact Structure

RESEARCH AND INNOVATION

The Department of Geology is expanding its research and innovation activities in various sectors of geological sciences.

Prof John Carranza is involved in several activities in two major EU-funded projects, namely Exploration Information System (EIS) and the Sustainable Exploration for Orthomagmatic Critical Raw Materials, in the EU Charting the Road to the Green Energy Transition (SEMACRET) research project. Prof Carranza is involved in the testing of a computer EIS wizard developed in another work package of the same project using real data from the project's test sites in Europe, and test case studies and assessment for lithium-tin-tantalum-tungsten mineral potential in granite/pegmatite-related systems. The test case study in South Africa is the 450-km-long Orange River pegmatite belt.

In the SEMACRET project, Prof Carranza is responsible for 2D prospectivity modelling by integrating multi geo-data obtained from publicly available geo-databases of the Geological Survey of Finland, as well as for machine learning on 3D prospectivity modelling and resource modelling at three project sites using data sets provided by the Czech Geological Survey, Polish Geological Institute, and Geological Survey of Finland.

Prof Carranza is also the research competence leader of the Centre for AOK under the SAMERDI funded by CSIR. The AOK Centre was launched in early 2023 and has subsequently established the governance of the Centre, set up a computing facility equipped with high-performance computers, and recruited postgraduate (one PhD and two MSc) students.

Postgraduate students in the newly established Advanced Orebody Knowledge (AOK) Lab

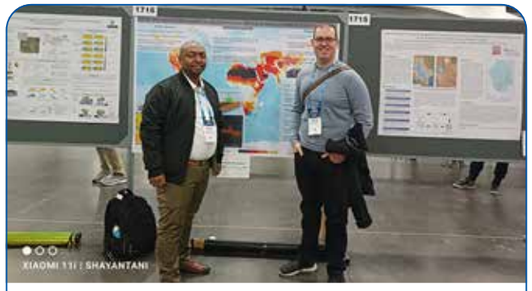
Prof Freddie Roelofse's involvement on the steering committee of the International Continental Scientific Drilling Program (ICDP) Bushveld Drilling Project (BVDP) continued during the year, with drilling on the Eastern Limb of the Complex likely to kick off in early 2024. As a member of the steering committee, he is collaborating with partners at the University of the Witwatersrand (Prof Lew Ashwal and Prof Susan Webb), the GFZ German Research Centre for Geosciences (Dr Robert Trumbull), and the Friedrich-Alexander University (Prof Reiner Klemd). Prof Roelofse also continued to serve as chairman of the Paleoproterozoic Task Group of the South African Committee for Stratigraphy (SACS) and as a member of the South African National Committee for the ICDP. As a member of the ICDP-BVDP steering committee, Prof Roelofse was invited to attend the sampling workshop of the ICDP Barberton Archean Surface Environments (BASE) workshop in Spandau, Germany. He was also invited to become involved in the project as an investigator of the volcanic rocks intersected by the BASE drill cores and returned to South Africa with a suite of samples collected at the workshop. He was accompanied by Justine Magson, who was heavily involved with the logging of drill core material that was donated to the ICDP-BVDP project. During the same visit, Prof Roelofse also met with collaborators working on the ICDP-BVDP project (Dr Robert Trumbull and Dr Ilya Veksler, from GFZ) in Potsdam and at the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) in Hannover (Dr Wilhelm Nikonow and Dr Dieter Rammlmair).

Prof Roelofse, Dr Jarlen Keet, and Justine Magson participated in the 14th International Platinum Symposium in Cardiff that took place from 4 to 7 July 2023, where they collectively presented three papers and a poster.

The Merensky Group for Airborne Geological Image Classification (MAGIC), which is led by its principal investigator, Dr Martin Clark, celebrated the third year of its inception. In 2023, the Group refined its research focus and attended national and international conferences at which its students presented papers. The Group also welcomed its first Postdoctoral Research Fellow who began a new project within MAGIC's research focus. With a refined research focus, the growing alignment of projects in the group aims to resolve key questions and remotely identify elements and their concentrations. The use of drones, which are a central tool for the Group, aim to yield the correct type of imagery in areas where satellite or aerial data is incomplete or inapplicable. With a certified drone pilot, MAGIC's drones are the first in the UFS that are compliant to operate. The MAGIC is poised to acquire a new hyperspectral imaging system in 2024, along with the start of a new research project.

In December 2023, Dr Martin Clark, Dr Shayantani Ghosal (Postdoctoral Research Fellow), and Samkelo Radebe (PhD Candidate) contributed to discussions in geoscientific argumentation and remote mineral and groundwater exploration at the American Geophysical Union (AGU) Fall Conference in San Francisco. Dr Clark's talk focused on the concept of 'Seeing is believing' and how transdisciplinary comprehensive argumentation is necessary for effective geoscientific investigation. Dr Ghosal's talk presented preliminary findings on the efficacy of ASTER and Sentinel-2A satellite imagery in mapping iron and manganese in South Africa's Maremane Dome, while Samkelo Radebe presented a poster on how vegetation indices can be harnessed to understand the effect of dolerite dikes on groundwater, with specific emphasis on effective groundwater management for the main Karoo Basin of South Africa.

From the left, Dr Jarlen Keet, Prof Freddie Roelofse, and Justine Magson at the 14th International Platinum Symposium in Cardiff



PhD candidate, Samkelo Radebe (left) and Dr Martin Clark at the American Geophysical Union (AGU) Fall Meeting in San Francisco

Justine Magson continued with her PhD research on a project titled 'Probing magma dynamics and mineralization in the Bushveld Complex using high-resolution, multi-isotope (Sr-Nd) analysis across major compositional and mineralogical discontinuities'. Justine is expected to complete her PhD by the end of 2024 to be capped in early 2025.

Justin Nel continued his research on the investigation of the structural and metamorphic evolution of the Namaqua Mobile Belt together with Prof Wayne Colliston, an affiliated member of staff of the Department.

The Department continued to collaborate with the DSI-NRF Centre of Excellence for Integrated Mineral and Energy Resource Analysis (CIMERA), jointly hosted by the Department of Geology at the University of Johannesburg (UJ) and the School of Earth Sciences at the University of the Witwatersrand (Wits). In 2023 one PhD student and one MSc student were funded by DSI-NRF CIMERA.

Dr Robert Muir started the Genus Accelerator Programme (GAP), an outreach programme designed to retain talent in the palaeosciences among under-represented groups. The programme includes a four-day field trip during which four undergraduate students from the UFS Geology and Geography Departments learn new skills that will help them in their postgraduate studies and outside of them. This is an NRF-funded initiative.

Dr Robert Muir, Dr Martin Clark, Thendo Mapholi, Justin Nel, Ernest Moitsi, Prof Bisrat Yibas, and Siphokazi Madaka (Honours student) attended Geocongress 2023, held in Stellenbosch from 11 to 13 January 2023, during which they delivered ten papers and presented two posters.

Dr Hendrik Minnaar's study on U-Pb zircon and monazite dating of migmatite leucosomes in the Paleoproterozoic Steinkopf Gneiss, Namaqua Metamorphic Province, is near completion.

Dr Robert Hansen continued his biogeochemistry research investigating mine drainage environments and mine tailings underground disposal, b) the mine impacted Welkom wetlands, c) the Berg River estuary and riparian wetlands, and d) environmental geochemistry and optimisation of the Zaalklapspruit constructed wetland.

The mine drainage projects are focused on the biogeochemistry of the disposal of gold mine tailings in underground mine voids. The Zaalklapspruit wetland project is focused on the optimisation of the wetland depending on the contaminants to be removed from the water column. So far the research team found that depending on the contaminant (e.g. nitrate), different biomolecules need to be introduced to feed different types of microbes with different metabolisms. The Berg River wetland project is focused on carbon cycling and net production of sequestering of carbon. The plan is to branch the project out to the cycling of other elements of environmental concern. The Welkom wetland project has shown that Arsenic and Uranium contamination is occurring and the research team, through Rinae Makhadi's PhD project, is focusing on the impacts these contaminants may have on the health of surrounding communities.

Rinae Makhadi enrolled for her PhD in Medical Geology at the University of Johannesburg. Her study is based on a multidisciplinary approach to assess if and how the presence of gold mining tailings dams poses a potential health threat to the environment and proximal communities. The main aim of the study is to identify and assess the presence of Potentially Harmful Elements (PHEs) in gold tailings dams in the Welkom goldfields from existing geochemical data, and to determine possible human health and ecological implications.

Megan Welman-Purchase completed her research for her Doctoral degree on 'An investigation of the iron-cyanide mineralization in gold mine dumps'. She attended the International Mine Water Association (IMWA) Conference from 17 to 21 July 2023 in Newport, Wales, where she presented a portion of her PhD research. She discussed how ferric and ferrous iron behave in a gold tailings environment when cyanide (from the gold mining extraction process) is present.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Prof Roelofse continued to serve on the editorial board of the *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie*. He also continued to serve as the South African representative on the International Mineralogical Association Commission on Gem Materials (IMA-CGM), the Council of the Geological Society of South Africa (GSSA), and the Mineralogical Association of South Africa (MINSA).

Prof Roelofse was interviewed on two occasions by Radio Sonder Grense (RSG) in November to discuss the likelihood of a volcanic eruption in Iceland and Europe's most active volcano, Mount Etna, and the risk that volcanoes in that part of the world pose to the local population.

Prof John Carranza served as President of the Association of Applied Geochemists (formerly Association of Exploration Geochemists).

Prof Carranza is also a Fellow of the Society of Economic Geologists, a member of the International Association for Mathematical Geosciences, the International Association on the Genesis of Ore Deposits, the Society for Geology Applied to Mineral Deposits, and the Geochemical Society. He also served as Editor-in-Chief of the journal *Natural Resources Research*, Senior Associate Editor of *Geochemistry: Exploration, Environment, Analysis*, Associate Editor of the *Journal of Geochemical Exploration*, and Associate Editor of the *Journal of Ore Geology Reviews*. He was also the Guest Editor of a Special Issue on Machine Learning-Based Mapping for Mineral Exploration *(Mathematical Geosciences*, Vol 55, and a Special Issue on Applications of Innovations in Geochemical Data Analysis *(Geochemistry: Exploration, Environment, Analysis* Vol 22). He was also a convener of the session on 'AI-Driven Mineral Prospectivity Mapping' at the 2023 Annual Conference of the International Association for Mathematical Geosciences IAMG2023, held in Trondheim, Norway, from 5 to 12 August 2023.

Justin Nel is a member of the Professional Working Group of the GSSA and an active member of the Northern Cape branch of the GSSA.

Dr Keet, Prof Yibas, Dr Muir, and Matome Moitsi hosted invited prospective first-year students (Grade 12 learners) who visited the Department as part of the Faculty of Natural and Agricultural Sciences Open Day held on 29 July. On 31 August, Dr Keet, Matome Moitsi, and Johannes Malebati (MSc student) represented the Department at the UFS 'Grade 9 Undergraduate Intervention' event that took place at the Centenary Complex, Bloemfontein Campus. This was a great opportunity to get young learners intrigued and excited about the different fields of Natural Sciences before they get to Grade 12.

Introducing Geology to the public at the UFS Grade 9 Undergraduate Intervention and learners and parents visiting the Department of Geology during the Open Day

NATIONAL AND INTERNATIONAL COLLABORATION

The Department has excellent relationships with industry, as illustrated by Minerals Education Trust Fund (METF) subventions to all our full-time academic staff members to date. The feedback the Department received from mining companies on the quality of our graduates was very encouraging. As a result, student bursaries and research support (such as access to mine facilities and provision of research materials, such as drill cores and samples), are improving. Several Honours, MSc, and PhD research projects are supported by industry. Staff research and interaction with the industry have also improved significantly.

Prof Roelofse is collaborating with scientists at the University of the Witwatersrand (Prof Lew Ashwal and Prof Susan Webb) and with the GFZ German Research Centre for Geosciences (Dr Robert Trumbull and Dr Ilya Veksler) on several projects forming part of the Bushveld Complex ICDP project.

The collaboration between the Department and DSI-NRF CIMERA, which has secured funding for MSc projects since 2019, continued into 2023.

Dr Robert Muir undertakes a research project titled 'Environmental change across the Jurassic-Cretaceous boundary in South Africa', funded by the DST-NRF Centre of Excellence in Palaeoscience (Genus) in collaboration with the University of Cape Town, Berkeley Geochronology Centre, and the University of Johannesburg.

Justin Nel is currently involved in two collaborative research projects – an interdisciplinary research group within the UFS and with Prof Albertus Smith at the University of Johannesburg.

Dr Robert Hansen worked in collaboration with the intergovernmental committee and specialists on the Jagersfontein tailings disaster as well as with Zuka Private Game Reserve with a number of UFS specialists from various departments in the Faculty of Natural and Agricultural Sciences (e.g. Crop, Climate and Soil Sciences, Zoology and Entomology, and Genetics), as well as with the Department of Pharmacology in the Faculty of Health Sciences, on determining the biogeochemistry and potential for soil rehabilitation at their site.

On 31 July 2023, a delegation of five members led by Prof Jun Yao, Director of the School of Environmental Studies from China University of Geosciences (Beijing and Wuhan), visited the Department of Geology to initiate collaboration. The team also visited other laboratory facilities in the Faculty, including the facilities in the Institute for Groundwater Studies (IGS), Centre for Mineral Biogeochemistry (CMBG), and Centre for Microscopy.

Delegates from the China University of Geosciences visited the laboratory facilities of the Geology Department and the Centre for Mineral Biogeochemistry (CMBG)

Overall, in 2023 the staff of the Department continued maintaining active collaboration and expanding their collaborative spheres with researchers from the following institutions:

- Agencia Estatal Consejo Superior de Investigaciones Cientificas, Spain (collaboration in EU-funded EIS project)
- Albany Museum, South Africa (SA)

- Associacao para a Investigacao e Desenvolvimento de Ciencias, Portugal (collaboration in EU-funded SEMACRET project)
- Australian Nuclear Science and Technology Organisation (ANSTO)
- BEAK Consultants Gmbh, Germany (collaboration in EU-funded EIS project)
- Berkeley Geochronology Center, US)
- Bureau de Recherches Géologiques et Minières (BRGM), Nancy, France
- Bureau of Geo-Exploration and Mineral Development of Guangxi, Nanning, China
- Cardiff University
- Center for Development Research (ZEF), University of Bonn, Germany
- Central University of Technology, SA
- Centre for Applied Geosciences of the Geological Survey of Brazil, Brasília, Distrito Federal, Brazil
- Chhattisgarh Space Applications Centre, CCOST, Raipur, India
- China Aero Geophysical Survey and Remote Sensing Center for Natural Resources, Beijing, China
- China Earthquake Administration
- China Geological Survey
- China Mining News, China Geological Survey
- China State Environmental Protection Key Laboratory of Soil, Health and Green Remediation, College of Resources and Environment, Huazhong Agricultural University
- CIMERA, South Africa
- College of Marine Geosciences, Ocean University of China, Qingdao, China
- College of Resources and Environment, Huazhong Agricultural University, Wuhan, China
- College of Resources and Environmental Engineering, Guizhou University, Guiyang, China
- Council for Geoscience, SA
- Czech Geological Survey
- Dagang Oilfield Company, China National Petroleum Corporation, Tianjin, China
- Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Luleå, Sweden
- Department of Earth Sciences, Uppsala University, Uppsala, Sweden
- Department of Mining Engineering, Faculty of Environment, Urmia University of Technology, Urmia, Iran
- Department of Mining Engineering, Isfahan University of Technology, Isfahan, Iran
- Department of Mining Engineering, University of Kashan, Kashan, Iran
- Deutsche Lithium Gmbh, Germany (collaboration in EU-funded EIS project)
- Development Research Center of China Geological Survey, Beijing, China
- Earth and Planetary Science Division, Physical Science Department, Kingsborough Community College of the City University of New York, Brooklyn, NY, USA
- Eduardo Mondlane University, Mozambique
- Faculty of Earth Resources, State Key Laboratory of Geological Process and Mineral Resources, China University of Geosciences, Wuhan, China
- Far East Geological Institute, Far Eastern Branch of Russian Academy of Sciences, Vladivostok, Russia.
- Freidrich-Alexander University, Germany.
- Geological Survey of Finland (collaboration in EU-funded EIS project)
- Geological Survey of Sweden (collaboration in EU-funded EIS project)
- Geology Team No. 4 of Guangxi Zhuang Autonomic Region, Nanning, China
- Geophysical Survey Center, China Geological Survey, Langfang, China
- GFZ German Research Centre for Geosciences – GFZ Potsdam, Germany
- Gispo Ltd, Finland
- Global Mountain Safeguard Research (GLOMOS), United Nations University, Bonn, Germany
- Hebei Key Laboratory of Strategic Critical Mineral Resources, Hebei GEO University, Shijiazhuang, Hebei, China
- Hubei Geological Survey, Wuhan, PR China
- Indian Institute of Remote Sensing, Dehradun 248001, India
- Inner Mongolia Geological Prospecting Co., Ltd, Hohhot, China
- Institute of Advanced Studies, China University of Geosciences, Wuhan, China
- Institute of Geomechanics, Chinese Academy of Geological Sciences, Beijing, China
- Institute of Geosciences, University of Campinas (UNICAMP), Campinas, São Paulo, Brazil
- International Mining Research Center, China Geological Survey, Beijing, China
- James Cook University, Townsville, Australia
- Keliber Technology Oy, Finland
- Key Laboratory of Isotope Geology of Ministry of Natural Resources, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China
- Key Laboratory of Mineral Resources in Western China (Gansu Province), School of Earth Sciences, Lanzhou University, Lanzhou, China
- Korzinsski Institution, Chernogolovka, Russia
- Laboratoire de Géosciences, Géo-environnement et Prospection Minière et Hydrique, Faculté des Sciences, Morocco
- Laboratoire des MatériauxUtiles, Institut National de Recherche et d'Analyse Physico-chimiques, Technopole de Sidi, Thabet, Tunisia
- Laboratory of Dynamic Diagenesis and Metallogenesis, Institute of Geomechanics, Chinese Academy of Geological Sciences, Beijing, China
- Louisiana State University, USA.
- Luleå University of Technology, Sweden (collaboration in EU-funded EIS project).
- McGregor Museum, SA
- MNR Key Laboratory of Metallogeny and Mineral Resource Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing, China
- Museum of Natural History, Sweden
- Natural History Museum Vienna, Austria
- Natural History Museum, London, UK
- Natural Resources Canada, Geological Survey of Canada, Ottawa, Ontario, Canada
- Nelson Mandela University, SA
- Oulu University, Finland.
- PetroChina Hangzhou Institute of Petroleum Geology, Hangzhou, China
- Polish Academy of Sciences
- Polish Geological Institute
- Rhodes University, SA
- School of Chemistry, Joseph Banks Laboratories, University of Lincoln, UK
- School of Civil and Resource Engineering, University of Science and Technology Beijing, Beijing, China
- School of Earth Science, China University of Geosciences, Wuhan, China
- School of Earth Sciences and Resources, China University of Geosciences, Beijing, China
- School of Earth Sciences, Hebei GEO University, Shijiazhuang, Hebei, China
- School of Gemology, China University of Geosciences, Beijing, China
- School of Materials Science and Engineering, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China
- Second Geological Mineral Exploration Institute of Gansu Provincial Geology and Mineral Bureau, Lanzhou, China
- Shenyang Geological Survey, China Geological Survey, Shenyang, China
- SHRIMP Centre of the Chinese Academy of Geological Sciences, Beijing, China
- Sibanye-Stillwater Company, SA
- State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Beijing, China
- Technical University of Vienna, Austria
- Third Geological and Mineral Exploration Institute of Gansu Bureau of Geology and Mineral Resources, Lanzhou, China
- Tianjin Geological Survey Center, China Geological Survey, Tianjin, China
- Universität Hamburg, Germany
- Université de Gafsa, Faculté des Sciences, Département de Géologie, Sidi Ahmed Zarroug, Gafsa, Tunisia

- Université De Lille, France
- Université de Tunis El Manar, Faculté des Sciences de Tunis, Département de Géologie, El Manar, Tunis, Tunisia
- Université du Quebec en Abitibi-T´emisamingue, Quebec, Canada
- University of Cape Town, SA
- University of Colorado, USA
- University of Exeter, UK
- University of Gothenburg, Sweden
- University of Idaho, USA.
- University of Johannesburg, SA
- University of Leoben, Austria
- University of Oslo, Norway
- University of Pretoria, SA
- University of the Witwatersrand, SA
- University of Tsukuba, Ibaraki, Japan
- University of Turku, Finland
- University of Vienna, Austria
- University of Zambia
- Xi'an Center of Mineral Resources Survey, China Geological Survey, Xi'an, China
- Zavaritsky Institute of Geology and Geochemistry, Russia

POSTGRADUATE STUDENTS

The Department of Geology offers a variety of postgraduate programmes, including Honours, four different MSc programmes (Geology, Geochemistry, Environmental Geology, and Mineral Resource Management [MRM]), and the PhD degree by research. In 2023, the Department enrolled 95 postgraduate students – 17 Honours, 66 MSc, and 12 PhD candidates.

Seventeen (17) BSc Honours, four MSc (three majoring in MRM and one in Geology), and four PhD students graduated in 2023. The three MSc in MRM graduates were Anthony Daniel Davis, Charlotte Maenge Kali, and Alet van Deventer.

PhD degrees were conferred on the following candidates in 2023:

Fourie, Petrus Johannes (Geochemistry)

Thesis: Geochemical evolution in defunct gold mine tailings and modeling of seepage water quality: an investigation of a typical tailings storage facility in the East Rand, Johannesburg, South Africa

Supervisor: Dr R Hansen

Netshitungulwana, Khashane Tshishonga Robert (Geology)

Thesis: Geochemical and mineralogical characterization of the lithological units of the Geodehoop Colliery in the Witbank Coalfield to fathom the source and the receptor of metals in the Riet-Olifants Catchment, South Africa

Supervisors: Prof CD Gauert, Prof B Yibas and Prof D Vermeulen

Welman-Purchase, Megan Dayl (Geochemistry)

Thesis: An investigation of the iron-cyanide mineralization in gold mine dumps

Supervisor: Dr R Hansen

Keet, Jarlen Jocelyn (Geology)

Thesis: A multi-isotope (S-Sr-Nd) investigation of the Flatreef, Northern Limb, Bushveld Complex: Petrogenetic implications and comparison with the Merensky Reef.

Supervisors: Prof F Roelofse and Prof CD Gauert

POSTDOCTORAL RESEARCH FELLOWS

Dr Shayantani Ghosal (from India) joined the MAGIC Centre as a Postdoctoral Research Fellow. Her research is on the efficacy of ASTER and Sentinel-2A satellite imagery in mapping iron and manganese in South Africa's Maremane Dome, under the leadership of Dr Martin Clark. Dr Ghosal attended the American Geophysical Union (AGU) Fall Conference in San Francisco and presented a paper on the preliminary findings of her research.

Dr Shayantani Ghosal

Dr Nolukholo Sinovuyo Busakwe (from South Africa) joined the Department in 2023 to undertake postdoctoral research under the supervision of Prof John Carranza in the EU-funded EIS research project.

STAFF MATTERS

Jarlen Keet and Megan Welman-Purchase were awarded their PhD degrees at the 2023 graduation ceremonies held in March and December 2023, respectively. Dr Keet was appointed as a Programme Director for the Department, effective from 1 March 2023, taking over the responsibility from Justine Magson who served in the position for over seven years. The Department appreciates Justine for the excellent and passionate service she provided during her tenure.

Daniel Radkgomo and Andries Felix retired at the end of 2023 after 40 and 41 years of service, respectively. The Department would like to thank and honour the long services they rendered to the Department and the UFS.

Lesego Moqhaisa was appointed as a Senior Assistant Officer on 1 July 2023, replacing Ruvey Zaal who resigned from her duties after two years of service in the Department.

Dr Nolukholo Busakwe

Andries Felix

Daniel Radkgoma

RESEARCH OUTPUTS

Research Articles

Abrahams, J.L.R. & Carranza, E.J.M. 2023. Trace metal content prediction along an AMD (acid mine drainage)-contaminated stream draining a coal mine using VNIR–SWIR spectroscopy. *Environ Monit Assess* 195: 1-15. doi.org/10.1007/s10661-023-11837-y.

Beg, K.M., Kumar, N., Srivastava, S.K. & Carranza, E.J.M. 2023. Interpretation of Fluoride Groundwater Contamination in Tamnar Area, Raigarh, Chhattisgarh. *India Earth* 4: 626-654. doi.org/10.3390/earth4030033

Cairncross, B., Harris, C., Roelofse, F. & Van Huyssteen, C. 2023. Who's Who in Mineral Names: Marian Tredoux (1952–2019). *Rocks & Minerals* 98:187-189. doi.org/10.1080/00357529.2023.2129305.

Cherai, M., Rddad, L., Talbi, F. & Carranza, E.J.M. 2023. 3D modeling for mineral resource assessment of fluorite ore and its industrial application in Jbel Tirremi, northeast Morocco. *Modeling Earth Systems and Environment* 9:3135-3150. doi.org/10.1007/s40808-022-01684-0.

Chiweshe, T.T. & Welman-Purchase, M. 2023. Fusion Extraction of Base Metals (Al, Cr, Fe, Ti, and V) Using Ammonium Phosphate Salt as Flux. *Crystals* 13: 1-12. doi:10.3390/cryst13050784.

Esmaeiloghli, S., Tabatabaei ,S.H. & Carranza E.J.M. 2023. Empirical mode decomposition and power spectrum filtering for detection of frequency channels related to multi-scale geochemical anomalies: Metal exploration targeting in Moalleman district, NE Iran. *Journal of Geochemical Exploration* 246: 1-16. doi.org/10.1016/j.gexplo.2023.107157.

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Conference Contributions

Conference Papers / Posters

Allwright, A., De Lange, S.S., Lubbe, R., Mbonambi, L., Vivier, K., Witthuser, K.T., Webb, S., Ashwal, L., Roelofse, F., Khoza, D., Trumbull, R. & Klemd, R. 2023. *Research-based exploration of deep groundwater within the Eastern Limb of the Bushveld Complex.* Paper delivered at the IAH Worldwide Groundwater Congress, Cape Town. South Africa. 18-22 September 2023.

Clark, M.D. 2023. *Seeing is Believing: An Important Component of the Comprehensive Argument Equation.* Paper delivered at the American Geophysical Union, San Francisco, United States of America. December 11-15, 2023.

Clark, M.D., Kovaleva, E., Huber, M.S. & Fourie, F. 2023. *Emplacement dynamics of impact melt dikes: evidence from the Lesutoskraal Pavement, Vredefort, South Africa, derived from high-resolution unmanned aerial vehicle orthophotography*. Paper delivered at the Geocongress, Stellenbosch, South Africa. 11-13 January 2023.

Ghosal, S. & Clark, M.D. 2023. *Multispectral satellite and drone imagery: mapping iron and manganese in the Maremane Dome of the Northern Cape, South Africa.* Paper delivered at the American Geophysical Union, San Francisco, USA. 11-15 December 2023.

Kahle, B., Jones, T., Muir, R.A., New, T., Tamagadne, A., Rieger, S., Scheiber-Enslin, S. & Sloan, R.A. 2023. *Inherited structural control on large stable continental region (SCR) earthquakes: comparison of active fault scarps with mapping from aeromagnetic data in Botswana and Namibia.* Paper delivered at the Geocongress, Stellenbosch, South Africa.11-13 January 2023.

Keet, J.J., Roelofse, F. & Gauert, C.D.K. 2023. *A multi-isotope (S-Sr-Nd) investigation of the Flatreef, Northern Limb, Bushveld Complex: Petrogenetic implications and comparison with the Merensky Reef.* Paper delivered at the 14th International Platinum Symposium, Cardiff University, Cardiff, Wales. 4-7 July 2023.

Madaka, S. & Clark, M.D. 2023. *Fault-slip inversion of slickensides from a historical quarry supports post-impact crustal relaxation model for the Vredefort Impact Structure.* Paper delivered at the Geocongress, Stellenbosch, South Africa. 11-13 January 2023.

Magson, J., Roelofse, F., Bybee, G. & Bolhar, R. 2023. *Constraints on the Nd-isotopic composition and nature of the last major influx of magma into the Bushveld Complex.* Paper delivered at the 14th International Platinum Symposium, Cardiff University, Cardiff, Wales. 4-7 July 2023.

Mapholi, T.A. 2023. *Mineralogical Study of Phosphate Mineralization in the Nkombwa Hill Carbonatite.* Paper delivered at the Geocongress 2023, Stellenbosch, South Africa. 11-13 January 2023.

Mathee, H.L.M, Colliston, W.P. & Nel, W.J. 2023. *Augrabies Fold Nappe: Stratigraphic insights into the Grunau Terrane.* Paper delivered at the Geocongress, Stellenbosch, South Africa. 11-13 January 2023.

Moitsi, E.M. *Investigation into the mineralogy and metallurgical performances of various UG2 ore-types from Hossy shaft of Sibanye-Stillwater Marikana Platinum Operation, Bushveld Complex, South Africa.* Paper delivered at the Geocongress 2023, Stellenbosch, South Africa. 11-13 January 2023.

Muir, R.A., Abrahams, M. & Hadebe, G. 2023. *Geomorphology, sedimentology and preliminary radioisotopic age constraints of Middle Pleistocene termitaria near Calitzdorp, South Africa.* Lecture delivered at Geocongress 2023, Stellenbosch, South Africa. 11-13 January 2023.

Muir, R.A., Whitehead, B., New, T., Stevens, V., Macey, P.H., Groenewald, C., Salomon, G., Kahle, B., Hollingsworth, J. & Sloan, R.A. 2023. *Exceptional scarp preservation in SW Namibia reveals geological controls on large magnitude intraplate seismicity in southern Africa.* Paper delivered at the Geocongress 2023, Stellenbosch, South Africa. 11-13 January 2023.

Nel, W.J. & Colliston, P. 2023. *Structural deformation of the Mesoproterozoic eastern Aggeneys Terrane, western Namaqua Province.* Poster presented at the Geocongress, Stellenbosch, South Africa. 11-13 January 2023.

Nel, W.J. & Colliston, W.P. 2023. *Structural and stratigraphic analysis of the T-Goob structure within the eastern mesoproterozoic Aggeneys Terrane.* Paper delivered at the Geocongress, Stellenbosch, South Africa. 11-13 January 2023.

Nel, W.J. & Colliston, W.P. 2023. *The stratigraphic interpretation of the T-Goob Succesion and its correlation to the western Aggeneys Terrane.* Paper delivered at the Geocongress, Stellenbosch, South Africa. 11-13 January 2023.

Radebe, S. & Clark, M.D. 2023. *Unveiling earth's hidden resources: High-resolution satellite surveys in arid lands to decode groundwater dynamics along dolerite dikes.* Poster presented at the American Geophysical Union, San Francisco, USA. 11-15 December 2023.

Roelofse, F., Allwright, A., Ashwal, L.D., Khoza, D., Klemd, R., Trumbull, R. & Webb, S. 2023. *Scientific drilling in the Bushveld Complex: A status update on the ICDP-BVDP project.* Paper delivered at the 14th International Platinum Symposium, Cardiff University, Cardiff, Wales. 4-7 July 2023.

Roelofse, F., Magson, J., Nicholson, M. & Nyakane, T. 2023. *Development of bifurcated chromitite in the UG1 footwall at Impala Platinum Mines, Rustenburg.* Poster presented at the 14th International Platinum Symposium, Cardiff, Wales. 4-7 July 2023.

Sloan, R.A., Muir, R.A., Whitehead, B., New, T., Stevens, V., Macey, P.H., Groenewald, C., Salomon, G., Kahle, B. & Hollingsworth, J.

2023 *Exceptionally preserved neotectonic fault scarps in SW Namibia record large-magnitude structurally-controlled SCR paleoseismicity*. Paper delivered at the EGU General Assembly 2023, Vienna, Austria. 24-28 April 2023.

Trumbull, R., Allwright, A., Ahswal, L., Haase, K., Klemd, R., Roelofse, F., Veksler, I. & Webb, S. 2023. *Scientific drilling in the Bushveld Complex: An update on the BVDP project*. Paper delivered at the IODP / ICDP Colloquium, Leibniz University, Hannover. Germany. 29-31 August 2023.

Trumbull, R., Klemd, R., Webb, S., Ashwal, L. & Roelofse, F. 2023. *The Bushveld Drilling Project BVDP*. Paper delivered at the IV International Conference on Scientific Drilling, GFZ, Potsdam. Germany. 21-23 July 2023.

Webb, S.J., Trumbull, R., Roelofse, F., Allwright, A. & Ashwal, L.D. 2023. *Deep drilling in the Bushveld Complex: The BVDP project*. Paper delivered at Geocongress 2023, University of Stellenbosch, Stellenbosch, South Africa. 11-13 January 2023.

Whitehead, B., Sloan, R.A., Quiros, D., Salomon, G., Kahle, B., Kahle, R. & Muir, R.A. 2023. *Microseismicity associated with the Hebron Fault scarp, a major neotectonic earthquake rupture in SW Namibia*. Paper delivered at the Geocongress 2023, Stellenbosch, South Africa. 11-13 January 2023.

Yibas, B. 2023. *Consistency of geological, structural, and geochronological data in constraining the dynamic evolution of the Arabian Nubian Shield of the East African Orogen*. Paper delivered at Geocongress 2023, University of Stellenbosch, Stellenbosch, South Africa. 11-13 January 2023.

Conference Proceedings

Welman-Purchase M. & Hansen R.N. 2023. Modelling the Behaviour of Ferric and Ferrous Iron in a Goldmine Tailings Environment, Free State – South Africa. In: *IMWA 2023 - The future:* Newport, Wales. 17-21 July 2023. J. Pope, C. Wolkersdorfer, R. Rait, D. Trumm, H. Christenson, & K. Wolkersdorfer. (Eds). pp. 529-533.

Staff of the Department of Geology 2023. Front row, from the left: P Lehloenya, Dr JJ Keet, EM Motsi, Prof B Yibas, T Mapholi, and P Tsiu; Middle row, from the left: Dr M Welman-Purchase, Dr R Muir, Dr M Clark, R Makhadi, A Felix, and D Radikgomo; Back row, from the left, Dr H Minnaar, Dr R Hansen, Prof F Roelofse, C van der Vyver, J Magson, and JJ Nel. (Absent: Prof J Carranza)

STAFF (2023)

Head of Department:
Prof B Yibas

Professors:	Prof J Carranza and Prof B Yibas
Associate Professor:	Prof F Roelofse
Affiliated Professors:	Prof DE Miller and Prof R Schemers
Affiliated Associate Professors:	Prof CD Gauert and Prof GJB Germs
Senior Lecturers:	Dr M Clark, Dr R Hansen, Dr H Minnaar and Dr R Muir
Lecturers:	M Dimmick-Touw, Dr JJ Keet, J Magson, R Makhadi, ME Moitsi and J Nel
Junior Lecturer:	T Mapholi
Affiliated Lecturers:	E Bergh, T Diale, Prof C Dohm, Dr DH Prinsloo, K van der Merwe, A van Niekerk, A Venter, P Viljoen and Prof K Visser
Programme Directors:	Dr JJ Keet and M Dimmick-Touw (MRM MSc)
Research Fellows:	Dr W Archer, Prof WP Colliston, Dr RJ Giebel, Dr PG Meintjes, Dr L Nel, HCF Pretorius, Dr MJ van der Merwe and Prof WA van der Westhuizen
Senior Assistant Officers:	A Felix, L Moqhaise and C van der Vyver
Technical Officers:	Dr M Welman-Purchase, P Lehloenya and D Radikgomo

DEPARTMENT OF

MATHEMATICAL STATISTICS AND ACTUARIAL SCIENCE

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Mathematical Statistics and Actuarial Science at the University of the Free State (UFS) had a good academic year in 2023, fully back to face-to-face (F2F) lecturing. Liza da Silva completed her PhD in 2023, and Louwtjie Voges completed his Master's degree. Two new staff members joined the Department – Prof Fabio Correa from Rhodes University and Kojo Essel-Mensah, an actuary from Ghana. Publications were consistent with previous years. Jan Blomerus returned as Programme Director and is doing an exceptional job selecting the best students from more than 2 600 applications to the Department.

We have increased our intake of good actuarial first-year students to the highest ever, exceeding 100 first-year students and at maximum capacity. We aim to introduce two new actuarial subjects by 2025.

Prof Maksim Finkelstein decided to continue his contract for another five years, and this appointment was successful. William Baranye retired at the end of 2023 after more than 40 years of service.

In the coming year Wallina Oosthuizen and Jan Blomerus should complete their PhDs, and we managed to relieve the load off Elizabeth Girmay to enable her to start her PhD in 2024. Our intake will again be at maximum capacity, and the post-graduates are slowly increasing.

ACHIEVEMENTS

Staff Achievements

Prof Maksim Finkelstein delivered a plenary talk at the Conference of the South African Statistical Association (SASA) on the topic 'Virtual age, is it real?'. He was awarded the Thought Leader Award for lifetime contribution at the conference.

Prof Maksim Finkelstein receiving the Thought Leader Award for Lifetime Contribution at the SASA 2023 Conference

The Ewha Womans University in South Korea awarded the 2023 Ewha Global Fellow (EGF) award for outstanding collaboration with Ewha researchers, to Prof Maksim Finkelstein.

In 2023 Prof Finkelstein was appointed as a Visiting Professor at the Department of Management Science at the University of Strathclyde in Glasgow, UK, for the period 2024 to 2026.

Student Achievements

The following student awards were made in 2023:

- Best 1st-year student in Statistics: Simamnkele Tshem
- Best 2nd-year student in Statistics: Gugulethu Nhlapho
- Best 3rd-year student in Statistics: Ntanganedzeni Sithuga
- Best 1st-year students in Business Calculations: Owethu Lutho, Muriel Grootboom and Naledi Nicole Hagemeister
- Best 1st-year student in Mathematical Statistics: Thulisile Ntuli
- Best 2nd-year student in Mathematical Statistics: Lize-Marie Pretorius
- Best 3rd-year student in Mathematical Statistics: Louwrens Vorster

Louwrens Vorster also won the Dean's medal for the best student in the Faculty of Natural and Agricultural Sciences and the Senate medal for the best student in all UFS faculties.

Louwrens Vorster (right) receiving his award from Prof Paul Oberholster

TEACHING AND LEARNING

Our Department presents degrees in Actuarial Science, Mathematical Statistics, Applied Statistics, Risk Analysis, and Econometrics.

RESEARCH AND INNOVATION

The UFS Department of Mathematical Statistics and Actuarial Science specialises in Extreme Value Theory, Bayesian Statistics, Reliability Theory, and various financial types of research within Actuarial Science, as well as mortality analysis and improvements.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Our Department continued to demonstrate its commitment to engaged scholarship with regard to service to the science community, through co-editorships and reviewing of articles and manuscripts for journals and books. Our interactions with especially the actuarial industry and professional sectors are good, with participation in several professional committees. Some staff members are involved in the professional actuarial examinations, as well in the marking thereof.

The Statistical Consultation Unit continued to grow and performed extremely well, providing a professional statistical service to the UFS research community.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Jan Beirlant from KU Leuven visits the Department on an annual basis and lectures the Extreme Value Theory (EVT) Course. He also actively engages in research with researchers in the Department on the topic of EVT.

POSTDOCTORAL RESEARCH FELLOWS

Three Postdoctoral Research Fellows were hosted in the Department in 2023 – Dr Tendai Makoni and Dr Ali Yeganeh with Prof Delson Chikobvu, and Dr Braimah Joseph with Prof Fabio Correa.

POSTGRADUATE STUDENTS

In 2023, as in previous years, between 20 and 35 students were enrolled for the MSc, and 10 to 15 for the PhD. Master's students generally take between two and four years to qualify, and PhDs can take up to six years.

A total of 43 students graduated from the Department with the BSc Honours - 16 majoring in Actuarial Science, 2 in Applied Statistics, 13 in Mathematical Statistics (Aita Taylor passed with distinction), and 12 in Risk Analysis (with Thusang Buthelezi, Karabo Dimema, Zoha Hussain, Sibongiseni Mncela, and Lereko Naile passing with distinction).

In 2023, six students graduated with their Master's degrees – Providence Mushori (Mathematical Statistics), Samkele Skenjana (Actuarial Science), Sarah Lerato Mahlangu (Risk Analysis), Walena Anesu Marambakuyana (Risk Analysis), Sefiso Doctor Mbongo (Mathematical Statistics), and Laenita Groenewald (Actuarial Science).

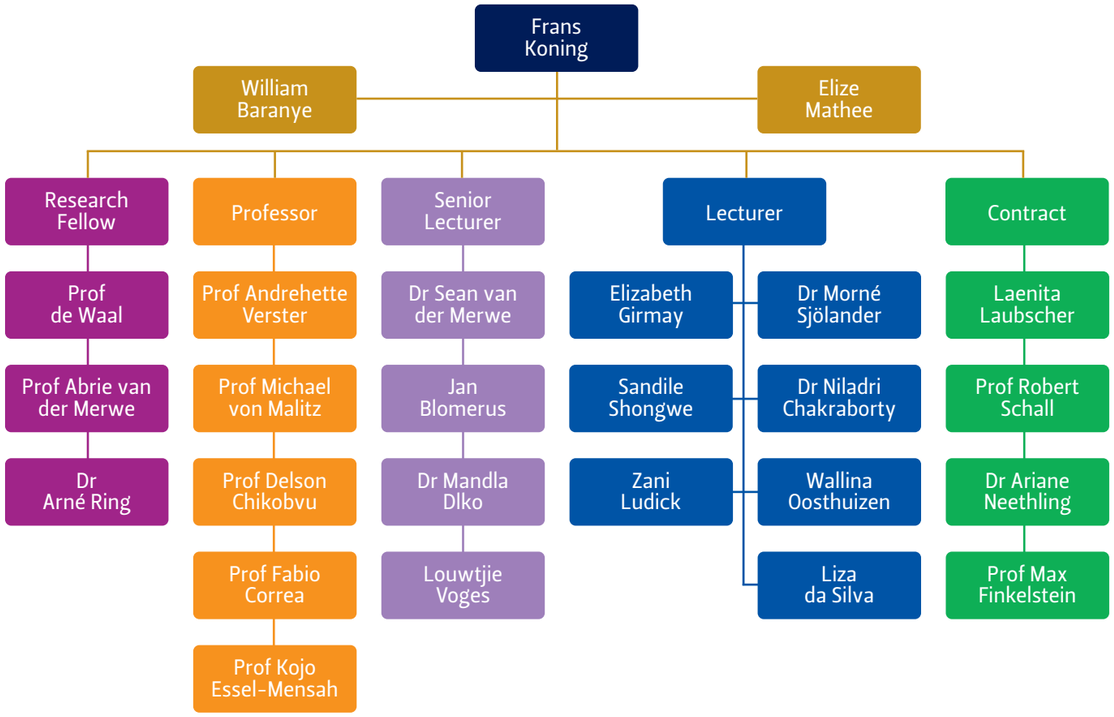
STAFF MATTERS

William Baranye (right) with Frans Koning (left) at the farewell function

Willam Baranye retired after 40 years of exceptional service to the UFS.

RESEARCH OUTPUTS

Organogram of the Department – November 2023



Research Articles

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Conference Contributions

Conference Proceedings

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STAFF (2023)

Head of Department:
FF Koning

Professors:	Prof D Chikobvu, Prof F Correa, Prof K Essel-Mensah, Prof M Finkelstein (Contract), Prof R Schall (Contract), Prof A Verster and Prof M von Maltitz
Senior Lecturers:	J Blomerus, Dr M Diko, Dr A Neethling (Contract), Dr S van der Merwe and L Voges
Lecturers:	Dr N Chakraborty, E Girmay, L da Silva, Z Ludick, W Oosthuizen, S Shongwe and Dr M Sjölander
Junior Lecturer:	L Laubscher (Contract)
Research Fellows:	Prof DJ de Waal, Dr A Ring and Prof A van der Merwe
Programme Director:	J Blomerus
Secretary:	E Mathee
Messenger:	W Baranye

DEPARTMENT OF

MATHEMATICS AND APPLIED MATHEMATICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Mathematics and Applied Mathematics had a productive year in 2023, marked by notable achievements in teaching, research, and engagement. In terms of staff achievements, Dr Elizabeth Maritz received an Innovation in Learning and Teaching award, while Gerhard Venter obtained his MSc in Mathematics with distinction.

Teaching and learning initiatives focused on addressing pass rate concerns, with new interventions planned for 2024. Postgraduate activities saw growth, with new students joining across various levels.

Research output remained strong, with an increase in seminars and successful research initiatives, such as the establishment of a pulsar timing research group. Engaged scholarship activities included participation in Olympiads, academic conferences, and presenting of specialised talks and workshops.

The Department also witnessed international collaborations and notable presentations by members of the Department at various institutions. The establishment of 'The Mathematics Club' provided a platform for knowledge sharing outside traditional avenues.

Staff matters included a change in personnel, with new appointments and resignations in key positions, ensuring continuity and leadership on both campuses.

Overall, the Department of Mathematics and Applied Mathematics at the University of the Free State (UFS) demonstrated progress across all spheres of activity in 2023, laying a solid foundation for continued excellence in the field.

ACHIEVEMENTS

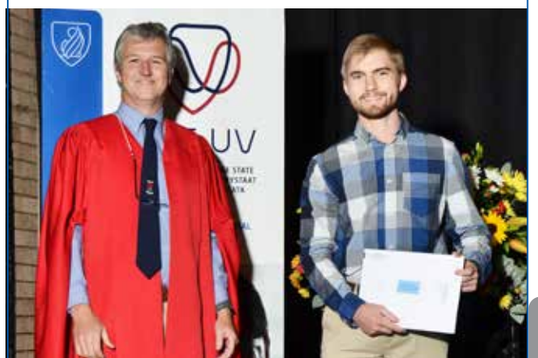
Staff Achievements

Dr Elizabeth Maritz won an Innovation in Learning and Teaching award in the category 'Innovating curriculum through a redesign or renewal of a module' at the annual UFS Teaching and Learning Awards.

Gerhard Venter obtained his MSc in Mathematics (Graph Theory) with distinction and the degree was conferred at the December 2023 graduation ceremony.

Student Achievements

Christine Rossouw and Louwrens Vorster received the CB van Wyk prizes for, respectively, the best first-year and second-year student in Mathematics and Applied Mathematics in 2022. These prizes were officially awarded at the Faculty Prize-Giving Ceremony in April 2023.



Christine Rossouw (above) and Louwrens Vorster (below) with Dr Venter at the Annual Faculty Prize-Giving

TEACHING AND LEARNING

The Department offered a total of 24 undergraduate modules in 2023. Results in some modules were of concern and received special attention. In particular, the very large modules at first-year level have been experiencing pass rates that are under pressure. In part this necessitated the first ever repeat of the first semester Calculus course in the second semester. For 2024, a number of new interventions are planned to turn around the trend in declining pass rates.

RESEARCH AND INNOVATION

2023 saw a publication output that was above the average of the previous five years. Positives from 2023 are the increase in research seminars and a successful repeat of the Research Day, all contributing to a growing culture of research in the Department.

Besides the seminars and departmental Research Day, another 'bread-on-the water' set of activities revolves around the beginnings of the establishment of a research group on pulsar timing, spearheaded by Prof Jeandrew Brink. Prof Brink started supervising two MSc students in this research field and continued to develop and present tailor-made courses to enable students to channel towards this research. From 25 to 27 September Prof Brink took the two MSc students, and the best of the Honours and third-year Dynamical Systems students, to a Pulsar Timing Workshop at the North-West University, Potchefstroom Campus. This was a valuable opportunity for the students to gain practical experience on the theory, programming, and data handling involved in pulsar timing analysis, but it was also a wonderful opportunity to network with national and international players in this field. A follow-up workshop is planned in Stellenbosch in February 2024.

Prof Brink (bottom left) and the future pulsar timing specialists

In the Department, the Graph Theory group continues to grow in numbers and strength. Two permanent staff members form part of this group, namely Prof Tomas Vetrik and Dr Elizabeth Maritz. Two part-time lecturers also work in this group – Elize Swartz who is in her first year of PhD under supervision of Prof Vetrik and Dr Maritz, and Gerhard Venter, who obtained his MSc in 2023.

Another positive in terms of collaborations is Dr Yibeltal Terefe's continued research in the field of Biological modelling. Dr Terefe has a long-standing collaboration with researchers from outside the University, but in 2023 included Dr Christiaan Venter as an internal collaborator. In 2024, an attempt will be made to expand the collaboration to include two colleagues from the Qwaqwa Campus, namely Dr Narcisse Loufouma Makala and Dr Komi Afassinou.

A number of staff members presented talks at the Departmental seminars, aimed at stimulating research. On 20 January 2023 Prof Jeandrew Brink gave a seminar talk in the Department on 'Geodesic Equations from Hamilton Formulation' and on 14 and 21 April, Dr Renier Jansen gave a two-part series of seminar talks titled 'From pre-ordered sets to categories: an introduction of Galois theories'. Prof Johan Meyer gave a seminar talk on 'Unique maximal rings of function' on 28 July, and on 11 August Eduard Stoffberg presented on 'Banach algebras: A few interesting bits'. Gerhard Venter presented on 'Methods for distinguishing vertices in a graph', at the final seminar talk on 17 November.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Prof Johan Meyer engaged in the setting and moderation of Olympiad papers for nationally written maths Olympiads and also organised the UFS students' participation in the annual SA Tertiary Maths Olympiad (SATMO). Dr Elizabeth Maritz organised the UFS students' participation in the annual WITS Mathematics competition. Dr Renier Jansen and Dr Christiaan Venter were again involved with Nautilus Mathematics.

Most staff members functioned as reviewers for academic journals. Prof Vetrik continued his role as an Editor of the *Iranian Journal of Mathematical Chemistry*.

Tomas Vetrik visited the Mongolian National University of Education in Ulaanbaatar, Mongolia from 3 to 11 June 2023. In the period 5 to 9 June 2023, he presented a short course on extremal graph theory. The course was organised by the Centre International De Mathématiques Pures et Appliquées (International Centre for Pure and Applied Mathematics [CIMPA]), a UNESCO centre based in France.

Prof Tomas Vetrik (centre) at the CIMPA course in Mongolia

In August 2023, Prof Vetrik gave two talks at the King Mongkut's University of Technology in Thonburi, Bangkok, Thailand. The titles were respectively 'The metric dimension and the partition dimension of graphs' and 'The degree-diameter problem'.

On 11 October 2023, Dr Yibeltal Terefe gave a seminar talk at the School of Computer Sciences and Applied Mathematics at the University of the Witwatersrand, on 'The use of perfect vaccination and awareness campaign in the control of antibiotic resistant gonorrhoea infection: mathematical perspective'.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Tomas Vetrik continued with various international collaborations in 2023, with researchers from Saudi Arabia, Ethiopia, United Arab Emirates, and Qatar.

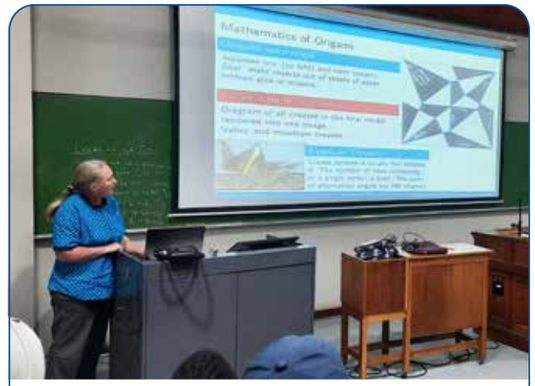
Prof Johan Meyer continued his collaboration with Prof W-F Ke from the National Cheng Kung University, Tainan, Taiwan. Prof Ke visited the UFS in April and Prof Meyer visited Tainan in November. From these fruitful visits, three manuscripts have been submitted for publication.

In 2023, the Department hosted a number of national and international visitors. On 22 May, the Department hosted collaborators of Dr Yibeltal Terefe in an interdepartmental colloquium with the broad theme of biological modelling. The collaborators were Prof Jean Lubuma (University of the Witwatersrand), Prof Berge Tsanou (University of Dschang in Cameroon), Dr Arsène Tassé (University of Pretoria), and Prof Michael Chapwanya (University of Pretoria). Dr Christian Budde from the UFS gave a talk on 'Non-autonomous flows on metric graphs'.

On 16 February, Dr Christian Seifert, from the Institute of Mathematics at the Hamburg University of Technology, Germany, gave a seminar talk in the Department, and on 28 August, Dr Ronalda Benjamin from the Department of Mathematics at Stellenbosch University, also presented a seminar talk in the department. These talks formed part of their research visits with Dr Christian Budde.

OTHER ACTIVITIES

A highlight of 2023 was the establishment of 'The Mathematics Club'. This is not only a place or an event where like-minded individuals share their interest in Mathematics, but also a platform to share new Mathematics knowledge which might not typically fit into more standard dissemination avenues.



Prof Brink presenting a lecture on the Mathematics of Origami

Students and lecturers stretching their minds with a Maths game

POSTGRADUATE STUDENTS

In 2023, six students were enrolled for BSc Honours in Mathematics and Applied Mathematics. Two students were enrolled for a Master's degree in Mathematics and two students were enrolled for a Master's degree in Applied Mathematics. Two

students were enrolled for PhD studies. Attracting more, but talented honours, MSc and PhD students will remain an important goal in 2024.

One student graduated with an Honours in Mathematics and Applied Mathematics, while at Master's level, JG Venter graduated with the MSc in Mathematics (with distinction).

Hangwelani Magau graduated with the PhD in Applied Mathematics, with the thesis, 'Global rate of change with local and non-local operators: a new approach to predict complex systems', supervised by Prof A Atangana.

An aspect we are pleased with is the completion in 2023 of a postgraduate 'lab' in the Mathematics building. This new space was completed at the end of July and was immediately used by the postgraduate students and also currently gives working space for our Postdoctoral Research Fellow, Dr Marieme Lasri.

WWG215 converted to a space for postgraduate students

POSTDOCTORAL RESEARCH FELLOWS

Dr Marieme Lasri from Morocco joined the Department in August 2023 as Postdoctoral Research Fellow, under the supervision of Dr Christian Budde.

STAFF MATTERS

Dr Ur Koumba from the Qwaqwa Campus resigned in July 2023. This left open not just a lecturing position but also the subject head position and the programme director position. From 1 August Dr Komi Afassinou was appointed on a contract to take responsibility for the modules of Dr Koumba.

Dr Komi Afassinou

From 1 October Christa Faber started as the new programme director on the Qwaqwa Campus for the three programmes where Mathematics is a major. From 1 October, Dr Narcisse Loufouma Makala started as the new subject head on the Qwaqwa Campus.

Dr Narcisse Loufouma Makala

RESEARCH OUTPUTS

Research Articles

Benjamin, R. & Budde, C. 2023. A note on the order Lozanovsky spectrum for positive operators. *Complex Anal. Oper. Theory* 17(5): Paper 61- 12. doi.org/10.1007/s11785-023-01374-4.

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Haddad, C.R., Codron, D., Venter, C., &Booysen, R. 2023. The unique buckspoor webs of Seothyra optimize silk use and capture efficiency. *Journal of Arid Environments* 218(105057). doi.org/10.1016/j.jaridenv.2023.105057.

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Maritz, E.C.M. & Vetrik, T. 2023. On the partition dimension of directed circulant graphs, *Journal of Discrete Mathematical Sciences and Cryptography*. 26(1): 1-10. doi.org/10.1080/09720529.2019.1694739

Swartz, E. & Vetrik, T. 2023. General sum-connectivity index and general Randic index of trees with given maximum degree. *Discrete Mathematics Letters* 12: 181-188.

Terefe, Y.A., Njagarah, J.B.H. & Kassa, S.M. 2023. Effect of cross-border migration on the healthcare system of a destination community: Insights from mathematical modelling of COVID-19 in a developing country. *Mathematics and Computers in Simulation* 208: 444-479.

Vetrik, T. 2023. Degree-based function index for graphs with given connectivity. *Iranian Journal of Mathematical Chemistry* 14(3): 183-194.

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Vetrik, T. 2023. General sum-connectivity index of trees with given number of branching vertices. *Transactions on Combinatorics* 12(4): 227-238.

Vetrik, T., 2023. General approach for obtaining extremal results on degree-based indices illustrated on the general sum-connectivity index. *Electronic Journal of Graph Theory and Applications* 11(1): 125-133.

Vetrik, T., Imran, M., Knor, M.& Skrekovski, R. 2023. The metric dimension of the circulant graph with 2k generators can be less than k. *Journal of King Saud University Science* 35: 102834.

Vetrik, T., Masre, M.S. & Balachandran, S. 2023. Eccentric connectivity coindex of bipartite graphs, *Discrete Mathematics*, Algorithms and Applications 15(1): 2250054.

Conference Contributions

Conference Papers / Posters

Budde, C.J. 2023. *Non-autonomous Desch–Schappacher perturbations*. Paper delivered at the International Workshop on Operator Theory and its Applications, Helsinki, Finland. 31 July–4 August 202.

Budde, C.J. 2023. *On Trotter–Kato type inductive limits in the category of C0-semigroups*. Paper delivered at the International Conference: "One-Parameter Semigroups of Operators 2023" (Online). 14 March 2023.

Budde C.J. 2023. *Quantum dynamical semigroups and its generators*. Paper delivered at Integrable Systems and Orthogonal Polynomials - Numerical and Analytical Perspectives, African Institute of Mathematical Sciences, Muizenberg, South Africa. 11-15 April 2023.

Budde C.J. 2023. *Well-Posedness of Non-Autonomous Transport Equation on Metric Graphs*. Paper delivered at SIAM Conference on Applications of Dynamical Systems, Portland, Oregon, USA. 14-18 May 2023.

Maritz, E.C.M. 2023. *Enhancing graduate attributes: Developing logic, reasoning and practical skills in mathematics using blended learning*. Paper delivered at the Annual UFS Teaching and Learning Conference, Bloemfontein, South Africa. 11-15 September 2023.

Maritz, E.C.M. 2023. *Graph theory applications in grid related research*. Paper delivered at the 5th National Global Change Conference, Bloemfontein, South Africa. 30 January–2 February 2023.

Meyer, J.H. 2023. *Unique Maximal Rings of Functions*. Paper delivered at the Conference on Rings and Factorizations, Graz, Austria. 10-14 July 2023.

Terefe, Y.A. 2023. *Analysis of war and conflict on the transmission dynamics of the Tenth Ebola outbreak. Paper delivered at the Ethio-Italy Colloquium on Applied Mathematics* (ETICAM) 2023 Conference, Hawassa University, Hawassa, Ethiopia. 6-10 February 2023.

Terefe, Y.A. 2023. *Effect of cross-border migration on the healthcare system of a destination community*. Paper delivered at the Southern Africa Mathematical Sciences Association (SAMSA) annual conference, Pretoria, South Africa. 21-24 November 2023.

Terefe, Y.A. 2023. *Impact of self-protection measures to reduce antibiotic resistant gonorrhoea infection*. Paper delivered at BIOMATH 2023 Conference, Pomorie, Bulgaria. 18-23 June 2023.

Vetrik, T. 2023. *General distance-based indices of graphs*. Keynote address delivered at the 8th International Conference on Combinatorics, Cryptography, Computer Science and Computation, Tehran, Iran. (Online). 15-16 November 2023.

Vetrik, T. 2023. *General distance-based indices of graphs*. Keynote address delivered at the 2nd International Conference on Recent Advances in Mathematics, Lahore, Pakistan (Online).

4-5 December 2023.

Vetrik, T. 2023. *General indices of graphs*. Keynote address delivered at the 6th International Conference on Pure and Applied Mathematics, Sargodha, Pakistan (Online). 6-7 December 2023.

Vetrik, T. 2023. *The metric dimension of graphs*. Keynote address delivered at the 7th UMT International Conference on Pure and Applied Mathematics, Lahore, Pakistan (Online). 4-5 December 2023.

Conference Proceedings

Budde, C., Seifert, C. 2023. Non-autonomous Desch-Schappacher perturbations. In: *Operators, Semigroups, Algebras and Function Theory*. IWOTA 2021. Birkhäuser, Operator Theory: Advances and Applications, Vol 292: 71-90. Choi, Y., Daws, M. & Blower, G. (Eds). Cham. doi.org/10.1007/978-3-031-38020-4_4.

STAFF (2023)

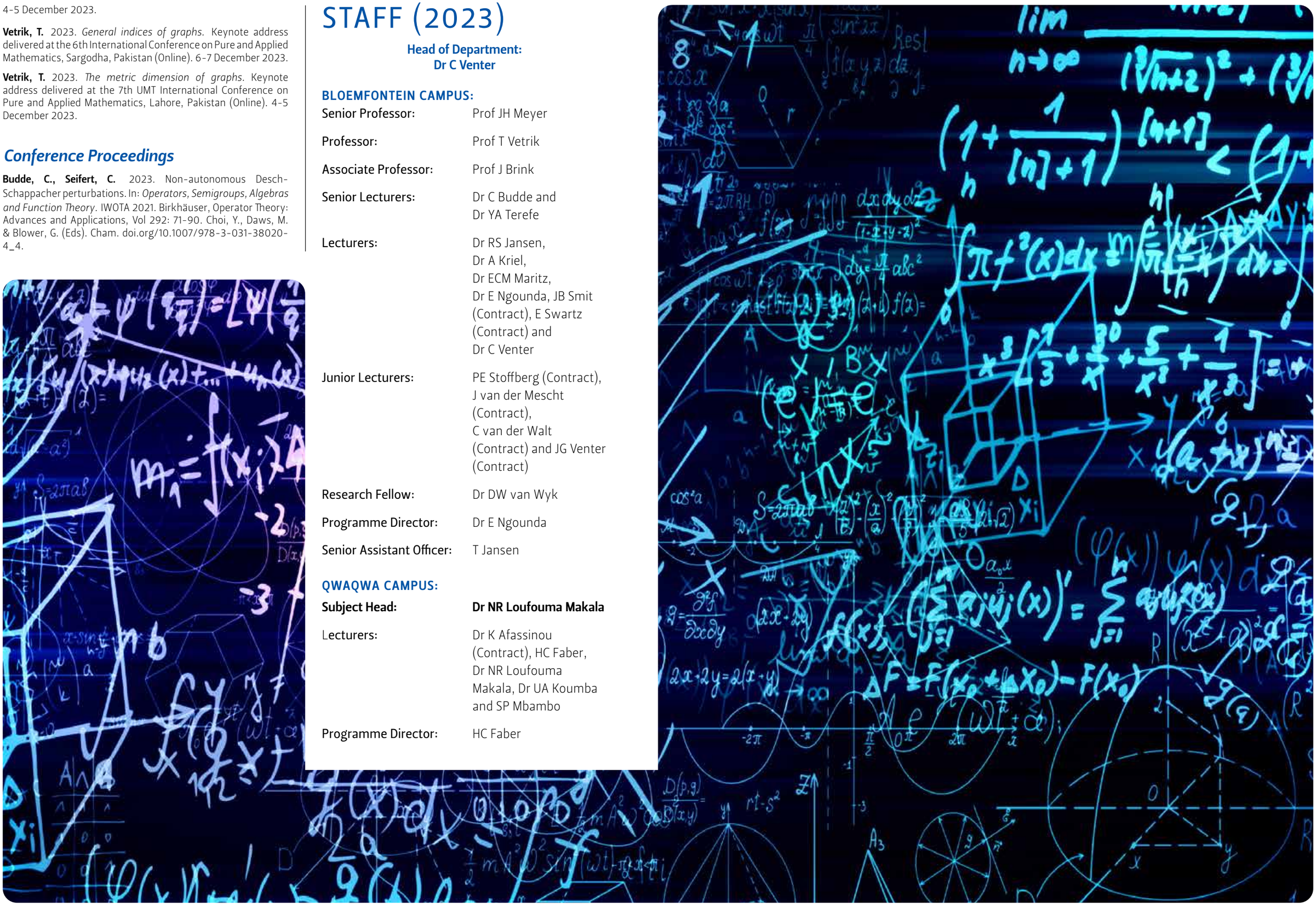
Head of Department:
Dr C Venter

BLOEMFONTEIN CAMPUS:

Senior Professor:	Prof JH Meyer
Professor:	Prof T Vetrik
Associate Professor:	Prof J Brink
Senior Lecturers:	Dr C Budde and Dr YA Terefe
Lecturers:	Dr RS Jansen, Dr A Kriel, Dr ECM Maritz, Dr E Ngounda, JB Smit (Contract), E Swartz (Contract) and Dr C Venter
Junior Lecturers:	PE Stoffberg (Contract), J van der Mescht (Contract), C van der Walt (Contract) and JG Venter (Contract)
Research Fellow:	Dr DW van Wyk
Programme Director:	Dr E Ngounda
Senior Assistant Officer:	T Jansen

QWAQWA CAMPUS:

Subject Head:	**Dr NR Loufouma Makala**
Lecturers:	Dr K Afassinou (Contract), HC Faber, Dr NR Loufouma Makala, Dr UA Koumba and SP Mbambo
Programme Director:	HC Faber



DEPARTMENT OF

MICROBIOLOGY AND BIOCHEMISTRY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

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OVERVIEW OF 2023

The Department of Microbiology and Biochemistry is responsible for undergraduate teaching and postgraduate training in Biochemistry, Microbiology, and Biotechnology. Research conducted in the Department focuses on Drugs and Vaccines, Green Chemistry, Human and Animal Health, Food Biotechnology, and Microbial Diversity. The Department houses a yeast culture collection of over 3 000 yeast isolates from various habitats in South Africa and worldwide. This is the largest yeast collection in the Southern Hemisphere. This collection forms part of the core Biodiversity Biobanks SA initiative under the South African National Biodiversity Institute (SANBI) and is a national resource for researchers and industries interested in yeast diversity. A core research area in the Department is the study of Pathogenic Yeast. The importance of understanding these pathogens and finding ways of combating these infections is highlighted by the fact that Prof Carlien Pohl is the current holder of the NRF SARChI Research Chair in Pathogenic Yeasts. In 2022, the postgraduate students in the Department comprised 19 Honours, 30 MSc, and 17 PhD students. A large group of staff and students attended the 22nd Biennial Conference of the South African Society for Microbiology, a highlight in South African Microbiology circles. Staff changes included the resignation of Dr Onele Gcilitshana, who accepted a position at the University of the North, and the appointment of Dr Winschau van Zyl as Lecturer. Prof Albie van Dijk and Prof Jennifer Hiscock were appointed as Affiliated Professors.

ACHIEVEMENTS

Staff Achievements

Prof Trudi O'Neill received a National Research Foundation (NRF) C1-rating for the period 1 January 2023 to 31 December 2028.

Dr Winschau van Zyl was elected to the South African Society for Microbiology Council at the 18th biennial South African Society for Microbiology Conference.

Dr Julio Castillo was recruited as a member of the National Committee of the International Continental Scientific Drilling Programme (ICDP). In November 2023, Dr Castillo was the guest speaker at the Deep Life Meeting at the Institute of Deep-Sea Science and Engineering at the Chinese Academy of Sciences.

Precious Letebele joined the Albert Einstein College of Medicine in New York, USA, as a research intern in the infectious diseases department. She is working with Prof Daniel Zamith-Miranda and Prof Joshua Nosanchuk. The Nosanchuk laboratory focuses on fungal pathogenesis and innovative therapeutic development, including nanoparticle use. During the three-month visit, Precious learned the different techniques used to investigate extracellular vesicles released by fungal species and their impact on host-pathogen interactions.

Precious Letebele at the Albert Einstein College of Medicine, New York, USA

Student Achievements

At the annual Faculty prize giving, Tyla Baker received the Inqaba Biotechnical Industries Prize for the best Honours student in Microbiology, Gunther Staats received the ICA International Chemicals Prize for Best MSc dissertation in Microbiology/Microbial

Tyla Baker receiving her award

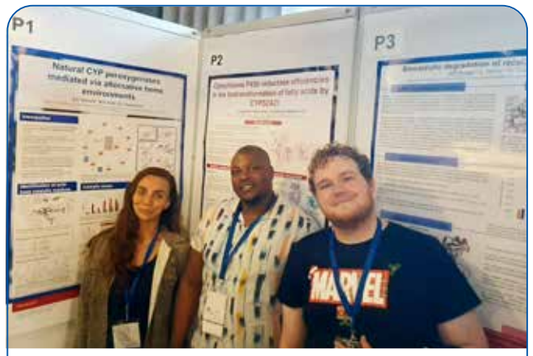
Biotechnology, and Thato Mofokeng received the Inqaba Biotechnical Industries Prize for Best MSc dissertation in Biochemistry.

Gunther Staats (above) and Thato Mofokeng (below) receiving their awards

PhD student Songezo Gidaga, from the Biocatalysis Group, was the African recipient of the David Blow Bursary to attend the Diamond Light Source-CCP4 Data collection and processing workshop, held at the Diamond Light Source, Harwell Oxford campus, UK, from 27 November to 5 December 2023. The workshop included a series of theoretical lectures from leading scientists, such as Andrey Lebedev (Rutherford Appleton Laboratory), Elspeth Garmanc, and Ed Lowe (both from the University of Oxford). During the workshop, students and researchers, under the guidance of Beamline scientists and DLS-CCP4 tutors, engaged in discussions and tutorial sessions in areas such as data collection (onsite), phasing, refinement, data validation, and deposition before solving similar challenges in their data.

Songezo Gidaga at the Diamond Light Source (Synchrotron) in the United Kingdom

Songezo Gidaga also attended the 8th European Crystallography School (ECS8) in Berlin (Germany) from 18 to 24 June 2023. The school was held at the Helmholtz-Zentrum (Bessy II) Synchrotron facility and coordinated by Manfred Weiss. Songezo presented his work on the structural investigation of P450 reductase enzymes. The Biocatalysis Research Group attended the 33rd conference of the Catalysis Society of South Africa (CATSA) in Mossel Bay from 5 to 8 November. He received the runner-up prize for best poster.



Dr Ana Ebrecht (left) and PhD students Songezo Gidaga and Michail Kruger with posters at CATSA

Some of our students were recognised for their achievements at the 18th biennial South African Society for Microbiology Conference. Tyla Baker received the Best Honours Student in Microbiology Prize, Azil Coertzen received the Best Poster Presentation, and Sam McCarlie received the prestigious SASM Bronze Medal for Best Publication. The South African Society for Microbiology travel bursaries were awarded on merit to two PhD students, Samantha McCarlie and Poojah Jawallapersand.

Pinky Sanele Cebekhulu was recognised as the Best Master of Science Student by the Inter-Programme Bursary Scheme, Council for Scientific Research (CSIR) and the Department of Science and Innovation (DSI). Parts of her dissertation on 'Role of Indigenous Microbial Communities in the Mobilisation of Potentially Toxic Elements and Rare-Earth Elements from Alkaline Mine Waste' were published in the *Journal of Hazardous Materials* (IF:13.6).

RESEARCH AND INNOVATION

The research undertaken within the Department is focused on five themes: Drugs and Vaccines, Green Chemistry, Human and Animal Health, Food Biotechnology, and Microbial Diversity:

- Drugs and Vaccines: Rational drug and vaccine design refers to developing next-generation drugs and vaccines based on knowledge of the biological target or infectious agent. At the Department of Microbiology and Biochemistry, drug and vaccine development focuses on infections and diseases affecting humans, animals, and plants.
- Green Chemistry: In contrast to standard chemical processes, using microorganisms or enzymes to produce chemicals facilitates bioprocesses that use renewable feedstocks, produce less pollution or clean up pollution, are more energy-efficient, and are more specific.
- Human and Animal Health: Although a minority of microbes are pathogenic, they significantly impact our well-being and economic activities involving animals. Understanding the pathogenic microbes and the biochemistry of certain non-infectious diseases will improve treatment and quality of life.
- Food Biotechnology: The Food Biotechnology research group is involved with the production, preservation, quality control, and research and development of food products using plants, animals, or microorganisms. Their work focuses on food quality and safety, food waste utilisation, and novel and enhanced foods.
- Microbial Diversity: The study of pathogenic yeasts is a core research area, and the Department houses a yeast culture collection of over 3 000 yeast isolates from various habitats in South Africa and worldwide, a national resource for researchers and industries interested in yeast diversity. Yeasts belonging to the genera *Candida* and *Cryptococcus* are essential pathogens in immunocompromised persons, causing from mild disease to lethal infections. This research is housed in the NRF SARChI Research Chair in Pathogenic Yeasts.

Prof Garry Osthoff

Prof Celia Hugo

Safe and novel food products and processes

Prof Celia Hugo and her research group continued their research on the use of natural preservatives as a replacement, or partial replacement, of sulphur dioxide in the production of Boerewors. Rooibos extract, green rooibos extract, heuningbos extract, commercially available plant extracts containing rosemary extract, and protective cultures showed promising results.

In collaboration with Prof Arno Hugo from the Department of Animal Science, a study on Wet Carcass Syndrome in sheep carcasses, which causes significant losses to farmers and the abattoir industry, indicated that these carcasses could be used for both human and animal (pet food) consumption, due to its equally good quality when compared to normal carcasses. A study on beef carcasses is currently investigating the origin of the Bone taint defect in beef carcasses and ways to mitigate the defect. This study is undertaken in collaboration with Profs Arno Hugo and Errol Cason from the Department of Animal Science and Prof PE Strydom from Stellenbosch University. These studies are contributing to the knowledge of food safety and food security.

The research on milk composition of African non-dairy animals undertaken by Prof Garry Osthoff continues to add surprises to the knowledge of

milk composition. The study of the metabolites in milk resulted in the description of the dynamic changes of metabolites over a whole lactation period in elephant milk. It was also the first time such an analysis was described for mammalian milk in general. Elephant milk is unique in that the macronutrient content constantly increases with the progression of lactation. The metabolome confirmed an increase in energy metabolism to supply the macronutrients, with an emphasis on the building blocks that are most needed, specifically the fatty acids and carbohydrates. Simultaneously, the blood serum metabolites were analysed, and the serum metabolites of lactating elephant cows showed an increase in energy metabolism that was directed to milk production. This work became a cover theme of the thirteenth edition of the journal *Animals*. The research on milk was also directed towards the phospholipid composition, and the results promise to contribute to information on the milk fat globule membrane.

The research on the functional properties of Opuntia (prickly pear plants) mucilage polysaccharides in collaboration with Prof Maryna de Wit (Department of Sustainable Food Systems and Development) led to a PhD thesis and three publications. This polymer may find industrial use in combinations with pectin and alginates to improve the physical properties of gels and films. An MSc and several publications are forthcoming.

Prof Bennie Viljoen and his group continued their research on exotic mushrooms' medicinal and animal feed potential. They primarily use industrial and agricultural waste products as substrates for fungal cultivation, and the mushroom spent for animal feed is used to establish a zero-waste business. They endeavoured to find alternative food security solutions using selected mushrooms as biological decomposers of indigestible substances, such as lignocellulose and lignin in agri-waste pecan and peanut shells. Currently, they produce certified organic oyster mushrooms from local wheat straw and shavings of pruned pecan nut trees and peanut shells. Despite planning to grow Shiitake, Lion's Mane, and other gourmet mushrooms to secure a viable income for rural people, the most sustainable plan was to produce mushroom substrate growth blocks – something novel and not available in South Africa.

As explained above, these substrate blocks are produced using agri-waste and inoculated with the relevant mushroom spawn. As a result, it will minimise logistic nightmares for the rural people to get the fresh produce in time to the markets. Therefore, we researched conditions for optimal growth of various strains of mushrooms using peanut shells as substrate and are currently developing a protocol for mass production of these gourmet mushroom substrate blocks. Our outreach programmes will educate farmers and the public about the new substrates, mushrooms, and animal feed or fertiliser available. It will be a win-win for farmers, consumers, and the environment.

Shiitake and Lion's Mane mushrooms

Biocatalysis, Bioremediation and Bioprospecting

The Applied and Environmental Microbiology Group (AEMG), led by Dr Julio Castillo, apply the knowledge gained from their work in extreme environments to develop biotechnology strategies for the treatment of polluted water for various industries, recovery of metals of economic interest, and discovery of secondary metabolites with potential applications in the human and animal health sectors (i.e. antibiotic and anticancer compounds).

In a project funded by the Technology Innovation Agency (TIA), Dr Castillo and PhD candidate Andisiwe Matu have characterised several alkaline pit lakes' metagenomes and chemical composition. Their study proposes using a non-genetically modified microbial consortium in a natural desalinisation process for mine drainage remediation with high salt concentrations. This strategy might revolutionise the treatment of this type of contaminated water and have a large socio-economic impact in a water-stressed country like South Africa.

In the project 'Biogeochemical Processes in a Subsurface Hypersaline Environment near the Abiotic Fringe Zone', Dr Castillo, Dr Alba Gomez, and Prof Maggy Lau investigate the aerobic biogenic methane production in the deep subsurface. This project will bring new knowledge about a biogeochemical pathway that might have contributed to subsurface methane production, yet it has never been reported in the deep continental subsurface. The isolated bacteria from a hypersaline aquifer 2 billion years old at 3.5 km deep in the Moab mine will be used to confirm this biogeochemical pathway.

Applied and Environmental Microbiology Group members at the Goldschmidt conference held in Lyon, France, from the left, Dr Julio Castillo, Dr Alba Gomez Arias, Andisiwe Matu (PhD student), Sanele Cebekhulu (PhD student), and Dr Maleke Maleke

Dr Julio Castillo, Aoate Tsimatsima, and Andisiwe Matu collaborate with Prof Miquel Senar from the Department of High-Performance Computing of the Autonomous University of Barcelona, Spain, to explore the genome of the endophytic microbial dark matter of a medicinal plant, the African potato. The group has developed a protocol that has revealed, through next-generation sequencing, the microbial composition of the endophytic microorganisms (i.e., fungi and bacteria) that inhabit African potatoes. In addition, Aoate Tsimatsima, Dr Castillo, and Prof Senar are creating a new pipeline to improve the binning step for fungi genomes obtained from metagenomes.

The project titled 'Mine tailings reprocessing, revalorisation and risk reduction through sequential innovations in metal recovery, geopolymerization, ceramics, and sealing processes (TailingR32Green)' has been approved within the ERA-MIN3 programme of HORIZON EUROPE. Dr Julio Castillo is the PI of the study on the effect of Quorum Sensing on bioleaching and selective biorecovery processes of cobalt and rare earth elements from mining tailings.

The international collaborative project on 'Biomineralisation in extreme environments' between Dr Ana Miller, leader of the Geomicrobiology Group at IRNAS-Sevilla, and Dr Julio Castillo, was selected for funding by the DSI and Spanish National Research Council (CSIC) within the CSIC Programme for Scientific Cooperation for Development (i-COOP) programme.

PhD student Andisiwe Matu with her poster at the conference

The Biocatalysis Group of Prof Dirk Opperman and Prof Martie Smit focuses almost exclusively on novel biocatalytic systems for the selective introduction of oxygen into molecules and the further conversion of these hydroxylated products in cascade reactions. Moreover, the group uses protein X-ray crystallography to explore the structure-function relationship of these biocatalysts through structure determination. This allows the study of their natural evolution and informs their experimental evolution through rational design and directed evolution. Since their discovery of a cytochrome

P450 monooxygenase (CYP) with unique in-chain hydroxylase activity of n-alkanes, and fatty alcohols and acids, the group has expanded their work with this class of CYP. The group is currently exploring ways to engineer these enzymes for improved activity and selectivity. The group has also started several projects on hydrogen peroxide-driven peroxygenases, exploring more industrially feasible routes to value-added products.

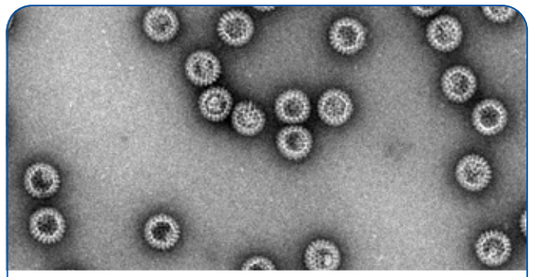
The Biocatalysis Group is also one of five nodes of the Industrial Biocatalysis Hub (IBH) in South Africa, coordinated by the CSIR and funded by TIA and the DSI. The IBH node at UFS focuses on developing industrially relevant biocatalysis technologies. Prof Opperman is also the South African PI of the European Research Area Network (ERA-NET) Co-fund on Food Systems and Climate (FOSC) project. The ThermoK project centres on the thermophilic breakdown of keratin-laden biomass waste and has several international partners within the EU ERA-NET framework.

The Biocatalysis research group attended the 33rd Conference of the Catalysis Society of South Africa (CATSA) in Mossel Bay from 5 to 8 November. Prof Dirk Opperman and PhD student Marko Marinkov presented talks, with more students from the group presenting posters.

UFS delegation to CATSA2023, from the left, Prof Dirk Opperman, Songezo Gidaga, Prof Martie Smit, Michail Kruger, Marko Marinkov, Dr Ana Ebrecht, and Prof Vladimir Azov (Chemistry)

Improvement of human and animal health

The Molecular Virology Group of Prof Trudi O'Neill continued to investigate rotavirus strain diversity, specifically focusing on whole genome constellations of human field strains originating from Mozambique. In line with a One Health approach, rotavirus strain diversity studies have also been expanded to include various animal strains, with an explorative surveillance study on the incidence of bovine rotavirus in three locations, one in the Western Cape and two in the Free State. In addition, the group also follows two approaches for rotavirus vaccine development, namely a replication-deficient rotavirus vaccine through recombinant production of rotavirus proteins in yeast or bacteria, as well as the engineering of rotavirus reassortants making use of the rotavirus reverse genetics system. The latter is funded through a collaborative grant from the Deutsche Forschungsgemeinschaft (DFG). In a quest for a possible broad-spectrum antiviral, the role of lipids during rotavirus replication is also being investigated.



Electron micrograph of Rotavirus virus-like particles

The work of the Clinical Biochemistry Group, led by Dr Frans O'Neill, focuses on the metabolism of selected sterols in various fauna and the production of reproductive hormones. The former includes an interdisciplinary project in which a holistic approach to understanding rhinoceros biology and its interaction with the environment is investigated. Markers for stress within animals are also being investigated. Regarding the latter, the primary focus is on equine chorionic gonadotropin (eCG) and a follicle-stimulating hormone (FSH), which are important hormones used in animal breeding.

Dr Carmien Tolmie leads the Structure-Based Drug Discovery Group, which uses structural biology methods to develop novel therapies to treat infectious diseases. Firstly, a protein in a pathogen is rationally identified as a possible drug target, and the three-dimensional structure is determined using X-ray crystallography. The protein structure is used to guide further drug development efforts. The first of these projects focuses on the development of novel antifungal drugs against enzymes of the ergosterol biosynthesis pathway. In 2023, delta-24 sterol methyltransferase was added as a target, from the pathogens *Candida albicans, Candida auris, Cryptococcus neoformans and Aspergillus fumigatus.* A second project on antiviral drug discovery is based on the reverse transcriptase-polymerase from hepatitis B virus as a target. In 2023, variants of the polymerase's reverse transcriptase and RNAse H domain were successfully expressed as soluble proteins in *Escherichia coli* and partially purified. These projects will use X-ray crystallographic fragment screening to develop lead compounds that can be developed into novel inhibitors using medicinal organic chemistry. The fragment screening experiments will be performed in collaboration with the Xchem team researchers at the Diamond Light Source synchrotron, UK. To date, X-ray crystallographic fragment screening has not been used in the development of antifungal compounds.

Dr Tolmie attended the International School of Crystallography: Structural Drug Design 2023 in Erice, Italy, from 2 to 10 June, during which she presented a poster ('Structural studies of squalene synthase from *Candida albicans* for developing novel antifungal therapies'), and also acted as a session chair.

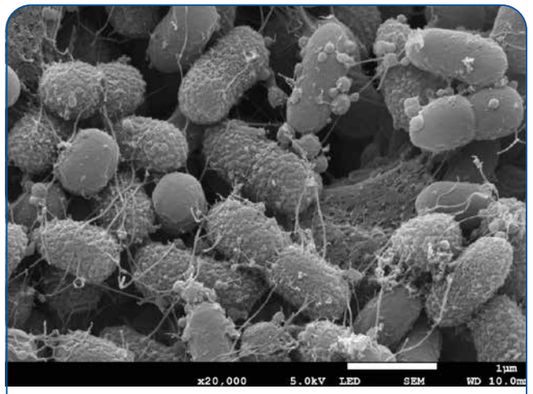
Dr Carmien Tolmie (middle) with organisers of the Structural Drug Design 2023 School, Dr Giovanna Scapin (left) and Dr Annalisa Guerri (right)

The Pathogenic Yeast Research Group currently consists of three academics – Prof Carlien Pohl-Albertyn (who holds the Research Chair in Pathogenic Yeasts under the National Research Foundation [NRF] South African Research Chairs Initiative [SARChI]), Prof Koos Albertyn, and Prof Olihile Sebolai. The group focuses on molecular virulence mechanisms and bioactive lipids' role in pathogenic yeasts, specifically *Cryptococcus neoformans* and several *Candida* species. They are also interested in the virulence of polymicrobial infections consisting of *Candida* spp. and the bacterium *Pseudomonas aeruginosa*. Research regarding these themes was conducted by three international Postdoctoral Fellows, six PhD students, 13 MSc students and six BSc Honours students.

Prof Carlien Pohl-Albertyn, holder of the NRF SARChI Chair in Pathogenic Yeasts

The Veterinary Biotechnology Research Group of Prof Rob Bragg and Dr Charlotte Boucher (currently appointed as a Research Fellow) continued their work on the development of sub-unit vaccines against *Avibacterium paragallinarum* and SARS-CoV-2. They are also using the full genome sequence of *A. paragallinarum* to identify novel targets for sub-unit vaccine production. Work continued on phage display libraries for the development of antibody fragments and antiviral peptides to neutralise Newcastle disease virus. As part of their research on resistance to disinfectants, the group

sequenced the genome of a highly resistant bacterial strain and found genomic islands that contain a wide range of genes resistant to disinfectants, antibiotics, and heavy metals. This work opens the door to a very interesting new field investigating the link between disinfectant and antibiotic resistance. Transcriptomic analysis of the highly resistant strain was also completed. Many genes were found to be substantially up- or downregulated. These include many efflux pump genes which were not previously regarded as playing a role in disinfectant resistance. Another exciting finding was the large number of hypothetical proteins, which could lead to the discovery of novel mechanisms of disinfectant resistance. It was established that there is co-resistance between disinfectants and antibiotics, and it was demonstrated that when the disinfectant resistance of a bacterium is increased, the organisms also develop resistance to antibiotics.



Electron micrograph photo of the highly resistant bacterial strain taken by PhD student Sam McCarly

Since 2021, the efficacy of novel antimicrobial privacy curtains for hospital use has been evaluated. These curtains were shown to be highly effective against a wide range of common hospital-acquired infections. In 2023 detailed evaluation of microbial loads in a hospital was undertaken. A total of 20 wards were tested for air contamination levels as well as surface load. It was found that there are substantial problems with microbial load in this hospital. The renal ward was targeted for a disinfection experiment using a novel disinfectant, and an 85% reduction in microbial load was obtained. It was also demonstrated that there was a residual antimicrobial effect for at least four days.

The research group led by Dr Winschau van Zyl focuses on applied and fundamental microbiology and has a special interest in antimicrobial peptides and probiotic bacteria. Antimicrobial resistance poses a global health threat to human well-being. Probiotic lactic acid bacteria and their antimicrobial peptides have considerable potential as alternatives to antibiotics, both in prophylactic and therapeutic applications. In collaboration with researchers from Stellenbosch University and the University of the Western Cape, the group has developed and optimised a method for producing and purifying lanthipeptides fused to the mCherry fluorescent protein in *Escherichia coli* BL21. The work was published and presented at the 18th biennial South African Society for Microbiology Conference in Stellenbosch in September 2023.

Lanthipeptides are a rapidly expanding family of natural compounds with diverse biological functions, which include antibacterial, antiviral and anticancer activities. In 2023, work continued as a BSc Honours project to use genome mining tools to identify novel anti-clostridial and anti-staphylococcal lanthipeptides *in silico* and was produced effectively in the *E. coli*-based heterologous expression system. One PhD and two Master's students have been recruited for 2024. This will allow the expression and characterisation of a vast array of novel lanthipeptides and new classes of lanthipeptides, which may have novel and more effective modes of action. The group also molecularly identified several probiotic lactic acid bacteria in fermented food products produced by Numesa (Pty), a company based in Centurion, Gauteng, specialising in fermented kefir food and beverages. This work opens the door to identifying potentially novel probiotic bacteria with improved therapeutic effects.

Mass Spectrometer Facility

Dr Gabré Kemp heads the Mass Spectrometer Facility. In August 2023, the Faculty of Natural and Agricultural Sciences approved the acquisition of R13 million worth of mass spectrometers under the large equipment programme. A Sciex QTRAP4500 hybrid triple quadrupole ion trap mass spectrometer and a Sciex X500R high-resolution QTOF instrument were delivered. These new instruments will replace the existing 4000QTRAP mass spectrometer and will be housed in a newly refurbished laboratory in the Department serving as the Mass Spectrometer Facility. The refurbishment, totalling R1.5 million, includes a larger laboratory specifically for the instruments with adjoining laboratory space for sample preparation.

New mass spectrometers housed in the Mass Spectrometer Facility

Dr Kemp attended the first Ubuntu Proteomics Summer school held in Stellenbosch from 30 January to 3 February 2023 and the Sciex User meeting at the University of Cape Town (UCT) from 1 to 3 November 2023.

Participants of the Sciex User meeting at the University of Cape Town

Yeast Culture Collection

The Department of Microbiology and Biochemistry houses a yeast culture collection of over 3 000 yeast isolates from various habitats in South Africa and worldwide. This collection forms a core part of the Biodiversity Biobanks South Africa (BBSA), funded by the DSI's South African Research and Infrastructure Roadmap (SARIR) initiative under the South African National Biodiversity Institute (SANBI) and is a national resource for researchers and industries interested in yeast diversity. Dr Adepemi Ogundeji, curator of the Yeast Culture Collection, represented the BBSA at the 2023 Global Genome Biodiversity Network (GGBN) Conference in Aguascalientes, Mexico, hosted by the Universidad Autónoma de Aguascalientes from 17 to 20 October. It was a gathering of academic institutions and representatives of the private and public sectors, as well as members and non-members of the GGBN community who are interested in preserving and studying our world's biodiversity. BBSA and SANBI won the bid to host the 5th GGBN conference in 2025.

Dr Adepemi Ogundeji presenting on the UFS Yeast Culture Collection at the 4th GGBN Conference, Aguascalientes, Mexico

22nd Biennial Conference of the South African Society for Microbiology

Members of the Department of Microbiology and Biochemistry attended the 22nd Biennial Conference of the South African Society for Microbiology, a highlight in South African Microbiology circles. This year it was held in Stellenbosch from 17 to 20 September 2023, and our Department was represented by the largest delegation consisting of academic staff (Precious Letebele, Dr Winschau van Zyl, Prof Rob Bragg, Prof Carlien Pohl, and Prof Olihile Sebolai), researchers (including postdocs Dr Adepemi Ogundeji, Dr Maryam Bello-Akinosho, and Dr Kayode Afolabi) and a busload of postgraduate students, totalling 39 delegates. Everyone presented their work either as oral presentations or as posters.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Prof Robert Bragg visited India, where he assisted Ventri Biologicals (a poultry vaccine manufacturer based in Pune) with their infectious coryza vaccine. In the past, he has assisted them with the development of this vaccine, which is currently doing very well in the market. The purpose of his visit was to discuss research possibilities with the research and development team of Ventri Biologicals and explore possibilities of joint projects, particularly on the molecular typing system that he has been working on and the possibilities of a universal vaccine. He visited their production facility, quality control, and animal facilities. Thereafter, he presented six talks in six days to about 600 Indian layer farmers in southern India, including Bangalore, Hospet, Mysore, Namakkal (one of the major layer production regions in South India), Rajahmundry, and Hyderabad. A meeting with technical people and consulting vets was also held in Coimbatore.

Prof Bragg was interviewed by the national broadcaster, the SABC, to give his expert opinion on the current avian flu outbreak in South Africa.

The UFS annual Open Day, now known as Connect2Kovsies, took place on 29 July 2023. In line with Vision 130, the University moved from a mass approach to a targeted approach where prospective students who applied and received conditional offers were invited to explore and experience the University. The Department's exhibition was held in-house, and it attracted much attention from prospective students. Personnel and students were on duty to answer questions from prospective students. In addition, departmental corporate pamphlets were available to provide additional information.

Prof Bragg making a presentation to poultry producers in India on infectious coryza

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Dirk Opperman

Prof Dirk Opperman continued his ongoing collaborative projects with Prof Frank Hollmann and Dr Caroline Paul from Delft University of Technology (Netherlands), and Prof Selin Kara (Leibniz University Hannover, Germany). The groups bring together experts in biocatalysis, including protein structure determination, directed evolution, and process development, and they are currently focusing on the application of biocatalysts. Together with research groups from Norway (University of Bergen and NORCE), the United Kingdom (Exeter University), France (Commissariat à l'énergie atomique et aux énergies alternatives [CEA]), and Kenya (University of Nairobi), Prof Opperman continued his collaboration within the ThermoK consortium, funded via the ERA-NET co-fund on FOSC to develop biotechnological routes to upcycle waste products and promote a circular economy.

Within the IBH node in the biocatalysis group of Prof Martie Smit and Prof Dirk Opperman, a new collaboration with Prof Vlada Urlacher from the Heinrich Heine University Düsseldorf (Germany) was initiated and a cooperation agreement was signed for a joint project, termed 'PiLacto'.

Dr Carmien Tolmie continued her collaboration with Prof Frank von Delft from the University of Oxford and the XChem group at the Diamond Light Source for structure-based drug discovery for novel antifungal drugs. Dr Tolmie also initiated a collaboration with Dr Annette von Delft, a medicinal chemist from the University of Oxford, on the development of novel antifungals. Dr Tolmie and Dr Opperman continued their collaboration with Dr Felix Ferroni from the Department of Physics at the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina, on the structural and functional characterisation of a copper nitrite reductase.

Prof Trudi O'Neill continued to collaborate with Dr Nilsa de Deus from the Mozambique National Institute of Health, on rotavirus diversity in Mozambique. She also continued to work on this topic with Prof Martin Nyaga from the UFS Next Generation Sequencing (NGS) Unit and Dr Celeste Donato from the Enteric Diseases Group at the Murdoch Children's Research Institute, Melbourne, Australia. The DFG-funded project on 'Antigens and reassortant strains for rotaviruses circulating in Africa (AfRota)' also continued, and includes researchers in Germany (Prof Reimar Johne and Dr Alexander Falkenhagen, Federal Institute of Risk Assessment, Berlin, Germany), Mozambique (Dr De Deus) and South Africa (with Prof O'Neill and Prof Albie van Dijk based at UFS). The project utilises the rotavirus reverse genetics system and aims to generate chimeric viruses for next-generation rotavirus vaccine development. Prof O'Neill and Prof Van Dijk hosted Dr Nilsa de Deus and Prof Reimar Johne and their research teams for the annual AfRota consortium meeting (5-7 September 2023). Following the meeting, PhD students from BfR (Roman Valusenko-Mehrkens) and the Mozambique National Institute of Health (Benilde Munlela) remained in Bloemfontein for a month-long scientific visit in the Molecular Virology group.

Dr Julio Castillo

Dr Julio Castillo signed a collaborative agreement with the University of Limpopo, (Dr Kgabo Moganedi, Department of Biocheistry, Microbiology and Biotechnology) on a project titled 'Developing a bacterial consortium for improving the quality of mining-contaminated water'. The research group also collaborated with Prof Alfonso Corzo (University of Cadiz), Prof Jon Lloyd, and Dr Natalie Byrd (University of Manchester) on a project involving the bioprecipitation of metallic copper from acid mine drainage in the Iberian Pyrite Belt.

Collaboration continued with Princeton University and New Mexico Tech on the project 'Biogeochemical Processes in a Subsurface Hypersaline Environment near the Abiotic Fringe Zone' and with Prof Hiroshi Ogasawara (Ritsumeikan University, Japan) on the project 'Drillhole Investigations of earthquake physics and deep life in fault zones in South African mines'. In addition, collaboration is ongoing with Golders Associates, analysing data collected from the pilot-scale BDAS system (acid mine drainage treatment) installed at Parys Mountain Mine and Cwm Rheidol Mine.

Dr Castillo, together with Dr Alba Gomez-Arias and Prof Walter Purcell from the UFS Department of Chemistry, signed a collaboration agreement with a consortium which includes the University of Huelva (Dr Manuel Caraballo), the University of Aveiro (Prof Victor Ferreira), the Basque Centre Materials (Dr Roberto Fernandez), the National University of Altiplano Puno (Dr Charango Munizaga-Rosas), and the Central University of Technology (Dr Maleke Maleke) for a project on 'Mine tailings reprocessing, revalorisation and risk reduction through sequential innovations in metal recovery, geopolymerization, ceramics and sealing processes'. The ERA-MIN3

The AfRota team during the annual project meeting hosted by Prof O'Neill and Prof Van Dijk from 5 to 7 September 2023

programme supported by European Commission's Horizon 2020 funds the project. Two PhD and two Master's students are expected to graduate from this project.

Dr Castillo has started a collaboration with Dr Ana Miller from the Institute for Development of Advanced Applied Systems (IRNAS) in Sevilla, Spain, within the project 'Biomineralisation in extreme environments'. In addition, Dr Castillo and Prof Fransico Cordoba from the University of Huelva are collaborating on the biocorrosion of concrete impacted by acid mine drainage.

A chicken with infectious coryza

The Veterinary Biotechnology Group continued their collaborative projects on various potential commercial products with Dr Asgar, of Saife VetMed in India. There was also continued collaboration with Dr Gavakar, of Ventri Biologicals, the largest poultry vaccine manufacturer in India, on the development of effective vaccines against infectious coryza.

Dr Frans O'Neill

Dr Frans O'Neill is still involved with the interdisciplinary collaborative effort centred on rhinoceros, which includes researchers from several departments within the UFS Faculty of Natural and Agricultural Sciences and the Faculty of Health Sciences. He is also part of an interdisciplinary project with Dr Angelique Lewies of the UFS Department Cardiothoracic Surgery, looking at developing a cardiac organoid model for drug screening and disease modelling, and is collaborating with Dr Fanie Steyn, of AniPharm (Pty) Ltd, on the recombinant production of reproductive hormones, and with Dr Martin Blasco (of the Instituto Nacional de Tecnologia Industrial in Argentina) on receptor-based assays.

Dr Winschau van Zyl continued a collaboration with Dr Anton du Preez van Staden, Prof Leon Dicks, both from the Department of Microbiology at Stellenbosch University, and Prof Marla Trindade from the Institute for Microbial Biotechnology and Metagenomics at the University of Western Cape. The collaboration relates to developing and optimising a method to produce lanthipeptides in *Escherichia coli,* peptides with potent antimicrobial activity against multi-drug resistant bacteria. Dr Van Zyl also collaborated with Dr Deepak Govindaraj from the Synthetic Biology Centre at CSIR, Pretoria, as part of a highly multi-disciplinary collaborative effort to engineer a minimal and synthetic version of the probiotic *Lactobacillus casei* as a chassis with robust growth, capable of surface display and secretion of therapeutic proteins.

Prof Jennifer Hiscock

Prof Carlien Pohl-Albertyn continued her collaboration with Prof Jennifer Hiscock from the School of Physical Sciences at the University of Kent and hosted her during her visit to the Department, during which she shared expertise on novel self-associating amphiphiles. They are collaborating on the application of these molecules as antibiofilm compounds. As part of the collaboration, Prof Hiscock was co-supervisor of an MSc student, Henco Steyn, who obtained his degree with distinction in 2023.

Prof Olihile Sebolai hosted Prof Wilber Sabitti from St Andrews University, Scotland, who presented a lecture on revolutionising tuberculosis treatment monitoring using the tuberculosis Molecular Bacterial Load Assay (TB-MBLA).This technology may be expanded to other respiratory pathogens. Prof Wilber Sabitti's visit coincided with a visit to the Centre for AIDS Programme of Research in South Africa (CAPRISA) at the University of KwaZulu Natal (UKZN).

OTHER ACTIVITIES

Prof Mike Wingfield

A highlight for 2022 was the awarding an honorary doctorate to Prof Mike Wingfield following a nomination by Prof Koos Albertyn. Prof Wingfield began his academic career in the Department of Microbiology and Biochemistry at the UFS in 1988. Shortly after, he received the NRF President's Award and held an NRF A-rating for over 26 years. He was the founding director of the Forestry and Agricultural Biotechnology Institute (FABI) established at the University of Pretoria in 1998, stepping down from this position at the end of 2017, after 20 years. 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 has published widely on this topic and has been included in the Clarivate list of approximately 6 000 highly cited scientists in the world for many years. He has advised more than a hundred PhD students.

POSTGRADUATE STUDENTS

In 2023, 19 students were enrolled in the Department for the BSc Honours – 10 for Microbiology and 9 for Biochemistry. Eighteen students (10 in Microbiology and 8 in Biochemistry) graduated at the April 2023 graduation ceremony.

A total of 30 students were registered in the Department in 2023 for Master's degrees – 22 in Microbiology and 8 in Biochemistry. During 2023, eight students were awarded Master's degrees:

- Alom, Jameel (MSc in Microbiology)
- Beauzec, Deon (MSc in Microbiology)
- Boneschans, Martha (MSc in Biochemistry)
- Mofokeng, Thato (MSc in Biochemistry - with distinction)
- Staats, Gunther (MSc in Microbiology – with distinction)
- Thobane, Tshegofatso Benedict (MSc in Biochemistry)
- Van Heerden, Sunél (MSc in Biochemistry)
- Van Zyl, Mart-Louise (MSc in Microbiology)

Seventeen (17) students were registered for Doctoral degrees – nine in Microbiology and eight in Biochemistry. During 2023, the PhD was conferred on four students:

Aschenbrenner, Jasmin Cara (Biochemistry)

Thesis: Addressing the limitations of self-sufficient cytochrome P450 monooxygenases

Supervisors: Prof DJ Opperman and Prof MS Smit

Coetsee, Elke (Microbiology)

Thesis: Investigation into the presence of HP2-like and Mu-like prophages within the genomes of the most prevalent South African Avibacterium paragallinarum serovars

Supervisors: Prof RR Bragg and Dr C Boucher

Lekena, Nkhasi (Biochemistry)

Thesis: Recombinant expression and purification of equine chorionic gonadotropin in mammalian cells

Supervisor: Dr FH O'Neill

Matu Andisiwe (Microbiology)

Thesis: Developing a bacterial consortium for improving the quality of mining-contaminated water

Supervisor: Dr J Castillo

Sander, Willem Jacobus (Microbiology)

Thesis: Investigating the role of viroplasm formation and calcium levels on the production of prostaglandin E2 during rotavirus infection

Promoter: Prof T O'Neill

POSTDOCTORAL RESEARCH FELLOWS

The Department of Microbiology and Biochemistry hosted six postdoctoral research fellows during 2023. These were:

- Dr Kayode Afolabi (from Nigeria)
- Dr Eric Akintemi (from Nigeria)
- Dr Maryam Bello-Akinosho (from South Africa)
- Dr Kamini Govender (from South Africa)
- Dr Nkhasi Lekena (from South Africa)
- Dr Wico Sander (from South Africa)

Dr Nkhasi Lekena, Postdoctoral Research Fellow in the Molecular Virology group of Prof Trudi O'Neill, was awarded the highly competitive and prestigious Werner Baltes Fellowship offered by the Bundesinstitut für Risikobewertung (BfR), Berlin, Germany in 2023. This enabled Dr Lekena to visit Prof Reimar Johne and Dr Alexander Falkenhagen at BfR during a three-month stay between October and December 2023. The Werner Baltes Fellowship is offered annually to up to ten guest scientists from new EU member states and non-European countries. It aims to promote not only the capacity development of young scientists but also strengthen international cooperation. During the visit, Dr Lekena received training in rotavirus reverse genetics and related virological techniques. The visit also formed part of the 'Antigens and Reassortant Strains for rotaviruses circulating in Africa (AfRota)' research project that is led by Prof Johne, with Prof O'Neill as co-investigator. AfRota is funded by the German Research Foundation. An important deliverable of the project is the exchange of young scientists and capacity development.

STAFF MATTERS

Prof Albie van Dijk

Prof Albie van Dijk and Prof Jennifer Hiscock were appointed as Affiliated Professors in the Department of Microbiology and Biochemistry in January 2023. Previously from North-West University (NWU), Prof Van Dijk has more than 40 years of experience in molecular virology and recombinant vaccine development of dsRNA viruses. Her research focused mostly on Orbiviruses, but shifted during the past 15 years to rotavirus, specifically rationally designed vaccine development. She is a close collaborator of Prof Trudi O'Neill in our Department, and as a result of her appointment, Prof Van Dijk's rotavirus research group moved from NWU in Potchefstroom to join Prof Trudi O'Neill's laboratory at the UFS during 2023.

Prof Hiscock is a supramolecular chemist at the University of Kent, with a special focus on novel antimicrobial compounds. This has led to a long-standing collaboration between Prof Carlien Pohl-Albertyn and Prof Hiscock on the topic of self-associating amphiphiles as novel antibiofilm compounds. Her expertise in the intersection between biology and chemistry has allowed her to act as co-supervisor for an MSc student (Hendrik Steyn) who received his degree with distinction. During his studies, Hendrik spent six weeks in Prof Hiscock's laboratory. She is continuing her supervision in our Department as co-supervisor of the PhD study of Henco Steyn and the MSc study of Kusalethu Luthuli. This collaboration resulted in one publication under review and several national and international conference presentations.

Dr Winchau van Zyl

Dr Onele Gcilitshana left the University in April 2023, and Dr Winschau van Zyl was appointed as a Lecturer at the beginning of 2023. Dr Van Zyl's appointment is part of the University's Qhubeka Development Programme (QDP) – an initiative of the Vice-Rector: Academic and a developmental programme of the UFS aimed at developing young, promising academics.

RESEARCH OUTPUTS

Research Articles

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Nisson, D.M., Walters, C.C., Chaćon-Patiños, M.L., Weisbrod, C.R., Kieft, T., Sherwood Lollar, B., Warr, O., Castillo, J., Perl, S.M., Cason, E.D., Freifeld, B.M. & Onstott, T.C. 2023. Radiolytically reworked Archean organic matter in a habitable deep ancient high-temperature brine. *Nature Communications* 14:6163. doi.org/10.1038/s41467-023-41900-8.

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Van Wyngaard, B.E., Hugo, A., Strydom, P.E., De Witt, F.-H., Pohl, C.H. & Kanegoni, A.T. 2023. A comparison of *Echium,* fish, palm, soya, and linseed oil supplementation on pork quality. *Animal Bioscience* 36: 1414-1425. doi.org/10.5713/ab.22.0362.

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Chapters in Books

Bello-Akinosho, M., Afolabi, K.O., Chandra, H., Mayashinta, D.K., Setia, Y.D., Mishra, A.P. & Pohl-Albertyn, C.H. 2023. Opportunities and challenges in the development of antiparasitic drugs. In: *Parasitic infections. Immune Responses and Therapeutics.* A.P. Mishra & N. Manisha (Eds). John Wiley and Sons, Inc. ISBN: 978-1-119-87804-9. pp. 227-250.

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Conference Contributions

Conference Papers / Posters

Baker, T., Bester, A., Albertyn, J. & Pohl, C.H. 2023. *Biofilms on urban aquatic plastic pollution as a reservoir for pathogenic yeasts.* Paper delivered at the 4th Annual CanFunNet Conference (Virtual). 31 May-2 June 2023.

Baker, T., Bester, A., Albertyn, J. & Pohl, C. 2023. *Biofilms on urban aquatic plastic pollution as a reservoir for pathogenic yeasts.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Barron, N., Strydom, A., Strydom, M., Pretorius, B. & O'Neill, H.G. 2023. *Evaluating the incidence and zoonotic potential of bovine rotavirus in South Africa.* Poster presented at the 14th International Rotavirus Symposium, Bali, Indonesia. 14-16 March 2023.

Barron, N., Strydom, A., Strydom, M., Steyn, T. & O'Neill, H.G. 2023. *Surveillance and genome characterisation of bovine rotavirus in the Western Cape and Free State provinces of South Africa.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Bello-Akinosho, M., Ogundeji, A., Swart, V., Kemp, G., Albertyn, J. & Pohl, C. 2023. *Biodegradation of esfenvalerate by yeast isolates from brown locust guts.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Belter, B., Tolmie, C., Boucher-van Jaarsveld, C. & Bragg, R. 2023. *The production of SARS-CoV-2 proteins in Yarrowia lipolytica for vaccine development.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Beneke, C., Albertyn, J. & Pohl, C. 2023. *The role of the High Osmolarity Glycerol (HOG) response pathway in Candida auris.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Bisschoff, E., Albertyn, J. & Pohl, C. 2023. *Molecular investigation of the multidrug resistance of Candida auris, focusing on the ABC transporters.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Bolsenbroek, A., Pohl, C. & Albertyn, J. 2023. *Molecular investigation of prostaglandin E2 production in Candida auris.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Castillo, J., Papaspyrou, S., Duran, M., Corzo, A., Nieto, J., Caraballo, M. Becerra-Herrera, M., Gomez Arias, A. & Valverde, A. 2023. *Extracellular elemental copper bioaccumulation.* Poster presented at the Annual Goldschmidt Conference, Lyon, France. 9-14 July 2023.

Cebekhulu, S. Gomez Arias, A., Alom, J., Valverde, A., Ololade, O. & Castillo, J. 2023. *Indigenous microorganisms and the bioavailability of organic matter drive the mobilisation of potentially toxic elements and rare-earth elements in alkaline mine wastes.* Paper delivered at the Annual Goldschmidt Conference, Lyon, France. 9-14 July 2023.

Dalbock, A., Senekal, N., Bothma, C., Hugo, A. & Hugo, C. 2023. *The effect of sodium reduction and replacement by potassium chloride on the survival of Escherichia coli ATCC 8739TM and Staphylococcus aureus ATCC 25923TM in Feta cheese.* Poster presented at the 25th Biennial South African Association of Food Science and Technology Congress, Cape Town, South Africa. 28-30 August 2023.

Ebrecht, A.C., Smit, M.S. & Opperman, D.J. 2023. *New natural CYPs displaying peroxygenase activity mediated via alternative heme environments.* Poster presented at the 33rd Annual CATSA Conference, Mossel Bay, South Africa. 5-8 November 2023.

Fourie, C., Ogunyinka, M.I., Legisa, D., Blasco, M. & O'Neill, H.G. 2023. *Analysis of yeast-produced rotavirus VP6 as subunit vaccine candidate.* Poster presented at the 14th International Rotavirus Symposium, Bali, Indonesia. 14-16 March 2023.

Fourie, C., Ogunyinka, M.I., Legisa, D.M., Blasco, M., Albertyn, J. & O'Neill, H.G. 2023. *Analysis of microbially produced Rotavirus VP6 as a subunit vaccine candidate.* Oral presentation at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Gidaga, M.S., Ebrecht, A.C., Smit, M.S. & Opperman, D.J. 2023. *Cytochrome P450 reductase efficiencies in the biotransformation of fatty acids by CYP52A21.* Poster presented at the 33rd Annual CATSA Conference, Mossel Bay, South Africa. 5-8 November 2023.

Gidaga, M.S., Ebrecht, A.C., Smit, M.S. & Opperman, D.J. 2023. *Interaction and electron transfer mechanism of cytochrome P450 monooxygenase reductases (CPRs).* Poster presented at Diamond-CCP4 Data Collection and Structure Solution Workshop, Didcot, UK. 27 November–5 December 2023.

Gomez Arias, A., Castillo, J., Yesares, L., Canovas, C., Caraballo, M. Maleke, M. & Purcell, W. 2023. *Re-purposing BDAS system as a green technology to concentrate REE from mine tailings.* Paper delivered at the Annual Goldschmidt Conference, Lyon, France. 9-14 July 2023.

Jawallapersand, P., Albertyn, J. & Pohl, C. 2023. *Effect of polyunsaturated fatty acids and eicosanoids on Candida albicans germination.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Krüger, M.W., Tolmie, C. & Opperman, D.J. 2023. *Biocatalytic degradation of recalcitrant biopolymers.* Poster presented at the 33rd Annual CATSA Conference, Mossel Bay, South Africa. 5-8 November 2023.

Kruger, M.W., Tolmie, C. & Opperman, D.J. 2023. *Biocatalytic degradation of recalcitrant biopolymers.* Poster presented at the Catalysis Society of South Africa Conference, Mossel Bay, South Africa. 5-8 November 2023.

Letebele, P., Pohl, C. & Albertyn, J. 2023. *Role of EHT1, encoding octanoyl-CoA: ethanol acyltransferase, in Candida albicans biofilm lipid droplet.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Lourens, T., Pohl, C. & Albertyn, J. 2023. *Investigating the lipases of the multi-drug resistant yeast, Candida auris.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Maleke, M., Matu, A., Cason, E., Gomez Arias, A. & Castillo, J. 2023. *Energy sources like iron contribute to shaping the microbial communities in scalding hot springs.* Poster presented at the Annual Goldschmidt Conference, Lyon, France. 9-14 July 2023.

Maliehe, M., Folorunso, O., Pohl, C.H. & Sebolai, O.M. 2023. *The potential influence of amoebal predation on Cryptococcus neoformans and its virulence.* Oral presentation at the 4th Annual CanFunNet Virtual Conference. 31 May–2 June 2023.

Maliehe, M., Kemp, G., Pohl, C. & Sebolai, O. 2023. *Evaluation of the crude extract of Artemisia tea to control the growth of the fungus Cryptococcus neoformans.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Marinkov, M., Ebrecht, A.C., Opperman, D.J. & Smit, M.S. 2023. *Investigating functionally relevant residues in cytochrome P450 monooxygenases using a 3D class specific molecular information system.* Paper delivered at the 33rd Annual CATSA Conference, Mossel Bay, South Africa. 5-8 November 2023.

Mathangana, S. Cebekhulu, A., Gomez Arias, A. Matu, A., Maleke, M. & Castillo, J. 2023. *Indigenous microbial communities aid to the leaching of technologically important metals available in alkaline mine waste.* Paper delivered at the 22nd Biennial Congress of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Matshoba, L., Gcilitshana, O., Albertyn, J., Pohl, C. & Sebolai, O. 2023. *The role of phospholipases in Candida auris pathogenicity.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Matu, A., Cason, E., Valverde, A., Moganedi, K. & Castillo, J. 2023. *Developing a bacterial consortium for improving the quality of mining-contaminated water.* Poster presented at the Annual Goldschmidt Conference, Lyon, France. 9-14 July 2023.

Mc Carlie, S.J. & Bragg R.R. 2023. *Antimicrobial resistance islands indentified in highly resistant Serratia sp. HRI.* Oral presentation at the 41st Annual European Society for Paediatric Infectious Diseases Conference. Lisbon, Portugal. 8-12 May 2023.

Mjokane, N., Maliehe, M., Folorunso, O.S., Ogundeji, A.O., Gcilitshana, O.M.N., Albertyn, J., Pohl, C.H. & Sebolai, O.M. 2023. *Activation of SARS-CoV-2 Spike protein by a fungal protease(s).*

Paper delivered at the 4th Annual CanFunNet Virtual Conference. 31 May-2 June 2023.

Mjokane, N., Maliehe, M., Folorunso, O.S., Ogundeji, A.O., Gcilitshana, O.M.N., Albertyn, J., Pohl, C.H. & Sebolai, O.M. 2023. *Activation of SARS-CoV-2 Spike protein by a fungal protease(s).* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Moukangwe, L., Maliehe, M., Mjokane, N., Albertyn, J., Pohl, C. & Sebolai, O. 2023. *Characterisation of Cryptococcus albidus growth and virulence potential.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Mqambalala, A., Castillo, J., Deysel, L-M. & Valverde, A. 2023. *First insight into the natural attenuation of emerging contaminants using a metagenomic approach from drinking water sources in the Free State.* Paper deliveered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Munlela, B. João, E.D., Strydom, A., Bauhofer, A.F.L., Chissaque, A., Chilaúle, J.J., O'Neill, H.G. & De Deus, N. 2023. *Description of a rare NSP4- E6 genotype associated with a G9P[4] rotavirus strain detected in Mozambique.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Nisson, D., Kieft, T., Drake, H., Warr, O., Sherwood, B., Ogasawara, H., Perl, S., Friefeld, B., Castillo, J., Whitehouse, M., Kooijman, E. & Onstott, T. 2023. *Radiolysis-driven evolution of an ancient subsurface habitable brine in the Witwatersrand Basin, South Africa.* Paper delivered at the Annual Goldschmidt Conference, Lyon, France. 9-14 July 2023.

Ntshangase, N., Mjokane, N., Maliehe, M., Albertyn, J., Pohl, C. & Sebolai, O. 2023. *The repurposing of aspirin as a photo- and chemo-sensitising agent to inactivate the growth of Staphylococcus aureus.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Ogundeji, A. & Pohl, C. 2023. *Biodiversity Biobanks SA Yeast culture collection, UFS: Meeting the needs of researchers.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Opperman, D.J. & Smit, M.S. 2023. *H_2O_2 driven biocatalytic oxyfunctionalization reactions.* Paper delivered at the 33rd Annual CATSA Conference, Mossel Bay, South Africa. 5-8 November 2023.

Opperman, R., Van Wyngaard, B., Roodt, E., Hugo, C., Bothma, C. & Hugo, A. 2023. *The effect of salt reduction and salt replacer combinations on the chemical, microbial and sensory quality of dry sausage.* Poster presented at the 25th Biennial South African Association of Food Science and Technology Congress, Cape Town, South Africa. 28-30 August 2023.

Opperman, R., Van Wyngaard, B., Roodt, E., Hugo, C., Bothma, C. & Hugo, A. 2023. *The effect of salt reduction and salt replacers as sodium reduction strategies on the chemical, microbial and sensory quality of Biltong, a traditional South African intermediate moisture meat product.* Poster presented at the 25th Biennial South African Association of Food Science and Technology Congress, Cape Town, South Africa. 28-30 August 2023.

Sander, W.J., Pohl, C.H. & O'Neill, H.G. 2023. *Rotavirus NSP4-mediated increase in intracellular calcium results in increased levels of the pro-inflammatory eicosanoid, prostaglandin E_2, during infection.* Paper delivered at the 14th International Rotavirus Symposium, Bali, Indonesia. 14-16 March 2023.

Senokoane, R., Albertyn, J. & Pohl, C. 2023. *The impact of FET99 deletion on the fluconazole susceptibility and lipid droplet formation of Candida albicans.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Setsiba, L., Albertyn, J. & Pohl, C. 2023. *Investigation of the influence of vacuolar iron permease, Fth2p, on lipids of Candida albicans during competition for iron.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Steyn, H., Hilton, K., Hassan, M., Hind, C., Hiscock, J. & Pohl, C. 2023. *Evaluating the efficacy of supramolecular self-associating amphiphiles as novel antifungal substances against Candida albicans biofilms.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Steyn, H., Hilton, K., White, L-J., Hiscock, J. & Pohl, C.H. 2023. *Evaluating the efficacy of supramolecular self-associating amphiphiles as novel antifungal substances against Candida albicans.* Oral presentation at the 4th Annual CanFunNet Virtual Conference. 31 May–2 June 2023.

Swart, W., Mc Carlie, S.J. & Bragg, R.R. 2023. *Incorrectly used disinfectants may drive resistance development in clinical settings.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Thusi, A.X., Mendes dos Ramos, S., Tolmie, C., Albertyn, J. & O'Neill, H.G. 2023. *Evaluation of cytokine responses in macrophage- like cells induced by a rotavirus NSP4-VP4 fusion protein.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Thusi, A.X., Mendes dos Ramos, S., Tolmie, C., Albertyn, J. & O'Neill, H.G. 2023. *Production of a bacterially expressed truncated NSP4p-dVP4 fused protein as a rotavirus subunit vaccine candidate.* Poster presented at the 14th African Rotavirus Symposium, Abuja, Nigeria. 8-10 November 2023.

Van Baalen, C., Albertyn, J. & Pohl, C. 2023. *Construction of a single gRNA expression vector to facilitate RNA-guided CRISPR-Cas9 gene editing for Candida auris.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Van Zyl, W.F., Van Staden, A.D., Dicks, L.M.T. & Trindade M. 2023. *Use of the mCherry fluorescent protein to optimise the expression of class I lanthipeptides in Escherichia coli.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Vermaas, J., Monnapula, M., Hugo, C., Du Toit, A. & Pretorius, W. 2023. *Check-all-that-apply (CATA) question compares sensory characteristics of bacterial cellulose, with four other textiles.* Poster presented at the 15th Pangborn Sensory Science Symposium, Nantes, France. 20-24 August 2023.

Visser, C. Mc Carlie, S.J. & Bragg, R.R. 2023. *Development of phage display- derived antiviral peptides against Newcastle disease virus.* Poster presented at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

Visser, M., Potgieter, C., O'Neill, H.G. & Van Dijk, A.A. 2023. *Generating rotavirus reassortants with spike proteins from human and bovine strains for the development of region-specific vaccine candidates.* Paper delivered at the 22nd Biennial Conference of the South African Society for Microbiology, Stellenbosch, South Africa. 17-20 September 2023.

STAFF (2023)

Head of Department:
Prof J Albertyn

Professors:	Prof J Albertyn, Prof R Bragg, Prof C Hugo, Prof D Opperman, Prof G Osthoff, Prof T O'Neill, Prof C Pohl-Albertyn, Prof M Smit and Prof B Viljoen
Affiliated Professors:	Prof J Hiscock and Prof A van Dijk
Associate Professor:	Prof O Sebolai
Affiliated Associate Professors:	Prof AS Bareetseng and Prof A Valverde Portal
Senior Lecturer:	Dr F O'Neill
Affiliated Senior Lecturer:	Dr M Labuschange
Lecturers:	P Letebele, L Steyn, Dr C Tolmie and Dr WF van Zyl,
Senior Researchers:	Dr J Castillo-Hernandez and Dr G Kemp
Research Fellow:	Dr C Boucher
Senior Officer – Professional Services:	S Marais
Officers – Professional Services:	Y Makaum, Dr A Ogundeji and C van Rooyen
Officer:	A van der Westhuizen
Senior Assistant Officer:	E van den Heever
Storeman:	M Mogopodi
Technical Help:	K Mashuga, L Mazwi, P Mereko and J Mvula

DEPARTMENT OF

PHYSICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

2023 has been an exciting year for the Department of Physics. The Department is recognised as one of the leading physics departments in the country, with research in astrophysics, phosphor- and solid-state physics that is internationally recognised. The Department boasts a well-equipped nano surface characterisation laboratory (with state-of-the-art research infrastructure), an observatory (Boyden) with a 1.5 m telescope, and a digital planetarium. Most of the staff members are also involved with the Boyden Science Centre and the Naval Hill Planetarium, both of which are intensively involved with science engagement with local, provincial, and national communities. The undergraduate and postgraduate programmes are challenging and well-balanced and students exiting these programmes are of high quality and sought after by industry.

At the end of 2023, after a career at the University of the Free State (UFS) spanning 38 years, Prof Matie Hoffman retired from his position as Lecturer in the Department of Physics as well as the Manager of the Naval Hill Planetarium.

ACHIEVEMENTS

Staff Achievements

Prof Richard Ocaya published a peer-reviewed Springer Nature book that he wrote singly, complete with editorial reviews. The title of the book is *Extraction of Semiconductor Diode Parameters: A Comparative Review of Methods and Materials*. Over the years, Prof Ocaya's work has earned him numerous accolades, including awards from various scientific societies. He is a passionate educator who enjoys sharing his knowledge with students and colleagues alike, having mentored many successful researchers in the field of physics.

Student Achievements

Tebogo Motsei, a PhD student at the Qwaqwa Campus, received the prestigious CV Raman International Fellowship for African Researchers for 2023. The Fellowship provides opportunities for African researchers to conduct collaborative research and/or training for one to twelve months at universities and research institutions in India. She will do part of her PhD work at the prestigious hosting institution, CSIR-Electrochemical Research Institute, under the guidance of Prof Arul Manuel Stephan, a leading international scholar with a long history of collaboration with our group. She is the only candidate from South Africa.

Tebogo Motsei, awarded the prestigious CV Raman International Fellowship for African Researchers

At the 9th South African Conference on Photonic Materials (SACPM) four of our students won awards:

- Dr Zamaswazi Tshabalala – best Postdoc Poster
- Rethabile Makole – best PhD Poster
- Dr Simon Ogugua – best Postdoc Paper in the Department of Physics
- Lucas Erasmus – best PhD Paper
- Ifran Itoo – best MSc Paper

This year the Department encouraged the students and Postdoctoral Fellows to compete in the Faculty of Natural and Agricultural Science's Flash Fact competition. The elimination round was presented in the form of a mini conference on 9 June 2023 which brought about excitement and fun for the competitors. Elimination round winners were:

- Astrology MSc: C R Immelman
- Astrology PhD: J Barnard
- Solid State Physics MSc: E Makoloane
- Solid State Physics PhD: H Ramolahloane
- Solid State Physics Postdoc: Dr G Nair

RESEARCH AND INNOVATION

There were many significant developments in the research related to the Boyden Observatory and the Astrophysics research group during this period. These included, *inter alia*:

An important MSc student project was undertaken to test and commission a CMOSc Camera for use on the 1.5-m telescope.

The High Energy Stereoscopic System (HESS) collaboration and the South African Large Telescope (SALT) showed a surprising turn-off of the Optical/Fermi emission region, while the X-ray and very higher energy gamma-rays stayed on. Joleen Barnard, a research assistant in the Department, led the optical follow-up observations. A paper, titled 'The Vanishing of the Primary Emission Region in PKS 1510-08' was published in the *Astrophysical Journal Letters* with data from this study.

Joleen Barnard completed her MSc degree during 2023. She led the Spectro polarimetry analysis of the SALT data as part of her MSc and was one of the corresponding authors on this paper. She graduated with distinction.

Prof Brian van Soelen was an invited speaker and Natalie Matchett presented at the Variable Galactic Gamma-ray Sources (VI) meeting in Innsbruck, Austria in April 2023.

The UFS sent a strong delegation to the HEASA 2023

meeting in Mtunzini, KwaZulu-Natal, delivering six papers and presenting two posters.

Staff and postgraduate students from the Astrophysics group who attended the 2023 HEASA meeting. From the left, Prof Brian van Soelen, Dr Pat van Heerden, Joleen Barnard (PhD student), Natalie Matchett (MSc student), Spencer Madzime (PhD student), Lurgasho Minnie (MSc student), Ruben Immelman (MSc student), and Wian Smit (MSc student)

Hélène Szegedi

Hélène Szegedi, a Lecturer in the Department, attended X-Vision 2023: X-ray Vision of the Energetic Universe workshop at North-West University (NWU), Potchefstroom, from 6 to 17 February 2023. X-Vision 2023 was a joint workshop of the International Astronomical Union (IAU) Hands-on Workshops (I-HOW) and the Committee on Space Research (COSPAR) Capacity Building Workshop in X-ray Astronomy and supported by South African Gamma-ray Astronomy Programme (SA-GAMMA), the Centre for Space Research at NWU, National Aeronautics and Space Administration (NASA), and European Space Agency (ESA). Hélène had the opportunity to present her X-ray project 'Super soft X-ray variability visible during the 2021 eruption of nova RS Ophiuchi' at the end of the workshop.

Hèléne also attended the AHEAD2020 High Resolution X-ray Spectroscopy School at the University of Alicante, in Alicante, Spain (22 to 25 May 2023). During the school, world-class experts in various Astrophysics fields (Atomic data, Low-mass X-ray Binaries, Galaxy clusters, active galactic nuclei [AGN], etc.) delivered lectures and conducted practical sessions. The participants gained hands-on experience in analysing data from grating-based spectrometers (XMM-RGS, Chandra HETG) and the new era calorimeters (XRISM, X-IFU), enabling them to successfully utilise current and the future generation X-ray instruments. In addition, Hélène attended the Golden Age of Cataclysmic Variables and Related Objects – VI conference in Palermo, Italy (4 to 9 September). During the conference, she presented her research on 'Long amplitude outbursts of long orbital period CVs' and was a recipient of the ceremonial "passing of the baton to the new generation" of researchers.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Two Observatories Project

As mentioned in previous reports, the UFS is responsible for both the Lamont-Hussey Observatory (now the Naval Hill Planetarium) and the Boyden Observatory. The two observatories work in synergy to educate and inform citizens about the natural sciences. Most people first visit the Naval Hill Planetarium and follow–up with a visit to Boyden Observatory. The observatories are also important for the display and communication of South African astronomical heritage. Collectively all the facilities in the observatories operate under the banner of the Free State Centre for Earth and Space.

The two observatories are important to the UFS on many levels. The observatories help the UFS to connect with the scientific community, schools, as well as the public. Both Boyden Observatory and the Naval Hill Planetarium are unique venues and are also used for UFS events and to host high-profile guests.

There were numerous memorable and impactful events throughout 2023, including:

- Events associated with the 5th National Global Change Conference (30 January 2023 to 2 February 2023) hosted by the UFS, took place at the Naval Hill Planetarium and at Boyden Observatory.
- Prof Patrick Seitzer, from the University of Michigan, a long-term partner of the UFS and Patron of the Friends of Boyden Observatory, visited the UFS from 4 to 7 May. While in Bloemfontein, he presented a lecture at the Naval Hill Planetarium on 'Intruders in the Night Sky: Satellites, more Satellites and even more Satellites'.
- The American Spaces in Bloemfontein's science club at Navalsig Secondary School, an initiative of the US Consulate in Johannesburg, visited the Boyden Observatory and the Planetarium on 23 September 2023. This initiative has developed into a partnership project with the US Consulate.

Prof Koos Terblans addressing first- and third-year Physics students, who visited Boyden Observatory and Naval Hill Planetarium

With the upgrade to the projection system completed, the planetarium thrived. With more than 40 shows in September 2023, the Planetarium broke its previous record for the number of shows per month that was set in September 2019. In September and October many primary schools visit the Planetarium due to the relevance of certain planetarium programmes for the theme 'Earth and Beyond' in the science curriculum. More than 17 000 people attended events at the two observatories. Approximately 15 200 of these attended science education or communication programmes.

During November and December 2023, the planetarium's first decade was celebrated with events and special shows, including the South African premier of the American Museum of Natural History (AMNH) full-dome film, 'Worlds Beyond Earth'. As part of the partnership between the AMNH and SALT, AMNH provides sponsorship for education and outreach efforts in South Africa. The Naval Hill Planetarium benefits from this initiative and receives content for the planetarium in the form of AMNH full-dome films.

Community Service Module

This module (CLNS3702) is an elective credit-bearing course at the UFS. The purpose of the module is to improve content knowledge of science and math education students and give them practical experience in teaching learners from disadvantaged schools. Part of the course includes visits to Boyden Observatory for intensive workshop sessions. In 2023, 20 students enrolled in the CLNS3702 module.

Antique Telescope Society

Dawid van Jaarsveldt presented an online talk at the Antique Telescope Society in November. His talk was titled 'A Glass Universe: Displaying the World's First Photographic Atlas of the Whole Sky at the Boyden Observatory Museum'.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Matie Hoffman attended the Stars for All Planetarium Conference in Kingsport, Tennessee,

USA, in June 2023, at which he presented a poster. While in the USA, Prof Hoffman visited the AMNH, Prof Richard Gray at the Appalachian State University, and Prof Patrick Seitzer at the University of Michigan. Both Prof Gray and Prof Seitzer have been involved with our observatories for many years. Prof Hoffman also presented a talk at the Detroit Observatory Astronomy Night on 'A University of Michigan Observatory ... in Bloemfontein, South Africa'. These international partnerships, cultivated over many years, continue to be invaluable to the development of our activities.

OTHER ACTIVITIES

WiPiSA lunch hosted by Department of Physics

Prof Liza Coetsee-Hugo

The women in the UFS's Physics and Medical Physics Departments hosted a Women in Physics in South Africa (WiPiSA) Departmental Lunch on 10 August 2023 at the Department of Physics. The purpose was to inspire and motivate woman to continue with their Physics degrees and to continue with careers in Physics. Prof Liza Coetsee-Hugo was the chairperson, and the speakers were Rethabile Makole (a PhD student in Solid State Physics), Teniel Theron (an MSc student in Medical Physics), and Hélène Szegedi (an Astrophysics PhD student and Lecturer). Prof Coetsee-Hugo concluded the programme with her presentation on her research outputs and discussed possible career paths.

9th South African Conference on Photonic Materials

The successful series of bi-annual conferences focusing on photonic materials continued in 2023, four years after the last conference in 2019 due to the COVID restrictions. The 9th South African Conference on Photonic Materials (SACPM 2023) was held in May at the Nombolo Mdluli Conference Centre at the Skukuza Rest Camp in the Kruger National Park. The conference attracted a record number of delegates from many local institutions as well as from abroad, including our plenary and invited speakers from the UK, Germany, France, Italy, Sweden, Norway, and India.

SALT Board meeting

On 13 and 14 November 2023, the Boyden Observatory hosted the SALT Board meeting. This is the bi-annual executive meeting of the SALT Board that oversees the running of SALT, South Africa's flagship optical telescope. SALT is run as an international collaboration between various shareholder partner institutions, including various partners from the USA, UK, Poland, and India. South Africa, via the National Research Foundation (NRF), is the majority shareholder. The two-day meeting brings together the board members, representing the different shareholder institutions and the operational managers of SALT.

POSTGRADUATE STUDENTS

During 2023, the Department delivered a total of five PhD and six MSc graduates.

On the Bloemfontein Campus, N Matchett, BRJ Thamaga, TJ Theka, Makolaoe, GJ Odendaal, and J Barnard (with distinction) graduated with an MSc degree, while on Qwaqwa Campus TKW Mohapi obtained an MSc degree.

Five candidates graduated with the PhD in 2023:

Erasmus, LJB

Thesis: Luminescent solar concentrators – where Sm2+ doped phosphors shine

Supervisor: Prof HC Swart

Kgomo, MB

Thesis: Highly selective and responsive In2O3 products displaying various morphologies induced by different metal-ion addition for Food-Agri sector

Supervisors: Prof G Mhlongo and Prof HC Swart

Makole, R

Thesis: Fabrication of Highly Sensitive p-n Co3O4-In2O3-Heterostructure-based Sensor Doped with Phosphors and Noble Metals for Detection of BTEX Compounds

Supervisor: Prof DE Motaung

Nemufilwi, NI

Thesis: Exploitation of the pure, Cr-doped and ZnO loaded spinel-type ZnFe2O4 based chemiresistive sensors for their detection capabilities towards VOCs for potential use in the food sector

Supervisors: Prof G Mhlongo and Prof HC Swart

Yimamu, AU

Thesis: Synthesis and characterization of electrodeposited CdTe, CdSe AND CdTeSe thin films for solar energy application.

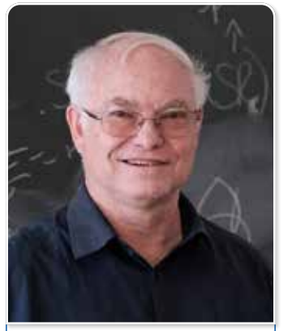
Supervisor: Prof SJ Motloung

POSTDOCTORAL RESEARCH FELLOWS

In 2023, the Department of Physics hosted thirteen postdoctoral research fellows – all involved in Solid-state Physics. They are:

- Dr VNK Basina, from India
- Dr EHH Hasabeldaim, from Sudan
- Dr D Janardhana, from India
- Dr P Kumar, from India
- Dr RG Motsoeneng, from South Africa
- Dr NA Mustafa, from Sudan
- Dr GB Nair, from India
- Dr SN Ogugua, from Nigeria
- Dr SJ Panchu, from India
- Dr NJ Shivaramu, from India
- Dr SJ Tamboli, From India
- Dr ZP Tshabalala, from South Africa
- Dr MYB Yagoub, from Sudan

STAFF MATTERS



Prof Matie Hoffman

At the end of 2023 Prof Matie Hoffman retired from his position as Lecturer in the Department of Physics as well as the Manager of the Naval Hill Planetarium. Prof Hoffman started his career at UFS in 1985 as a theoretical solid-state physicist. He is known across Bloemfontein and even South Africa for his participation in astrophysics and space news through programmes such as 'Sterre en Planete' on *RSG* and 'Op verre vlugte' on *Radio Rosestad*. Prof Hoffman put all his energy and time to rescue Boyden Observatory from closing in the late 1990's. Today it is thriving and of great significance to the public and especially schools. Furthermore, Prof Hoffman founded the first digital planetarium south of the sub-Sahara region. Prof Hoffman will be missed in the Department, but he will still contribute towards the planetarium and Boyden as presenter and fundraiser. Indeed – a star that will keep on shining.

Johane Odendaal was appointed as Senior Assistant Officer: Professional Services.

RESEARCH OUTPUTS

Research Articles

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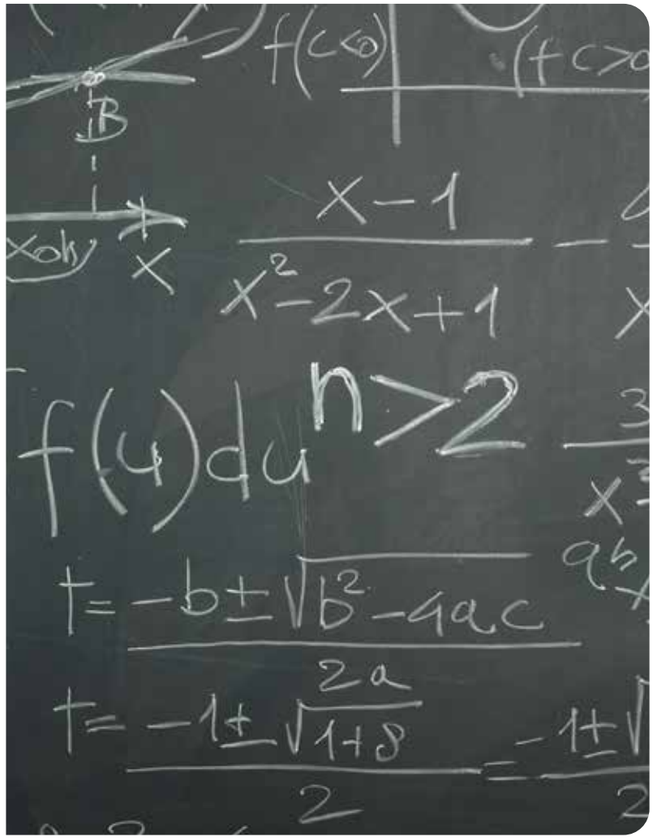

STAFF (2023)

Head of Department:
Prof JJ Terblans

BLOEMFONTEIN CAMPUS:

Senior Professors:	Prof PJ Meintjes and Prof HC Swart
Professors:	Prof RE Kroon, Prof DE Motaung and Prof JJ Terblans
Associate Professors:	Prof E Coetzee-Hugo, Prof RA Harris, Prof MJH Hoffman and Prof B van Soelen
Lecturers:	Dr S Cronje, DP van Jaarsveldt, H Szegedi and IP van der Westhuizen
Researcher:	Dr M Duvenhage
Junior Researcher:	LJB Erasmus
Affiliated Associate Professors:	Prof KT Hillie and Prof G Mhlongo
Research Associates:	Prof JPK Hölsä, Dr V Kumar and Dr J Prakash
Senior Officer - Professional Services:	Dr HJ van Heerden
Officers - Professional Services:	AJ Fourie, B Mohlala and J Odendaal
Officer:	K Cronje
Assistant Officers:	Y Loots and D Mangope

QWAQWA CAMPUS:

Subject Head:	**Dr KG Tshabalala**
Associate Professors:	Prof LF Koao and Prof RO Ocaya
Senior Lecturer:	Dr KG Tshabalala
Lecturer:	Dr SJ Motloung
Senior Assistant Officer - Professional Services:	V Adoons
Assistant Officer:	S Bogacwi

DEPARTMENT OF

PLANT SCIENCES

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The Department of Plant Sciences is a dynamic department contributing towards research, teaching and learning, community service, and entrepreneurial development. The Department has three divisions – Botany (both Bloemfontein and Qwaqwa Campuses), Plant Breeding, and Plant Pathology. The Department underwent a departmental review in 2023. Some of the commendations received from the external review panel, include: (1) Partnership between all departmental stakeholders is commendable and is attested with a joint effort portrayed in the well-written self-evaluation review. This is evidence of a proper work ethic and co-ordination of duties among staff members; (2) all staff members on both campuses are focusing properly on the prescribed teaching and learning goals despite some challenges that they face, particularly frequent community protests as well as electricity and water outage at the Qwaqwa Campus; (3) researchers are specific in their research foci and keep intensifying on one or very few plant species, which is one of the recommendations to become National Research Foundation (NRF)-rated; (4) the NRF-rating of several staff members on both campuses is a good achievement for the Department and the entire University; (5) there are excellent partnerships between the Department and the international institutions; and (6) community engaged scholarship is incorporated in the Department at both campuses, which ensures the relevance of the Department to different community stakeholders.

Postgraduate students in the Department excelled during the year with various students receiving first-, second- or third-prizes for oral or poster presentations. Two students were invited to attend specialised national conferences, four students attended international conferences, and one student received a three-month international internship. Postgraduate students also contributed towards engaged scholarship by presenting talks at community groups and farmers' days.

Academic staff members excelled through various involvements in teaching and learning activities, engaged scholarship activities as well as national and international collaborations. Staff published a total of 55 scientific papers in accredited journals, contributed towards six books/book chapters, and delivered 57 lectures at national and international symposia, research days, and student symposia. Many of these publications were co-authored with national and international collaborators. The Department hosted six Postdoctoral Fellows during the year. A total of 110 postgraduate students were registered in the Department, of which 14 were international students. During 2023, 10 honours, 15 Master's, and 6 Doctoral students obtained their degrees.

ACHIEVEMENTS

Staff Achievements

Prof Sandy-Lynn Steenhuisen received a C2 National Research Foundation (NRF)-rating.

Dr Kwame Shamuyarira

Dr Kwame Shamuyarira obtained his PhD degree in Plant Breeding and Dipuo Mosea obtained her MSc degree in Botany.

Dipuo Mosea (right) with her supervisor, Dr Rudo Ngara

Prof Maryke Labuschagne received a short stay research fellowship from Ghent University in Belgium and spent two months at the Department of Food Technology, Safety and Health.

Dr Ntombi Mbuma was appointed as Associated Editor to the *Crop Science* Editorial Board for three-years, starting on 1 January 2023.

Dr Ntombokulunga Mbuma is an award recipient of 2022 Editor's Citation for Excellence as Reviewer. She received an outstanding reviewer award from the *Crop Science Society of America Journal* in April 2023.

Dr Mpho Mafa was promoted from the Emerging Scholars Accelerator Project (ESAP) to be a member of the Transformation Future Professoriate Programme (FPP) of the University of the Free State (UFS). He was awarded a Performance Excellence Award in the Transformation FPP during the UFS Research Awards and 2023 UFS Book Prize function, hosted by the Deputy Vice Chancellor for Research and Internationalisation, Prof Vasu Reddy. He was nominated by the UFS for the Thamsanqa Kambule-National Science and Technology Forum (TW Kambule-NSTF) Emerging Researcher Awards, for contribution through research and outputs over a period of up to six years of research work since the commencement of the research career, predominantly in South Africa.

Dr Arun Gokul was voted as the Chairperson of the Advisory Committee for the Department of Agriculture at the University of Zululand.

Dr Rudo Ngara was invited to serve a Review Editor for 'Plant Abiotic Stress', a specialty section of the journal *Frontiers in Plant Science*.

Prof Liezel Herselman was appointed as the Vice-Dean: Teaching and Learning of the Faculty of Natural and Agricultural Sciences.

Dr Lisa Rothmann was awarded the Scholarship of Teaching and Learning Fellowship and is part of the second cohort of this initiative under Deputy Vice-Chancellor: Academic. Dr Rothmann's research will focus on 'Assessing the Plant Sciences honours research syllabus for graduate preparedness and researcher development'.

Student Achievements

In Plant Pathology, Thabiso Masisi was presented with the runner-up oral presentation award at the Annual Business Meeting of the American Phytopathology Society - African Division, hosted online in September 2023. Neo Hlongwane was selected to attend the International Seed Federation: World Seed Congress 2023 in Cape Town (June 2023) and he was sponsored by the South African National Seed Organisation for his participation at the congress.

Thabiso Masisi rating sorghum leaf diseases during the sorghum disease survey

Winners of the 2023 Postgraduate Student Symposium at the University of Johannesburg. From the left Karabo Pule (third prize BSc Honours), Sellwane Moloi (third prize PhD), and Faith Kobedi (first prize MSc)

Also in Plant Pathology, Wessel Strydom received the second-year incentive prize, Amy Coetzer received the award for the best third-year student, and Estie Coetzee for the best final-year student. Dr Marlese Meiring was recognised for an exceptional PhD in Plant Pathology.

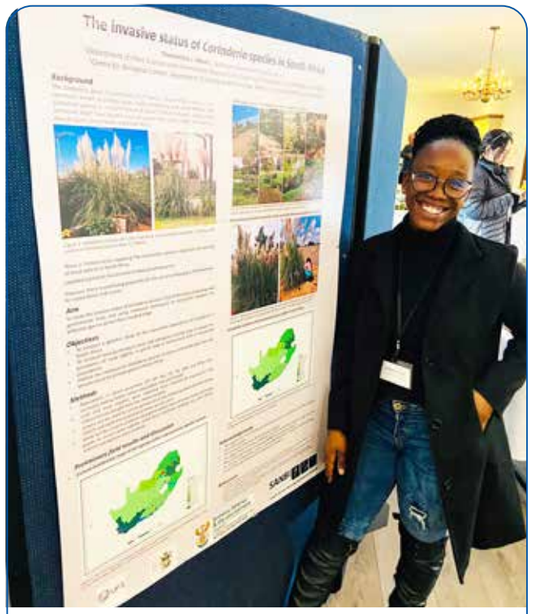
Eight postgraduate students from the Department of Plant Sciences attended the 2023 Postgraduate Student Symposium at the Department of Botany and Plant Biotechnology, University of Johannesburg. Faith Kobedi won the first prize in the MSc category, Sellwane Moloi third prize in the PhD category, and Karabo Pule third prize in the BSc Honours category.

Jeremiah Hlahla and Ninikoe Lebusa were awarded Plant Sciences, Botany Division best MSc and best BSc Honours students for 2022, respectively. Ninikoe Lebusa and Tshililo Gumani received certificates as finalists of the best assignment library competition. In addition, Tshililo Gumani received the Bronze Medal for presenting his practical report for BTNY6884.

Botany MSc student Nomcebo Mngomezulu was one of 20 postgraduate students who were selected to attend a highly competitive platform to present her work at the 15th South African Environmental Observation Network (SAEON) Graduate Student Network (GSN) Indibano from 22 to 27 October 2023. This year's Indibano themed 'Mountain meet Seas: Exploring environmental interactions', presented workshops on bridging the transdisciplinary gap, artificial intelligence, carbon flux, and spatial machine learning.

Kelvin Hlatshwayo was awarded a Plant Breeding internship from Bayer (Field Testing) in Germany.
In Plant Breeding, Estiaan Coetzee received the prize for the best second-year student, Franco Botha for the best third-year student, Moshieng Ntswane for the best MSc student, and Dr Nakai Matongera for the best PhD student.

Botany (Qwaqwa Campus) Master's student, Thembelihle Mbele, was awarded the best poster presentation prize at the National Symposium on Biological Invasions (4 to 6 July 2023, Houw Hoek, Western Cape) as well as at the Biodiversity Research Symposium (27 September 2023, Sol Plaatje University, Kimberley). Thembelihle is investigating the invasive status of Pampas grass *(Cortaderia sp.)* in South Africa for her MSc.



Thembelihle Mbele was awarded the best poster presentation at the National Symposium on Biological Invasions (4 to 6 July 2023)

Doctoral student Karabo Moloi was awarded second place for her speed talk at the 12th Oppenheimer Research Conference (4 to 6 October 2023, Randjesfontein Cricket Pavilion, Midrand), while Doctoral student, Lehlohonolo Donald Adams, was awarded the best poster presentation prize at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI 2023, 23 to 25 October 2023, Pucón, Chile). Honours student, Zinhle Sithole, received an Academic Excellence Award from the UFS Faculty of Natural and Agricultural Sciences on the Qwaqwa Campus for academic excellence as Honours student.

TEACHING AND LEARNING

During the annual second-year Botany excursion that took place from 29 September to 2 October, 28 students were exposed to the new plant ecophysiological techniques that are used in the field, including capturing and processing of data. The excursion took place at the Amanzi Game Reserve, 42 km outside Bloemfontein. Dr Dimitri Veldkornet and Dr Makoena (Boke) Moloi facilitated the excursion, and they were both delighted by the enthusiasm and effort made by students. The aim of the field excursion was to determine the ecophysiological response of two species, *Tarchonanthus minor* Less. (small-leaf camphor bush) and *Olea africana subs. africana* (wild olive), to variation in daily temperature and across an elevation gradient, in terms of stomatal numbers/ adaptations, transpiration capacity, photosynthetic rate, leaf area, and diameter at breast height. After two days of fieldwork, groups presented their findings to the lecturers and demonstrators. Students indicated that the excursion on the physiological adaptations of plants in their natural environment was valuable for their learning and increased their understanding of plant-environment interactions. It is comforting to know that the future of ecophysiological research at the UFS is in good hands.

Second-year Botany students patiently waiting for the Chlorophyll Fluorometer to become dark-adapted to take readings of the Small-leaf Camphor Bush

The annual third-year Botany excursion took place from 9 to 17 February at Hogsback in the Eastern

Third-year Botany excursion to Hogsback. An excursion of extremes – sunny days and wet days

Cape. This year 11 students participated and learned various fieldwork techniques in Ecology and Taxonomy in challenging weather conditions. The students however did enjoy the time in the field and learned a great deal.

The final-year Botany students on the Qwaqwa Campus studying ecology and phytomedicine, undertook several fieldtrips to learn various field survey techniques and be exposed to our natural heritage at Witsieshoek Mountain Lodge, the Basotho Cultural Village, Mopeli Historic Statue at Namahadi, Wetsi's cave in Monontsha, and the yellowwood forests of Royal Natal National Park. In addition, a successful weekend fieldtrip was undertaken to the Golden Gate Highlands National Park with students spanning majors in Life Sciences, Botany, and Zoology. The field trip was jointly run by the Department of Plant Sciences and the Department of Zoology and Entomology, led by Prof Steenhuisen and Prof Aliza le Roux.

Third-year Vegetation Ecology students from the Qwaqwa Campus on a field excursion to Witsieshoek, to learn about different vegetation survey techniques

Prof Sandy Steenhuisen teamed up with Naquita Fernandes and Dr Tatenda Marange from the UFS Faculty of Economic and Management Sciences to present on the topic 'From silos to synergy: Fostering skills development through interdisciplinary collaboration' at the Annual UFS Learning and Teaching Conference (11 to 15 September 2023). The study involved assessing the development of creative and presentation skills of first-year Marketing students on the Bloemfontein Campus as they participated in assignments, and a competition to create a logo for Prof Steenhuisen's plant ecology lab in Qwaqwa. The new name of the research group has been revealed as the 'Q-PAIR' lab, standing for Qwaqwa Plant-Animal Interactions Research. The logo design is currently being refined and will be used as the group's branding from 2024.

RESEARCH AND INNOVATION

SARChI Chair in Disease Resistance and Quality of Field Crops

The NRF South African Research Chairs Initiative (SARChI) Chair in Disease Resistance and Quality of Field Crops, held by Prof Maryke Labuschagne, was in its eighth year in 2023 and again had several highlights. In a collaborative project with the University of Ghent in Belgium, research was done on the influence of maturity period on wheat quality and gluten characteristics. The cowpea research progressed significantly with one PhD project on genetic variation in an international germplasm collection and another on the genetic basis of nutritional value in cowpea ending. One project on sorghum nutritional value in Ethiopia was completed and another on South African sorghum is underway. On the disease resistance side, MARPLE technology was applied to genotype 48 *Puccinia triticina* isolates and four fungicide sensitive genes were sequenced to detect genetic variants that could indicate increased fungicide insensitivity in South Africa. A project on genetic diversity of *Puccinia coronata* from grasses and cultivated oat in South Africa was also completed. Herbarium specimens were used to study the development of the oat leaf rust population in South Africa. A study on functional analysis of *AvrSr35* and *AvrSr50* avirulence genes in South African *Puccinia graminis* f. sp. *tritici* isolates has been completed. Another project on the molecular and biochemical characterisation of the adult plant disease resistance response of two different wheat varieties against *Puccinia graminis* f. sp. tritici (*Pgt*, wheat stem rust) infection has also been completed.

Prof Maryke Labuschagne (left) working with two Postdoctoral Fellows, Dr Tesfay Mekonnen (middle) and Dr Neila Abdi (right)

Breeding for resistance against the mycotoxins associated with Fusarium head blight (FHB) causal species formed part of the SARChI Chair. Several *Fusarium* species associated with FHB were identified, but *F. graminearum* was identified as the predominant causal species in South Africa. The mycotoxins involved pose a threat to both human and animal health. These mycotoxins also impact food security negatively, therefore resistance breeding against these toxins should receive priority. Knowledge gained from analyses will assist with the development of effective control strategies, i.e. resistance breeding against FHB and the mycotoxins associated. This will assist with improving wheat production in South Africa.

Dr Shamuyarira worked with Prof Labuschagne, Prof Hussein Shimelis, Elize Botha, and Petru Fourie on a sorghum breeding project that aims to evaluate exotic germplasm as a precursor to sorghum pre-breeding. As part of the project, Dr Shamuyarira has developed a report on sorghum breeding that is done in South Africa. This project is funded by the Department of Science and Innovation (DSI).

Botany

Plant physiology/biochemistry and molecular biology

Dr Moloi specialises in plant ecophysiology. Her research focus is on the investigation of the effects of abiotic stress factors such as drought, elevated temperature, and the combination of both stressors on the physiological, biochemical, and morphological responses of crop plants. Furthermore, she oversees a project that utilises natural bio-stimulants, biodegradable inorganic compounds, and micronutrients to mitigate the adverse impacts of these stressors in agricultural crops. This research is of considerable importance because it provides valuable solutions to enhance crop production in the face of changing climatic conditions.

Dr Lintle Mohase and her research team investigate plant defence mechanisms in wheat infested by the Russian wheat aphid (RWA) *(Duiraphis noxia).* She collaborates internally with a biochemist (Dr Mafa), and externally with entomologists at the Agricultural Research Council – Small Grain (ARC-SG), Bethlehem (Dr Astrid Jankielsohn), and the Lesotho Agricultural Research Unit (wheat germplasm). Her research concentrates on wheat defence mechanisms to aphids, exploring tolerance mechanisms in various wheat germplasm, including landraces from Lesotho. The influence of environmental factors such as drought on the resistance response to aphids, is also investigated. In addition, the team explores plant protection strategies by investigating the role of inorganic nutrients, such as selenium and silicon, signalling molecules (salicylic acid) and leaf rust isolates in mitigating drought and aphid stress on wheat.

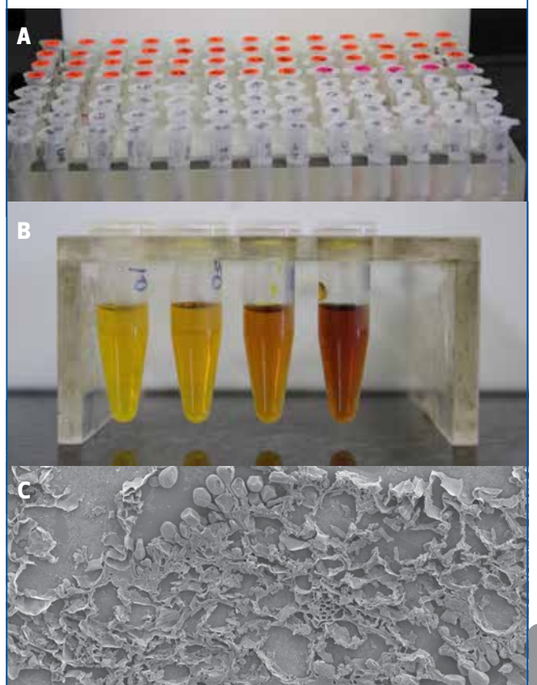
PhD student, Jesumayowa Ajidahun, working in the greenhouse

Prof Botma Visser and his students completed three genetic studies on rust pathogens of crops. In the first, the two alleles of the *AvrSr35* and *AvrSr50* genes from several wheat stem rust isolates were sequenced. Analysis indicated no potential virulence

alleles against *Sr35* and *Sr50* in these isolates. In the second study, genetic analysis of field isolates of maize rust confirmed little genetic variation between the tested individuals, suggesting the presence of a single genetic lineage within the country. This project was done with the financial support of the Maize Trust. In the third study, genetic analysis of oat crown rust using herbarium specimens suggested that the current population developed from at least one recent exotic introduction and one possible herbarium lineage. Two other herbarium lineages disappeared from the field, leaving the two current lineages. All three projects were done as part of MSc studies.

Dr Mpho Mafa's research group is named the Carbohydrates and Enzymology Laboratory (CHEM-LAB) and includes research on plant carbohydrate metabolism, CAZymes' physiological functions during plant-pathogen/pest interaction, and the application of CAZymes in the synthesis of value-added products for circular economy.

The total soluble carbohydrates extract from wheat samples (A) and determination of the total reducing carbohydrates using DNS-reagent (B). In (C), the scanning electron microscopy image shows that wheat leaf-rust disease-causing fungus (Puccinia triticina) degrades the plant cell wall's structural carbohydrates in the susceptible cultivars



Dr Arun Gokul's research continued on previously identified candidate microbial biocontrol agents. These biocontrol agents were tested both *in vitro* and *in vivo*. Experiments showed no adverse effects on the growth and health of commodity crops treated; however, a marked reduction in disease incidence was observed. The potential control mechanism was different for each putative biocontrol isolate, with some affecting the nutrient solubilisation within plants and others producing volatile organic compounds to deter colonisation and growth of the phytopathogen. Proteomic profiling was also conducted and showed certain proteins that were unique to the plants treated with the putative biocontrol agents and could play a critical role in suppressing phytopathogen infection and increasing phytopathogen tolerance in these commodity crops.

Phytomedicine and ethnobotany

Prof Tom Ashafa's research group conducted various ethnobotanical surveys. An ethnomedicinal survey of plants used in the management of skin infections in Mothabothe District of Lesotho was conducted. Furthermore, the use of medicinal plants to manage cancer and cancer-related diseases in the Thabo Mofutsanyana District Municipality of the Free State was done. Lastly, an ethnobotanical survey of plants used in the treatment of diarrhoeal disease in the Abakulusi Municipality of KwaZulu-Natal (KZN) was undertaken. The overall aim of these surveys is to document plants used in the management (curative or ameliorative) of different diseases to have a pool of plants to investigate scientifically to confirm their potency and use the outcome to advise the community. Prof Ashafa formed part of the group that visited the Appalachian State University for the Mountain-to-Mountain research collaborations in September 2023.

Dr Pheello Mojau's research focuses on bioprospecting cheap, affordable, and readily accessible herbal remedies for both *Diabetes mellitus* and cancer in order to reduce dependence of victims of these diseases on orthodox medicines that come with deleterious side effects.

Plant taxonomy and molecular systematics

Dr Lize Joubert collaborated with Pieter Bester from the South African National Biodiversity Institute (SANBI) on the taxonomic revision of the genus Nemesia, which are indigenous snapdragons. This project has progressed for the past five years, and Dr Mariëtte Jackson oversaw the DNA sequencing and phylogenetic analyses for the project. Two Master's students submitted their dissertations and one BSc Hons project was completed. Orateng Sedimo worked on the systematics and morphometrics of Nemesia and received the award for the best poster presentation at the 48th South African Association of Botanists (SAAB) Annual Conference held in Polokwane in January 2023. Dr Jackson is heading the Molecular Systematics Research group in which phylogenetic analysis of some genera in the family Asteraceae is continuing. Dr Jackson was also involved in a Plant Pathology MSc project with Dr Rothmann, in which fungi within sorghum kernels and in soybean cultivars are being identified using molecular techniques.

Orateng Sedimo (centre) receiving his poster award during the 48th South African Association of Botanists (SAAB) Annual Conference held in Polokwane in January 2023

Palaeoecology and Ecology

Dr Andri van Aardt continued her research on pollen cores from Colbyn and Rietvlei Dam from the Gauteng region, supplied by Dr Piet-Louis Grundling and co-workers and dated by Stephan Woodborne at iThemba Laboratories for Accelerator Based Sciences (LABS). She also collaborates with researchers from Spain, Germany, and the USA on the PalaeoEcology and OPen-LandscapE (PEOPLE) project. In terms of modern ecology, she is working on mapping of various vegetation types in the Free State in collaboration with Anisha Dayaram at SANBI. She is also investigating soil-plant relationships with Prof Johan van Tol from the UFS Department of Crop, Soil and Climate Sciences.

Together with collaborators, Prof Louis Scott is currently working on the palynodebris in offshore Cainozoic marine borehole cores and the palynology of Holocene swamp deposits from KZN.

Dr Lloyd Rossouw from the Bloemfontein National Museum contributed to the Methods in Palaeoecology course (BTNE6804) and provided access for students to study archaeological and palaeontological contexts at the Florisbad Quaternary Research Station near Soutpan.

Dr Dimitri Veldkornet's research focuses on the diversity and distribution of saline plants. In collaboration with Prof Anusha Rajkaran (University of the Western Cape) and Dr Nasreen Peer (Stellenbosch University), MSc student Nomcebo Mngomezulu has found that uncontrolled boating activity and strong winds, often resulting in high-intensity waves, have led to erosion of large areas of intertidal salt marshes at the Berg River Estuary. Her results suggest that immediate ameliorating actions are needed to prevent the loss of biodiversity in one of South Africa's most productive estuarine systems.

Under the guidance of Prof Steenhuisen, Postdoctoral Fellow Dr Stephanie Payne-Smith, Doctoral student Karabo Moloi, and Master's student Lesego Malekana, joined the Third BioBlitz at Witsieshoek Mountain Lodge, led by Prof Peter Taylor (Department of Zoology and Entomology and Afromontane Research Unit [ARU]). Biodiversity records were collected for nine different taxa.

Dr Stephanie Payne-Smith (left) and Lesego Malekana identifying and cataloguing plant species during the 3rd BioBlitz at Witsieshoek Mountain Lodge

Karabo Moloi received training from Prof Taylor on the correct and ethical procedures to trap rodents and other small mammals for her PhD research. Lesego Malekana and Dr Payne collected flowering plant specimens at two different sites at different elevations, to document the plant biodiversity in the Qwaqwa Maloti-Drakensberg Mountains. Over the course of the last three BioBlitz's, over 240 different plant species have been recorded and collected, with more species continuing to be added to the list from other datasets, such as Global Biodiversity Information Facility (GBIF) and PhD projects in the area.

Karabo Moloi (left) and Muzikayifani Ndimande (Zoology) received training from Prof Peter Taylor (Zoology, not pictured) on how to ethically and safely process small mammals for research

The RangeX team funded by the DSI through a BiodiverSA call (Horizon 2020) and led by South African principal investigator (PI) Prof Ralph Clark (UFS ARU Director) and Swiss PI Prof Jake Alexander (ETH-Zürich), continued to fly high this year with several helicopter-aided research fieldtrips to their Alpine Research Station on the plateau of the Amphitheatre at 3 100 meters above sea level in the Maloti-Drakensberg. South African co-PI, Prof Steenhuisen, Postdoctoral Fellow Dr Payne-Smith, Master's student Lesogo Malekana, and several team members from the ARU and Centre for Biological Control at Rhodes University, conducted their second full cycle of plant trait measurements and camera trap observations to assess the effects of elevation and warming on range expanding plant species. A new experimental set-up with flowering indigenous plant species having been transplanted recently to the lower and upper alpine sites for the third summer season of data collection on pollinator networks, was done. This work yielded a publication in *Global Change Biology* (IF= 11.6) on using machine learning to assess weather patterns with camera trap photos taken at reciprocal experimental setups in South Africa, Switzerland, and Norway. The team also gathered for a productive writing retreat in Glengarriff, Ireland, to discuss data management, publication ideas, and progress. Funding opportunities for a further team effort into expanding their expertise to assess biodiversity along elevation gradients in several other mountain ranges globally, using acoustic and photographic recorders, eDNA and environmental variables, was also discussed.

Members of the RangeX project in Glengarriff Nature Reserve, Ireland – including researchers from the UFS (Plant Sciences and Geography) , University of Gothenburg, ETH Zürich, Swedish University of Agricultural Sciences, University of Bergen, Aarhus University, and Martin Luther University Helle-Wittenberg

In October 2023, Prof Steenhuisen was invited to serve on the steering committee of the Mountain Invasion Research Network (MIREN), that encourages research avenues using standard field protocols for understanding global changes in the distribution of invasive plants along elevational gradients. This builds on the relationships established with the network by Prof Clark of the ARU, and the introduction of MIREN survey sites in South Africa and Lesotho, with plans to find funding for introducing further sites in Zimbabwe, Angola, and Madagascar.

The high elevation weeds group led by Prof Steenhuisen and members of Rhodes University's Centre for Biological Control – Dr Grant Martin (affiliate of UFS Zoology and Entomology) and Dr Kim Canavan (affiliate of UFS Plant Sciences) – had a productive year with the completion of projects by MSc student Nthambeleni Bologo, a project coordinator at the Department of Environmental Affairs, NRF-funded MSc student Patricia Masole, and Honours student Zinhle Sithole. Nthambeleni investigated the perceptions of employees and landowners of the Working for Water Programme, and the impact of clearing invasive alien plants on the native plant diversity in the Northern Drakensberg (Blyde River catchment and surrounds), pioneering work by our lab group in Mpumalanga. Patricia and Zinhle worked on various aspects of the invasive sweet briar rose, a conflict species that has both negative and positive impacts on our montane grasslands and human communities living within them. Thembelihle Mbele, funded by SANBI, commenced a Master's project on the genetic diversity and distribution of pampas grass this year, finding that local trade of the inflorescences containing viable seed may be adding to the potential spread of these grasses.

Thembelihle Mbele sampling Pampas grass (Cortaderia species) for her MSc research

Prof Steenhuisen attended several engagements with the Department of Higher Education and Training (DHET) FPP, such as writing retreats in the Eastern Cape and Kruger National Park, seminars and workshops with Nobel Prize winners and FPP fellows at the Stellenbosch Institute for Advanced Study (STIAS), personal sessions that assisted with her development and promotion to a C2-rated Associate Professorship, and funding opportunities for bringing international researchers from Cornell University and University of Arizona to South Africa in 2024. This follows a successful grant award from the USA National Science Foundation (NSF) for a joint project with Dr Nora Mitchell from the University of Wisconsin-Eau Claire, and fieldwork in the Western Cape and KZN aiming to refine the phylogeny of the *Protea* genus.

Plant Breeding

Molecular plant breeding

Prof Rouxléne van der Merwe is involved in breeding for resistance to pod shattering in vegetable-type soybean (in collaboration with the Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences). This research continued to make progress towards the development of an improved South African vegetable type soybean cultivar that shows resistance to pod shattering. This project is done in collaboration with both Prof Adré Minnaar-Ontong and Dr Ansori Maré who assist with marker-assisted selection of progenies grown in field trials. One MSc student (Kelvin Hlatshwayo) has submitted his MSc dissertation for examination on this project.

Dr Maré worked with Prof Liezel Herselman and Prof Willem Boshoff (Plant Pathology division) to identify new rust resistance sources in wheat using molecular markers and phenotypic evaluations to screen mapping populations. Selected wheat cultivars/ lines from two different breeding backgrounds have been identified with unknown rust resistance. The two breeding backgrounds include the International Maize and Wheat Improvement Center (CIMMYT) rust resistant nursery and Sensako. This research is funded by the South African Winter Cereal Industry Trust (SAWCIT). Further progress has been made with cross-breeding using molecular markers to combine additional rust and FHB resistance genes into wheat lines to ensure durable disease resistance in wheat. This project is funded by the UFS Central Research Fund (CRF).

Breeding for resistance against fungal diseases

across multiple economically important crops, which include resistance breeding against Sclerotinia stem rot in soybean, soybean sudden death syndrome (SDS) and associated phytotoxins, as well as resistance to mycotoxins produced by FHB causal pathogens, to promote the improvement of disease control strategies, is the central point of Prof Minnaar-Ontong's research.

The Sclerotinia resistance research forms part of the South African Sclerotinia Research Network (SASRN) founded in 2017. Due to this collaboration, the *Sclerotinia sclerotiorum* culture collection was established containing more than 1 000 isolates from multiple crops from eight of the nine South African provinces.

A pre-breeding programme for SDS resistance was initiated using marker-assisted breeding approaches after the evaluation of the South African commercial soy-bean as well as edamame germplasm for potential resistance to this destructive disease. Furthermore, a population diversity study was initiated to determine the causal pathogen of SDS as well as the distribution of the fungal species involved. The outcome of the research on soybean diseases will contribute signficantly to soybean production of South Africa.

Conventional breeding

Prof Rouxléne van der Merwe's focus on breeding for tolerance to drought and heat stress in vegetable-type soybean continued to make progress towards the characterisation of vegetable-type soybean cultivars in terms of drought and heat stress tolerance. This project is done in collaboration with Drs Van Biljon and Moloi, who assisted with physiological response analyses. The project is funded by the NRF - Competitive Support for Unrated Researchers. One MSc student (Drikus Coertzen) has submitted his MSc dissertation for examination on this project.

Edamame field trials planted to investigate the drought-tolerance responses of cultivars as part of the pre-breeding programme

Research on the impact of water-limited-stress on the morphology, physiology, and nutritional quality of dry beans is making progress. This project, which aims to characterise dry bean cultivars in terms of drought stress tolerance and nutritional quality, is done by Dr Angeline van Biljon, who assisted with nutritional quality analysis, Dr Moloi, who assisted with physiological response analyses, and Dr Diedré Fourie (Dry Bean Producers' Organisation) who co-supervise students. One MSc student (Lesole Sefume) is enrolled for his degree on this project.

Wheat-quality and crop-nutritional value research

Dr Van Biljon continued with research on the nutritional profile and quality of various crops such as wheat, maize, vegetable-type soybeans, dry beans, and sorghum. Nutritional screening includes the study of storage protein through size exclusion- and reverse-phase high-performance liquid chromatography, as well as the determination of total starch, amylose, sugars, tryptophan, mineral content (especially iron and zinc), and the bioavailability of these minerals. Dr Van Biljon collaborated with Prof Maryna de Wit from the UFS Department of Sustainable Food Systems and Development on a successful Master's student's study on the study of protein in *Opuntia* genotype mucilage.

Plant Pathology

Cereal rust diseases

Prof Willem Boshoff continued with wheat cultivar and breeding line assessment for resistance to rust pathogens. This research involves annual greenhouse and field screening with selected races of the three rust pathogens of wheat. During 2023 field trials were carried out near Napier in the Western Cape and Greytown, KwaZulu-Natal. Results from this industry-funded project are annually shared with wheat breeders and published in the National Wheat Production Guidelines of the ARC-SG. A study to characterise isolates of the maize rust pathogen, *Puccinia sorghi,* continued with financial support of the Maize Trust. Race typing of rust isolates was carried out in collaboration with Dr Tarekegn Terefe from the ARC-SG. Field phenotyping of wheat and barley research populations to map rust resistance sources was successfully carried out in collaboration with Dr Renée Prins from CenGen.

Amy Coetzer, BSc Honours student in Plant Pathology, assisting with rust inoculation in a wheat trial

Mycology

The Pecan Health Research Group at the UFS has been supporting the pecan industry regarding pecan diseases and their management since 2017. During the 2023 growing season, six field trips were undertaken, covering all the pecan producing areas in South Africa. These include areas such as the Orange River from Luckhoff to Upington, Vaalharts, Jacobsdal, as well as various other areas in Limpopo, Mpumalanga, Gauteng, Eastern Cape, Western Cape, and KwaZulu-Natal. Farmers' days were organised during these trips where information regarding the newest findings on student projects was shared with pecan producers and interested parties.

Students from the Pecan Health Research Group on a trip to Upington for field work. From the left, Gilbert Meyer, Pieter van der Walt, Estie Coetzee, and Wilmarie Kruger

Currently, a three-year project is being undertaken with the South African Pecan Nut Producers Association (SAPPA), focusing on the cause of overall decline in pecans. Studies focus on the transfer of potential pathogens through the flowers of pecans, eventually affecting seedlings and grafted nursery plants. Studies are also ongoing on the effect of fungal pathogens such as *Neofusicoccum parvum, Alternaria alternata, Cladosporium species* and bacteria on pecan health in South Africa. To support future pecan research at the UFS, a one-hectare pecan orchard was established on the UFS Paradys Experimental Farm in Bloemfontein, which has now entered its fourth season.

Dr Gert Marais standing at a dead pecan tree (+/- 60 years old) with a fruiting structure of the bracket fungus, Phellinus rimosus, a pathogen and likely the cause of the death of the tree

Epidemiology

Dr Lisa Rothmann leads the McLab Field Pathology and Epidemiology Research Group, which focuses on diseases associated with summer grain crops, i.e. dry bean, sorghum, soy-bean, and sunflower. The project for Thabiso Masisi's PhD study on 'Incidence,

management and producer perceptions of fungal diseases in sorghum cropping systems' was successful in obtaining NRF-Thuthuka Funding and is co-funded by the Sorghum Trust. The research is done in collaboration with Dr Jackson (Botany) and Dr Lindy Rose (Stellenbosch University). An exciting component of this research is done in conjunction with the UFS Department of Sociology, who assist in investigating socio-economic factors associated with sorghum disease management decision-making. The preliminary results of Thabiso Masisi's research were presented at the American Phytopathology Society – African Division Annual Business Meeting, in September 2023. Nomvula Moloi completed her BSc Agric Plant Pathology research component, 'Occurrence and distribution of fungal grain pathogens associated with sorghum production', with samples collected during the 2023 surveying season. The sorghum disease surveys commenced again in the 2023/2024 growing season, surveying producers' fields in the Eastern Cape, Free State, KZN, Limpopo, Mpumalanga and North West. Additionally, the research group as a team has been working on 'Seeds of knowledge: exploring fungi associated with uChokwane (tepary bean), a climate-smart landrace'. Soybean and sunflower cultivar evaluations, done in collaboration with Annelie de Beer and Dr Safiah Ma'ali from the ARC-SG in Potchefstroom, were successful in the 2022/2023 season. This study was supported by the DSI, the Oil and Protein Seeds Development Trust (OPDT), Oilseeds Advisory Committee (OAC), and Grain SA. The project aims to evaluate soybean and sunflower cultivars for tolerance towards *Sclerotinia sclerotiorum* and will be ongoing for the 2023/2024 season, with Dr Derick van Staden and Koos Strydom. A new research project supported by OPDT and the OAC was initiated at the start of 2023, with Kwanele Sabela, MSc Agric researcher, conducting research on 'Premature desiccation of sunflower to preserve at-risk crops from sclerotinia head rot'. The field work was initiated at the end of 2023 during the sunflower planting season. The project on 'Identifying and assessing soybean seedborne diseases, towards improving seed health through reducing prevalent fungal pathogens' was carried out by Neo Hlongwane as part of his MSc Agric study.

Healthy sorghum grain

Thabiso Masisi (right) and Kwanele Sabela (middle) interviewing a farmer during the sorghum disease survey

Michelle Rossi enrolled for the MSc Agric Plant Pathology programme in February 2023. Her research, supported by Plantovita and the Dry Bean Organisation, is on 'Race identification of *Colletotrichum lindemuthianum* isolated from South African production areas'. Dr Rothmann is supervising Michelle along with Dr Deidre Fourie from the Dry Bean Organisation. During the 2023 season Marais Cloete initiated his MSc Agric Plant Pathology research on sunflower head rot, led by Dr Belinda Janse Van Rensburg from ARC-GC and with funding from the ARC-GC and OPDT/OAC.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Dr Moloi reviewed manuscripts for *Agronomy* (Q1) and *South African Journal of Botany* (Q2). She was an external examiner for MSc dissertations from the University of the Witwatersrand and the University of Zululand and is an external moderator for North-West University. She delivered a lecture for the postgraduate students at the University of Debrecen in June 2023.

Dr Joubert, Dr Van Aardt, and Prof Van der Merwe were guest speakers on two programmes of *Pretoria FM's* Nature and Science programme, 'Ek wil weet', during which they answered listener's questions on plants and nature.

Dr Lintle Mohase

Dr Mohase featured in an interview for the *Plaas/ Farm TV* (The danger of RWASA biotype 5, 19 October) and participated as a panel member in the United Kingdom Research and Innovation (UKRI) Future Leadership fellowship Round 7 Panel Interview Meeting (13 and 14 September). She also participated as an expert in the SA / Flanders (FWO) Joint Research Programme Joint Review Panel.

Dr Rothmann has continued in her role as President of the American Phytopathology Society: African Division, which hosted a successful online meeting in September on the theme 'Translating Plant Health Knowledge to Practice'. The National Grain Research Programme hosted at Stellenbosch University was held in April 2023, at which Dr Rothmann was invited to contribute on the panel on climate change and grain production in South Africa. Discussions were translated into a popular article for the *SA Grain Magazine*, titled 'Researchers discuss the effect of climate change on grain production'. Dr Rothmann was also invited to deliver a guest lecture at the Plant Pathology Department of Stellenbosch University in April; her presentation was aimed at encouraging postgraduates to see plant pathology as a service to society, a vocation, and not just a career.

Dr Rothmann contributed to the Grain SA Research Roadshow, sponsored by John Deere Financial and ABSA. The focus was on discussing Sclerotinia diseases with industry partners under the auspices of the SASRN, supported by Grain SA. The purpose of interacting with producers is to develop and communicate practical management strategies for diseases caused by Sclerotinia for local producers.

Scientific communication and popular articles were produced and distributed through the *SA Grain Magazine*, *Oilseed Focus Magazine*, and *Pula Imvula Magazine*. Contributions were made by Dr Rothmann, Nomvula Moloi, and Kwanele Sabela from the McLab research group. Topics that were covered included *Sclerotinia sclerotiorum* taxonomy and life of an ascospore, and two articles on the agronomic, biological and chemical control of Sclerotinia head and stem rot. The article 'Tactics to disrupt *Sclerotinia'*, co-authored by Dr Rothmann, Dr Godfrey Kgatle, and Dr Miekie Human (from Grain SA) won the article of the year for 2022/2023 at the Grain SA Awards.

Dr Lisa Rothmann, Diana Mngomezulu, Thabiso Masisi, and Neo Hlongwane represented the SASRN

From the left, Dr Lisa Rothmann, Diana Mngomezulu, Thabiso Masisi, and Neo Hlongwane at the International Congress for Plant Pathology

at the International Congress for Plant Pathology in Lyon, France (August 2023)

Dr Rothmann was invited to join the scientific committee for the *Botrytis, Monilinia* and *Sclerotinia* symposium (MoBoSclero2025), hosted by Aristotle University of Thessaloniki, in Greece. She also presented a guest lecture at the Peritum Agri Institute on 'Introductory plant pathology and crop protection'. This is the third year she has been invited as a guest lecturer.

Dr Van Aardt's postgraduate student, Marius Muller, gave a talk about alien invasive plants in the Bloemfontein area to the Kiepersol Tuinbouklub at the Kiepersol Tuinbouklub in Bloemfontein. Another postgraduate student, Linde de Jager, presented two talks to the community – 'Ken jou gras / Know your grasses' for the Botanical Society of South Africa's Free State branch at the Free State National Botanical Garden, and 'Invasive alien plants in the Bloemfontein area' for the Bainsvlei Tuinbouklub at Monte Bello Estate in Bloemfontein.

Prof Maryke Labuschagne

Prof Labuschagne continued to serve as Speciality Chief Editor for *Frontiers in Sustainable Food Systems*, as editorial board member of *Cereal Chemistry* and *Journal of Cereal Science*, and as a member of the subcommittee to the advisory committee for Genetically Modified Organisms for the Department of Agriculture, Land Reform and Rural Development. She also served on a task team that evaluated the Centres of Excellence funded by the DSI/NRF.

Dr Mbuma is an external moderator of the Biometry IV: Advanced Diploma module for Mangosuthu University of Technology and an external assessor of the University of Limpopo for the Faculty of Science and Agriculture.

Dr Angeline van Biljon and Prof Willem Boshoff presented invited lectures titled 'Nutritional improvement through biofortification' and 'Stem rust in wheat – the Southern African perspective', respectively, as part of the spring online seminar to MSc students taking the Plant Breeding and Protection for Sustainable Production course in the Department of Plant Protection Biology at the Swedish University of Agricultural Sciences, Alnarp, Sweden.

Prof Boshoff contributed at a pre-plant wheat farmers' day held at Bothaville during February 2023. He presented a talk on 'The control of Fusarium head blight under irrigation'. He also presented a talk on 'The control of rust diseases following outbreaks in the warmer irrigation areas' to representatives from African Explosives and Chemical Industries (AECI) Plant Health at a training meeting in March in Bloemfontein. The rust research group contributed to two popular papers – 'Stripe rust on wheat – new race detected' and 'Fungicide sensitivity among isolates of the stem rust fungus on small grains – both published in *SA Grain.*

Dr Mafa is an active reviewer of articles submitted to the following journals: *Journal of Chemical Ecology, Biomass Conversion and Biorefinery, European Food Research and Technology, Plant Physiology and Biochemistry, Basic and Applied Ecology, Biotech, Genes, Agronomy, World Journal of Microbiology and Biotechnology*, and *Biofuels, Bioproducts & Biorefining.*

Prof Minnaar-Ontong reviewed articles for international journals such as *Agronomy, Discover Agriculture*, and *BMC Plant Biology*. She is the coordinator of the Crop Research Platform, a board member of the National Grain Research Programme (University of Pretoria) and an Agriculture ambassador where roadshows with Food for Mzanzi were held to engage with schools on careers in agriculture.

Prof Steenhuisen continued in 2023 as a Council member and Honorary Treasure for the Council of the South African Association of Botanists, a Review Board Editor for the *South African Journal of Botany*, Associate Editor for the *American Journal of Botany*, and scientific member of the Free State Wetlands Forum. She joined the steering committee of MIREN during 2023.

NATIONAL AND INTERNATIONAL COLLABORATION

Dr Van Biljon collaborated with Prof Erik Alexandersson and Sajeevan Radha Sivarajan from the Department of Plant Protection Biology at the Swedish University of Agricultural Sciences in Alnarp, Sweden.

Dr Moloi collaborated with Prof Ned Bowden from University of Iowa, USA, on a project involving the use of biodegradable dithiophosphates for the improvement of drought tolerance in edamame. They co-supervised an MSc student who graduated in 2023 and are also co-supervising a PhD project. Dr Moloi also has an ongoing collaboration with Prof Brigitta Tóth (University of Debrecen, Hungary), which commenced in 2019. During 2023 their work produced one publication in a peer reviewed journal. Dr Moloi visited the University of Debrecen in Hungary on the Erasmus teaching mobility programme. She also hosted Prof Brigitta Tóth in May 2023 through the same programme.

Drs Joubert and Jackson continued their collaboration with Pieter Bester from SANBI on the systematics of *Nemesia*, a genus of indigenous snapdragons.

Dr Mohase collaborated with Dr Astrid Jankielsohn, an entomologist with specialised expertise on RWA biodiversity, at ARC-SG. Dr Mohase also belongs to a newly formed consortium of RWA researchers in South Africa.

Dr Rothmann was involved in the official Memorandum of Understanding (MOU) between Grain SA and the Department, which was re-signed for the sixth term to administer the SASRN. The Network provides a platform for South African researchers, industry, and producers to work together towards a management solution for Sclerotinia diseases in South Africa. Dr Rothmann collaborates with AgriSeed/Agronomy Info Services in Delmas where soybean and sunflower field trials on the experimental farm are aimed at cultivar and fungicide evaluations.

Diana Mngomezulu, Thabiso Masisi and Dr Lisa Rothmann during the national sorghum disease survey in the Free State, that forms part of the South African Sclerotinia Research Network

Dr Rothmann is co-supervising Mariana van Deventer's MSc Agric (Plant Pathology) research titled 'Modelling the effect of environmental conditions and inoculum load on the development of sclerotinia stem rot of canola in the Western Cape' led by Dr Diane Mostert (Stellenbosch University), and Dr Gert van Coller and Lizette Nowers (Western Cape Department of Agriculture), co-funded by OPDT/OAC.

Prof Scott collaborated with Christopher Moore of the University of South Carolina on a project about a global platinum spike at the Younger Dryas, with Abraham Dabenwa from the University of the Witwatersrand on a project on Tswaing Crater fire history, and with Dr Frank Neumann and Eugene Bergh (North-West University), Andrea Sandersen (previous postdoctoral fellow), and Angela Effiom (University of the Witwatersrand student) on different projects.

Prof Scott and Dr Van Aardt collaborated with Paloma de la Peña (Universidad de Granada, Spain) on a project on Marshill Rock Shelter in the Eastern Cape, with Yolanda Fernandez-Jalvo (Museo Nacional de Ciencias Naturales, Spain) on a project on paleobiodiversity and climatic fluctuations in the Northern and Southern Hemispheres, and with Piet Louis Grundling and Althea Grundling (affiliated with the UFS Centre for Environmental Management) on the reconstruction of past environments at Colbyn wetland in Gauteng.

Dr Andri van Aardt

Dr Van Aardt collaborated with SANBI on the refining of the vegetation map of the Free State and with Prof

VanTol from the UFS Department of Soil, Crop and Climate Science on various soil-plant interactions in National Parks across South Africa.

Dr Van Aardt and Dr Rossouw collaborated with Dr Michael Toffolo from the Spanish National Research Center for Human Evolution (CENIEH) in Spain on the PEOPLE adaptations of Pleistocene humans in South Africa project, exploring the role of changing environments in the adaptation strategies of *Homo sapiens* in the Middle and Late Pleistocene in the central interior of the country. This project also includes other researchers from Germany and the USA.

Dr Rossouw is currently collaborating with Dr Michaela Ecker from Kiel University in Germany on the Kgalagadi Human Origins project, and with Dr Tyler Faith from the University of Utah, USA, on the population dynamics of the extinct blue antelope *(Hippotragus leucophaeus)*.

Prof Labuschagne spent two months at Ghent University in Belgium working on a collaborative wheat quality project with Corteva in South Africa. Her collaboration with the University of Córdoba in Spain on wheat quality also continued, as well as research on the application metabolomics in legume breeding with the Institute for Sustainable Agriculture, Córdoba. Collaboration with the International Institute for Tropical Agriculture (Nigeria and Zambia) on cassava and cowpea, respectively, continued this year. Maize research on biofortification continued with the CIMMYT in Harare and Zamseeds in Zambia. A new collaborative project on mutation breeding in legume crops was initiated in 2023 with the University of Namibia. National collaborative projects with the ARC on cowpea, sorghum, and maize continued in 2023.

Prof Van der Merwe continued her research collaboration with TransfOrmus to evaluate the effect of enOrmus and Soil Life Combo on plant biomass and yield of vegetable-type soybean and maize cultivars under field and glasshouse conditions. The aim of this collaboration is to evaluate the effectiveness of using the different plant bio-stimulants on crop biomass and yield and to determine possible phytotoxic effects on plants. The report developed by Prof Van der Merwe will assist with the registration of the newly developed bio-stimulants as group 3 fertilisers with the Department of Agriculture, Forestry and Fisheries. This project is also done in collaboration with Dr Elmarie van der Watt at Agronomy (UFS). One BSc Hons student (Brandon da Paixao) is enrolled for his degree on this project.

Brandon da Paixao busy with biostimulant foliar application on soybean plants

Prof Van der Merwe continued her collaboration with Prof Qiuying Zhang from the Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences. The project focuses on breeding for resistance to pod shattering in vegetable-type soybean. Prof Van der Merwe initiated research collaboration with Dr Armand Smit, the KZN Agricultural Technical Manager at Green Farms Nut Company. The project, funded by Macadamias South Africa, focuses on establishing a correlation between thrip insect levels on macadamias to nitrogen and calcium in the macadamia leaf.

From international collaboration between the UFS rust group of Profs Visser and Boshoff, and Prof Melania Figueroa at Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia, a paper titled 'Genome-enabled analysis of population dynamics and virulence associated loci in the oat crown rust fungus *Puccinia coronata* f. sp. *Avenae*' was accepted for publication in *Molecular Plant Microbe Interactions*. A novel wheat leaf rust resistance gene from Thinopyrum intermedium chromosome $7J^s$ has been identified and introgressed into wheat through collaborative research between Prof Boshoff and Dr Qi Zheng and colleagues at State Key Laboratory of Plant Cell and Chromosome Engineering, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, Beijing, China. Prof Boshoff also collaborated with Prof Brande Wulf from the King Abdullah University of Science and Technology (KAUST), Kingdom of Saudi Arabia. This included training of Dr Renjie Chen in rust phenotyping at the UFS from 23 April to 19 May 2023.

Profs Boshoff and Visser collaborated with Drs Sam Markell and Upinder Gill of North Dakota State University on the sunflower rust project. They provided DNA of their prevalent sunflower rust races for a Genotype by Sequencing (GBS) project to determine the genetic relationships of the global sunflower rust population.

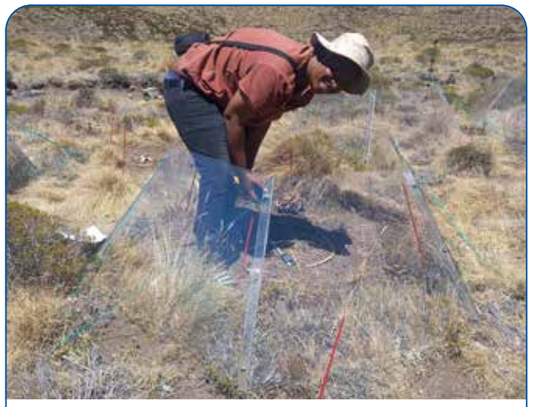
Dr Mafa collaborated with Dr Malgas (University of Pretoria, Department of Biochemistry, Genetics and Microbiology) and Prof Pletschke (Rhodes University Department of Biochemistry and Microbiology) on the application of Carbohydrates or CAZymes in the biorefinery sector for the production of value-added products. Dr Mafa hosted an RWA-consortium research meeting, which was attended by researchers specialising in the fields of Biochemistry, Genetics, Entomology, Plant Physiology, and Molecular Biology from the University of Johannesburg, Stellenbosch University, ARC-SG, and the UFS. The purpose of the meeting was to foster collaborations and develop a memorandum of understanding between the research groups in attendance.

Participants in the RWA-consortium meeting. Front row, from the left, Jesumayowa Ajidahun, Dr Mpho Mafa, and Dr Nicolis Vic; Middle row, from the left, Dr Lintle Mohase, Siphephelo Zondo, Prof Eduard Venter, Nokulunga Mzimela, Prof Anna-Maria Botha-Oberholster, and Dr Marlon le Roux; Back row, from the left, Dr Huzaifa Bilal, Dr Francois Burger and Dr Astrid Jankielsohn

Prof Minnaar-Ontong collaborated with South African breeding companies and researchers from the University of Manitoba, Canada, the University of Nebraska and the United States Department of Agriculture.

Dr Gokul continued his collaboration with the University of the Western Cape (running for the fourth year) and the University of Zululand. The collaboration has resulted in four peer-reviewed articles in high impact factor journals. The International Centre for Medical Research, Franceville also signed an MOU with the UFS.

Prof Steenhuisen is part of the RangeX project, a collaborative reciprocal experimental venture with a consortium of international ecologists from over eight countries. The South African component is managed by the ARU on the Qwaqwa Campus. This project supports Master's student Lesego Malekana, who is involved in collecting data along MIREN



Lesego Malekana measuring plant traits of transplanted plants in an Open Top Chamber on the Maloti-Drakensberg, as part of the RangeX project

transects with Dr Onalenna Gwate (Postdoctoral Fellow in Geography). MIREN transects have been actively surveyed in Lesotho and South Africa by the team.

Prof Steenhuisen conducted fieldwork in the Western Cape with collaborators from the University of Wisconsin-Eau-Claire, USA, in the winter of 2023. Her largest national collaboration is with Dr Grant Martin and Dr Kim Canavan from the Centre for Biological Control, Rhodes University, with whom she collectively supervises seven postgraduate projects. She also externally supervises two Doctoral and two Master's students from the University of KwaZulu-Natal (with Dr Michelle Tedder) and University of Witwatersrand (with Prof Glynis Goodman). Postgraduate students are funded by SAEON (with Prof Dave Thompson) in conjunction with the NRF, SANBI, and the Centre for Biological Control. In December 2023, she hosted members of the 7th International Plant Functional Traits Course (led by University of Pretoria and international researchers from Universities of British Columbia, Buffalo, and Bergen) at the Qwaqwa Campus, sharing research discoveries through seminars and discussion, and assisting with equipment needs.

POSTGRADUATE STUDENTS

At the 2023 graduations, eight students graduated with BSc Hons majoring in Botany (three on the Bloemfontein Campus and five on the Qwaqwa Campus), one student graduated with BSc Hons majoring in Plant Pathology, and one student graduated with BSc Hons majoring in Plant Breeding.

Twelve students from the Department of Plant Sciences graduated with an MSc in 2023. They were:

- Bologo, N (Botany, Qwaqwa Campus)
- Botha, CJ (Botany, Bloemfontein Campus - with distinction)
- Du Toit, I (Botany, Bloemfontein Campus - with distinction)
- Khiba, KF (Plant Breeding)
- Khoza, BM (Botany, Bloemfontein Campus - with distinction)
- Letaoana, TM (Botany, Qwaqwa Campus)
- Moloi, L (Botany, Qwaqwa Campus)
- Mosea, D (Botany, Qwaqwa Campus)
- Muthego, D (Botany, Qwaqwa Campus)
- Nienaber, K (Botany, Bloemfontein Campus)
- Sekhurwane, M (Botany, Bloemfontein Campus)
- Tsotetsi, ME (Botany, Bloemfontein Campus - with distinction)

Three students from the Department of Plant Sciences graduated with the MSc Agriculture:

- Khajoane, TJ (Plant Breeding)
- Ntswane, M (Plant Breeding)
- Omenoba-Nee Ubah, CG (Plant Breeding - with distinction)

Six candidates from the Department of Plant Sciences graduated with a PhD in 2023:

Adams, Zanele (Botany)
Thesis: Pharmacological screening and isolation of bioactive compounds from plants used against elephantiasis in the Eastern Cape, South Africa
Supervisor: Dr P Mojau

Bilal, Huzaifa Bilal (Botany)
Thesis: Priming effect of leaf rust and salicylic acid in Russian wheat aphid resistance
Supervisor: Dr L Mohase

Chiuraise, Nyashadzashe (Plant Pathology)
Thesis: Pathogen variation and genetic control of Puccinia triticina in Zimbabwe
Supervisor: Prof WHP Boshoff

Mapaura, Anthony (Botany)
Thesis: Determining the trajectory of graminoid invasions in Southern Africa's mountains: the case of Nassella
Supervisor: Prof S Steenhuisen

Olckers, Schae-Lee (Food Science)
Thesis: The influence of abiotic stress on gluten in wheat and its effect on bread baking quality
Supervisor: Dr A van Biljon

Simelane, Victor Bongumusa (Plant Breeding)
Thesis: Genetic diversity, agronomic performance and nutritional status of maize (Zea mays) landraces from Eswatini
Supervisor: Dr A van Biljon

POSTDOCTORAL RESEARCH FELLOWS

Dr Conrad Achilonu (from Nigeria) was appointed in November 2022 and continued to contribute to the Pecan diseases in South Africa programme.

Three Postdoctoral Fellows were active on research conducted under the SARChI Chair, namely Neila Abdi (from Tunisia), Tesfaye Mekonnen (from Ethiopia,) and Isaac Amegbor (from Ghana).

Dr Laetitia Otomo (from Gabon), a Postdoctoral Fellow in Botany on the Qwaqwa Campus, undertook a research trip from the 13 November 2023 to 13 January 2024 to Gabon to engage with the International Centre for Medical Research Franceville. The trip included testing of synthesised therapeutic nanoparticles and endosymbionts on tissues infected with tropical diseases.

Dr Stephanie Payne-Smith (from South Africa), hosted by Prof Steenhuisen, co-taught BIOL6834: Advanced Biostatistics in 2023, presented at an international conference in Chile, leads the pollination aspects of the international RangeX project in affiliation with the ARU, and is co-supervising three Master's and one Doctoral candidate in the Department. In November 2023, she participated in a RangeX writing retreat, hosted by the Swiss collaborators of the RangeX project in Glengarriff, Ireland. Dr Payne-Smith was selected to represent the Qwaqwa Department of Plant Sciences in the postdoctoral category of the Flash Fact competition in Bloemfontein in 2023. In addition, she co-authored a technical advances paper, recently accepted in *Global Change Biology*, emanating from the RangeX project, which uses machine learning techniques and remote cameras to assess weather conditions at the top of the Maloti-Drakensberg.

Dr Radim Šarlej (University of Gothenburg) and Dr Stephanie Payne-Smith (right) conducting research on carbon flux at the South African RangeX site at the top of the Maloti-Drakensberg

STAFF MATTERS

Sandy-Lynn Steenhuisen, Adré Minnaar-Ontong and Rouxléne van der Merwe were promoted to Associate Professors.

Five new appointments were made in the Department during 2023. Dr Kwame Shamuyarira was appointed as Lecturer in Plant Breeding (SARChI Chair contract appointment), Dr Norman Muzhinji as Senior Lecturer in Plant Pathology, Johnica Vlotman as Senior Assistant Officer, Grace Mochologi as Officer: Professional Services in Botany on the Qwaqwa Campus, and Sellwane Moloi as Academic Facilitator in Botany on the Qwaqwa Campus.

Associate Professor Sandy-Lynn Steenhuisen

Associate Professor Adré Minnaar-Ontong

Orpah Taylor (Senior Assistant Officer at Plant Breeding) and Ngaka Mzizi (Officer: Professional Services,

Associate Professor Rouxléne van der Merwe

Botany, Qwaqwa Campus) resigned, while Prof Wijnand Swart, Professor in Plant Pathology, retired during 2023.

Dr Mafa was appointed as a writing consultant by the UFS Centre for Graduate Support (CGS) to teach the postgraduate students to write scientific academic reports, conceptualise new theories or link new theories to existing theoretical frameworks, and to ask students questions that help them improve their aims and objectives, read, and give feedback on their reports.

RESEARCH OUTPUTS

Research Articles

Abdi, N., VanBiljon, A., Steyn, C. & Labuschagne, M. 2023. Zn fertilizer and mycorrhizal inoculation effect on bread wheat cultivars grown under water deficit. *Life* 13: 1078. doi.org/10.3390/life13051078.

Achilonu, C.C., Gryzenhout, M., Ghosh, S. & Marais, G.J. 2023. In vitro evaluation of azoxystrobin, boscalid, fentin-hydroxide, propiconazole, pyraclostrobin fungicides against *Alternaria alternata* pathogen isolated from *Carya illinoinensis* in South Africa. *Microorganisms* 11: 1691-1704.

Achilonu, C.C., Gryzenhout, M., Marais, G.J. & Ghosh, S. 2023. Differential detection of *Alternaria alternata* haplotypes isolated from *Carya illinoinensis* using PCR-RFLP analysis of *Alt a1* gene region. *Genes* 14: 1115-1129.

Achilonu, C.C., Gryzenhout, M., Marais, G.J., Madisha, T.T. & Ghosh, S. 2023. Random amplified microsatellites (RAMS) analysis ascertains genetic variation of *Alternaria alternata* causing black spot disease on *Carya illinoinensis* in South Africa. *Frontiers in Genetics* 14: 1-11.

Achilonu, C.C., Marais, G.J., Ghosh, S. & Gryzenhout, M. 2023. Multigene phylogeny and pathogenicity trials revealed *Alternaria alternata* as the causal agent of black spot disease and seedling wilt of pecan *(Carya illinoinensis)* in South Africa. *Pathogens* 12: 672-691.

Adams, L.D., Giovannoni, D., Clark, V.R., Steenhuisen. S-L. & Martin, G.D. 2023. Reproductive ecology of the invasive alien shrub *Pyracantha angustifolia* in the grassland biome, South Africa. *Plants* 12(6): 1308. doi.org/10.3390/plants12061308.

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Alison, J., Payne, S., Alexander, J.M., Bjorkman, A.D., Clark, V.R., Gwate, O., Huntsaar, M., Iseli, E., Lenoir, J., Mann, H.M.R., Steenhuisen, S.-L. & Høye, T.T. 2023. Deep learning to extract the meteorological by-catch of wildlife cameras. *Global Change Biology* 30: e17078. doi.org/10.1111/gcb.17078.

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Archer, W., Presnyakova, D., Aldeias, V., Colarossi, D., Hutten, L., Lauer, T., Porraz, G., Rossouw, L. & Shaw, M. 2023. Late Acheulean occupations at Montagu Cave and the pattern of Middle Pleistocene behavioural changes in Western Cape, southern Africa. *Journal of Human Evolution* 184: 103435. doi.org/10.1016/j.jhevol.2023.103435.

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Books/Chapters in Books

Bousman, B., Brink, J., Rossouw, L., Bateman, M., Morris, S., Meier, H., Ramsey, B.C., Trower, G., Herries, A.I.R., Ringstaff, C., Thornton-Barnett, S. & Dworkin, S. 2023. Erfkroon, South Africa. In: *Handbook of Pleistocene Archaeology of Africa: Hominin behaviour, geography, and chronology*. A. Beyin, D.K. Wright, J. Wilkins & D.I. Olszewski (Eds). Springer Cham. pp 1431-1450. doi.org/10.1007/978-3-031-20290-2_92.

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Conference Contributions

Conference Papers

Achilonu, C.C. & Marais, G.J. 2023. *RNAi spray-mediated silencing of Alternaria alternata AGO and DCL gene transcripts enhanced resistance to Alternaria black spot disease.* Paper delivered at the 16th European Conference on Fungal Genetics (ECFG16), Innsbruck, Austria. 5-8 March 2023.

Adams, L.D, Steenhuisen, S-L., Martin, G.D. & Downs, C. 2023. *Community perceptions of a fleshy-fruited invasive alien plant in the Grassland biome of South Africa.* Paper delivered at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Alison, J., Payne, S., Steenhuisen, S. & Høye, T. 2023. *Exploring the microclimate by-catch of wildlife cameras.* Paper delivered at the Ecological Society of America's 108th Annual Meeting, Oregon, USA. 4-9 August 2023.

Bologo, N., Steenhuisen, S. & Martin, G. 2023. *Impact of the invasive alien plant species clearing programme on socio-economic benefits and plant biodiversity along the northern Drakensberg, Mpumalanga province, South Africa.* Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Canavan, K., Canavan, S., Clark, V.R., Gwate, O., Mapaura, A., Richardson, D.M., Steenhuisen, S.-L., Sutton, G. & Martin, G.D. 2023. *Invasive alien plants in South Africa's mountains.* Paper delivered at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Coetzer, A., Maré, A. & Boshoff, W.H.P. 2023. *First report of Puccinia striiformis f. sp. tritici race 142E30A+ on wheat in South Africa.* Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Cordova, C. & Scott, L. 2023. *The phytolith record of Lake Ngami, Botswana, during the past 17 ka and correlation with other paleoclimatic and palaeoecological proxies.* Paper delivered at the XXI Congress INQUA, Roma, Italy. 13-20 July 2023.

Dabengwa, A. N., Scott, L., Bond, W., Archibald, S., Lehmann, C. & Bamford, M. 2023. *An eco-evolutionary approach for examining charcoal-based fire dynamics in grassy ecosystems.* Paper delivered at the XXI Congress INQUA, Roma, Italy. 13-20 July 2023.

Du Toit, I., Rothmann, L.A., Boshoff, W.H.P. & Visser, B. 2023. *The sensitivity to triazole fungicides among South African Puccinia graminis f. sp. tritici isolates.* Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Effiom A., Neumann, F., Bamford, M., Schefuβ, E., Zabel, M., Scott, L. & Humphries, M. 2023. *Late Holocene palaeoecological studies at Lake St Lucia, KwaZulu-Natal.* Paper delivered at the XXI Congress INQUA, Roma, Italy. 13-20 July 2023.

Gwate, O., Payne, S., Steenhuisen, S., Martin, G.D. & Clark, V.R. 2023. *Exploring mechanisms underlying the success of range expanding plant species in Maloti-Drakensberg mountains, South Africa.* Paper delivered at the 58th Grassland Society of Southern Africa (GSSA) Annual Conference, Rustenburg, South Africa. 24-28 July 2023.

Hlongwane, N.V., Jackson, M., Minnaar-Ontong, A. & Rothmann, L.A. 2023. *Identification and prevalence of seedborne fungal pathogens associated with soybean.* Paper delivered at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Khoza, B.M., Bowden, N. & Moloi, M.J. 2023. *Physiological, morphological and biochemical traits of dibutyldithiophosphate treated drought stressed edamame.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Khoza, B.M., Bowden, N. & Moloi, M.J. 2023. *Physiological, morphological and biochemical traits of dibutyldithiophosphate treated drought stressed edamame.* Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Kobedi, F.K., Maré, A. & Minnaar-Ontong, A. 2023. *Evaluation of South African soybean cultivars for resistance to Sclerotinia sclerotiorum.* Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Labuschagne, M.T., Van Bockstaele, F., De Leyn, I., Van Biljon, A. & Du Toit, A.G.A. 2023. *Wheat growing period effects on baking quality and gluten composition.* Paper delivered at the XIVth International Gluten Workshop, Madrid, Spain. 19-21 June 2023.

Liatile, P.C., Potgieter, G. & Moloi, M.J. 2023. *A natural bio-stimulant consisting of a mixture of fish protein hydrolysates and kelp extract enhances the physiological, biochemical and growth responses of spinach under different water levels.* Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Liatile, P.C., Potgieter, G. & Moloi, M.J. 2023. *A natural bio-stimulant consisting of a mixture of fish protein hydrolysates and kelp extract enhances the physiological, biochemical and growth responses of spinach under different water levels.* Paper delivered at the 5th National Global Change Conference, University of the Free State, Bloemfontein, South Africa. 30 January–2 February 2023.

Malekana, L., Martin, G.D., Steenhuisen, S. & Clarke, V.R. 2023. *Impact and management of range expanding Rosaceae species along elevational gradients in the Maloti Drakensberg.* Paper delivered at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Martin, G., Steenhuisen, S. & Bolongo, N. 2023. *25 Years of working for water - Successful?* Paper delivered at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Martin, G.D., Weaver, K.N., Chikowore, G., Steenhuisen, S.L. & Venter, N. 2023. *Northern temperate weeds program in South Africa.* Paper delivered at the 6th International Symposium on Biological Control of Weeds, Misiones, Argentina. 7-12 May 2023.

Mashamba, T., Steenhuisen, S., Payne, S. & Martin, G. 2023. Current status and population demographics of the Salix species in the grassland biome of South Africa. Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Masole, P., Steenhuisen, S., Payne, S. & Martin, G. 2023. Is the thorny invasive Rosa rubiginosa facilitating the recruitment of native and exotic woody species in the mountain grasslands of the eastern Free State? Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Mbele, T., Steenhuisen, S. & Canavan, K. 2023. Seed germination of naturalised and horticultural traded Cortaderia species in South Africa. Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Mekonnen, T.W., VanBiljon, A. & Labuschagne, M.T. 2023. The impact of different planting dates on protein quality and quantity, and grain yield of maize. Paper delivered at the EUCARPIA Cereals Section Conference, Szeged, Hungary. 15-20 May 2023.

Minnaar-Ontong, A. 2023. Diversification and enhancement of food and nutrition security. Paper delivered at the Science Forum South Africa, CSIR, Pretoria, South Africa. 4-5 December 2023.

Minnaar-Ontong, A., Maré, A., Vander Merwe, R., Basson, H.J. & Steyn, C. 2023. Development of South African soybean lines with resistance to sudden death syndrome. Paper delivered at the International Congress on Oil and Protein Crops, Antalya, Turkey. 2-4 November 2023.

Mngomezulu, D.N., Maré, A., Rothmann, L.A., Steyn, C. & Minnaar-Ontong, A. 2023. Resistance to Fusarium head blight in wheat: Influence of the fungal mycotoxin profile. Paper delivered at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Mngomezulu, N.T., Veldkornet, D.A., Rajkaran, A. & Nasreen, P. 2023. The influence of creek dynamics and physiochemical variables on the diversity and distribution of estuarine macrophytes at the Berg River Estuary. Paper delivered at the Southern African Society for Aquatic Scientists Annual Congress (SASAqS), Somerset West, South Africa. 21-25 June 2023.

Moloi, K., Martin, G. & Steenhuisen, S. 2023. Seed biology and spread of the alien invasive Cotoneaster pannosus in Afromontane grasslands of eastern Free State. Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Moloi, K.T., Martin, G.D. & Steenhuisen, S. 2023. Seed dispersal and germination of the alien Cotoneaster pannosus in Afromontane grasslands of the eastern Free State. Paper delivered at the 12th Oppenheimer Research Conference, Midrand, South Africae. 4-6 October 2023.

Moloi, M.J, Liatile, P. & Potgieter, G.P. 2023. *Fish protein hydrolysates and kelp concoction: a green solution for drought stress protection in spinach.* Paper delivered at the 10th International Plant Protection Symposium (online), University of Debrecen, Hungary. 24-26 October 2023.

Moloi, S.J., Moloi, M.J., Gokul, A., Chivasa, S. & Ngara, R. 2023. *Physiological, biochemical and leaf proteomic analyses of wheat varieties to water limitation stress.* Paper delivered at the Annual post-graduate symposium of the Department of Botany

and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Payne, S., Alison, J., Høye, T.T. & Steenhuisen, S. 2023. *Camera surveillance monitors invertebrate abundance, plant phenology and weather events within a montane climate change experiment.* Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Payne, S., Alison, J., Høye, T.T. & Steenhuisen, S. 2023. *Camera surveillance monitors invertebrate abundance, plant phenology and weather events within a montane climate change experiment.* Paper delivered at the 5th National Global Change Conference, Bloemfontein. 30 January–2 February 2023.

Payne, S., Steenhuisen, S., Moloi, K.T., Masole, P., Carvalho, G., Sithole, Z., Chikowore, G., Westwood, T., Rahlao, M., Chatanga, P., Seleteng-Kose, L. & Martin, G.D. 2023. *Review of the invasive, yet economically beneficial, Rosa rubiginosa L. (Rosaceae) within southern Africa.* Paper delivered at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Payne, S.L., Alison, J., Steenhuisen, S. & Høye, T. 2023. *Ain't no sunshine when it snows: microclimate by-catch of wildlife cameras.* Paper delivered at the Faculty of Natural and Agricultural Sciences Annual Flash Fact competition, Bloemfontein, South Africa. 11-12 July 2023.

Pule, K., Boshoff, W.H.P. & Maré, A. 2023. *Phenotypic and genotypic evaluation of wheat plants developed for combined rust and Fusarium head blight resistance.* Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Sedimo, G., Bester, S.P., Jackson, M. & Joubert, L. 2023. *Morphometric analysis in Nemesia (Scrophulariaceae).* Paper delivered at the South African Association of Botanists (SAAB) Postgraduate Symposium (online). 28 September 2023.

Sedimo, G., Joubert, L., Jackson, M. & Bester, S.P. 2023. *Systematics and morphometrics in Nemesia (Scrophulariaceae).* Paper delivered at the 48th South African Association of Botanists (SAAB) Annual Conference, Polokwane, South Africa. 17-20 January 2023.

Shamuyarira, K. W., Shimelis, H., Figlan, S. & Chaplot, V. 2023. *Combining ability analysis of yield and biomass allocation related traits in newly developed wheat populations.* Paper delivered at the 2023 Combined Congress, Pretoria, South Africa. 23-26 January 2023.

Sithole, Z., Moloi, K.T., Steenhuisen, S. & Martin, G.D. 2023. *Role of mammals in the seed dispersal of the invasive plant species, Rosa rubiginosa, in the Free State rangelands.* Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Sivhada, R., Labuschagne, M.T. & Van Biljon, A. 2023. *Going back to the wild for better bread.* Paper delivered at the Annual post-graduate symposium of the Department of Botany and Plant Biotechnology at University of Johannesburg, South Africa. 23-25 October 2023.

Steenhuisen, S., Martin, G., Moloi, K., Adams, L.D., Gwate, O., Payne, S., Masole, P., Malekana, L., Downs, C. & Clark, V.R. 2023. *Expanding ranges of invasive Rosaceae.* Paper delivered at the 5th National Global Change Conference, Bloemfontein. 30 January–2 February 2023.

Steenhuisen, S., Martin, G.D., Moloi, K.T., Adams, L.D., Payne, S., Gwate, O., Masole, P., Malekana, L., Downs, C. & Clark, V.R. 2023. *When roses go rogue: Expanding ranges of invasive Rosaceae in South Africa.* Paper delivered at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Steyn, C., Meyer, C., Minnaar-Ontong, A. 2023. *Characterisation of the Sclerotinia sclerotiorum population on soybean and sunflower in South Africa to improve resistance breeding strategies.* Paper delivered at the International Congress on Oil and Protein Crops, Antalya, Turkey. 2-4 November 2023.

Tóth, B., Grusak, M., Labuschagne, M., Guzman, C., Szoke, L., Kaczur, D., Harangi, R., Radocz, L., Makhsatova, S., Danter, M., Nagy, J. & Moloi, M.J. 2023. *Evaluation of the impacts of stressors on crops in the context of climate change.* Paper delivered at the International Summit on Renewable Energy (INSORE2023), Dubrovnik, Croatia. 11-13 February 2023.

Van Aardt, A.C., De Jager, J.C.L., Giddy, J.N. & Dayaram. A. 2023. *Karroid Islands in a sea of grasses, Free State Province, South Africa.* Paper delivered at the 65th Annual Symposium of the International Association of Vegetation Science, Coffs Harbour, Australia. 3–8 September 2023.

Van Biljon, A., Olckers, S-L., Osthoff, G. & Labuschagne, M.T. 2023. *Size exclusion and reverse-phase high-performance liquid chromatography as complementary tools to study wheat gluten protein.* Paper delivered at the 44th South African Chemical Institute (SACI) National Convention, Chemistry for Sustainable Development in Africa, Stellenbosch, South Africa. 8-13 January 2023.

Van der Merwe, R., Hlatshwayo, K.K., Maré, A., Minnaar-Ontong, A. & Zhang, Q. 2023. *Development of South African soybean lines with resistance to sudden death syndrome.* Paper delivered at the International Congress on Oil and Protein Crops, Antalya, Turkey. 2-4 November 2023.

Van der Merwe, R., Hlatshwayo, K.K., Minnaar-Ontong, A., Maré, A. & Zhang, Q. 2023. *Breeding for pod-shattering resistance in vegetable-type soybean.* Paper delivered at the International Congress on Oil and Protein Crops, Antalya, Turkey. 2-4 November 2023.

Veldkornet, D.A. 2023. *The influence of macroclimatic drivers on the macrophyte phylogenetic diversity in South African estuaries.* Paper delivered at the Southern African Society for Aquatic Scientists Annual Congress (SASAqS), Somerset West, South Africa, 21-25 June 2023.

Venter, K., Marè, A., Herselman, L., Pretorius, Z.A. & Boshoff, W.H.P. 2023. *Exploiting wheat landraces to boost food security and sustainable agriculture.* Paper delivered online through LOGYTalks. 12th April 2023

Venter, K., Swart, W.J., Visser, B. & Rothmann, L. 2023. *A quantitative and qualitative analysis of rhizosphere populations of maize and soybean as influenced by soil and plant genotype.* Paper delivered at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Zondo, S., Mohase, L., Tolmay, V. & Mafa, M. 2023. *Characterisation of the cell wall reinforcing peroxidase and β-1,3-glucanase induced upon wheat infestation by Diuraphis noxia.* Paper delivered at the 10th International Plant Protection Symposium (online) in Debrecen, Hungary. 24-26 October 2023.

Zondo, S.N., Mohase, L., Tolmay, V. & Mafa, M.S. 2023. *Consolidating the cell wall modification roles of Peroxidase and β-1,3-Glucanase during Diuraphis noxia-wheat interaction.* Paper delivered at the South African Association of Botanists (SAAB) Postgraduate Symposium (online). 28 September 2023.

Conference Posters

Adams, L.D., Steenhuisen, S., Martin, G.D. & Downs, C. 2023. *The role of mammals in seed dispersal of fleshy-fruited invasive alien plants in the Grassland Biome of South Africa.* Poster presented at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Ajidahun, J., Mafa, M. & Mohase, L. 2023. *Effect of drought and Russian wheat aphid infestation on wheat yield and quality traits.* Poster presented at the Combined Congress, University of Pretoria, Future Africa campus. 23-26 January 2023.

Delport, B., Castillo-Hernandez, J., Marais, G.J., McCarlie, S.J. & Bragg, R.R. 2023. *Metagenomic evaluation of the bacterial diversity in pecan nut trees with overall decline symptoms.* Poster presented at the 22nd Biennial Congress of the South African Society for Microbiology (SASM2023), Protea Hotel Technopark, Stellenbosch, South Africa. 17-20 September 2023.

Hlakotsa, N.M.M.S. & Ngara, R. 2023. *Physiological responses of sorghum seedlings exposed to mild drought stress.* Poster presented at the 48th South African Association of Botanists conference, Polokwane, South Africa. 17-20 January 2023.

Hlongwane, N.V., Rothmann, L.A. & Swart, W.J. 2023. *Exploring soybean and sunflower microbiomes for beneficial bacterial microorganisms.* Poster presented at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Malekana, L., Clark, V.R., Steenhuisen, S., Martin, G.D. & Alexander, J. 2023. *Impact and management of range expanding Rosaceae species along elevational gradients in the Maloti Drakensberg.* Poster presented at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Masisi, T.V., Mclaren, N.W., Jackson, M. & Rothmann, L.A. 2023. *Identifying sorghum grain fungal colonisers, quantification of mycotoxins and development of weather-based predictive models for Fusarium graminearum.* Poster presented at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Mbele, T., Steenhuisen, S. & Canavan, K. 2023. *Invasive status of Cortaderia species in South Africa.* Poster presented at the 18th Biodiversity Research Symposium, Kimberley, South Africa. 27 September 2023.

Mbele, T., Steenhuisen, S. & Canavan, K. 2023. *Invasive status of Cortaderia species in South Africa.* Poster presented at the National Symposium on Biological Invasions, Grabouw, South Africa. 4-6 July 2023.

Mboyi, L., Clark, V.R., Mapaura, A., Steenhuisen, S. & Canavan, K. 2023. *Invasion patterns and impacts of the grass Nassella tenuissima in the Eastern Cape Drakensberg, South Africa.* Poster presented at the 58th Grassland Society of Southern Africa (GSSA) Annual Conference, Rustenburg, South Africa. 24-28 July 2023.

Meiring, M., McLaren, N.W. & Rothmann, L.A. 2023. *The viability of Sclerotinia sclerotiorum sclerotia exposed to dry heat temperatures and the rumen of cattle.* Poster presented at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Mngomezulu, D.N., Rothmann, L.A., and Minnaar-Ontong, A. 2023. *Resistance to Fusarium head blight in wheat: influence of the fungal mycotoxin profile.* Poster presented at the 12th International Congress of Plant Pathology, Lyon, France. 20-25 August 2023.

Mngomezulu, N.T., Veldkornet, D.A., Rajkaran, A. & Nasreen, P. 2023. *The influence of physiochemical variables on the distribution of aquatic invertebrates (snails and crab abundance) in salt marsh creeks.* Poster presented at the Southern African Society for Aquatic Scientists Annual Congress (SASAqS), Somerset West, South Africa. 21-25 June 2023.

Mohotloane, M.M. & Mafa, M.S. 2023. *HRP pretreatment modifies structural and chemical properties of rooibos biomass, improving its saccharification by enzyme cocktails.* Poster presented at the 4th International Conference for Bioresource Technology for Bioenergy, Bioproducts & Environmental Sustainability (BIORESTEC2023). Lake Garda, Italy. 14-17 May 2023.

Moloi, K.T., Martin, G.D. & Steenhuisen, S. 2023. *Seed dispersal and germination of Cotoneaster pannosus on Afromontane grasslands of eastern Free State, South Africa.* Poster presented at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Moshieng, N., Labuschagne, M., Shandu, S.F., Rantso, P. & Mbuma, N.W. 2023. *Variation in seed protein, selected minerals, phytic acid and potential mineral bioavailability of cowpea [Vigna unguiculata (L.) Walp] mutants and accessions.* Poster presented at the African Plant Breeders Association Conference, Mohammed VI Polytechnic University (UM6P), Benguerir, Morocco. 23-27 October 2023

Ngara, R. 2023. *Comparative morpho-physiological and molecular studies of sorghum under drought stress.* Poster presented at the VIB Conference: Translational Research in Crops, Ghent, Belgium. 22-23 June 2023.

Payne, S., Steenhuisen, S., Moloi, K.T., Masole, P., Carvalho, G., Sithole, Z., Chikowore, G., Westwood, T., Rahlao, M., Chatanga, P., Seleteng-Kose, L. & Martin, G.D. 2023. *Review of the invasive, yet economically beneficial, Rosa rubiginosa L. (Rosaceae) within southern Africa.* Poster presented at the 16th International Conference on Ecology and Management of Alien Plant Invasions (EMAPI), Pucón, Chile. 23-25 October 2023.

Sekhurwane, M. & Moloi, M.J. 2023. *Influence of different selenium application methods on physiology and biochemistry of drought stressed edamame.* Poster presented at the 48th Annual conference of the South African Association of Botanists (SAAB), Polokwane, South Africa. 17-20 January 2023.

Research Reports

Amegbor, I.K., Darkwa, K., Nelimor, C., Manigben, K.A., Adu, G.B., Aboyadana, P.A., Kusi, F., Keteku, A.K., Owusu, E.Y., Ackah, H. & Labuschagne M.T. 2023. *Yield performance and genetic analysis of drought tolerant provitamin A maize under drought and rainfed conditions.* Report delivered to Forum for Agricultural Research in Africa (FARA).

Boshoff, W.H.P. 2023. *Evaluation of wheat cultivars and lines for genetic resistance to rust diseases.* Report delivered the Wheat Trust, Pretoria, South Africa.

Coetzee, E. 2023. *Fungi associated with overall decline in pecan orchards in the Northern Cape.* Progress report delivered to Annual General Meeting of the South African Pecan Nut Producers Association (SAPPA).

Delport, B. 2023. *Metagenomic evaluation of the bacterial diversity in pecan nut trees with overall decline symptoms.* Progress report delivered to Annual General Meeting of the South African Pecan Nut Producers Association (SAPPA).

Figuero, M., Lewis, D.C., Henningsen, E.C., Hewitt, T., McElroy,

K., Dillon, S., Webers, C., Nguyen, T.D., Mago, R., Nazareno, E., Hartwig, E., Visser, B., Pretorius, Z.A., Boshoff, W.H.P., Pereira, D., Stuckenbrock, E., Lubega, J., Kanyuka, K., Huang, Y.-F., Hickey, L., Milgate, A., Stone, E., Steffenson, B.J., Kianian, S.F., Sperschneider, J. & Dodds, P. 2023. *Rust's biggest secret tactic to kill a crop.* Report delivered to Grains Research Development Corporation (GRDC).

Marais, G.J. 2023. *Fungal diseases of pecans in South Africa: What do we know?* Progress report delivered to Annual General Meeting of the South African Pecan Nut Producers Association (SAPPA).

McDonald, S. 2023. *Disease resistance of selected pecan cultivars based on their chemical composition and bioactivity*. Progress report delivered to Annual General Meeting of the South African Pecan Nut Producers Association (SAPPA).

Van Biljon, A. 2023. *Annual wheat purity tests of new breeding lines by SDS-PAGE*. Report delivered to the Southern African Grain Laboratory.

Yilmaz, N., Visagie, C.M., Visser, B. & Boshoff W.H.P. 2023. *Survey of fungal pathogens affecting maize production in the Eastern Cape.* Report delivered to the Maize Trust.

Industry Papers

Du Toit, I., Boshoff, W.H.P., Rothmann L. & Visser B. 2023. *Fungicide sensitivity among isolates of the stem rust fungus on small grains* (in Afrikaans). SA Grain 50 (71): 38-39.

Terefe, T., Boshoff, W.H.P. & Coetzer, A. 2023. *Stripe rust on wheat – new race detected.* Lead article. SA Grain 50 (5): 8-11.

STAFF (2023)

Head of Department:
Prof L Herselman

BLOEMFONTEIN CAMPUS:

Professors:	Prof L Herselman and Prof MT Labuschagne
Associate Professors:	Prof WHP Boshoff, Prof A Minnaar-Ontong, Prof R van der Merwe and Prof B Visser
Senior Lecturers:	Dr L Joubert, Dr GJ Marais, Dr L Mohase, Dr MJ Moloi, Dr N Muzhinji, Dr AC van Aardt and Dr A van Biljon
Lecturers:	Dr M Jackson, Dr MS Mafa, Dr A Maré, Dr L Rothmann, Dr KW Shamuyarira and Dr DA Veldkornet
Mentor:	Prof L Scott
Research Fellows:	Dr NW Mbuma, Dr GP Potgieter, Prof ZA Pretorius, Dr S Ramburan, Dr L Roussow, Prof WJ Swart, Dr AM Venter and Prof HJT Venter
Programme Director:	Prof B Visser
Subject Coordinators:	Prof WHP Boshoff, Prof A Minnaar-Ontong and Dr L Joubert
Chief Officer – Professional Services:	Dr CM Bender
Officer – Professional Services:	Dr C Steyn
Senior Officers:	M Frylinck and HP Pretorius
Senior Assistant Officers:	LP Mbingeleli and JM Vlotman
Assistant Officer:	K Mbatha
Technical Assistant:	PR Chakane
Cleaners:	NH Dlamini, NS Macwili and LHA Maile
Gardener:	MI Mojampa
Labourer:	TP Motlhacwi

QWAQWA CAMPUS:

Subject Head:	**Prof S-L Steenhuisen**
Associate Professors:	Prof AOT Ashafa and Prof S-L Steenhuisen
Senior Lecturers:	Dr A Gokul and Dr R Ngara
Lecturers:	Dr PJ Mojau and TR Pitso
Research Fellows:	Dr K Canavan, Dr RJ McKenzie and Prof RO Moffet
Academic Facilitator:	SJ Moloi
Officer:	D Mosea
Officer – Professional Services:	NG Mochologi

DEPARTMENT OF

ZOOLOGY AND ENTOMOLOGY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

More than two decades ago, our Department of Zoology and Entomology had the honour and privilege to be involved in the process of awarding an honorary doctorate in Zoology to Tim Liversedge, the internationally renowned documentary filmmaker and photographer from Botswana. During the April graduation ceremony of 2023, we did it again. Well-known as the face and voice of 'Groen', *KykNet's* environmental documentary with 84 000 followers on Facebook, Dave Pepler is truly an ecologist, naturalist, and environmentalist, or, as we referred to him in the motivation documentation, the David Attenborough of South Africa, our own Charles Darwin. To quote Dr Pepler during his acceptance message "I accept this honour with deep gratitude and a hell of a lot of pride. Jetz, bin ich ein Kovsie".

Dr David Pepler receiving his Honorary Doctorate

Conferences attended by staff and students from both campuses are mentioned in the report and include not just South Africa, but also Gabon, Ghana, Namibia, India, a few European countries, Argentina, and the USA.

During July 2023, the Department was represented by a delegation of eleven entomologists, ranging from third-year students to researchers, at the 23rd Congress of the Entomological Society of Southern Africa (ESSA) held in Stellenbosch. The Department has secured the honour of hosting the prestigious ESSA 24, scheduled to convene in 2025. This opportunity underscores our commitment to advancing entomological research in Africa and fostering scholarly exchange within our community.

Staff and students attending the Entomological Society of South Africa conference in Stellenbosch. From the left, Thabo Moabi, Keletso Makaota, Enzo van Lingen, Thandeka Mahlobo, Adriaan Stander, Tshepiso Notolo, Dr Michel Vickers, Dr Aileen van der Mescht, Dr Vaughn Swart, Dr Nontembeko Dube, and Prof Charles Haddad

In September, the 40th Conference of the Zoological Society of Southern Africa (ZSSA) took place. Staff from both Bloemfontein and the Qwaqwa Campuses were part of the local organising committee, with Prof Aliza le Roux as the convenor. A total of 13 UFS contributions presented by staff and students were included in the programme.

Staff and students attending 40th Annual Conference of the Zoological Society of Southern Africa. Front, from the left, Prof Aliza le Roux, Thlonolofatso Sefojane, Toka Mosikidi, Lehlohonolo Mofokeng. Back, from the left, Prof Daryl Codron, Veli Mdluli, Ngitheni Nyoka, Monnique Barnard, Nonhlanhla Radebe, Dr Nthatisi Molefe-Nyembe, Prof Peter Taylor, Rasekuwane Mosia, Jabulile Maseko, Chanel Lewis, Alexandra Howard, and Dr Mpho Ramoejane

In 2003, the Department of Zoology on the Qwaqwa Campus (formerly the University of the North) was incorporated into the University of the Free State (UFS). During the last two decades, we have had joint Zoology excursions, collaborated on several projects, and since 2008, ended the academic year with joint postgraduate seminar days. In 2023 it was Bloemfontein's turn to visit the Qwaqwa Campus for a two-day programme.

Staff and students from both campuses during our annual postgraduate seminar day on the Qwaqwa Campus

ACHIEVEMENTS

Staff Achievements

Prof Daryl Codron (Bloemfontein) and Prof Aliza le Roux (Qwaqwa) were both promoted to Full Professor, and Dr Patricks Voua Otomo (Qwaqwa) was promoted to Associate Professor; these promotions take effect from January 2024.

Lindi Heyns was awarded a prestigious Learning and Teaching Innovation Award from the UFS during the annual Teaching and Learning Conference. This recognition highlights Lindi's exceptional contributions to promoting innovative approaches to learning within the University community.

In September, during the 40th conference of the ZSSA, Prof Peter Taylor was awarded the ZSSA Gold Medal for his outstanding contribution to the field of Zoology.

One of the other highlights of 2023 was the graduation of Dr Michelle van As with her PhD in Zoology, on 'Organochlorine pesticide exposure levels and haemoparasite infections as health parameters for leopards in South Africa', from North-West University (NWU). Her achievement makes the Department of Zoology and Entomology at Qwaqwa one of the few Departments on that Campus in which all academic staff hold PhD degrees.

In 2023, Prof Liesl van As was appointed as the South African representative on the International Committee of the International Symposium of Fish Parasitology (ISFP). The 10th ISFP is scheduled to take place in January 2025 in Merida, Mexico. The 6th ISFP was hosted two decades ago by staff and students from Aquatic Parasitology on the Bloemfontein Campus in 2003.

Student Achievements

On the Bloemfontein Campus, Chanel Lewis (PhD) obtained a competitive research grant from the Palaeontological Scientific Trust (PAST), which will be a major contribution towards her research. Runé van der Merwe (PhD) completed several postgraduate training modules in advanced ecological theory, quantitative analysis, and statistical programming, hosted at the University of Groningen (UG), Netherlands, as part of her joint UFS-UG PhD research. Prof Daryl Codron is the supervisor for both these PhD students.

Elizna Terblans (MSc) won 4th best oral presentation at the Afrikaanse Studente Simposium vir Natuurwetenskappe that was held in Pretoria. At the same symposium, Bianca Cronje (BSc Hons) won a spelling application. Dr Ellie van Dalen supervised both students. Elizna also received the World Association for the Advancement of Veterinary Parasitology (WAAVP) African Foundation Scholarship to attend the 23rd International Conference of the WAAVP in Chennai, India in 2023. She was one of the eight successful candidates from the African continent.

Maintaining her record from 2022, Keletso Makaota (MSc) won the best student presenter award at the 18th Kimberley Biodiversity Research Symposium, which was held at the Sol Plaatje University, Kimberley. She is supervised by Dr Nontembeko Dube.

Bernie Jordaan, Doctoral candidate of Dr Ed Netherlands, won the Junior WO Neitz medal for the best MSc dissertation in parasitology across South Africa, from the Parasitological Society of Southern Africa (PARSA). Bernie also won the Angela Davies-Russel medal for the best student paper in parasitology awarded by PARSA.

Thabo Moabi (BSc Hons – supervised by Dr Dube) received an award for the outstanding quality and depth of his presentation at the 5th National Global Change Conference (GCC5) hosted by the Department of Science and Innovation (DSI) and the National Research Foundation (NRF), in partnership with UFS earlier in 2023.

Thabo Moabi, Alexandra Howard, and Veli Mduli with their awards at GCC5

On the Qwaqwa Campus, Veli Mdluli (PhD) and Alexandra Howard (PhD) (both supervised by Prof Peter Taylor) received awards for the outstanding quality and depth of their presentations at GCC5.

Veli Mdluli was also ranked third in the PhD student category during the Faculty of Natural and Agricultural Sciences Flash Fact competition on the Bloemfontein Campus, whilst Alexandra Howard received the prestigious 2023 L'Oréal-UNESCO Award for Women in Science South Africa.

Alexandra Howard receiving the L'Oréal-UNESCO award from Dr Phil Mjwara, Director-General of DSI (left) and Serge Sace, CEO of L'Oréal South Africa (right)

During the 40th ZSSA conference held in October 2023, Veli Mdluli and Toka Mosikidi (PhD student of Dr Mpho Ramoejane), received prizes for the best and second-best student presentations. Toka also received an award for the best short presentation by a student at the Conservation Symposium held in Port Edward.

Mary Joe (supervised by Drs Emile Bredenhand and Nthatisi Molefe-Nyembe) was recognised as the best Zoology Honours student and the best overall performer in the Faculty of Natural and Agricultural Sciences on Qwaqwa Campus.

TEACHING AND LEARNING

In the Department we undertake annual excursions for both the undergraduate and Honours students.

Dr Candice Jansen van Rensburg and Prof Daryl Codron accompanied the third-year Zoology students from the Bloemfontein Campus on the annual Ecology excursion to the Wildlife and Environmental Society of South Africa (WESSA) facilities near Howick, during the autumn recess. In 2023 the excursion week was extended to also include Treasure Beach on the Bluff, just outside Durban. Once again, the WESSA staff organised a day programme on water quality and aquatic invertebrate surveys in and around Howick.

Students collecting macroinvertebrates from the Umgeni River at WESSA, Howick

Prof Codron used the remaining two days with the students to uncover patterns of dispersal. At Treasure Beach the students had to construct a rocky shore zonation pattern of the communities present, while also looking at species associations and turnovers. Students also had to individually compile a digital species inventory list of the organisms occurring on the east coast rocky shore and submit it before the end of the semester. At the end of the week, student groups presented their results via poster and PowerPoint presentations.

Melissa van Niekerk, Anien van Niekerk, JC Beukes, Hendriette Stroebel, and Gladys Mohono busy with the shore zonation project at Treasure Beach

Zoology Biodiversity Honours students participating in the Herpetology Honours excursion at the Bankfontein Research Station. Front, from the left, Natania Mzileni, Leah Blayi, and Dr Ed Netherlands; Middle, from the left, Pieter Jansen, Bianca Cronje, Monique Barnard, Jabulile Maseko, and Kopano Mohohlo; Back, from the left, Jade Hastings, Bernie Jordaan, and James Kidd

The Bloemfontein Honours Biodiversity excursion, under supervision of Dr Ed Netherlands, took place at the beginning of October to Bankfontein, in the western Free State. This was a combined excursion with the Herpetology module and the focus was on identification techniques and data analysis.

Adriaan Jordaan (kneeling), explaining to students the correct method to set up a drift fence. From the left, Kopano Mohohlo, Pieter Jansen, Leah Blayi, Natania Mzileni, Bianca Cronje, Jabulile Maseko, and Monique Barnard

Dr Cora Stobie, Senior Museum Scientist in the Herpetology Department at the National Museum, presented a one-day workshop to the students prior to the excursion, and Adriaan Jordaan, Principal Technician of the Science Collections at the South African National Biodiversity Institute (SANBI) presented a pre-excursion workshop on the Specify Database, after which he joined the excursion for a few days and participated in the field programme.

Ferdi de Lange (Anuran acoustic scientist, private environmental and freshwater consultant) also joined the excursion, focusing on acoustic monitoring methods.

For the first time, the excursion for the third-year Entomology students on the Bloemfontein Campus was undertaken to the Witsand Nature Reserve in the Northern Cape. This is a unique reserve with extensive white sand dunes and is renowned for its exceptionally unique fauna and flora. This provided an opportunity to sample insects and arachnids from the reserve for the first time using a standardised sampling protocol, which generated valuable biodiversity data for the South African National Survey of Arachnida.

Virtual field visits and expert engagements significantly enhanced the educational experience of second-year Zoology students from the Bloemfontein Campus. Through ShareScreenAfrica live events (online), students embarked on immersive virtual journeys to diverse destinations, including Kenya, Kruger National Park, and the Western Cape. Highlights included up-close encounters with giraffe at the Giraffe Centre in Nairobi and an insightful tour through Letaba Elephant Hall. Additionally, students gained fascinating insights into whales from Dave de Beer, a renowned wildlife photographer and whale tour guide based in Hermanus.

Two of the third-year modules on the Qwaqwa Campus offer student excursions. In mid-March, Prof Aliza le Roux took the students to the Golden Gate Highlands National Park on a joint weekend excursion with Plant Sciences.

A second excursion took place during mid-October with a visit to the Cradle of Humankind in Magaliesburg, Gauteng.

The third-year Zoology students from Qwaqwa went on a field trip as part of the Introduction to Animal Behaviour module, during which students were shown how to set up Sherman traps for field mice collections

In 2023 Dr Nthatisi Molefe-Nyembe accompanied her third-year and postgraduate students from the Qwaqwa Campus on a field excursion to the Seotlong Agriculture and Hotel School in Bluegumbosch for faecal and blood sampling. This formed part of the Introduction to Parasitological Diagnosis Methods module. This is an ongoing collaboration between the UFS Parasitology lab and Seotlong Agriculture and Hotel School. In addition, the UFS members presented to the school learners the importance of regular checks of domestic animals, treatment options, and the collection of samples for detecting parasites.

Dr Nthatisi Molefe-Nyembe and students visiting Seotlong Agriculture and Hotel School in Bluegumbosch

RESEARCH AND INNOVATION

Bloemfontein Campus Research Groups

Aquatic Ecology / Parasitology

Prof Linda Basson completed a five-week visit to the University of Pisa in Italy as part of the Arger project – under the umbrella of Marie Sklodowska-Curie Actions. This is an H2020-MSCA-RISE-2019 project, titled 'Next Generation Taxonomy: Ciliophora and their bacterial symbionts as a proof of concept (NGTax)'. Prof Basson completed the visit as part of a 12-month secondment. This period was spent in the lab of Prof Giulio Petroni, in which his research team concentrates on various free-living ciliates and their symbionts, using an integrated approach of light-, confocal-, and electron microscopy to study the morphology, taxonomy, biology, and ecology of various ciliates and their symbionts. During the visit, a week-long course was presented to selected undergraduate students from various institutions. This course on Biodiversity and Morphological Techniques included lectures in the mornings and demonstration of various practical techniques during the afternoons. Prof Basson assisted with the various practical sessions. The rest of the period in Pisa was spent networking with fellow NGTax members, working on collaborative publications,

Official NGTax meeting held in Pisa (Italy). From the left, Dr Maksim Melekhin (Chulalongkorn University, Thailand, and University of Innsbruck Mondsee, Austria), Dr Gerhard de Jager (University of Pisa, Italy), Prof Alexey Potekhin (University of Innsbruck Mondsee, Austria), and Prof Linda Basson (UFS)

collecting fresh marine material at Marina di Pisa, and attending various meetings to discuss the next postgraduate student from UFS who will complete a secondment of six months in various Italian laboratories.

The Okavango Fish Parasite project started in 1997 and in 2004 the semi-permanent research camp was built on the commercial crocodile farm, Krokovango. We had never foreseen that more than two decades later, we would still be working in the Okavango Delta and River. Phase one of the research camp renovation was completed in 2021, which was delayed due to COVID. Our Botswana research permit has been renewed for an additional three years, and phase two of the camp upgrade and renovation is on the table. During June, Profs Danie Vermeulen (Dean of Natural and Agricultural Sciences) and Paul Grobler (Genetics) joined Prof Liesl van As for a few days, visiting the Leseding Research Camp in Botswana. During the two-week fieldtrip, Luthando Bopheka (PhD student) did the last sampling for his research project.

Luthando Bopheka and Prof Liesl van As setting gill nets in a lagoon in the Okavango River

Profs Linda Basson and Liesl van As, attended the 51st Annual PARSA Congress that was held in Muldersdrift, together with some students and Dr Ed Netherlands. Posters and oral presentations were delivered on the research being undertaken.

Delegates at the 51st Annual PARSA Congress

Applied Agricultural Entomology

The year 2023 marked the conclusion of a collaborative project with the Stinkbug Research Group, Macadamias South Africa (SAMAC), and the Agriculture Research Centre (ARC) in Nelspruit, as part of De Villiers Fourie's PhD research. This challenge was approached in a holistic and novel manner, with focus placed on providing practical feedback to the industry, increasing awareness, promoting integrated management, and aiding in filling the significant knowledge gap regarding resistance management in South African macadamia orchards.

A research project was launched in collaboration with the Department of Agriculture that is investigating the viability of several new cactus pear cultivars for resistance to cochineal and *Cactoblastis* sp. damage. Conducted on the UFS Bloemfontein Campus, the study was initiated during 2023 and will be completed late 2024.

Arachnology

The Arachnology research group conducted field trips to the Witsand Nature Reserve in the Northern Cape in March 2023 and northern KwaZulu-Natal (Tembe Elephant Park and Ndumo Game Reserve) in December. Research focused on using standardised sampling protocols to generate biodiversity data on arachnids, with Postdoctoral Fellow, Dr Michael Vickers, sampling jumping spiders for a study on dietary specialisation in this group. Taxonomic research continued on Afrotropical spiders, including the description of three new genera of trachelid spiders from southern Africa (in collaboration with former student Robin Lyle) and the revision of southern African spitting spiders by PhD candidate Ruan Booysen. Hannelene Badenhorst successfully completed her PhD study at the end of 2023 on spider and springtail ecology in central South Africa. Several papers on spider biodiversity were submitted for publication, focusing on the Fynbos Biome and spider biology.

Etho-ecology

Honours student Pieter Jansen, under the supervision of Dr Hennie Butler, completed a study on the selection and preferences of aardvark burrows as shelter by other animals. Dr Ed Netherlands (Herpetology), Dr Butler, and Jade Hastings gave a public talk at Fauresmith on the identification of reptiles, whilst Dr Butler also gave a public talk at the South African Hunters Association on the occurrence of and reasons for geophagy amongst wild animals. Dr Butler was also part of the organising committee for the Southern African Wildlife Management Association conference that was held at Golden Gate Highlands National Park, as well as the conference of the ZSSA held at Champagne Sports Resort.

Environmental Entomology and Dipterology

The Environmental Entomology research group, led by Dr Vaughn Swart, focuses on studying insects and their interactions with the environment, covering areas such as ecology, population dynamics, pest management, and the impact of human activities on insect populations and ecosystems. Their expertise lies in developing strategies to preserve biodiversity, mitigate pest damage and promote sustainable agriculture, while also contributing to the understanding and control of insect-borne diseases. Dipterology, the scientific study of flies, explores the biology, behaviour, classification, and evolution of this diverse group of insects, plays a crucial role in revealing their ecological relationships and broader evolutionary patterns across various habitats and organisms.

Gary Edwards graduated with his MSc, which focused on ecological aspects of arthropod soil mesofauna in nut orchards. Adriaan Stander's MSc research focuses on the management of the brown locust *(Locustana pardalina),* performing bioassays on various plant-based products to manage the locusts.

Herpetology

Dr Ed Netherlands and his team research the diversity of blood parasites in amphibians and reptiles across various regions of the country, continent, and globe. Their research aims to enhance the understanding of the distribution, ecology, and evolutionary biology of these parasites, which can have significant implications for both conservation and public health.

Throughout the year, Dr Netherlands participated in various academic engagements. He attended the 15th Symposium of the Herpetological Association of Africa (HAA) held in Hoedspruit in January 2023, where he presented findings from his and his students' research on blood parasite diversity in local frogs and lizard hosts. In April, Dr Netherlands, along with Dr Johann van As (Qwaqwa Campus), hosted Dr Amanda Picelli from Villanova University, USA, for a research visit to the Soutpansberg mountains and the eastern Free State, focusing on fieldwork related to the blood parasite diversity in high-altitude reptile species.

Towards the end of April, Dr Netherlands was invited by Dr Patricks Voua Otomo to deliver an overview lecture on his work on blood parasites at the Department of Zoology and Entomology on the Qwaqwa Campus. This formed part of their annual project proposal day for postgraduate students.

In collaboration with Prof Louis du Preez (NWU), Dr

Netherlands undertook a research trip to Auburn University in Alabama, USA, from 18 May to 6 June. During this visit, he conducted a workshop on blood parasite sampling of local fish, amphibians, and reptiles, furthering their comparative research efforts. Additionally, he was invited to Temple University Campus in Philadelphia, USA, to establish a sustainable collaboration on the systematics and biogeography of haemosporidian parasites, which are a key focus of his research.

Dr Ed Netherlands sampling blood from alligators for blood parasites at Auburn University

Dr Netherlands was a finalist in the 2022/2023 National Science and Technology Forum (NSTF)-South32 Awards (Science Oscars) in the Emerging Researcher category. These awards are prestigious acknowledgements of outstanding contributions to science, engineering, technology, and innovation.

Prof Neil Heideman and Lindi Heyns continued their supervisory roles for James Kidd (MSc) as he investigated the influence of climate, vegetation, and geographic topography on the ecology and reproduction of an agamid lizard species in southern Africa. With their guidance, James completed his research project and submitted it by year's end. The results are a *cum laude* pass, with graduation in 2024.

Insect Physiology and Weed Biocontrol

This research group focuses on the pre-release studies for weed biological control, such as evaluation of the impacts of invasive alien plants on the ecosystem (particularly arthropods and nematodes) and post-release studies, which evaluate the impact of released natural enemies on the population dynamics of the target invasive alien plants and recovery of the animal communities after biocontrol agents have been released. The group also seeks to understand the impacts of dumping sites on arthropods and optimal environmental conditions for the development of insects of economic and ecological significance. Dr Nontembeko Dube was awarded NRF-Thuthuka funding for the period 2024 to 2026, for a project on 'Pre-release studies on *Gledetsia triacanthos* and harnessing two invaders (alien plants) in agroecological systems'.

In January 2023, Dr Dube joined Dr Patricks Voua Otomo (from the Qwaqwa Campus) to visit the Centre for Biological Control (CBC) at Rhodes University, where they learnt more about rearing water weeds and their insect biological control agents. This opened the opportunity for future collaboration between Drs Otomo, Dube, and the CBC.

From the left, Lyle Titus, Gertrude Tshithukhe, Nokuthula Kom, and Bongiwe Gobongcwa from the Centre for Biological Control, with Dr Nontembeko Dube and Dr Patricks Voua Otomo

Along with her postgraduate students (one Honours, one MSc, and one PhD), Dr Dube delivered papers at GCC5 in January/February 2023, and she attended the 18th Kimberley Biodiversity Research Symposium with Keletso Makaota, where she presented a component of her MSc work. The group also attended the 23rd Entomological Conference that was held in Stellenbosch.

Dr Nontembeko Dube and her students Thabo Moabi (BSc Hons), Keletso Makaota (MSc), and Thandeka Mahlobo (PhD), at the 23rd Entomological Society of Southern Africa

Nematology

Dr Candice Jansen van Rensburg's research focused on studying the biodiversity of free-living nematodes from nature reserves in the Free State as this group of nematodes is poorly studied within the province, as well as South Africa.

Anke de Smidt (PhD student) was awarded a scholarship to attend the 2nd Pan-African Nematology workshop that was held at the University of Mpumalanga in Mbombela during early March 2023. The workshop covered various aspects of Nematology. As part of the scholarship, Anke attended an online workshop on essential poster development, and at the workshop she presented a poster on her PhD, for which she won 2nd prize. Anke's PhD research focuses on the systematics of the superfamily Cephaloboidea from the Free State. These nematodes are bacterivorous and beneficial nematodes in the soil. She is currently making use of both morphological and molecular techniques to describe selected species from this group of nematodes. This research will contribute to the gap in taxonomic knowledge of this group in South Africa.

Raymond Collett, a PhD student from NWU co-supervised by Dr Jansen van Rensburg, joined the nematology lab in August 2023. They both attended and presented papers at the 24th Symposium of the Nematological Society of Southern Africa at Kloofzicht Lodge in Gauteng, in mid-September. Raymond's project involves comparing and measuring ecosystem health and restoration in both conservation agriculture and conventional agriculture grain crop rotation practices. This is being done at two experimental sites in the Free State (Bloemfontein and Kroonstad) by using nematode assemblages and other selected soil-health parameters.

Terrestrial Ecology

Most research in the lab is aimed at understanding species coexistence as the basis for biodiversity maintenance. At the individual level, theoretical models revealed that population niche structures are dependent on the niche structure of competing species across a wide range of life history traits and environmental conditions, explaining the inconsistency of population niche structures in empirical communities (to be submitted to *Nature Ecology and Evolution)*. The results of empirical studies (arising from a research visit by, and collaboration with, Chabi Djagoun from Benin) were submitted to *Ecological Indicators* and to *African Zoology*, with Chanel Lewis (PhD student) as lead author. Another manuscript will be submitted to *Oecologia*, with Rune van der Merwe (PhD student) as lead author.

At the population level, experimental studies using cockroaches revealed inevitable exclusion under conditions of higher inter- than intraspecific competition effects, indicating that niche differences on their own are an insufficient condition for coexistence, in the absence of differences in competitive fitness. These are results of two Honours projects.

At the community level, studies of natural orthopteran assemblages revealed a definitive link between species' life histories and turnover, supporting non-neutral assembly and the role of differences in competitive ability in stabilising coexistence. Finally, an empirical approach to studying Modern Coexistence Theory in large-bodied and long-lived species was developed, using eDNA evidence for niche separation and fitness differences amongst mammalian herbivores as

a test case. The final manuscript to be submitted is in the final stages of preparation, led by Dr Falko Buschke (formerly from the UFS Centre for Environmental Management), and co-authored by Rob Pringle (Princeton University) and Jurg Spaak (Cornell University).

In all, these contributions towards understanding coexistence provide a framework for future modelling of wildlife populations living in (African) protected refuges in the context of whole communities, a critical missing ingredient in how we understand the maintenance of biodiversity so that we can better conserve whole ecosystems.

Prof Codron continued collaborative work as co-PI of the ERC-Stg PEOPLE project. About 80% of the required samples for stable isotope analysis has been collected and processed. The project studies the relationship between the distribution of surface water and movement patterns of Middle Stone Age *Homo sapiens* within the ecosystems of the central interior of South Africa. With the stable isotope data, we are hoping to correlate the degree of aquatic inputs into nutrient cycling within terrestrial systems with past patterns of human occupancy.

From a project conducted prior to PEOPLE, Nyebe Mohale (MSc) produced a dataset of intra-individual tooth profiles of large mammal herbivores from the Middle Stone Age site of Kathu Pan. This data has been analysed and a manuscript prepared for submission during the first quarter of 2024. The data reflect extensive levels of intra-individual niche variation amongst all taxa studied, to an extent that palaeo-environmental studies based on species' averages are likely to contain substantial biases. This is equivalent to neo-ecological concepts that individualised niches, rather than species averages, should take the forefront of niche theory development.

Prof Codron's collaboration with Marcus Clauss from the University of Zürich on rumen function and the evolutionary significance of ruminal differentiation, revealed minimal to zero effect of a ruminant advantage over hindgut fermentation, signifying non-competitive reasons for displacement of species diversity in the latter by the former. This continues from last year's empirical revelation of the rumen washing mechanism, that together challenges traditional textbook concepts of the "perceived" benefits of rumination.

Tick Research Unit

The unit continued with the testing of tick populations received from different farms throughout South Arica, for development of resistance to a battery of acaricides used for chemical control. The pressure of the negative economic climate in South Africa was also perceived in the number of samples received, but ongoing discussions with the two main pharmaceutical clients, Virbac and Elanco, set the table for an increase in the projected samples that will be collected in 2024.

Elizna Terblans (MSc) continued her project on host resistance to ticks and the possible factors that might contribute to a higher resistance found in younger cattle age groups. This study was conducted on the Afrikaner breed of cattle on animals at the UFS Paradys Experimental Farm, under the supervision of Dr Ellie van Dalen and co-supervision of Dr Leon Kruger (UFS Animal Science). Part of her results and collections was also used in an interdisciplinary disease monitoring group project in collaboration with Prof Felicity Burt (Virology) and Dr Christopher Rothmann (Microbial Biotechnology) from the Faculty of Health Sciences, after a successful application to the Call for Interdisciplinary Research Grants. Her dissertation was submitted, examination is done, and the degree will be awarded in 2024.

Bianca Cronje (Honours) investigated the role that small mammals play as hosts of different tick species. Her project was also conducted on the UFS Paradys Experimental Farm. Elizna Terblans accompanied Bianca Cronje and Leah Blayi (another Honours student) to a farm in the Eastern Cape to investigate the most efficient way to collect immature ticks from the field, which formed part of Leah's project. During the survey, ticks were collected to investigate the invasion of the alien species, *Rhipicephalus microplus*, and the resistance development of both *R. microplus* and *R. decoloratus* to chemical control on this specific farm. This study has been ongoing since 2012 and the final monthly collections ended in December 2023. We are looking forward to the results and analysis of what this long-term study will reveal with great expectation.

Dr Van Dalen and Elizna Terblans attended the 29th International Conference of the World Association for the Advancement of Veterinary Parasitology in Chennai, India in August 2023. Both their talks were well-received and conference networking introduced them to many new ideas and possible projects for the future.

Dr Van Dalen was also involved in preliminary discussions on a combined initiative to study different aspects of tick ecology and resistance development over four southern African countries – Botswana, Mozambique, South Africa, and Zimbabwe. A more structured planning meeting will be held early in 2024.

Qwaqwa Campus Research Groups

Afromontane Molecular Phylogenetics Group (AMPG)

In 2023, the Dr Mpho Ramoejane's research group, formerly known as the Animal Molecular Genetics group, changed its name to the Afromontane Molecular Phylogenetics Group (AMPG). This was to align itself more with the scope of the research group within the Afromontane Research Unit (ARU). The group currently has four students – Zandile Dlalisa (Honours), and MSc students Nkanyiso Sishange, Maletsatsi Mampa, and Thokozani Ngcongwane. The group participated in its first field trip to Witsieshoek during July with the objective of sampling *Rhabdomys* and *Otomys* for Nkanyiso's MSc project, and collecting any additional rodents that had not previously been collected during the Bioblitz surveys. Three *Otomys* and more than ten *Rhabdomys* genetic samples and voucher specimens were collected. Nkanyiso Sishange graduated with Honours in 2023 and started his MSc studies, and Zandile Dlalisa completed her Honours studies and will continue with her MSc with the research group in 2024.

Zandile Dlalisa (back), Maletsatsi Mampa (middle), and Nkanyiso Sishange (front) during the Bioblitz survey to Witsieshoek

Dr Ramoejane joined the Emerging Scholar Accelerator Programme (ESAP) 2023–2024. He attended the Land Dynamics Course from 5 to 16 March 2023, hosted by the UFS and Wageningen University, and visited Prof Paulette's Molecular Ecology and Evolution Program Lab for a few days in May 2023. This was to foster collaboration with her research group and with the Department of Zoology at the University of Pretoria. Dr Ramoejane and Dr Nthatisi Molefe-Nyembe attended the Next Generation Sequencing Bioinformatics workshop in July 2023 hosted by the UFS Next Generation Sequencing Unit. Dr Ramoejane also attended the 40th Congress of the ZSSA from 24 to 29 September 2023.

Behavioural Ecology Research Group (BERG)

The Mammal Cognition Research Group changed its name to the Behavioural Ecology Research Group (BERG) as the students are conducting highly diverse research not confined to mammalian cognition.

Two students started their PhD studies with the BERG team (Toka Mosikidi and Sphindile Dlamini), while Rasekuwane Mosia continued his MSc by travelling to Germany to visit his co-supervisors at the Max Planck Institute for Animal Behaviour.

Prof Aliza le Roux arranged a special symposium on Small Carnivores at the International Mammalogical Congress in Anchorage, Alaska. She also initiated a special issue of the *Journal of Mammalogy*, based on the presentations at this conference, which should appear in 2024.

In 2023, our students represented the UFS at the 40th ZSSA congress. Thembelihle Mofokeng and Sphindile Dlamini both attended an international

field school at the Kuruman River Reserve in the Kalahari, learning new techniques in field biology and behavioural ecology.

Ecotoxicology

Students and researchers in the Ecotoxicology Research Laboratory (under the guidance of Dr Patricks Voua Otomo), conduct research on a wide range of topics including water quality and remediation, plastic degradation, and behavioural ecotoxicology. This research group, which includes one Postdoctoral Fellow, four PhD and three Master's students, is a vibrant team which consistently delivers high quality research outputs. Five research papers and one book chapter were published during the year. The book chapter, the first one from the lab, delved into lingering water-related challenges encountered in the Qwaqwa region, highlighting the compounding interplay between obsolete water infrastructure, local government maladministration, and climate change. In 2023, the research group had an exciting year of activities marked by work presented at conferences locally (5th National Global Change Conference, 22nd Biennial Congress of the South African Society of Microbiology, 40th ZSSA conference, and internationally in Gabon (EM Gabon University Biodiversity Conference), Ghana (SETAC Africa 11th Biennial Conference), and Ireland (33rd Annual Meeting SETAC Europe).

Mountain Bat Laboratory

The research group organised two additional BioBlitzes at Witsieshoek in February and December, bringing to five the number of surveys of a wide range of plants and animals conducted between 2021 and 2023. The initiative has involved students and researchers from the ARU and three UFS departments (Zoology and Entomology, Geography, and Plant Sciences), and from an additional 12 institutions in South Africa, Lesotho, and Eswatini. So far, around 1 000 species of plants and animals have been documented across an elevational gradient from 1 800 to 3 100 m, including a large proportion of South Africa's alpine habitat, an imperilled biome in Africa. The results will be submitted for publication soon.

Prof Taylor and his two PhD students (Veli Mdluli and Alexandra Howard) presented at several national and international conferences, including the 5th Global Change Conference in Bloemfontein in January/February, the IUCN African Bat Red List Workshop, Swakopmund, 14 to 17 September (where they were all invited participants), and the 14th African Small Mammal Symposium, Swakopmund, Namibia, 18 to 23 September (where Taylor was an invited plenary speaker).

Representatives from the Mountain Bat Lab, Alexandra Howard (second from the left), Veli Mdluli (third from the left), and Dr Joro Rakotoarivelo (far right), in Swakopmund, Namibia, with colleagues from Eswatini for the IUCN Redlist Workshop and 14th frican Small-Mammal Symposium

Veli Mdluli and Alexandra Howard also attended a field school in Madagascar from 21 to 31 October under the leadership of Dr Joro Rakotoarivelo, a researcher on contract in the ARU (2022 to 2023)

Parasitology

The Parasitology research group has been active following the awarding of an NRF-Thuthuka grant to Dr Nthatisi Molefe-Nyembe. Moreover, the group hosted a new Postdoctoral Fellow, Dr Lehlonolo Mofokeng, from the 1 November 2023. Three members of the group (Dr Molefe-Nyembe, Dr Mofokeng, and Hlonolofatso Sefojane) attended the 40th ZSSA conference in September 2023. Two Honours students, Mary Joe and Lizzy Machuga, completed their degrees with distinction in collaboration with the Kokonyana lab, led by Dr Emile Bredenhand. A new collaboration was initiated with Dr Zamantungwa Khumalo-Mnisi (University of Venda), which entails supervising a PhD student who will be hosted by Dr Molefe-Nyembe at the Qwaqwa Campus and is being funded by Dr Khumalo-Mnisi's project grant.

Kokonyana Lab (Applied Entomology)

As reported above, the Kokonyana Lab is involved in a collaborative project with the Parasitology research group.

Vertebrate Haemoparasite Biology

The Vertebrate Haemoparasite Biology lab of Drs Johann and Michelle van As researches the blood parasite biology of mostly reptiles and mammals, with a specific focus on malaria-like parasites, their vector interactions, life cycle biology, and ecotoxicological effects on parasite burdens. We also describe new species as yet unknown to the scientific world and look at other health aspects of the vertebrate hosts involved.

The lab hosted three visiting scientists (herpetologists and parasitologists) during April 2023. They were Dr Ed Netherlands, Bernie Jordaan (both from the Bloemfontein Campus), and Dr Amanda Picelli (Villanova University / Postdoctoral Fellow, Brazil). Dr Netherlands is an expert in taxonomy, molecular genetics, and herpetology, as well as blood parasites, and Dr Picelli specialises in herpetology, taxonomy, and Neotropical ecosystems. The aim of this visit was to establish and formalise working relationships

Bernie Jordaan (PhD student) with a Dusky-bellied Water Snake (Lycodonomorphus laevissimus) collected in the eastern Free State

in the field of reptile-associated blood parasites, with the expected outcomes including additional knowledge to the baseline blood parasite diversity of southern African reptiles. Field sampling was conducted from the home base at Harrismith, with trips taken to the eastern Free State escarpment and northern Drakensberg in KwaZulu-Natal.

The private dwelling of the Van As household was used as a temporary field lab. Sampling locations were also scouted and noted for future fieldwork. Successful sampling included valuable data, as well as documenting new haemoparasites in Free State reptilian hosts.

Dr Michelle van As (who graduated in 2023 from NWU) held several online meetings to establish working research collaborations with colleagues and interested institutions, such as the Mpumalanga Parks Board, SANParks, genealogists from the UK, and with Dr Netherlands. This is an ongoing process and a proposed research project on African carnivore health will kick off as soon as funding becomes available.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

As part of a continuing commitment to the Academy for Environmental Leadership SA in Upington, Dr Candice Jansen van Rensburg and her PhD student, Anke de Smidt, presented a number of themed lectures and practicals in freshwater ecology.

During early March 2023, the Free State National Botanical Garden transformed into a spirited haven of exploration and education. Prof Linda Basson and Dr Ed Netherlands were asked to help the Botanical Garden host a fun 'Frog Night' in collaboration with the Endangered Wildlife Trust's annual awareness campaign, Leap Day for Frogs.

Prof Charles Haddad is a member of the World Spider Catalog Specialist Board and a subject editor for the taxonomic journal *Zootaxa,* editing 21 manuscripts in 2023.

Prof Aliza le Roux was an editor for *Behavioral Ecology* (IF: 3.087), an editorial board member for *Scientific Reports* (IF: 4.997), Vice-president of the ZSSA, convenor of the 40th ZSSA Congress held in 2023, and an active steering group member of the Science Advisory Group on Emergencies (housed in the Academy of Science of South Africa [ASSAf], funded by the DSI). She published two science advisories in 2023 and served on the NRF specialist rating panel for Zoological Sciences. She was part of the team that created the Women's Academic Advancement Programme at the UFS, which was approved by the Rectorate in October 2023.

As an advisory committee member of the Prince Edward Islands (PEI), Dr Nontembeko Dube reviewed Environmental Control Officers' quarterly reports and permit applications for the PEI, and attended committee meetings in March and September 2023 at the offices of the Department of Forestry, Fisheries and the Environment.

Community outreach programme

Facilitated by Prof Liesl van As, Dr Nontembeko Dube, and postgraduate students from the Department, Grade 4 learners from Fichardtpark Primary School in Bloemfontein were hosted during June 2023. They were taught about the importance of studying Zoology and Entomology, with exhibitions demonstrating organisms that the learners could relate to in their day-to-day lives. These included cochineal insects on prickly pear, and pods of the honey locust tree with holes caused by a bruchid beetle that is a natural enemy of this alien tree.

Ruan Booysen giving a presentation on the importance of Zoology and Entomology to Grade 4 learners from Fichardtpark Primary School

On 20 October 2023 Dr Dube visited the Accelerated Christian College (ACC) primary school where she gave a presentation and shared departmental pamphlets with the Grade 7 learners.

These activities are an extension of the campaign of teaching and marketing Zoology and Entomology in schools, as by the time of enrolling at university most learners do not know about these important disciplines.

NATIONAL AND INTERNATIONAL COLLABORATION

National Collaboration

Dr Candice Jansen van Rensburg started a collaboration with Prof Gerhard du Preez from NWU, as well as with Dr Ebrahim Shookhi from Limpopo University on nematode-related research.

Prof Daryl Codron collaborates with Dr Andri van Aardt (Plant Sciences, UFS) and Dr Marthie Kemp (Centre for Environmental Management, UFS).

Dr Ed Netherlands maintains ongoing collaboration with Prof Louis du Preez and the African Amphibian Conservation Research Group (NWU). Furthermore, Dr Michael Bates and Dr Cora Stobie from the Department of Animal and Plant Systematics of the National Museum, both serving as Research Fellows at UFS, have been integrated into the Herpetology course, sharing their knowledge and expertise with the students.

Dr Nontembeko Dube continues collaborating with Dr Costas Zachariades from the Agricultural Research Council – Plant Health and Protection (ARC–PHP), with Dr Thabiso Mokotjomela from SANBI, Dr Grant Martin from CBC, Rhodes University, Dr Caswell Munyai from the University of KwaZulu-Natal, and Dr Makoena Moloi from UFS Plant Sciences.

Prof Charles Haddad continued collaborative research with Prof Ansie Dippenaar-Schoeman and Prof Stefan Foord of the University of Venda as part of the South African National Survey of Arachnida. Prof Foord tragically passed away in December 2023; his knowledge and analytical skills will be sorely missed by the arachnological community. Collaboration on taxonomic research continued with Robin Lyle at the ARC–PHP in Pretoria.

Dr Ellie van Dalen continued collaboration with animal health companies, with tick collections and dip samples received from Virbac and Elanco for tick resistance testing, as well as dip strength determinations to enable the successful treatment of ticks on commercial farms.

Prof Aliza Le Roux started a multidisciplinary collaboration with Prof Martin Nyaga, from the UFS Faculty of Health Sciences, and Dr Vivienne Williams, from the University of the Witwatersrand, investigating zoonotic diseases in small carnivore body parts sold at *'muthi'* markets in South Africa. This project was funded through a UFS interdisciplinary grant.

Dr Nthatisi Molefe-Nyembe is collaborating with Dr Zamantungwa Khumalo-Mnisi from the University of Venda.

International Collaboration

Prof Daryl Codron continued his ongoing collaborations with Marcus Clauss (University of Zurich), Britt Bousman (Texas A&M), Liora Horwitz (Hebrew University of Jerusalem), Matt Sponheimer (University of Colorado at Boulder), Chabi Djagoun (University of Abomey-Calavi), and Michael Toffolo (CENIEH). New collaborations were established with Caj Nuebauer (University of Colorado at Boulder), Tina Ludeke (Mainz University), and Rani Bakkour (University of Munich) as part of a Human Frontiers Science Programme (HFSP)- funded project launched in September 2023. As part of this new partnership, Prof Codron attended the annual HFSP awardees conference in Cape Town (December 2023) and will meet the group again in July 2023 in Boulder, Colorado.

Dr Ed Netherlands continues to collaborate with Prof Ash Bullard from Auburn University, USA. Drs Netherlands and Johann van As (Qwaqwa Campus) have been involved in a grant funded by the US National Science Foundation, focusing on African Lizard malaria. This collaboration includes Dr Amanda Picelli and Prof Aaron Bauer from Villanova University, USA, and Dr Maria Pacheco and Prof Ananias Escalante from Temple University, USA.

Prof Linda Basson forms part of a project of the European Union (Research and Innovation Staff Exchange (RISE) Call: H2020- MSCA-RISE-2019), titled 'Next Generation Taxonomy: Ciliophora and their bacterial symbionts as a proof of concept (NGTax)'. The project commenced at the end of 2019 and involves secondees (PhD students from UFS) to various chosen top laboratories in several countries where ciliate research is carried out and secondment of staff to any overseas laboratory. This led to a five-week visit of Prof Basson during June and July 2023 to the Department of Biology, University of Pisa, Italy.

Dr Nontembeko Dube continued collaborations with Dr Osariyekemwen Uyi of the College of Agricultural and Environmental Sciences, University of Georgia, and Dr Frank Chidawanyika from the International Centre of Insect Physiology and Ecology (ICIPE).

Prof Charles Haddad and his students were involved with collaborative research with Dr Danilo Harms (Leibniz Institute for the Analysis of Biodiversity Change, Hamburg) on arachnid biodiversity in the Fynbos Biome, and with Polish arachnologists, Prof Wanda Wesołowska (Wrocław University), and Prof Konrad Wisniewski (Uniwersytet Pomorski w Słupsku) on the taxonomy of Mozambican jumping spiders. They also worked with Drs Martín Ramírez and Cristian Grismado (Museo de Ciencias Naturales, Buenos Aires) on the taxonomy of anyphaenid, corinnid, and trachelid spiders, and with Prof Stano Pekar (Masaryk University, Czechia) on the biology of predatory specialist spiders.

Dr Ellie van Dalen was invited to be a Research Access Champion – Project Developer & Trainer by Dr Kebaneilwe Lebani, as a South African role player in the mission of ReachSci. The mission of ReachSci, a society at the University of Cambridge, is to make research and innovation accessible to anyone anywhere. To that end, a short course and accompanying research project will be developed

to impart research skills, especially in developing countries. In preliminary discussions, team leaders from four southern African countries were invited and accepted to be involved in this project. These were Dr Kebaneilwe Lebani (Botswana International University of Science and Technology, Botswana), Dr Marvelous Sungirai (Midlands State University, Zimbabwe), Dr Ellie van Dalen (UFS), and Dr Luis Neves (University of Pretoria, but representing Mozambique). Alec Evans and Maxine Madder, associated with Clinglobal in Madagascar, will also be involved in programme planning and overseeing this project for possible implementation during 2024.

POSTGRADUATE STUDENTS

In 2023, the following postgraduate students were enrolled in the Department of Zoology and Entomology:

- Honours: 7 in Zoology on the Bloemfontein Campus, and 5 in Zoology on the Qwaqwa Campus.
- MSc: 7 in Zoology and 5 in Entomology on the Bloemfontein Campus, with a further 8 in Zoology on the Qwaqwa Campus.
- PhD: 9 in Zoology and 7 in Entomology on the Bloemfontein Campus, and 10 in Zoology on the Qwaqwa Campus.

Three students graduated with an Honours degree on the Bloemfontein Campus and one student graduated with an Honours in Zoology on the Qwaqwa Campus.

At MSc level, the following students graduated during the April and December graduations:

- Entomology: Gary Edwards.
- Zoology: Kristen Darker, Klinette Sutherland, and Tino Nemaungwe (*cum laude*) on the Bloemfontein Campus.
- On the Qwaqwa Campus, Siphindile Dlamini, Nduduzo Kubheka, Sindiswa Mzizi, and Sipho Sithole obtained their MSc degrees.

Two students graduated with PhD's from the Bloemfontein- and one from the Qwaqwa Campus.

De Jager Gerhard (Zoology)

Thesis: Taxonomic study of the family Urceolariidae (Ciliophora: Peritrichia) from marine intertidal invertebrates, with emphasis on the southern coast of South Africa

Supervisor: Prof L Basson

Mbande, Abongile (Entomology)

Thesis: Evolutionary, physiological and phenological responses of *Spodoptera frugiperda* to climate change

Supervisor: Dr F Chidawanyika

Co-supervisor: Dr R Mutamiswa

Serero Modise (Zoology)

Thesis: Ecological analysis of Afromontane grasslands in the Eastern Free State using the Biotope Quality index

Supervisor: Dr E Bredenhand

Co-supervisors: Dr M Stander and Dr A Rakotoarivelo

POSTDOCTORAL RESEARCH FELLOWS

The Department of Zoology and Entomology hosted four Postdoctoral Fellows in 2023:

- Dr Aileen van der Mescht, from South Africa, supervised by Prof Codron (ongoing Bloemfontein).
- Dr Michael Vickers, from USA, supervised by Prof Haddad (ongoing Bloemfontein).
- Dr Michel Kamden, from Cameroon, supervised by Dr Patricks Voua Otomo (ongoing Qwaqwa).
- Dr Lehlohonolo Mofokeng, supervised by Dr Nthatisi Molefe-Nyembe and Prof Peter Taylor (ongoing Qwaqwa).

STAFF MATTERS

Prof Liesl van As delivered her inaugural address during May on the topic 'Parasite conservation, should we care? YEBO'.

Prof Liesl van As delivering her inaugural address in May 2023

At the end of December 2023, Prof Linda Basson and Dr Ellie van Dalen retired from the Department. Between them, they had accumulated more than four decades of service to Zoology and Entomology and the UFS. We said farewell to both during the postgraduate seminars that were held in Qwaqwa, followed by a street brunch/lunch in Bloemfontein together with the staff from the Bloemfontein campus.

Street brunch for Prof Linda Basson and Dr Ellie van Dalen

RESEARCH OUTPUTS

Research Articles

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Conference Contributions

Conference Papers / Posters

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Nyoka, N. & Voua Otomo, P. *The State of Aquatic Pollution in Qwaqwa Region: Application of Microbiotests for Toxicity Evaluation of River Waters.* Paper delivered at the 40th Conference of the Zoological Society of Southern Africa, Champagne Sport Resort, South Africa. 25-26 September 2023.

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STAFF (2023)

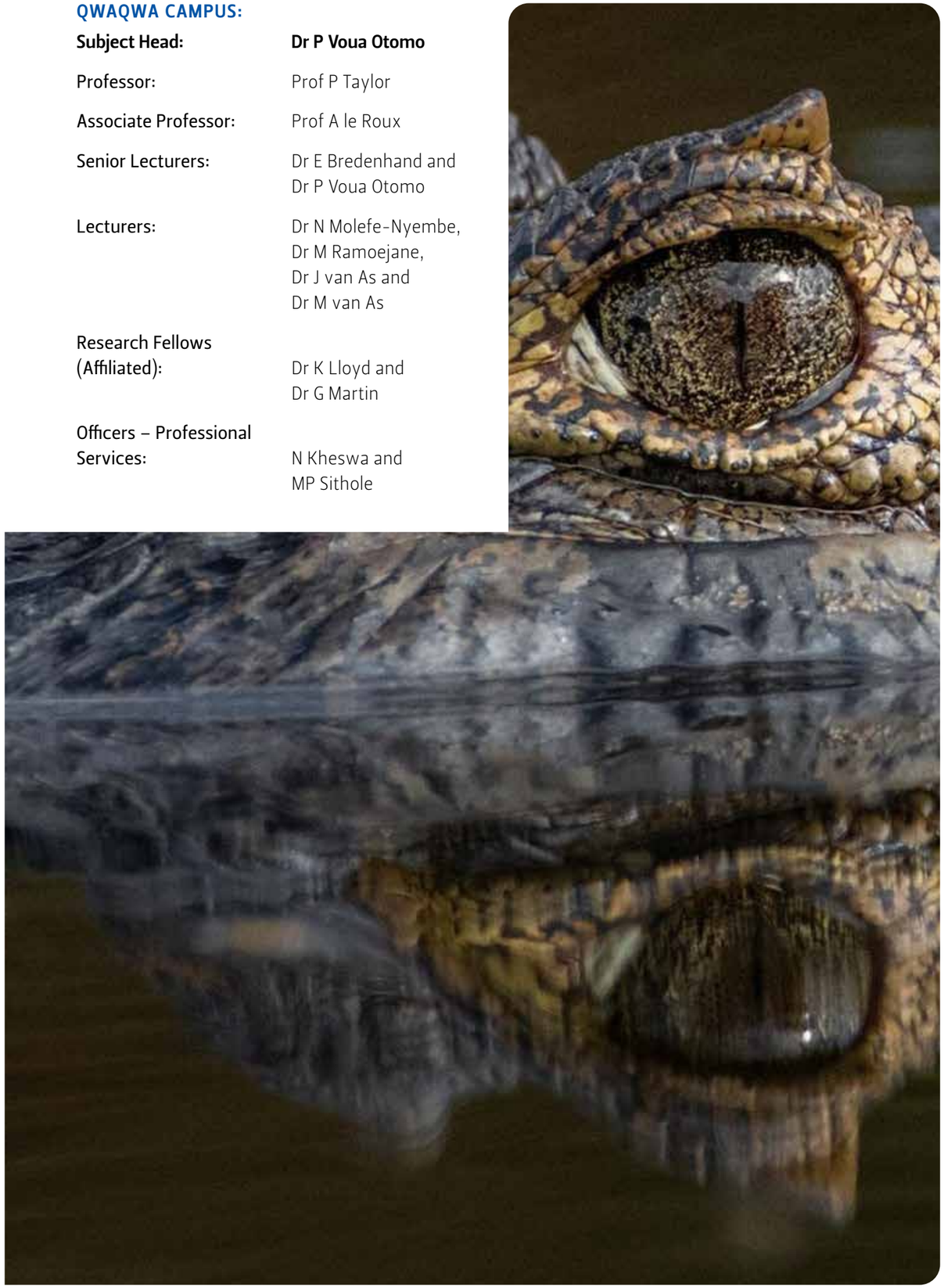
Head of Department:
Prof LL van As

BLOEMFONTEIN CAMPUS:

Professors:	Prof L Basson and Prof LL van As
Associate Professors:	Prof D Codron and Prof CR Haddad
Senior Lecturers:	Dr N Dube, Dr C Jansen van Rensburg, Dr EC Netherlands and Dr VR Swart
Lecturers:	Dr HJB Butler, Dr EMP van Dalen, L Heyns
Junior lecturers:	DV Fourie
Research Associate (Affiliated):	Dr Y Marusik
Research Fellows (Affiliated):	Dr LM Barkhuizen, Dr M Bates, Dr J Botha, Dr F Chidawanyika, Prof N Heideman, Dr EA Hugo-Coetzee, Dr C Stobie, Dr O Uyi and Dr L van der Mescht
Officers & Technicians – Professional Services:	L Bopheka, NW Mokhethi, Dr S Mahlobo-Shwabede, TW Lesaona and PK Mohasi

QWAQWA CAMPUS:

Subject Head:	**Dr P Voua Otomo**
Professor:	Prof P Taylor
Associate Professor:	Prof A le Roux
Senior Lecturers:	Dr E Bredenhand and Dr P Voua Otomo
Lecturers:	Dr N Molefe-Nyembe, Dr M Ramoejane, Dr J van As and Dr M van As
Research Fellows (Affiliated):	Dr K Lloyd and Dr G Martin
Officers – Professional Services:	N Kheswa and MP Sithole



ACADEMIC **CENTRES**

CENTRE FOR

ENVIRONMENTAL MANAGEMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The year 2023 continued to be accompanied with much success for the Centre for Environmental Management (CEM). Research outputs continued to grow steadily over the decades – the eight research reports and two accredited articles produced in 2005 increased to 128 research reports, 13 books/book chapters and 80 articles in accredited journals by the end of 2014, and to 157 research reports, 80 books/book chapters and 505 articles in accredited journals by the end of 2023, of which five books/book chapters and 38 accredited articles were produced during 2023. Even though the CEM's initial mandate was to coordinate the Master's of Environmental Management programme, it was important to develop our own research profile – not only to serve the wider community of environmental managers, but also to support and ensure quality postgraduate training. By continuing to develop our research profile alongside our postgraduate degree programmes, the CEM aims to establish itself as the thought-leader in southern African environmental and water management. This will create a hub where the best and brightest postgraduate students can come together to begin solving tomorrow's environmental problems.

The CEM is currently presenting the following programmes:

Environmental Management:

- Master of Science majoring in Environmental Management (structured and full dissertation)
- PhD in Environmental Management

Integrated Water Management:

- Postgraduate Diploma in Integrated Water Management
- Master of Science majoring in Integrated Water Management (structured and full dissertation)
- PhD in Integrated Water Management

The CEM hosted visitors from various institutes in other countries, including Dr Dirk Jungmann and Dr Hilmar Börnick from the Technical University of Dresden (TU Dresden) in Germany, delegates from Denmark collaborating on the Management of aquifer recharge in South Africa (MARSA) project, and representatives from San Diego State University (SDSU) in USA.

Dr Marinda Avenant and Dr Tascha Vos with Dr Dirk Jungmann and Dr Hilmar Börnick from TU Dresden, Germany

The CEM staff also visited various institutes in other countries for research, which included the University of Namibia, Denmark (MARSA project), SDSU in the USA, Zambia, Greece, University of Suceava in Romania and China.

Prof Shola Ololade (far left) at the Anza Borrego Desert Research Station with students from the San Diego State University

The CEM staff visited the solar farm on the UFS Bloemfontein Campus on 14 September 2023 with Nicolaas Esterhuysen, from University Estates Engineering Services, as their host and "tour guide".

CEM staff visiting the UFS Solar farm

ACHIEVEMENTS

Staff Achievements

Prof Paul Oberholster was appointed as Dean of the Faculty of Natural and Agricultural Science. He will take office on 1 January 2024. He also took

part in 'Institutionalising the Ecological Engineering Institute of Africa in the University of the Free State'.

In August 2023, Prof Shola Ololade was selected as one of the mentors for the Organisation for Women in Science in Developing Countries (OWSD) South Africa National Chapter.

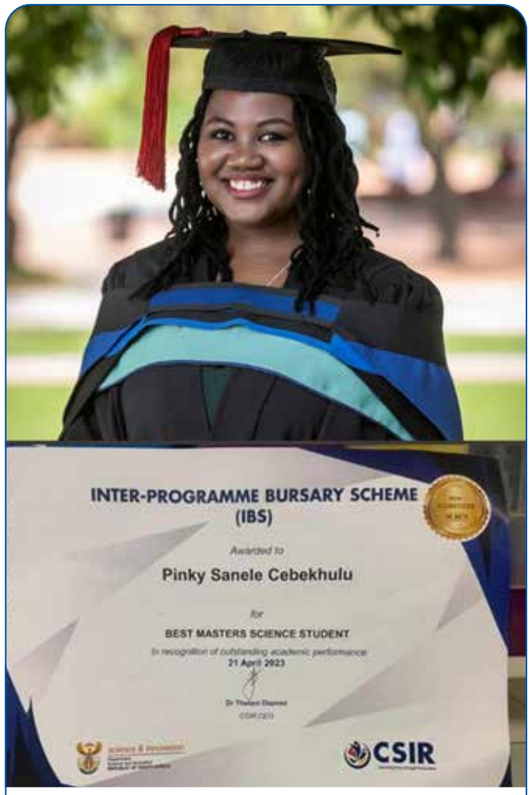
Marthie Kemp (Niemand) was elected as the Student representative for the Executive Committee for Tree-Ring Research (TRR) 2024-2026 in October 2023, at the 1st International Wood Identification Training course at the Ștefan cel Mare University of Suceava in Romania.

Student Achievements

On 21 April 2023, Sanele Cebekhulu received an award by the CSIR for Best Masters Science Student in their Inter-programme Bursary Scheme in recognition of outstanding academic performance, while Mariette Janse van Vuuren received the best student oral presentation award at the National Wetland Indaba 2023, which was held at Buffelspoort, South Africa, from 23 to 26 October 2023.

Mariette Janse van Vuuren received the best student oral presentation award at the National Wetland Indaba 2023

During the Faculty Prize-Giving ceremony (20 April 2023), the Maitland Seaman Prize for the best MSc student (2022) was awarded to Tshilidzi Mathedimosa (majoring in Integrated Water Management). Tshilidzi was also awarded the Centre for Environmental Management prize for best mini-dissertation in MSc majoring in Integrated Water Management for 2022, while Sivuyiswe Mapapu was awarded the Centre for Environmental Management prize for best mini-dissertation in MSc majoring in



Sanele Cebekhulu received an award by the CSIR for Best Masters Science Student

Tshilidzi Mathedimosa, Sivuyiswe Mapapu, and Venessa Nkosi received academic rewards from Prof Ololade at the Faculty Prize-Giving ceremony

Environmental Management for 2022. The winner of the Centre for Environmental Management Prize for the best student in the Postgraduate Diploma in Integrated Water Management (2022) was Venessa Nkosi.

RESEARCH AND INNOVATION

In a collaborative venture, Prof Paul Oberholster and Dr Yolandi Schoeman have joined forces with Goldfields Gold Mining, specifically focusing on the South Deep site, to explore and implement ecological engineering strategies. Their goal is to enhance the efficiency of the existing artificial wetland system, transforming it into a high-performing ecological unit.

Prof Oberholster and Dr Schoeman have pioneered the establishment of the Ecological Engineering Institute of Africa at the UFS, with a vision to forge a comprehensive educational and research hub. This endeavour is set to launch innovative Master's and PhD programmes and short courses in Ecological Engineering to foster academic excellence and advance the field globally. Central to their mission is cultivating robust networks and partnerships across public and private sectors, ensuring a collaborative approach to ecological solutions and the broad dissemination of knowledge and expertise.

Dr Yolandi Schoeman on a wetland near Goldfields South Deep gold mine, near Westonaria in Gauteng, with Temaswati Dlamini (the mine's Environmental Officer) who is helping with the project

Prof Oberholster and Dr Schoeman are also deeply involved in collaborative efforts with the mining sector to innovate nature-inspired solutions for addressing Acid Mine Drainage (AMD). They focus on developing passive treatment systems for AMD using constructed wetlands.

Prof Oberholster and Dr Nicolette Vermaak are involved in a research collaboration between Geological Survey of Denmark and Greenland (GEUS), the University of the Western Cape, the South African Department of Water and Sanitation, and Ramboll, Denmark, which focuses on the Langebaan road aquifer and Atlantis aquifer field sites. The MARSA project (which consists of two sub-projects) supports the overall aim of the Danish Strategic Sector Cooperation as it contributes knowledge to new solutions to mitigate water scarcity in South Africa. Prof Oberholster is the project leader for the MARSA project which was initiated in 2021. The primary aim of MARSA is to develop management aquifer recharge (MAR) technologies that allow for a broader span of water resources to be used for MAR, including storm water, river water, saline water, and even reclaimed water (treated wastewater). The research includes development of new monitoring strategies for the technologies and an assessment of the water saving achieved by implementing MAR on a larger scale in South Africa, with the focus on the West Coast District Municipality.

Prof Shola Ololade is involved in an ongoing project as a Co-Principal Investigator, with Prof Bethany O'Shea from University of San Diego and Dr Amy Quandt from SDSU, on the project titled 'The Salton Sea Crisis through the Water-Energy-Food nexus lens'. The study is based in San Diego, California.

Prof Ololade is the lead co-editor on an accepted book proposal by Taylor & Francis with other co-editors (Dr Israel Ropo Orimoloye from Western Michigan University, USA, Dr Adeyemi Oludapo

Olusola from York University, Canada, and Dr Suzanne Walther from the University of San Diego, USA) on a book titled *Sustainable Solutions: Remote Sensing and GIS Case Studies for Environmental and Disaster Management*.

Prof Ololade hosted Dr Suzanne Walther from 13 to 18 July. During this period she and her guest visited household biodigester facilities sponsored by the South African government and built by the Agricultural Research Council (ARC) in a village close to Malalane in Mpumalanga on 13 July, and the Department of Geography, Environmental Management and Energy Studies at the University of Johannesburg on 14 July, where they met with Prof Christopher Curtis and Dr Lee-Ann Modley, to discuss future research collaboration. Dr Walther also gave a guest lecture titled 'Lessons learnt from the Cape Town Water Crisis' on 17 July 2023 at the CEM. The lecture was presented both face-to-face and online.

Dr Marinda Avenant led an interdisciplinary project titled 'Threats of extreme weather events: improving the resilience of QwaQwa to the multiple risks of climate change', funded by the Water Research Commission (WRC), which came to an end in 2023. The project team included researchers from the Disaster Management Training and Education Centre for Africa (DiMTEC), the Department of Zoology and Entomology on the Qwaqwa Campus, the Cape Peninsula University of Technology (CPUT), and the TU Dresden. The project investigated the potential risks associated with extreme weather events on service delivery in Qwaqwa and sought to develop a risk reduction strategy for the area. Dr Avenant and Dr Tascha Vos joined Dr Dirk Jungmann and Dr Hilmar Börnick, from the TU Dresden, during July 2023 on a follow-up dry season sampling trip in Qwaqwa.

Dr Tascha Vos and Dr Hilmar Börnick sampling in Qwaqwa

Dr Surina Esterhuyse drafted a Memorandum of Understanding (MOU) together with the Institute for Groundwater Studies to assess environmental impacts of a proposed nuclear radiation facility upgrade at Vaalputs. This MOU aims to foster collaboration between various departments and centres at the UFS and the National Radioactive Waste Disposal Institute (NRWDI) of South Africa, to assist in upgrading the nuclear waste facilities at Vaalputs.

Dr Surina Esterhuyse researched the impacts of oil and gas drilling in Namibia and Botswana on the Okavango River basin groundwater resources and Delta with colleagues from the University of Edinburgh (Rory Sheldon), the University of Stirling (Sarah Greenwood), and the UFS Institute for Groundwater Studies (Anton Lukas). This research led to UNESCO recommending expanding the Okavango Delta protection zone to include the entire watershed, to protect the delta against upstream oil and gas drilling.

Dr Bimo Nkhata completed his role as a Co-Principal Investigator on a project funded by the WRC that investigated water use in food value chains of indigenous crops. The collaborative research project, which included researchers from Unisa and CPUT, came to an end in April 2023.

Dr Ernestine Atangana is a Principal Investigator with Prof Oberholster and Dr Nkhata on the Technology Innovation Agency (TIA) project, titled 'Developing and upscaling the use of modified biopolymer adsorbents in winery wastewater treatment'. The study is based in Stellenbosch.

Marthie Kemp, together with Prof Daryl Codron (Department of Zoology and Entomology) and Prof Louis Scott (Department of Plant Sciences), was awarded the UFS Interdisciplinary grant. The title of their study is 'A multiproxy climate reconstruction for the central interior of South Africa'.

Dr Schoeman is spearheading a groundbreaking research initiative in partnership with Madikwe Game Reserve, South African National Parks (including Kruger National Park), Phinda Private Game Reserve, and Tswalu Private Game Reserve. This project is dedicated to unravelling the intricate interplay between human and natural systems, framing it within the context of planetary health. Spanning over 20,000 km^2 across South Africa, the study aims to establish a comprehensive water-climate-food-rewilding-land nexus. This innovative framework seeks to assess the current state and limits of ecosystems when viewed as interconnected human-natural systems.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

Prof Shola Ololade participated as a WRC Water Reference Group Panel Member in 2023 and was invited as a panel member for the Virtual Peer Review for the SA/France PROTEA Freestanding, Innovation and Scare Skills (FISS)-Postdocs and Sustainable Development Goals (SDG) call in November 2023. She is also the lead Topic Editor for 'Operationalizing the Water-Energy-Food Nexus as an Adaptation and Mitigation Strategy for Climate Change and Resource Management' for *Frontiers in Sustainable Resource Management* – section Natural Resources.

Prof Ololade was appointed as a volunteer judge for different categories of students' poster presentations in her research area at the Sigma Xi IFoRE, held from 9 to 12 November 2023,in Long Beach, California, USA.

Dr Marinda Avenant participated and presented at the closing workshop for the Southern African Regional Universities Association (SARUA) Climate Change Programme, under the GCCA+ Climate Change and Sustainable Development Project, on 25 May 2023. The final curriculum that was developed as part of this project was presented to the Southern African Development Community (SADC) in 2023. Dr Avenant served as curriculum advisor for the project and was also the lead developer for two modules, focusing on 'Biosphere stewardship' and 'Science and climate change communication'. She will provide support on the implementation of the curriculum over the next year. She also represented the CEM on various Department of Water and Sanitation forums and committees.

Dr Surina Esterhuyse provided a geohydrology advisory and review of the environmental authorisation (EA) and related environmental impact assessment (EIA) on which the EA was granted to Rhino Oil for drilling for gas in the Free State. The advisory considered where impacts in the EIA were not adequately assessed and where mitigation measures should be improved to adequately protect the environment, specifically the water environment, and the public during oil and gas drilling. This advisory was provided to Groundwork (a non-profit environmental justice service and developmental organisation working primarily in southern Africa in the areas of climate and energy justice) and Natural Justice (an international group of lawyers and legal experts, specialising in human rights and environmental law in pursuit of social and environmental justice), to aid in the appeal that they lodged against the EA.

Dr Esterhuyse reviewed the book *Groundwater Contamination and Geoenvironmental Impacts of Upstream Oil and Gas Production* by RE Jackson, RW Walsh, M Kang, and MB Dussealt for the Groundwater

Dr Surina Esterhuyse and Dr Nicolette Vermaak at the 50th International Association of Hydrogeologists (IAH) congress in Cape Town during 2023

Project, based in Guelph, Ontario, Canada. The review assessed the technical content of the book and considered whether additional subject matter should be included in the book. Dr Esterhuyse served on the editorial board of *Water International*.

Dr Esterhuyse also published an analysis in *The Conversation Africa*, titled 'Oil drilling threatens the Okavango River Basin, putting water in Namibia and Botswana at risk'. This analysis article highlights the risks of oil drilling to the groundwater of the oil and gas target region, as well as its episodic rivers and the Okavango Delta, and makes recommendations to protect these water resources. This article has been analysed internationally in the 'Sunday Standard' under the article 'Halt oil drilling – new study warns Botswana and Namibia' and was republished in the 'Namibian'. The article also featured in the National Geographic article 'Can UNESCO safeguard this lush African watershed from oil drilling?' which directly led to UNESCO recommending enlarging the Okavango Delta World Heritage site to include the entire watershed, and encouraging Botswana, Angola and Namibia to continue their cooperation for the potential transboundary extension of the property. During UNESCO's annual meeting in Riyadh in September 2023, the committee members, representing 195 countries, expressed its "utmost" concern for the potential risk of oil and gas exploration to this protected wetland.

Dr Bimo Nkhata was nominated by UFS in November 2023 to be a member of the Council for Higher Education (CHE) Working Group that will be drafting the Environmental Assessment Practice Qualification Standard for the higher education sector. The Working Group is composed of academic experts and people with experience in quality assurance in the field. The Working Group will be central to the development of the standard through the determination of the scope of work and the approach.

Dr Nkhata was also assigned by UFS management to participate in the Presidential District Development Model (DDM) Imbizo in the Free State in December 2023. The Imbizo was used by the President of the Republic of South Africa, Cyril Ramaphosa, to monitor and accelerate the implementation of the DDM to enhance service delivery. It was also aimed at assisting the youth in making sound career choices by sharing information on academic pathways in the Post-School Education and Training (PSET) sector and raising awareness of available funding opportunities.

Dr Nkhata led a team of experts that supported the University of Namibia in further developing a new campus in Katima Mulilo. The support involved the enlargement of the Department of Wildlife Management and Tourism Studies at the Katima Mulilo campus. Dr Nkhata facilitated a workshop to support the Department and its lecturers in building capacity for developing new courses and implementing a new curriculum. The workshop was held under the auspices of the German Kreditanstalt für Wiederaufbau (KfW) in Katima Mulilo from 17 to 24 July 2023.

Dr Nkhata was invited to join the editorial board of *Frontiers in Sustainable Resource Management* as a review editor. This invitation represents a great opportunity for Dr Nkhata to contribute to the strategic direction and growth of this new journal in the *Frontiers* community. He will be joining and collaborating with an expert research community in the field of natural resources. Dr Nkhata participated in the annual meeting of the editorial board of the *International Journal of the Commons*. He also acted as a Guest Editor of a special issue for *Ecology and Society*.

Marthie Kemp was interviewed on *CapeTalk* about dendrochronology on 10 July 2023, and featured in an article 'Eight things we do make to make tomorrow better' in the *Bult* 2023.

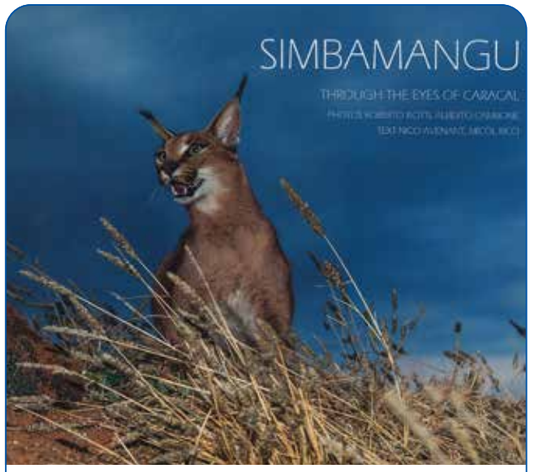
Since April 2017, Dr Tascha Vos has acted as the Vice-Chair of the Modder-Riet Catchment Management Forum, coordinated by the Free State Department of Water and Sanitation (DWS). She also represents the CEM on various DWS forums and committees.

Dr Yolandi Schoeman is teaming up with Dr Danie Jordaan at the UFS to create a planetary health framework. This initiative is tailored for a leading South African banking group, specifically designed to enhance their agricultural sector's investment and risk management strategies.

Dr Schoeman contributes her expertise to the IUCN Species Survival Commission's Human-Wildlife Conflict & Coexistence Specialist Group, addressing critical conservation challenges.

Dr Nico Avenant (Research Fellow) serves on the Editorial Board of *Integrative Zoology* (the journal of the International Society of Zoological Sciences). He acted as Chair for one of the Symposium sessions and served on the Scientific Advisory Committee for the 14th African Small Mammal Symposium (17 to 22 September 2023, in Swakopmund, Namibia). He served on the Executive Committee of the International Conference on Rodent Biology and Management and on the International Union for Conservation of Nature (IUCN) Species Survival Commission Cat Specialist Group, as well as the Technical Committee of the Department of Forestry, Fisheries and the Environment (DFFE) South African National Antarctic Programme (SANAP), for the review of the proposed Marion Island mouse eradication programme.

Dr Nico Avenant also gave several public lectures and seminars, such as 'Caracal and Black-backed jackal: their ecology and relationships with man' (a public lecture for the SPCA Central SA Branch, 4 February 2023); 'Small mammals as an indicator of habitat change in the Kalahari' (public lecture at Tswalu lecture / training venue, 19 May and 18 August 2023); '*SIMBAMANGU - through the eyes of caracal*' (lecture of book launched, 16 November 2023); 'Caracal and Black-backed Jackal: their role and status in the agro-ecosystem' (lecture at the University of the Third Age (U3A), 9 November 2023); 'Managing small stock predation in South Africa – progress since our 2010 visit' (a seminar to Wildlife Services [WS] scientists situated at the National Wildlife Research Centre, as well as online to WS scientists and managers over all states in the USA). He was mentioned twice in the 'Volksblad'– on 10 November 2023 ('Boek met pragfotos oor rooikat by Oliewenhuis bekend gestel') and on 17 November 2023 ('Ekoloog wil brug tussen die boere en rooikatte bou').



Simbamangu: Through the eyes of caracal

Dr Nacelle Collins (Research Fellow) received his second Doctoral degree from the UFS during the April 2023 graduations, and was mentioned in a featured article in *The Water Wheel*, July/August 2023, about his work on Wetlands (Bonthuys, J. 2023. UFS graduate's PhD findings adopted as national standard for wetland mapping. *The Water Wheel* 22(4): 24-27).

After many years' affiliation to the Centre (as Director and later Research Fellow), Prof Maitland Seaman ended his Research Fellowship with the CEM in 2023.

Dr Daan Toerien is still an Honorary Member of the Stilbaai Chamber of Commerce, for services rendered to them, since May 2020.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Paul Oberholster and Dr Yolandi Schoeman are actively engaged with the International Ecological Engineering Society to enhance and spread the discipline of ecological engineering worldwide. Together, Prof Oberholster and Dr Schoeman have been integral to the DWS efforts, serving on the Steering Committee tasked with formulating Rehabilitation Guidelines and advancing projects focused on Cleaner Technology Options for Water Quality in South Africa. Their specialised knowledge in constructed wetland technologies has been invaluable in advising DWS.

In a notable collaboration, Prof Oberholster and Dr Schoeman joined forces with Prof Emma Archer from the University of Pretoria to conduct an independent

evaluation of Operation Vulindlela's effects on South Africa, a study commissioned by the Rand Merchant Bank.

Furthermore, Prof Oberholster and Dr Schoeman have partnered with the City of Tshwane to develop a pioneering urban biosphere reserve model. This innovative concept, designed to counteract the impacts of climate change, was showcased at the inaugural City of Tshwane Climate Change and Research Conference held on 9 March 2023 at Tshwane House in Pretoria.

Prof Oberholster and Dr Nicolette Vermaak collaborated on the MARSA project (September 2021 to August 2024) – funded by the Danish International Development Agency (Danida) – with GEUS (Geological Survey of Denmark and Greenland), Ramboll (a Danish consulting company), UFS, DWS, and UWC. Study sites are at Atlantis and Langebaan Road, near Saldanha.

Dr Nicolette Vermaak (2nd from left) and Prof Paul Oberholster (right) with the MARSA delegates from Denmark

At a national level, Prof Shola Ololade collaborated with Dr Julio Castillo Hernandez (UFS Department of Microbiology and Biochemistry), Dr Maleke Maleke (Central University of Technology), Dr Issac Rampedi (University of Johannesburg), and Dr Funzani Asnath Melato (Tshwane University of Technology) on different projects involving postgraduate students. Internationally, she worked with Dr Bethany O'Shea and Dr Suzzanne Walther from the Department of Ocean and Environmental Resources, University of San Diego, California, Dr Amy Quandt from the Department of Geography, SDSU, and Dr Mihaela Sima, Romanian Academy.

Visitors from the San Diego State University (USA) with staff members of the CEM

Dr Marinda Avenant collaborates with Prof Johannes Belle (DiMTEC), Prof Patricks Voua Otomo (Zoology and Entomology, Qwaqwa Campus), Prof Beatrice Opeolu (Faculty of Applied Sciences, CPUT), and Prof René Pellissier (SARUA) in South Africa, and internationally with Dr Dirk Jungmann (Institute of Hydrobiology, TU Dresden), Dr Hilmar Boernick (Institute of Water Chemistry, TU Dresden), and Dr Noma Chico (BA ISAGO University, Botswana).

Dr Marinda Avenant and Dr Bimo Nkhata worked together with academics from various universities in developing a proposal for the EU ERAMUS+ Initiative. The proposal focused on the theme of 'Science Education' and involved the UFS, TU Dresden, University of Zambia, Copperbelt University, University of Venda, and The Hague University of Applied Sciences. Dr Nkhata was invited to Lusaka to discuss further the involvement of the University of Zambia in the ERAMUS+ proposed project. The invitation was also used to explore opportunities for research collaboration between the UFS and the University of Zambia.

Dr Surina Esterhuyse's local collaboration included developing an MOU together with Fanie de Lange from the Institute for Groundwater Studies and other departments of the UFS for the Nuclear Radiation facility upgrade (Vaalputs). Dr Esterhuyse also collaborated locally with the DWS, and the Environmental Isotopes Laboratory at iThemba LABS, on a book chapter ('Managed aquifer recharge projects in the Western Karoo, South Africa: Progress and challenges') that was published in *Managed Groundwater Recharge and Rainwater Harvesting - Outlook from Developing Countries,* edited by Dipankar Saha, Karen G. Villholth and Mohamed Shamrukh for Springer publishers.

Dr Esterhuyse's international collaboration included reviewing the book *Groundwater Contamination and Geoenvironmental Impacts of Upstream Oil and Gas Production* for the Groundwater Project, which is based in Guelph, Ontario, Canada, for Prof John Cherry, an Adjunct Professor at the University of Guelph and Professor Emeritus at the University of Waterloo Canada. The Groundwater Project is a volunteer-based, charitable nonprofit organisation registered in Canada and global in scope. It is committed to the advancement of groundwater understanding and awareness by creating and making high-quality groundwater learning materials available in many languages.

Dr Esterhuyse also collaborated with researchers from the University of Edinburgh (Rory Sheldon), Sarah Greenwood from University of Sterling and Anton Lukas (Institute for Groundwater Studies) on assessing possible risks from potential groundwater contamination from oil drilling in the Okavango.

Dr Nkhata participated in the annual management committee meeting of the INSAKA University Consortium that was held in May 2023. The Consortium is currently made up of Clemson University, Copperbelt University, University of Montana, University of Namibia, and the Independent Institute of Education. The meeting discussed, among other things, the formal inclusion of the UFS into the MoU of the Consortium.

Dr Bimo Nkhata in the Kruger National Park

Dr Nkhata was also invited to meetings with Prof Wayne Freimund, from Utah State University, in Kruger National Park from 31 May to 3 June 2023. The meetings were intended to explore new opportunities for research collaboration between Utah State University and academics in South Africa.

Dr Ernestine Atangana collaborated with Dr Marieka Gryzenhout (Department of Genetics) and Hendrik Swart (Department of Physics).

During her participation at the 1st International Wood Identification Training Course at the Faculty of Forestry at the Stefan cel Mare University of Suceava in Romania, Marthie Kemp established a working relationship with some the world's leading experts in Wood Stem Anatomy.

Marthie Kemp at the 1st International Wood Identification Training Course at the Faculty of Forestry, Stefan cel Mare University of Suceava, Romania

POSTGRADUATE STUDENTS

During 2023, a total of 24 students were registered for the Postgraduate Diploma in Integrated Water Management. Seven candidates were registered for the PhD in Environmental Management and four for the PhD in Integrated Water Management.

Twenty (20) students were registered (1st time registration) for the two structured MSc degrees – seven for the MSc majoring in Environmental Management and 13 for the MSc majoring in Integrated Water Management. A further 27 students were registered to continue their structured MSc degrees – 12 for the MSc majoring in Environmental Management and 15 for the MSc majoring in Integrated Water Management. Another six students were registered for the full MSc – two majoring in Environmental Management and four majoring in Integrated Water Management.

During the April and December graduation ceremonies, 17 students received their Postgraduate Diploma in Integrated Water Management. In the structured Master's, three students graduated with the MSc majoring in Environmental Management, while five students graduated with the MSc majoring in Integrated Water Management, two with distinction (NG Masimini and TS Mathedimosa). One student (SS Mnyango) graduated from the research MSc majoring in Integrated Water Management.

POSTDOCTORAL RESEARCH FELLOWS

The CEM hosted three Postdoctoral Research Fellows during 2023 – Dr Gladys Belle (from Cameroon), Dr Yolande Schoeman (from South Africa), and Dr Nicolette Vermaak (from South Africa).

Dr Gladys Belle received two prestigious research grants. In the WRC grant, she leads a team of six national and international experts in risk assessment of emerging contaminants in water resources. The project focuses on the Aquatic Ecosystem and Human Health Risk Assessment of COVID-19 Drugs within the Orange-Senqu Transboundary Water Basin. Dr Belle also received the Innovation Postdoctoral Fellowship award for 2023 from the National Research Foundation (NRF). This project investigates sources, pathways, occurrences, and potential risks of pharmaceuticals of emerging concern on potential receptors in water resources. The study targets the different wastewater treatment plants (WWTP) in Mangaung, as these plants pose a possible risk of introducing pharmaceuticals into water systems.

Dr Belle collaborated internationally with Prof Moodley Roshila from the University of Manchester, and nationally with three researchers from the Chemistry and Physics Department at the University of KwaZulu Natal (Prof Moodley Brenda, Prof Olatunji Olatunde, and Dr Omotola Elizabeth), as well as Dr Christoff Truter from Stellenbosch University.

Dr Yolandi Schoeman was runner-up in the 2023 Jennifer Ward Oppenheimer Research Grant for the project 'BioCredits: Regenerating Africa's Landscape bio-intelligently'. She participated as a UFS team member in the SDG Challenge South Africa, a global competition that unites students and organisations to address the United Nations (UN) SDGs. The UFS team also claimed victory in the event with their contribution on *'Institutionalising the Ecological Engineering Institute of Africa in the University of the Free State'*. Dr Schoeman was also invited to represent South Africa at the 2023 World Women Scientists Conference in China as part of the South African Council for Natural Scientific Professionals (SACNASP) delegation, during October 2023.

Dr Yolandi Schoeman represented South Africa at the 2023 World Women Scientists Conference in China

Dr Schoeman was invited to participate in the launch of the Alliance of World Women Scientists. Yolandi was selected to take part in the Jamii Femmes Program 2023, 'African Women Entrepreneurs for Sustainable Impact' (supported by the Coca Cola Foundation) and was invited to form part of the IUCN Species Survival Commission Human-Wildlife Conflict & Coexistence Global Specialist Group on human-wildlife conflict indicator framework development. She was also invited by the DWS to form part of the Steering Committee to develop Rehabilitation Guidelines for South Africa and to form part of the Steering Committee on Cleaner Technology Options for Water Quality in South Africa, as well as to act as specialist advisor on developing constructed wetland technologies' guidelines for the DWS.

She featured in UFS News items and in the *Bult* magazine and was interviewed by 'RSG Landbou Radio' on ecological engineering applications and solutions in the agricultural sector, 7 April 2023.

Dr Nicolette Vermaak) was voted onto the EXCO of the Groundwater Division of the Geological Society of South Africa (GSSA), and as the secretary for the International Association of Hydrogeologists-South Africa (IAH-SA).

STAFF MATTERS

Prof Paul Oberholster, Director of the Centre for Evironmental Management 2019-2023

Prof Oberholster, Director of the CEM from 2019 to 2023, was appointed as Dean of the UFS Faculty of Natural and Agricultural Science. The appointment commences on 1 January 2024.

Prof MH Solomon was appointed as an Adjunct Professor from June 2023, and Dr NA Rivers-Moore was appointed as a Research Fellow from August 2023.

After many years' affiliation to the Centre, Prof Maitland Seaman ended his Research Fellowship with the Centre for Environmental Management.

RESEARCH OUTPUTS

Research Articles

Adetunji, A.I., Oberholster, P.J. & Erasmus, M. 2023. Bioleaching of metals from e-waste using microorganisms: A Review. *Minerals* 13(6): 1-25 (Article #828). doi.org/10.3390/min13060828.

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Esterhuyse, S. 2023. A historical timeline of unconventional oil and gas extraction and fracking studies in South Africa: pointers for policy development. *Alternation* 30(1): 13-34. doi.org/10.29086/2519-5476/2023/v30n1a2.

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Le Roux, J.P., Beckedahl, H.R., Grundling, A.T. & Sumner, P. 2023. Determining the distribution of wetlands across Eswatini. *South African Geographical Journal* 105(1): 75-98. doi.org/10.1080/03736245.2021.2021975.

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Walker, S., Grundling, A. & Kau, J. 2023. Importance of an Agro-ecological Management Framework for South Africa. In: *Climate-smart Agriculture: Evidence-based Case Studies in South Africa*. L. Myeni, M. Moeletsi & T Fyfield (Eds). Agricultural Research Council, South Africa. pp. 309-313.

Conference Contributions

Conference Papers

Addo, S.E., Marais, L. & Ololade O.O. 2023. *Performance of Ghana's mining sector environmental regulatory institutions and agencies and factors affecting their performance.* Paper deliverd at the International Conference on Science, Technology, and Health Innovation for Sustainable Development" (STHISD), Sunyani, Ghana. 23-25 August 2023.

Avenant, M.F., Chicho, N. & Pellissier, R. 2023. *Reviewing a Master's curriculum in Climate Change & Sustainable Development: Data collection and analyses.* Paper delivered at the 5th National Global Change Conference, Bloemfontein, South Africa. 30 January-02 February 2023.

Avenant N.L., Nortier N. & Butler, H.J. 2023. *Sampling murid community structure and composition in the central South African grasslands: removal versus non-removal trapping* (NMB Project 561). Paper delivered at the 14th African Small Mammal Symposium (ASMS), Swakopmund, Namibia. 17-22 September 2023.

Benda, P., Uvizl M., Avenant N., Eiseb S.J. & Červený J. 2023. *On the systematic position of horseshoe bats (Chiroptera: Rhinolophidae) from Lesotho* (NMB project 456). Paper delivered at the 14th African Small Mammal Symposium (ASMS), Swakopmund, Namibia. 17-22 September 2023.

Cebekhulu, S., Gomez-Arias, A., Matu, A., Alom, J., Valverde, A., Ololade, O. & Castillo, J. 2023. *Indigenous microorganisms and the bioavailability of organic matter drive the mobilization of potentially toxic elements and rare-earth elements in alkaline mine wastes.* Paper delivered at the Goldschmidt 2023 Conference (Geochemical Society), Lyon, France. 09-14 July 2023.

Chicho, N., Pellissier, R. & Avenant, M.F. 2023. *Programme Implementation: Master's Degree in Climate Change and Sustainable Development.* Paper delivered at the 5th National Global Change Conference, Bloemfontein, South Africa. 30 January-02 February 2023.

De Causmaecker, L.M.S., Mentens, A., Vanschoenwinkel, B., Moorgat, R. & Jacobs, V.A. 2023. *Towards public LED lighting with minimal impact on insect movement.* Paper delivered at the 30th Quadrennial Session of the CIE & conference CIE 2023, Ljubljana, Slovenia. 18-20 September 2023.

Gangathele, A., Grundling, P-L., Grundling, A.T. & Le Roux, J.J. 2023. *Effects of head cut and gully erosion on the hydraulic properties of peat on a high-altitude mire.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Girgan, C., Marais, M., Le Roux, J. & Grundling, A. 2023. *Nematode diversity in selected peatlands in the North West Province, South Africa.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Grundling, P-L. 2023. *In the face of a total sewage onslaught: is there still a role to play for natural wetlands in contaminated watercourses?* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Henschel, J.R., Duncan, F.D., Du Toit, J.C.O., Milton, S.J. & Van der Merwe, H. 2023. *The brown locust in relation to Karoo ecosystem characteristics and processes - knowns, unknowns and relevance to rangeland management.* Paper delivered at 23rd Congress of the Entomological Society of Southern Africa (ESSA), Stellenbosch, South Africa. 11-14 July 2023.

Hohne, D. & Esterhuyse, S. 2023. *A conceptual model for methane occurrences in the Western Karoo as part of a geochemical baseline for shale gas development.* Paper delivered at the 50th International Association of Hydrogeologists (IAH) congress, Cape Town, South Africa. 18-22 September 2023.

Hohne, D.; Vermaak, N., Fourie, S. & Esterhuyse, S. 2023 *Mitigating climate change with managed aquifer recharge: 5 Case Studies.* Paper delivered at the 50th International Association of Hydrogeologists (IAH) congress, Cape Town, South Africa. 18-22 September 2023.

Jansen van Vuuren, M., Oberholster, P.J., Botha, A.M. & Schoeman, Y. 2023. *Determining the source, pathways and receptors of metals and sulphate in the bottom sediment of an ecologically engineered wetland, that receives acid mine drainage.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Jungmann, D., Börnick, H., Graumnitz, S., Nyoka, N., Opeolu, B., Voua Otomo, P. & Avenant, M. 2023. *Comprehensive Monitoring of Surface Water in the QwaQwa Area (South Africa) Combining Chemical and Biological In-Vitro Tests.* Paper delivered at SETAC Europe 33rd Annual Meeting Virtual & Dublin, Ireland. 30 April–4 May 2023.

Keilani H., Avenant N.L., Caminade P., Nokha R., Pillay N. & Ganem G. 2023. *Understanding the drivers of adaptation to increasing aridity* (NMB project 560). Paper delivered at the 14th African Small Mammal Symposium (ASMS). 17-22 September 2023. Swakopmund, Namibia.

Khosa, D., Grundling, P.L. & Brown, L.R. 2023. *The geomorphic characterisation of wetlands on various landscapes in Marakele National Park, Limpopo Province, South Africa.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Le Roux, J. & Grundling, P-L. 2023. *A hydrological investigation into a historic peat fire on the Maputaland Coastal Plain*. Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Malise, T., Grundling, A. & Brown, L. 2023. *Vegetation classification of the hydrogeomorphic wetland types in the Kgaswane Mountain Reserve.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Moloi, M.S., Lehutso, R.F., Motaung, L.T., Kühnel, D., Erasmus, M., Oberholster, P.J. & Thwala, M. 2023. *Aquatic risk assessment of product-released engineered nanomaterials (PR-ENMs) from personal care products.* Paper delivered at SETAC Europe 33rd Annual Meeting, Virtual & Dublin, Ireland. 30 April–04 May 2023.

Moloi, M.S., Raisibe, L.F., Erasmus, M., Oberholster, P.J. & Thwala, M. 2023. *Environmental exposure assessment of product-released engineered nanomaterials (PR-ENMs) from commercial products.* Paper delivered at the 3rd UNESCO-IWRA Online Conference Series, Virtual, USA. 17-19 January 2023.

Ndlela, T. Beckendahl, H. & Grundling P-L. 2023. *Comparing differences in the ecohydrology, physical and chemical characteristics of two differently managed peatlands in Eswatin.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Nkhase, T., Clulow, A., Moeletsi, M. & Grundling, A. 2023. *Seasonal variation of carbon dioxide net ecosystem exchange on Waterkloofspruit Peatland, Kgaswane Mountain Reserve.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Ololade O., Kabini D.T. & Seopela M. 2023. *Evaluation of treatment technologies used in the removal of estrogens from wastewater treatment plants.* Paper delivered at the World Recycling Convection, Madrid, Spain. 23-25 October 2023.

Oberholster, P.J. 2023. *(Invited guest speaker). Global change and the water-energy-food nexus.* Paper delivered at the 5th National Global Change Conference, Bloemfontein, South Africa. 01 February 2023.

Oberholster, P.J. 2023. (Invited guest speaker). *Water, energy food Nexus in relationship with climate change and water reuse in the upper Olifants River catchment.* Paper delivered at the Annual Conference, South African Colliery Environmental Safety and Health Association (SACESHA), Secunda, South Africa. 25 February 2023.

Oberholster, P.J. 2023. (Keynote speaker). *Climate change adaptation through natural base solutions to improve the reuse of wastewater: An African case study*. Paper delivered at the 2nd World Conference on Environmental and Earth Sciences (WCEES-Paris-2023), Paris, France. 15-16 May 2023.

Oberholster, P.J. 2023. (Invited guest speaker). *South African Colliery Management Association (SACMA).Pathways and receptors of metals and sulphate in the Zaalklapspruit wetland.* Paper delivered at the Northern Coaltech meeting, New Largo-Seriti, Emalahleni, South Africa. 06 June 2023.

Oberholster, P.J. & Schoeman, Y. 2023. *Assessing an ecological engineered wetland receiving AMD over a period of nine years using water quality and periphyton.* Paper delivered at the Closed Cycles and the Circular Society 2023 (CC23) and the International Conference of the International Ecological Engineering Society (IEES) 2023 conference, Chania, Greece. 01-05 October 2023.

Oberholster, P.J., Schoeman, Y. & Jansen van Vuuren, M. 2023. *The pathways and receptors of metals and sulphate in an ecologically engineered wetland that receives acid mine drainage.* Paper delivered at the Northern Coaltech meeting, New Largo-Seriti, Emalahleni, South Africa. 06 June 2023.

Ramugondo, P.R., Grundling, P-L., Van Rooyen, L., Visagie, S. & Grundling, A. 2023. *Community conservation initiatives for the wise use of wetlands.* Paper delivered at the National Wetland Indaba 2023. 23-26 October 2023. Buffelspoort, South Africa.

Roberts, C.S., McClain, E.L., Seely, M.K., Mitchell, D. & Henschel, J.R. 2023. *Beetles cooling by running in a hot desert.* Paper delivered at the Arid Zone Ecology Forum (AZEF) Hybrid Conference, Graaff-Reinet, South Africa. 17-19 October 2023.

Schoeman, Y. 2023. *Women leadership: At the centre of groundbreaking innovations in specialized industries- Towards a sustainable future.* Paper delivered at the Annual International Women's Day Conference, Durban, South Africa. 03 August 2023.

Schoeman, Y. & Oberholster, P.J. 2023. *A proposed urban biosphere reserve model concept for the City of Tshwane as a bio-intelligent approach to mitigate climate change.* Paper delivered at the Inaugural City of Tshwane Climate Change and Research Conference, Pretoria, South Africa. 09-10 March 2023.

Schoeman, Y. & Oberholster, P.J. 2023. *The Ecological Engineering Nexus Accounting Framework: a tool for impact valuation of ecological engineering projects.* Paper delivered at the Closed Cycles and the Circular Society 2023 (CC23) and the International Conference of the International Ecological Engineering Society (IEES) 2023 conference, Chania, Greece. 01-05 October 2023.

Schoeman, Y. & Oberholster, P.J. 2023. *From Learning to Leading: The Nexus of Education, Practice, and Climate-Resilient Water Strategies.* Paper delivered at the IIEMSA Water Symposium 2023: Bridging the Gap - Water Security, Climate Change and Resilience in the 21st Century, Roodepoort, South Africa. 9-10 November 2023.

Schoeman, Y., Oberholster, P.J. & Erasmus, M. 2023. *The Ecological Engineering Nexus Accounting Framework: advancing impact valuation for sustainable conservation practices in a South African Provincial Park*. Paper delivered at the 12th Oppenheimer Research Conference, Midrand, South Africa. 04-06 October 2023.

Schoeman, Y., Oberholster, P.J. & Erasmus, M. 2023. *Towards sustainable water management: a novel classification system for ecological engineering solutions as new-order Anthromes in human-modified landscapes.* Paper delivered at the 24th WaterNet/WARFSA/GWP-SA symposia, Zanzibar, Tanzania. 25-27 October 2023.

Schoeman, Y., Van der Merwe, P., Van der Walt, K., Huyser, M. & Oberholster, P.J. 2023. *Charting a New Course: Advancing Sustainable Management through the Managerial-Ecology Model in Luxury Game Lodges.* Paper delivered at the International Conference: From Recovery to Resilience in Tourism (ICFRRT) – Sustainable Pathways for Transforming Tourism, Johannesburg, South Africa. 11-12 September 2023.

Sekaleli, T. & Grundling, P-L. 2023. *A review of the mire types of Lesotho for current and future contribution to management.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Van der Waals, J., Paterson, D.G., Grundling, A., Turner, D.P., Van Huyssteen, C.W. & Rossouw, P.S. 2023. *Critical review of the soil wetness and soil form criteria for wetland delineation.* Paper delivered at the National Wetland Indaba 2023, Buffelspoort, South Africa. 23-26 October 2023.

Vermaak, N., Fourie, S., Esterhuyse, S. & Hohne, D. 2023. *Recharge under review: implications for Water Resources Management.* Paper delivered at the 50th International Association of Hydrogeologists (IAH) Congress, Cape Town, South Africa. 18-22 September 2023.

Vermaak, N., Oberholster, P., Mathivha, T., Mapapu, S., Magingi, A. & Fourie, S. 2023. *Groundwater Dependent Ecosystems or Wetland Dependent Groundwater Systems – a case study.* Paper delivered at the 50th International Association of Hydrogeologists (IAH) Congress, Cape Town, South Africa. 18-22 September 2023.

Conference Posters

Avenant, N. & MacFadyen, D. 2023. *Small mammals as an indicator of habitat change in the Kalahari, South Africa.* Poster presented at the 13th International Mammalogical Congress, Anchorage, Alaska, USA. 14-20 July 2023.

Bollmann, U., Bech, T., Vermaak, N., Magingi, A., Clarke, S., Smith, A., Gambino, M., & Aamand, J. 2023. *Hydrochar or biochar amendments to increase the retention of organic micropolutants and pathogens in managed aquifer recharge systems (MAR).* Poster presented at the 50th International Association of Hydrogeologists (IAH) Congress, Cape Town, South Africa. 18-22 September 2023.

Ololade O. 2023. *Interdisciplinary contribution to natural based solution research: A pathway to achieve sustainable development goals (SDGs).* Poster presented at the Sigma Xi IFoRE, Long Beach, California, USA. 9-12 November 2023.

Schoeman, Y., Oberholster, P.J., Erasmus, M. & Jansen van Vuuren, M. 2023. *Advancing impact valuation for sustainable conservation practices in a South African Provincial Park*. Poster presented at the 12th Oppenheimer Research Conference, Midrand, South Africa. 04-06 October 2023.

Thoré, E.S., Pinceel, T., Brendonck, L. & Merckx, W. 2023. *Colour matters: substrate colour guides turquoise killifish's choice of preferred spawning habitat.* Poster presented at the 5th Nothobranchius Symposium, Leuven, Belgium. 01-02 June 2023.

Research Reports

Avenant, M.F., Belle, J.A., Börnick, H., Jungmann, D., Opeolu, B., Voua Otomo, P., Davis, N. & Schulze, R. 2023. *Threats of extreme weather events: Improving the resilience of QwaQwa to the multiple risks of climate change.* Volume 1 WRC Report No. 3091/1/23. Water Research Commission, Pretoria. ISBN: 978-0-6392-0538-0 .

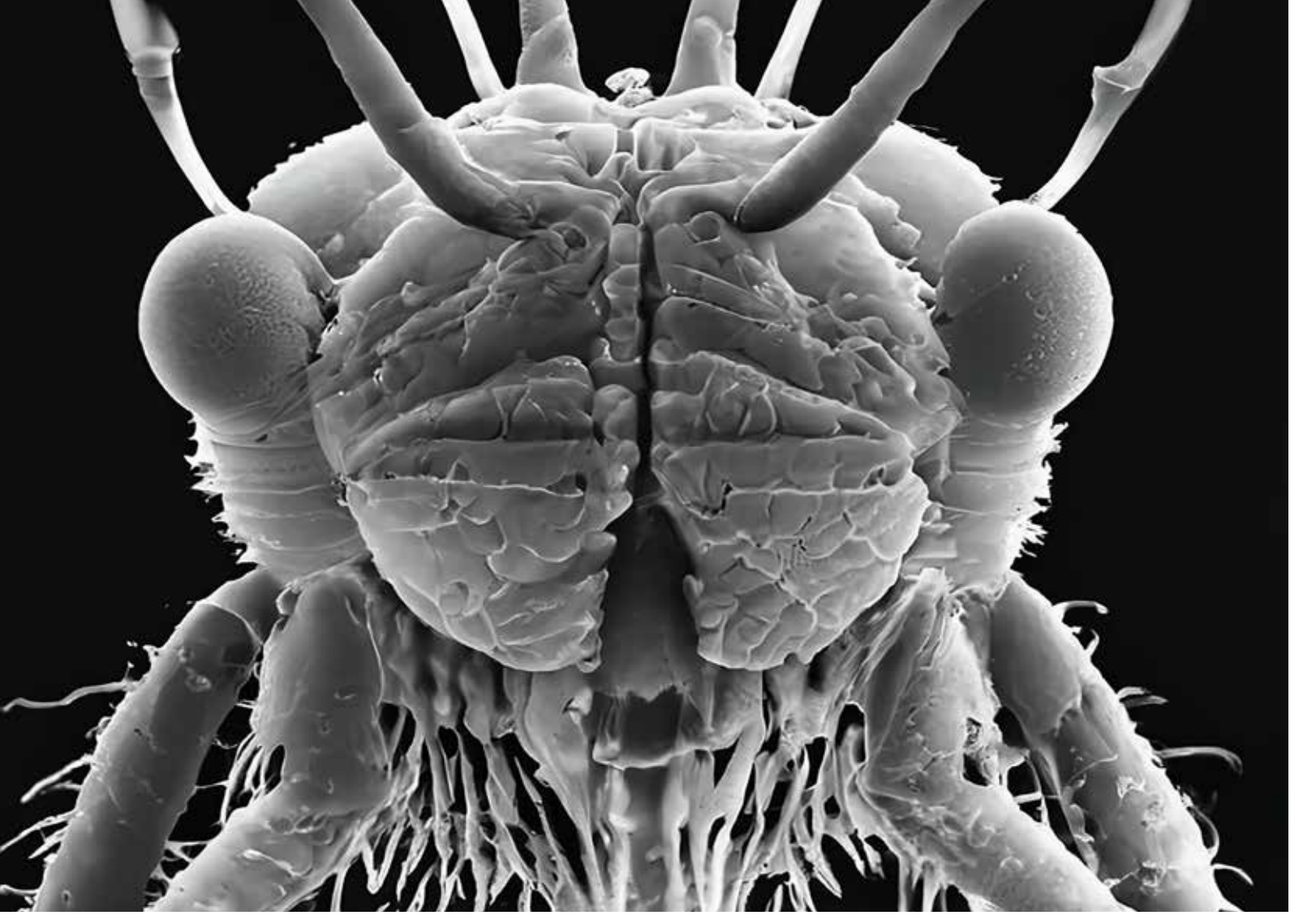
Oberholster, P.J., Archer, E. & Schoeman, Y. 2023. *South Africa's blue revolution: Investing in a thriving water future.* In: Rand Merchant Bank (Ed). Review, Renew, Reform: An independent assessment of Operation Vulindlela's impact on SA. Rand Merchant Bank, Johannesburg.

Schoeman, Y. & Oberholster, P.J. 2023. *Pre-feasibility report: Passive AMD treatment constructed wetlands.* University of the Free State.

STAFF (2023)

Director:
Prof PJ Oberholster

Professor:	Prof PJ Oberholster
Associate Professor:	Prof OO Ololade
Affiliated Professor:	Prof AR Turton
Adjunct Professor:	Prof MH Solomon
Senior Lecturers:	Dr MF Avenant, Dr S Esterhuyse and Dr BA Nkhata
Researcher:	Dr E Atangana
Research Fellows:	Dr NL Avenant, Dr NB Collins, Dr AT Grundling, Dr PL Grundling, Dr JR Henschel, Dr D Jungmann, Dr E Milne, Dr TWD Pinceel, Dr NA Moore, Prof MT Seaman, Dr M Thwala, Dr DF Toerien, Prof BJ Vanschoenwinkel and Dr PC Zietsman
Senior Officer – Professional Services:	ME Kemp
Officer – Professional Services:	Dr AT Vos
Course Administrator:	RI Mariti
Senior Assistant Officer:	DM Kolesky
Messenger:	PS Thibiri



CENTRE FOR

MICROSCOPY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCE

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OVERVIEW OF 2023

During 2023, the Centre for Microscopy witnessed remarkable achievements and a noticeable sense of enthusiasm. In March, the Centre hosted an event to unveil and commemorate the acquisition of cutting-edge microscopes from JEOL. This occasion not only symbolised a pivotal milestone but also instilled a shared feeling of joy among the community, emphasising the profound impact that state-of-the-art microscopy tools have in advancing scientific research. Moreover, the Centre's unwavering commitment to nurturing its staff's capabilities was unmistakably demonstrated through an intensive week-long training programme centred on the utilisation of JEOL JIB 4000PLUS focused ion beam specimen preparation equipment. This comprehensive training further honed the team's proficiency in leveraging advanced technologies to drive ground-breaking research endeavours. As the year drew to a close, the Centre bid farewell to Nonkululeko Phili, who left the Centre after four years of invaluable service.

RESEARCH SUPPORT

The Centre for Microscopy specialises in obtaining detailed structural data on a scale ranging from micro- to nano-meters, employing advanced microscopy techniques such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), and confocal laser scanning microscopy (CLSM). In addition, the Centre is also equipped with specialised specimen preparation equipment, including critical point dryers, sputter coaters, an ultra-microtome, and a recently installed focused ion beam (FIB). This essential range of equipment ensures that specimens are appropriately prepared for SEM and TEM. While beneficiaries of the Centre's resources are mainly researchers affiliated with the University of the Free State (UFS), external institutions, both domestic and international, also have access to these facilities.

In 2023, our team provided support to 77 researchers and students across various disciplines engaged in microscopy research. The collective utilisation of all microscopes amounted to 1 011 hours, marking a significant rise compared to the preceding two years and nearly returning to pre-pandemic levels.

The introduction of an easily operable SEM (JEOL IT200) alongside the high-resolution SEM (JEOL JSM 7800F) has notably enhanced workflow efficiency for the Centre. The IT200 SEM, with its user-friendly interface, has proven ideal for specimens not requiring high magnification, facilitating researchers' ease of operation following minimal training. This has consequently afforded the Centre's staff more time to focus on other equipment.

As indicated in Table 1, the SEM remains the preferred tool for researchers, due to its easy standard sample preparation and ability to capture impressive high-resolution three-dimensional images. The TEM and CLSM require more intricate preparation techniques, tailored to the specific specimen type, to fully utilise the capabilities of these systems. Notably, in 2023, the introduction of the high-resolution transmission electron microscope (HRTEM) for research measurements marked a significant development. Usage hours on the HRTEM for 2023 were mostly attributed to Centre staff for training activities to familiarise themselves with the equipment. However, HRTEM usage by other departments is still limited but will increase with the submission of projects that can effectively exploit the system's capabilities.

Table 1: Microscope usage per department (2023)

UFS Department	Usage hours					
	HRSEM	SEM	HRTEM	TEM	CLSM	TOTAL
Cardiothoracic Surgery	-	9	-	21	-	30
Centre for Microscopy	-	-	147	-	-	147
Chemistry	126	-	-	4	-	130
Engineering Sciences	3	2	-	-	-	5
Microbiology and Biochemistry	26	-		11	29	66
Pharmacology	-	-	7	-	-	7
Physics	401	-	18	21	-	440
Plants Sciences	31	13	-	-	-	44
Zoology and Entomology	11	49	-	-	-	60
External researchers/projects						
Central University of Technology	-	32	-	-	-	32
AC industries	6	-	-	-	-	6
Total usage	604	105	172	57	29	967

Table 2: Total number of users and hours (2020 – 2023)

	2020	2021	2022	2023
Users	55	62	75	77
Hours	391	655	1011	967

In addition to overseeing the operation and maintenance of the microscopes, the Centre staff also assist researchers with SEM and TEM sample preparation. The Centre is therefore able to keep inventory of the chemicals and consumables needed for specimen preparation. From intricate specimen handling to meticulous sample processing, our state-of-the-art equipment ensures the precision and accuracy required for sophisticated research endeavours, underscoring our unwavering dedication to fostering a conducive environment for ground-breaking scientific exploration and discovery.

This support system approach serves as a cornerstone of the Centre's offerings, facilitating researchers in conducting experiments of varying scales with efficiency and cost-effectiveness. Our commitment to providing such indispensable assistance has yielded remarkable success, enabling researchers to seamlessly integrate microscopy in their respective fields.

TEACHING AND LEARNING

The staff members at the Centre actively engage in delivering informative sessions tailored to meet the needs of various departments within the Faculty of Natural and Agricultural Sciences upon request. These interactive sessions typically entail a comprehensive tour of the Centre, during which our staff guide researchers and students through an exploration of the array of equipment available. Additionally, the tour includes a hands-on demonstration illustrating the functionality of each piece of equipment, elucidating the kind of data one can expect to derive, as well as the requisite sample preparation procedures.

Examples of such practical sessions are the annual SEM workshop, catered specifically for Honours students from the of Zoology and Entomology (ZLGY6814 and ENTO6814), as well as those from the Department of Microbiology and Biochemistry (MCBT6804 and BOCT6804), at the request of Prof Linda Basson and Prof Olihile Sebolai, respectively.

Beyond the standard tour, students from the Department of Zoology and Entomology are tasked with gathering and preparing their own specimens. Subsequently, they are guided through the operation of the SEM, affording them the opportunity to delve into the intricacies of the specimens they have collected. This hands-on approach not only offers students first-hand experience with electron microscopy, but also serves as a pivotal moment for many, marking either a once-in-a-lifetime encounter or an initial exposure to potential future SEM sessions as they progress in their academic pursuits.

Students from the Department of Zoology and Entomology at the JEOL IT200 SEM

OTHER ACTIVITIES

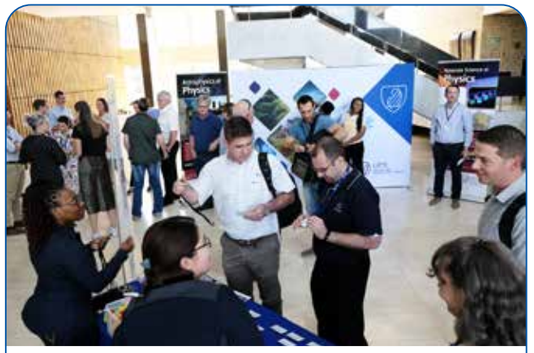
Unveiling of the JEOL F200 HRTEM

The unveiling event heralding the arrival of the new microscopes procured from JEOL marked a significant milestone for the University community,

Ceremonial ribbon cutting, from the left, Prof Koos Terblans, Prof Corli Witthuhn, and Prof Danie Vermeulen

attracting both seasoned supervisors and eager students to participate in the festivities spanning two enriching days. The inaugural day commenced with warm welcoming remarks by Prof Koos Terblans, Prof Corli Witthuhn, Dr Sarah Harper (JEOL UK), and Prof Danie Vermeulen, followed by the symbolic act of cutting the ribbon, signifying the official induction of these state-of-the-art instruments into the University's research arsenal.

Attendees were then treated to tour of the Centre for Microscopy, where the array of cutting-edge research equipment was proudly showcased, offering a glimpse into the realm of possibilities that these advanced technologies unlock. The day culminated in a convivial banquet dinner, fostering an atmosphere conducive to networking, idea exchange, and collective jubilation as participants toasted the promising horizons of scientific exploration illuminated by the advent of these sophisticated microscopy tools.



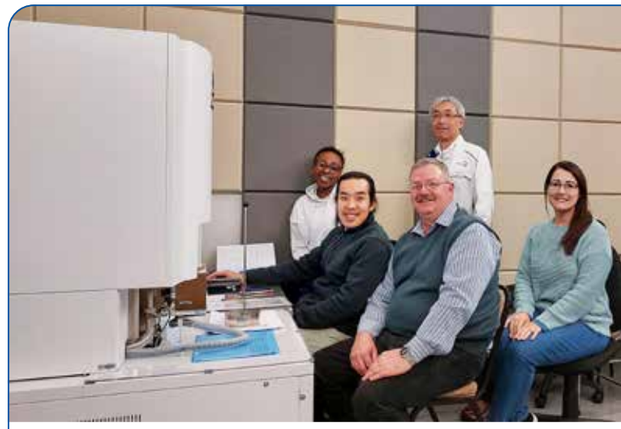
Unveiling of the JEOL F200 HRTEM event

As the event unfolded into its second day, presentations resumed, featuring supervisors and researchers from within the University who shared compelling insights into the transformative impact of the Centre for Microscopy on their respective research endeavours. Emphasising the indispensable role played by the newly acquired microscopes, these discussions underscored the profound implications for cutting-edge research across various disciplines. Moreover, the event welcomed distinguished speakers from Nelson Mandela University and Sefako Makgatho Health Sciences University, lending their expertise and diverse perspectives to further enrich the discourse, thereby elevating the event into a vibrant convergence of interdisciplinary collaboration and knowledge exchange.

From the left, Prof Jannie Swarts, Prof Danie Vermeulen, and Prof Koos Terblans with the impressive JEOL F200 HRTEM

Training on the of the JEOL JIB 4000PLUS

The Focused Ion Beam (FIB) emerges as an indispensable tool in materials science, offering precise capabilities for milling, sculpting, and modifying materials at the nanoscale level to facilitate TEM analysis. Our team embarked on an intensive week-long training session alongside JEOL



Mahira Tomohiro (back) conducting training on the FIB with (from the left) Nonkululeko Phili, Edward Lee, Prof Koos Terblans, and Hanlie Grobler

engineers, Koyano Kazuki and Mahira Tomohiro, to delve into a comprehensive exploration of the JEOL JIB 4000PLUS FIB research equipment. Covering foundational principles to advanced applications, the training encompassed an extensive array of topics essential for maximising the potential of this cutting-edge technology. Through hands-on demonstrations and interactive sessions, we gained invaluable insights into the intricate workings of the equipment, mastering techniques for sample preparation. The expertise and guidance provided by the JEOL engineers were instrumental in deepening our understanding and refining our skills in utilising FIB technology to its fullest extent.

STAFF MATTERS

In 2023 we bid farewell to Nonkululeko Phili, who resigned from her position at the end of the year. Nonkululeko had been an invaluable member of our team for four years, contributing her expertise and dedication to various projects and initiatives within the University. Her departure leaves behind a void that will be keenly felt, yet we are grateful for the indelible impact she has made during her tenure. We extend our heartfelt appreciation to Nonkululeko for her service and wish her all the best in her future endeavours.

STAFF (2023)

Director:
Prof JJ Terblans

Junior Lecturer/ Researcher:	E Lee
Senior Officer:	H Grobler
Assistant Officer:	N Phili

DISASTER MANAGEMENT TRAINING AND EDUCATION CENTRE FOR AFRICA (DiMTEC)

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The year 2023 was another prolific year for the Disaster Management Training and Education Centre for Africa (DiMTEC). DiMTEC achieved significant milestones, affirming that the successes of 2022 were not merely incidental. Research output increased in 2023, with DiMTEC staff and affiliated researchers delivering numerous presentations at international and local conferences. Reflecting on 2023, DiMTEC confidently asserts that it was an even more fruitful academic year.

Throughout 2023, we initiated various training programmes and community service activities in collaboration with our partners. We disseminated the message to diverse stakeholders of a paradigm shift from vulnerability to preparedness and reinforced this through the numerous training sessions we conducted. This paradigm shift entails transitioning from a reactive stance, primarily addressing vulnerabilities after an event, to a proactive approach focused on preparedness. While acknowledging the existence of vulnerabilities, adopting a proactive and prepared mindset is crucial for enhancing resilience and mitigating the impact of disasters. Achieving this necessitates a blend of community engagement, capacity building, technological innovation, and policy integration to foster a more resilient and adaptive society.

Towards the year's end, the Centre bid farewell to Phumla Gonya and Dr Annelene van Straten. Dr Van Straten served as the Centre's Senior Assistant Officer for 18 years, while Phumla Gonya held the position of Finance Officer for one year. Although their departure was bittersweet, the Centre looks forward to their continued growth and success in their new career endeavours.

ACHIEVEMENTS

Staff Achievements

Prof Abiodun Ogundeji was invited as a guest speaker to the Disaster Management Institute for Southern Africa Conference (DMISA) Conference held in Thohoyandou, Limpopo, on 25 and 26 October 2023. He presented a paper titled 'Economics for Disaster Prevention and Preparedness'. Congratulations to Prof Andries Jordaan and Dr Mmaphaka Tau for receiving DMISA Gold Commendation Awards for their significant and extensive contributions to the study and practice of disaster management.

Dr Olivia Kunguma played a crucial role as the Programme Coordinator for the Climate Change and Futures in Africa Conference. The conference was held in Maputo, Mozambique, from 8 to 10 November. She was also invited to participate in a panel discussion and make a presentation on 'Disaster declaration process and the media: A case study of Jagersfontein dam collapse', at the DMISA Conference. Dr Kunguma was appointed as a Co-Chair and Member of the National Research Agenda at the South African National Disaster Management Centre.

Dr Olivia Kunguma at the Climate Change and Futures in Africa Conference

Dr Tlou Raphela has been appointed as a Subject Matter Expert for Incident Management for the second-year module at Lyceum College. In addition, she was invited to chair a session at the 3rd Fire Engineering and Disaster Management Pre-recorded International Scientific Conference on 26 April 2023. This prestigious conference was hosted virtually by the University of Public Service Faculty of Law Enforcement, Institute of Disaster Management in Hungary.

Dr Alice Ncube was chosen to join the board of the Africa Science and Technology Advisory Group (AfSTAG) for Disaster Risk Reduction (DRR). Dr Ncube was invited to the Africa Conference on Science, Technology, Policy, and Private Sector Nexus for Disaster Risk Reduction held in Tunis on 2 and 3 October 2023. She was also invited to contribute to the discussion on 'Human Rights in the Context of Climate-Induced Migration and Displacement: Africa Regional Civil Society Consultation' in Addis Ababa, which took place on 10 and 11 May 2023.

We are very proud of our staff members who received awards and prizes at our annual year-end function and prize-giving ceremony, namely:

- Andries Jordaan Trophy for research:
  Prof Abiodun Ogundeji
- Director's awards for service to the Department:
  - Prof Johanes Belle – International engagements

- Dr Tlou Raphela – Short Leaning Programme
- Dr Olivia Kunguma – Marketing
- Dr Alice Ncube – 15 years' service award
- Zukiswa Poto – 5 years' service award
- Dr Danso-Abbeam – research in Postdoctoral category

Student Achievements

The following students received awards in 2023:

- Christopher Bell was awarded the National Disaster Management Centre prize for the best student in Post Graduate Diploma in Disaster Management
- Yewande Orimoloye won the Prof Andries Jordaan prize for the best Master's student in Disaster Management

TEACHING AND LEARNING

14th Annual Block Course

The Centre, in collaboration with the United Nations University – Institute for Environment and Human Security (UNU-EHS), hosted the 14th Block Course from 14 to 23 August 2023, with the theme 'Leaving no one behind: Enhancing sustainable resilience as we build back better - Lessons learned from the KwaZulu-Natal flood disaster in April 2022'. DiMTEC is grateful to Vincent Ngubane and the team from the eThekwini disaster management and emergency control unit, for the warm welcome to the province. The Centre is also grateful to Santam for sponsoring 10 participants.

The block course is held annually for two weeks. A strong emphasis is placed on building resilience, sustainable development, and reducing disasters. The participants are from diverse backgrounds and the facilitators engage in information sharing and transfer of knowledge concerning current affairs and inputs to solve some resilience-building problems. Besides the UFS facilitators, the course included facilitators from UNU-EHS (Bonn, Germany), the National University of Public Service (Budapest, Hungary), and the South African National Disaster Management Centre.

Participants in the 14th Annual Block Course

Short Learning Programme: Introduction to Disaster Management

Members of the Alfred Nzo District Municipality Advisory Forum participated in and completed the three-day Short Learning Programme on 'Introduction to Disaster Management' from 1 to 3 November 2023. The Old Mutual Foundation sponsored the training as part of their mandate to deliver on the humanitarian and disaster support (HDS) portfolio, including disaster preparedness, response, and recovery initiatives implemented in collaboration with strategic partners. The course equipped the participants with knowledge and skills to better comprehend and use terminologies, the morphologies of disasters, risk and impact assessments, implementation of the disaster legislation, information management and communication, development of disaster management plans, and more.

Participants from Alfred Nzo District Municipality Advisory Forum at 'Introduction to Disaster Management' Short Learning Programme (November 2023)

RESEARCH AND INNOVATION

DiMTEC is part of a project titled 'A Pan-African DRR Action-Research-Network of Excellence (Pan-African-DRR-NoE) to support Multi-Hazard Early Warning and Anticipatory Action'. The United Nations Office for Disaster Risk Reduction (UNDRR) is the project lead, and the project includes other institutions and organisations such as the University of Cape Town, University of KwaZulu-Natal and World Food Programme. With the continued need for risk reduction in Africa as a result of exposure to climate hazards and interaction with other drivers to create multiple risks, anticipatory action (AA) is more important than ever for equitable risk reduction. Despite promising initial attempts, scaling up AA across the region is currently inhibited by fragmented approaches of different triggers, inadequate coordination, and suboptimal risk reduction. The project consortium is a unique configuration of partners that combines proven scientific and technical expertise with significant local experience and operational mandates for multi-hazard early warning systems (MHEWS) and AA across three sub-regional hubs – East Africa, West Africa, and southern Africa. This transdisciplinary, pan-African partnership will generate a greater understanding about building a more resilient future for those most impacted by climate-related and other external shocks. The Network of Excellence (NoE) will facilitate the cooperation between academia and implementing institutions to provide technical-scientific knowledge and capacity development to adequately inform anticipatory action design, decision-making processes, and policy development. This network will build on existing centres of excellence in Africa and at the international level, to combine state-of-the-art forecasts and vulnerability information in co-developed and transdisciplinary environments to ensure that available information effectively supports AA through supporting frameworks for financing and action. It will combine this with institutional and user informed insights on effectively coordinating and managing the effective use of information. In so doing, the project consortium's scope of activities closely aligns with the priorities of the existing sub-regional coordination platforms, such as the Regional Anticipatory Action Working Group (RAAWG) for southern Africa. The project will also support the Eastern Africa AA roadmap, prioritising research, innovation, and learning. By combining science, policy, practice, and established regional structures the network will likely have the co-benefit of supporting socially responsive engagement in early warning and disaster risk reduction within Africa.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

South African and Sweden University Sustainability Forum

At the South African and Sweden University Sustainability Forum, held from 29 to 31 March 2023, Prof Ogundeji represented DiMTEC. In collaboration with Prof Paul Egan, Dr Enoch Owusu-Sekyere, and Prof Assem Abu Hatab from the Swedish University of Agricultural Sciences, Prof Ogundeji co-organised and hosted a workshop titled 'Food systems in the face of climate and exogenous shocks: Building back better for increased resilience'. This workshop fell under the sub-theme of climate change, natural resources, and sustainability, and addressed the critical issue of food system resilience in the face of various challenges, including the COVID-19 pandemic and other disasters. The workshop focused on the concept of resilience, which has gained significant attention among policymakers in Sweden and South Africa. The discussions centred on restructuring food systems to better handle and prevent crises, protect people and the environment, and adapt to changes and new challenges. Ensuring long-term access to healthy food without sacrificing sustainability goals

was crucial to this conversation. The event served as a platform for sharing insights and strategies for building more resilient and sustainable food systems in the face of environmental and external shocks.

From the left, Dr Enoch Owusu-Sekyere, Prof Paul Egan, and Prof Abiodun Ogundeji at the South African and Sweden University Sustainability Forum

Stakeholder engagement session on dam safety and management

The Eastern Cape Provincial Disaster Management Centre (ECPDMC) at the Eastern Cape Department of Cooperative Governance and Traditional Affairs (ECCOGTA) invited the Centre to a stakeholder engagement session on dam safety and management on 28 March. Dr Kunguma, Dr Raphela, and Prof Ogundeji presented on the disaster declaration process, dam safety custodianship, dam and flood maintenance, and a case study on the response to the Jagersfontein disaster. This engagement was in collaboration with the Department of Water and Sanitation (DWS) and the Water Research Commission (WRC). This knowledge-sharing session focused on learning from the recent dam incidents, sharing best practices, and facilitating an engagement platform to discuss management and policy issues that need to be implemented to reduce the risk of dam failures.

NATIONAL AND INTERNATIONAL COLLABORATION

Connective Cities and Global Initiative on Disaster Risk Management

A team from DiMTEC participated in a 12-month project focused on flood risk-informed urban development. Under the umbrella of Connective Cities and Global Initiative on Disaster Risk Management, this project emphasised 'Learning Process on Flood Management for Risk-Informed Urban Development'. The kick-off event, which took place in Namibia from 18 to 20 April 2023, featured engagements with stakeholders from various sector departments. This initiative represented a collaborative effort to enhance urban development strategies by incorporating comprehensive flood management and risk assessment practices.

From the left, Prof Belle, Dr Raphela-Masuku, Prof Ogundeji, and Dr Mmaphaka

Watershed Management Workshop

Prof Abiodun Ogundeji (DiMTEC) and Prof Angelinus Franke (UFS Department of Soil, Crop and Climate Sciences) attended a workshop titled 'Watershed Managements in Farmlands and African-Bavarian Academy on Climate Change Management' at the University of Applied Sciences, Freising, Germany, from 18 to 24 June, 2023. The workshop included delegates from other universities in South Africa and Africa. A new consortium emerged comprising academics from various universities, which will include joint research proposals and skills transfer.

PERIPERI U Climate Adaptation Research Programme Workshop 2023

As part of the Climate Adaptation Research Programme (CARP), the Partners Enhancing Resilience of People Exposed to Risks (PERIPERI U) Secretariat coordinated and co-hosted the first CARP workshop at Ardhi University in Dar es Salaam, Tanzania, from 30 October to 2 November 2023. Dr Alice Ncube attended as part of the African Union Commission (AUC) Science and Technology Advisory Board (AfSTAG). The main aim of this workshop was to assist in establishing the CARP community, to allow for greater networking and engagement between early career and established African professionals working in this sector. The invitation of Tanzanian government officials to attend the workshop underscored the importance of engagement between disaster risk reduction practitioners, policymakers, and local communities in order to address climate adaptation challenges. Seventy participants from different countries attended the workshop, which included South Africa, USA, Senegal, Nigeria, Algeria, Kenya, Uganda, Madagascar, Ethiopia, Cameroon, Morocco, Rwanda, and hosts Tanzania. Participants included emerging scholars from the 33 CARP research projects (125 members) focused on reducing climate-related disaster risks across 10 African countries. The event included several discussion sessions, group-based activities, poster presentations on research conducted by the various teams, and field excursions to project sites focused on reducing vulnerability and risk against flooding in Dar es Salaam.

Prof Alice Ncube

Women's University in Africa, Zimbabwe

On the 21 April 2023, Dr Olivia Kunguma engaged with Dr Albert Maipisi from the Women's University in Africa's Faculty of Social and Gender Transformative Sciences. The Women's University in Zimbabwe recently registered a Master of Science Degree in Disaster Risk and Livelihood Studies. To improve this qualification and explore other areas of collaboration, they invited DiMTEC to engage in a benchmarking exercise. The colleagues discussed potential collaborations regarding short learning courses, staff and student exchange, research projects, and appointment of research fellows. DiMTEC and the Women's University are in the process of signing a Memorandum of Agreement. Dr Kunguma also had the opportunity to meet with Hon Edmond Mkaratigwa, a Mines Portfolio Chairman interested in disaster risk management as an important area in the mining industry.

Dr Kunguma (left) meeting with Hon Mkaratigwa and Dr Maipisi

Friedrich-Ebert Stiftung, ACT Alliance, and the Climate, Migration and Displacement Platform

Dr Alice Ncube attended a regional consultation in Addis Ababa, Ethiopia on 10 and 11 May, on climate-induced migration and human rights considerations in Africa, hosted by the Friedrich-Ebert Stiftung

(FES), ACT Alliance, and the Climate, Migration and Displacement Platform (CMDP). This was one of a series of organised regional consultations aimed at strengthening collective analysis and advocacy while exchanging information on the climate and migration crises in different sub-regions. This workshop was held ahead of the UNFCCC inter-sessional meeting (Bonn, Germany). The consultation aimed to identify and build support for coordinating national responses to climate-related migration and displacement that address the human rights of people at risk of displacement and/or migrating under duress, and provide a forum for exchange on related challenges in the different countries, and to organise related national and global advocacy.

Participants at the regional consultation on climate-induced migration and human rights

United Nations Environment and Emergencies Forum

Prof Johanes Belle and Prof Joerg Szarzynski were guests at the 2023 Environment and Emergencies Forum (EEF), which took place on 22 and 23 March 2023 at the Albert Borschette Conference Center in Brussels, Belgium. This prestigious forum, hosted by the European Commission and jointly organised by the United Nations Environmental Programme (UNEP) and the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA)-Joint Environmental Unit (JEU), convened experts from around the globe specialising in environmental emergencies. The EEF served as a vital platform for sharing knowledge, strategies, and innovations in the field of environmental emergency management. During this conference, Prof Belle successfully negotiated a significant cooperative agreement with the UNOCHA-JEU. This collaboration aims to introduce, identify, and train local candidates from South Africa for the United Nations Disaster Assessment and Coordination (UNDAC) Programme. Candidates selected through this initiative will be added to the UNOCHA roster, preparing them for eventual deployment to disaster-affected areas in Africa and globally. This partnership underscores DiMTEC's commitment to enhancing disaster management capabilities and highlights the critical role of international cooperation in addressing global environmental emergencies. The involvement of DiMTEC in this programme marks a significant step in fostering global resilience and response capacity to environmental disasters.

Prof Johanes Belle (left) and Prof Joerg Szarzynski at the 2023 Environment and Emergencies Forum, held in Brussels (March 2023)

Africa Climate Summit

The Africa Climate Summit and the Africa Climate Week took place in Nairobi Kenya from 4 to 6 September 2023. Prof Belle from DiMTEC delivered a keynote presentation on Flood Risk Management, the essential role of cities, and the importance of municipal preparedness at the German government side event to the Summit (GIZ-Connective Cities). Prof Belle also moderated the panel discussion on various themes related to the same topic on urban flooding. Prof Belle joined the African Heads of States and other dignitaries in adopting the Nairobi Declaration ahead of COP28 in Dubai, which was held later in 2023.

Prof Johanes Belle at the 2023 Africa Climate Summit

Erasmus Mobility Staff Exchange

The Erasmus Staff Mobility Programme encourages lifelong learning by supporting the academic, professional, and personal growth of those working in the field of education throughout Europe and beyond. It provides academic professionals with the priceless chance to both contribute to and benefit from other countries' finest practices in education. From 26 to 30 June, colleagues from Babeș-Bolyai University, Romania, visited DiMTEC as part of the Erasmus Mobility staff exchange programme. Their visit also included many activities, presentations, and workshops with colleagues from other groups, such as the UFS Department of Communication Science, as well as the Central University of Technology. One topical discussion was on the significance of disaster communication for resilient communities.

Participants at the Erasmus Staff Mobility Programme presentation session with Babeș-Bolyai University

Stakeholder Engagement and Courtesy Visits

From 3 to 6 April 2023, the DiMTEC team engaged in a series of stakeholder engagement and courtesy visits. Meetings were held with key organisations,

DiMTEC and South African Local Government Association colleagues

including the National Disaster Management Centre (NDMC), Gauteng Provincial Disaster Management Centre (GPDMC), South African Local Government Association (SALGA), Disaster and Emergency Management Services (DEMS) Department, and City of Tshwane Emergency Services. These visits were to share the vision and purpose of DiMTEC and discuss strategies for future partnerships and collaborations.

OTHER ACTIVITIES

During the July school break, Chanelle Adams, a Grade 11 student, attended a career guidance programme at DiMTEC. Chanelle, aspiring to become a disaster manager, sought valuable insights into her chosen field. DiMTEC, recognising the importance of education in career development, warmly welcomed Chanelle and provided tailored guidance aligned with her aspirations. Two students from Christian Brothers College also participated in the programme, adding further depth to the experience.

DiMTEC personnel with Channelle Adams (front row, centre)

POSTGRADUATE STUDENTS

Master's Research Week

To equip our Master's students with much-needed theoretical and practical knowledge and research skills, the Centre hosts an annual Master's Research Week, during which lecturers and students have the opportunity to work together on a one-on-one basis. The Centre held a successful Master's Research Week from 2 to 5 May 2023, which included lectures on qualitative and quantitative research designs and addressing the students research challenges and expectations.

Participants at the Masters Research week 2023

Faculty of Natural and Agricultural Sciences Flash Fact competition

Vallery Poto, a PhD candidate, Dr Solomon Owolabi, and Dr Zachariah Mshelia (both Postdoctoral Fellows), presented their research at the Faculty Flash Fact competition held on 4 and 5 July 2023. Vallery delivered a presentation titled 'When the lights turn off, switch your enterprising mind on', while Zachariah discussed 'What is the immunity level of the environment? A case study of Bloemfontein watershed', and Solomon addressed 'Dam optimization for levee-based hydroelectric power setup'.

POSTDOCTORAL RESEARCH FELLOWS

In 2023, DiMTEC hosted four Postdoctoral Fellows – Dr Solomon Owolabi (from Nigeria), Dr Zachariah Mshelia (from Nigeria), Dr Sebastian Nyam (from Cameroon), and Dr Danso-Abbeam (from Ghana).

The ECPDMC invited Dr Kunguma and Dr Mshelia to present the significance of scientific or disaster studies in the fraternity. Their presentation emphasised how disaster research enables experts, academic institutions, non-governmental organisations, the commercial sector, and specialised sectors/ministries to validate research methods and findings. The research results challenge the *status quo* and contribute towards strengthening community resilience, and robust research increases the likelihood of a successful disaster risk reduction programme, improves coordination, and reduces the wastage of resources.

STAFF MATTERS

On Heritage Day, DiMTEC staff members and students came together to celebrate the rich tapestry of cultures that contribute to our identity. A highlight of this festive occasion was the presentation of Dr Kunguma's Best Heritage Cuisine Prize to the top three favourite dishes. Additionally, Akani Baloyi was recognised for her outstanding attire and awarded the 'Best Dressed: DiMTEC Heritage Day 2023' prize.

DiMTEC personnel celebrating heritage Day

RESEARCH OUTPUTS

Research Articles

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Conference Contributions

Conference Papers / Posters

Brago, P., Danso-Abbeam, G. & Ogundeji, A.A. 2023. *Impact of women empowerment on adoption of climate change adaptation strategies.* Paper delivered at the 7th African conference of Agricultural Economists and 60th Agricultural Economics Association of South African Conference (AAAE & AEASA), Durban, South Africa. 18-21 September 2023.

Danso-Abbeam, G., Selelo, O.T. & Ogundeji, A.A. 2023. *Impact of agroecological practices on farm performance in Botswana.* Paper delivered at the 2023 Tropentag Conference organised by the Leibniz Centre for Agricultural Landscape Research (ZALF) in cooperation with the Humboldt-Universität zu Berlin, Germany. 20-22nd September 2023.

Mshelia, Z.H. 2023. *Systematic Flood Risk Analysis of Bloemfontein Catchment.* Paper delivered at the 3rd Biennial Postdoctoral Research Conference for Africa, Stellenbosch, Stellenbosch, South Africa. 18-22 September 2023.

Owolabi, S.T. 2023. *Investigating morphometric parameters performance for hydrographic domain assessment and soil erosion risk and vulnerabilities.* Paper delivered at 4th Edition of World Congress on Geology & Earth Science 2023, at Rome, Italy (Virtual). 04-06 September 2023.

Owolabi, S.T. 2023. *Watershed morphometric parameters and soil erosion; validating the geomorphic indicators for improved watershed soil erosion risk assessment.* Paper delivered at 3rd Biennial Postdoctoral Research Conference of Africa 2023, Stellenbosch, South Africa. 18-22 September 2023.

Raphela T.D. & Duffy, K. 2023. *The impact of Lantana camara on invertebrates and plant species of the Groenkloof Nature Reserve, South Africa.* Paper delivered at the 5th Global Change Conference, University of the Free State, Bloemfontein, South Africa. 31 January–02 February 2023.

Raphela T.D. 2023. *Exploring the effectiveness of Community-Based-Conservation Initiatives in promoting biodiversity conservation and sustainable ecosystem management in Africa.* Paper delivered at the 5th Euro-Mediterranean Conference for Environmental Integration (EMCEI-23). Rende, Italy. 02-05 October 2023.

Raphela T.D. 2023. *The COVID-19 Pandemic and Its Mental Impacts on Motor Industry Workers in South Africa.* Paper delivered at the 7th International Symposium on Natural Hazard-Triggered Technological Accidents. (Pre-recorded. IDRM, Sichuan University, Chengdu, China (Virtual). 20-30 June 2023.

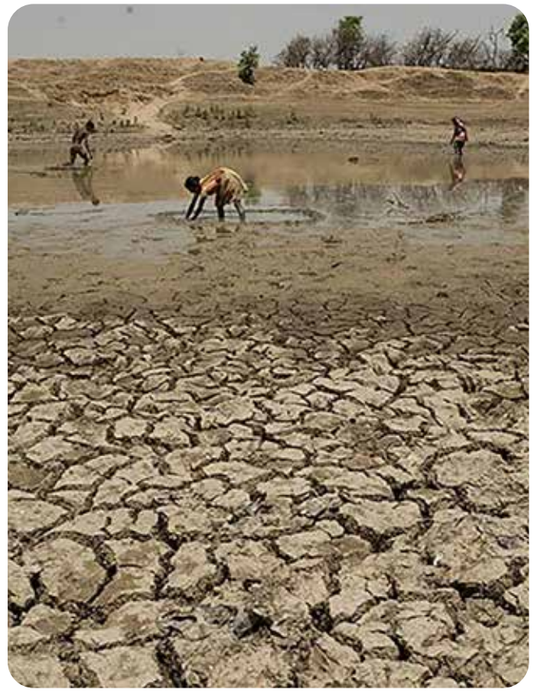
Selelo, O.T., Ogundeji, A.A. & Danso-Abbeam, G. 2023. *Impacts of agroecological practices on farm performance in Botswana.* Paper delivered at the 7th African Conference of Agricultural Economists and 60th Agricultural Economics Association of South African Conference (AAAE & AEASA), Durban, South Africa. 18-21 September 2023.

Torsu, D.A., Danso-Abbeam, G., Ogundeji, A.A. & Owusu, V. 2023. *Heterogenous impacts of greenhouse farming technology as climate-smart agriculture on household welfare in Ghana.* Paper delivered at the 7th African conference of Agricultural Economists and 60th Agricultural Economics Association of South African Conference (AAAE & AEASA), Durban, South Africa. 18-21 September 2023.

Torsu, D.A., Danso-Abbeam, G., Ogundeji, A.A., Owusu, V. & Owusu-Sekyere, E. 2023. *Greenhouse farming technology as climate-smart agriculture: heterogenous effects on farm performance in Ghana.* Paper delivered at the Agri4D Conference, University of Agricultural Sciences, Sweden. 26-28 September 2023.

Research Reports

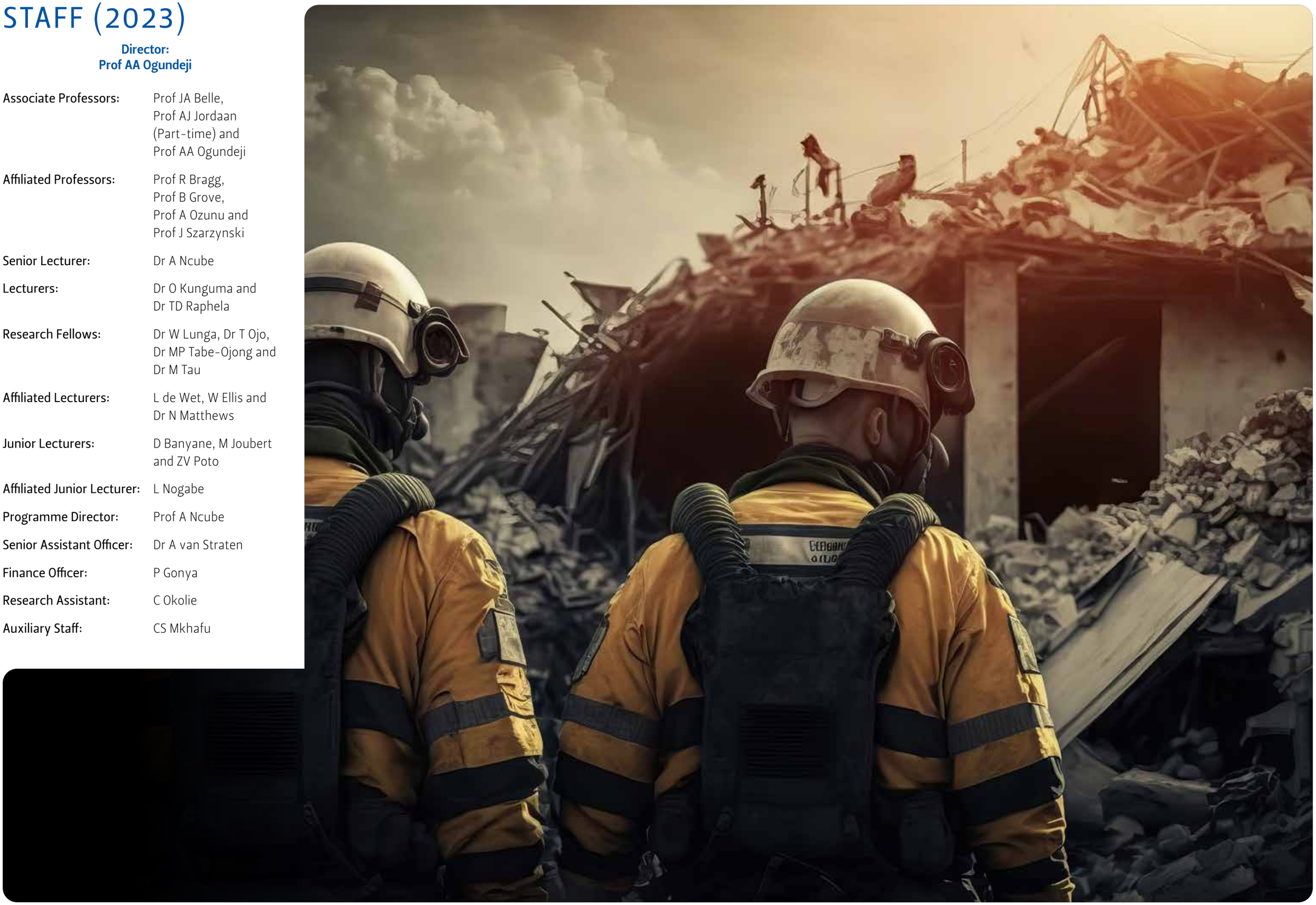
Hagenlocher, M., Okamoto, S., Nagabhatla, N., Diedrich, S., Hassel, J., Van der Heijden, S., Kreft, S., De Lombaerde, P., Nick, F., Oakes, R., Rackelmann, F., Rimmert, M., Sandholz, S., Sebesvari, Z., Shen, X., Skripka, T., Stojanovic, T., Szarzynski, J., Van de Walle, B. & Werners, S. E. 2023. *Building Climate Resilience: Lessons from the 2021 Floods in Western Europe. UNU-EHS, UNU-CRIS, UNU-MERIT.* Policy report. Bonn, Maastricht and Brugge. doi.org/10.53324/INCS5390.



STAFF (2023)

Director:
Prof AA Ogundeji

Associate Professors:	Prof JA Belle, Prof AJ Jordaan (Part-time) and Prof AA Ogundeji
Affiliated Professors:	Prof R Bragg, Prof B Grove, Prof A Ozunu and Prof J Szarzynski
Senior Lecturer:	Dr A Ncube
Lecturers:	Dr O Kunguma and Dr TD Raphela
Research Fellows:	Dr W Lunga, Dr T Ojo, Dr MP Tabe-Ojong and Dr M Tau
Affiliated Lecturers:	L de Wet, W Ellis and Dr N Matthews
Junior Lecturers:	D Banyane, M Joubert and ZV Poto
Affiliated Junior Lecturer:	L Nogabe
Programme Director:	Prof A Ncube
Senior Assistant Officer:	Dr A van Straten
Finance Officer:	P Gonya
Research Assistant:	C Okolie
Auxiliary Staff:	CS Mkhafu



INSTITUTE FOR

GROUNDWATER STUDIES

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

The year 2023 was very demanding but exciting as it built on the momentum of 2022. Both staff and students excelled in a number of aspects. The staff participated in various research activities, as well as teaching and learning engagements. All research projects, big or small, are used for capacity building and many form part of an MSc or PhD study. As we are unique, not only in South Africa but in the whole African continent, we get many students from abroad. The Institute for Groundwater Studies (IGS) appreciates its team of dedicated staff for their enthusiasm and valuable contributions towards achieving its vision.

ACHIEVEMENTS

Staff Achievements

Congratulations to Dr Paul Lourens who obtained his PhD Degree in Geohydrology under the supervision of Prof Danie Vermeulen.

On 19 June 2023, Prof Abdon Atangana, together with a group of exceptional young scientists from Argentina, Cameroon, China, Egypt, and Serbia, received the prestigious UNESCO-Al Fozan International Prize for the Promotion of Young Scientists in Science, Technology, Engineering and Mathematics (STEM) during a ceremony at UNESCO headquarters in Paris, France.

Prof Abdon Atangana

Student Achievements

The IGS Dux Prize for the Best MSc student in Geohydrology was awarded to Mathapelo Emely Kholotsa at the Annual Faculty prize-giving. Mathapelo achieved a final mark of 87%. The title of her dissertation was 'The analysis of dissolution trapping mechanism on carbon dioxide plume: Carbon Capture and Storage (CCS)'.

Mathapelo Emely Kholotsa being awarded the IGS Dux Prize by Dr Eelco Lukas

The International Association of Hydrogeologists (IAH) hosted the 50th Worldwide Congress in Cape Town, South Africa from 18 to 22 September 2023. Academic staff and PhD students from the IGS participated, served as session chairs, and presented at the Congress. Rolene Lubbe, an IGS PhD student, presented on 'A review of slug tests analysis on South African aquifers in potential yield and transmissivity estimations', for which she received the second prize for student oral presentations.

Rolene Lubbe presenting at the IAH 50th Worldwide Congress

TEACHING AND LEARNING

The IGS offers Honours, Master's and Doctoral degrees in Geohydrology.

Our Honours courses are presented in two or three-week blocks to enable working students to attend the lectures. All Honours students are required to attend the lectures conducted in the six modules. The classwork is complemented by fieldwork and practical assignments. Master's and Doctoral students who have not obtained their Honours degree through the IGS are required to attend these classes as well.

The annual field trip for Honours students is always a highlight, providing them with exposure to the practical aspects of groundwater. The 2023 field

trip took place from 10 to 12 July, facilitated by Dr Paul Lourens, Dr Fanie de Lange, Marius Smit, and Anton Lukas. The location of the 2023 field trip was Barkly East, where the highest elevation point of the excursion and the boundary between water catchments (water divide) and one of the origin points of the drainage system is the Saalboom River. At this point, the groundwater contribution to the origin of the Saalboom River can be visualised/ observed.

Honours students at the highest elevation point on the field trip to Barkly East

Moving down the mountain range, students can observe the change in geometry of the streams and rivers. The change in water quality is also recorded moving down the mountain range, recording measured field data such as pH, electrical conductivity (EC), total dissolved solids (TDS), and temperature. The concept of interflow and baseflow is also explained and visualised in the field.

Honours students collecting water samples from the Saalboom River

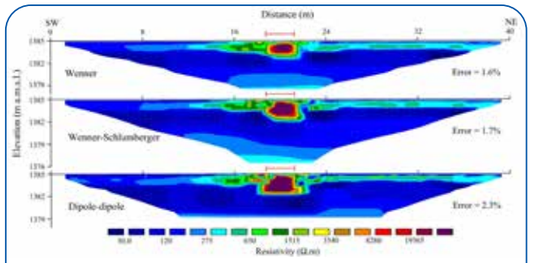
The IGS received permission from the University to convert the old garage behind the IGS building into a hydraulic laboratory. The reconstruction of the building was finalised and, as part of the annual fieldtrip, two boreholes were drilled in the green area between the lab and the Graduandi Avenue.

Boreholes being drilled as part of the annual field trip for Honours students

RESEARCH AND INNOVATION

The IGS conducts contract research on a wide variety of water-related topics of special interest as its contribution to the mining and industrial sectors in terms of water management, minimisation of pollution, as well as understanding the nature and behaviour of South Africa's aquifers. The Institute provides a complete service to these industries through field investigations, the development of specialised field equipment, a well-equipped commercial and water research laboratory, and a number of computer models for the management and operation of the aquifers, protecting them from pollution.

The IGS participated in a multi-disciplinary research project to investigate the granophyre dykes in the Vredefort Impact Structure. Geophysical surveys indicated that these dykes terminate within a few metres of the current topographical surface, suggesting that the current erosional level corresponds to the maximum depth of fractures in the crater floor formed during crustal relaxation after the meteorite impact. This is an extraordinary finding, considering that the impact occurred more than two billion years ago and that approximate 10 km of rock has been removed by erosion since the impact. A trench dug along an outcrop of one of the dykes confirmed its small remaining depth extent.



Inverse resistivity models from electrical resistivity tomography surveys across the Lesutoskraal granophyre dyke

The small depth extent of the Lesutoskraal granophyre dyke as observed in a trench

Prof Atangana has made significant contributions to the field of mathematics, particularly in the areas of fractional calculus, fractional differential equations, and mathematical modelling. These allow us to model complex phenomena to solve real-life problems, such as the spread of infectious diseases, heat transfer problems, groundwater flow, and contamination or weather patterns. He has suggested differential operators which can replicate complex processes that are hard to predict. He has also introduced a new methodology for assessing the impact of infectious diseases on groundwater. This type of interdisciplinary research can be applied to industry, such as in the development of the cruise control function in cars. By using fractional calculus to further our understanding of the intricate dynamics of heat transfer, the flow of fluids, and other physical phenomena, his work is contributing to new strategies for minimising energy consumption and optimising renewable energy systems.

Rolene Lubbe participated in the International Mine Water Association (IMWA) Conference that was held in Newport, Wales, from 17 to 21 July 2023. Rolene presented the paper 'Cost effective method to depressurise perched aquifers to prevent slope failures in open-pit mines, South Africa' on behalf of the authors (H Schreuder, Dr PJ Lourens, and Prof PD Vermeulen).

Rolene Lubbe at the IMWA Conference in Wales

The International Conference on Natural Science and Environment (ICNSE) in Dubai, United Arab Emirates (1 to 2 June 2023), was attended by Prof Modreck Gomo. ICNSE is sponsored by the International Institute of Engineers and Researchers (IIER) and aims to be a leading international conference for novel and fundamental advances in the fields of natural science and environment. It also serves to foster communication among researchers and practitioners working with a common interest in improving natural science- and environment-related techniques.

Prof Modreck Gomo

POSTGRADUATE STUDENTS

Sixteen (16) students enrolled at Honours level in 2023, with 29 at Master's level and 18 at Doctoral level.

In terms of graduations, eight students graduated with the MSc degree, three passing with distinction. They were:

- Cornè Engelbrecht (distinction)
- Mathapelo Emely Kholotsa (distinction)
- Mafuza Mzoxolo,
- Ndiada Faith Mudzunga
- Daniél Mulder (distinction)
- Mutshidzi Munyai
- Terrence Phelelani Ngilande
- Thandeka Fortunate Ngobe

Three PhD degrees were conferred in 2023:

Moleme, Malefa Florence

Thesis: Characteristics of Fluid Electrical Conductivity (FEC) profiles associated with a contaminant plume in porous and weathered aquifer systems

Supervisor: Prof M Gomo

Lourens, Paul Joël Havemann

Thesis: Development of a groundwater monitoring programme for the coal-based synthetic fuel industry in South Africa

Supervisor: Prof PD Vermeulen

Co-supervisor: Dr R Hansen

Zielke-Olivier, Josepha Simone Doris Renate

Thesis: Investigating the influence of a graben structure on the distribution of groundwater contaminants

Supervisor: Prof PD Vermeulen

Co-supervisor: Prof FD Fourie

STAFF MATTERS

Dr Amy Allwright (Lecturer), Thobeka Ntshingila (Quality Manager: Laboratory), and Vanessa Koagile (Senior Officer: Laboratory) resigned in 2023. We wish them all the best.

RESEARCH OUTPUTS

Research Articles

Abro, K.A. & Atangana, A. 2023. Simulation and dynamical analysis of a chaotic chameleon system designed for an electronic circuit. *Journal of Computational Electronics* 22: 1564-1575.

Abro, K.A., Atangana, A. & Gomez-Aguilar, J.F. 2023. Optimal synchronization of fractal–fractional differentials on chaotic convection for Newtonian and non-Newtonian fluids. *European Physical Journal: Special Topics* 232: 2403-2414. doi.org/10.1140/epjs/s11734-023-00913-6.

Abro, K.A. Siyal, A. & Atangana. A. 2023. Strange Fractal Attractors and Optimal Chaos of Memristor–Memcapacitor via Non-local Differentials. *Qualitative Theory of Dynamical Systems* 22(156). doi.org/10.1007/s12346-023-00849-1.

Abro, K.A., Siyal, A., Atangana, A. & Al-Mdallal, Qasem M. 2023. Analytical solution for the dynamics and optimization of fractional Klein–Gordon equation: an application to quantum particle. *Optical and Quantum Electronics* 55(704). doi.org/10.1007/s11082-023-04919-1.

Alharthi, N.H., Atangana, A. & Alkahtani, Badr.S. 2023. Analysis of Cauchy problem with fractal-fractional differential operators. *Demonstratio Mathematica* 56(1). doi.org/10.1515/dema-2022-0181.

Atangana, A. 2023. Some stochastic chaotic attractors with global derivative and stochastic fractal mapping: Existence, uniqueness and applications. *Mathematical Methods in the Applied Sciences* 46(7). doi.org/10.1002/mma.7262.

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Atangana, A. & Igret Araz, S. 2023. A successive midpoint method for nonlinear differential equations with classical and Caputo-Fabrizio derivatives. *AIMS Mathematics* 8(11): 27309-27327. http://dx.doi.org/ 10.3934/math.20231397.

Atangana, A. & Khan, M.A. 2023. Analysis of fractional global differential equations with power law.

Atangana, A. & Mishra, J. 2023. Analysis of nonlinear ordinary differential equations with the generalized Mittag-Leffler kernel. *Mathematical Biosciences and Engineering* 20(11): 19763-19780. doi.org/10.3934/mbe.2023875.

Atangana, A. & Morakaladi, M.I.C. 2023. Mathematical model for conversion of groundwater flow from confined to unconfined aquifers with power law processes. *OPEN Geosciences*. doi.org/10.1515/geo-2022-0446.

Djilali, S., Bentout, S., Touaoula, T.M. & Atangana, A. 2023. Threshold dynamics for an age-structured heroin epidemic Model with distributed delays. *Mathematical Methods in the Applied Sciences* 46(13): 13595-13619. doi.org/10.1002/mma.9275.

Fourie, F.D., Huber, M.S., Kovaleva, E. & Clark, M.D. 2023. Shallow depth extent of the Lesutoskraal granophyre dike in the Vredefort impact structure: Geophysical surveys and trenching data. *Meteoritics & Planetary Science* 58(9): 1345-1364. doi.org/10.1111/maps.14065

Gomo, M. 2023. On the use of late-time drawdown in interpreting aquifer pumping test.

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Morakaladi, M.I.C. & Atangana, A. 2023. Model of conversion of flow from confined to unconfined with the generalized Mittag-Leffler process. *Journal of African Earth Sciences* 197: 104753. doi.org/10.1016/j.jafrearsci.2022.104753.

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Welman-Purchase, M. & Chiweshe, T.T. 2023. Fusion Extraction of Base Metals. (Al, Cr, Fe, Ti and V) Using Ammonium Phosphate Salt as Flux. *Crystals* 13(5). doi.org/10.3390/cryst13050784.

Books

Atangana, A. & Akgűl, A. 2023. *Integral Transforms and Engineering. Theory, Methods, and Applications*. CRC Press.

Khan, M.A. & Atangana, A. 2023. *Numerical Methods for Fractal-Fractional Differential Equations and Engineering: Simulations and Modeling*. CRC Press.

Conference Contributions

Conference Papers

Clark. M., Kovaleva, E., Huber M. & Fourie, F. 2023. *Emplacement dynamics of impact melt dikes: evidence from the Lesutoskraal Pavement, Vredefort, South Africa, derived from high-resolution unmanned aerial vehicle orthophotography*. Paper delivered at Geocongress 2023, Stellenbosch, South Africa. 11-13 January 2023.

Saveca, P.S.L, Stigter, T.Y., Fourie, F. & Lukas, E. 2023. *Groundwater potential and lateral connectivity of the Limpopo sand river system mitigating water scarcity and salinity in semi-arid Mozambique*. Paper delivered at the 50th IAH Congress. Cape Town, South Africa. 18-22 September 2023.

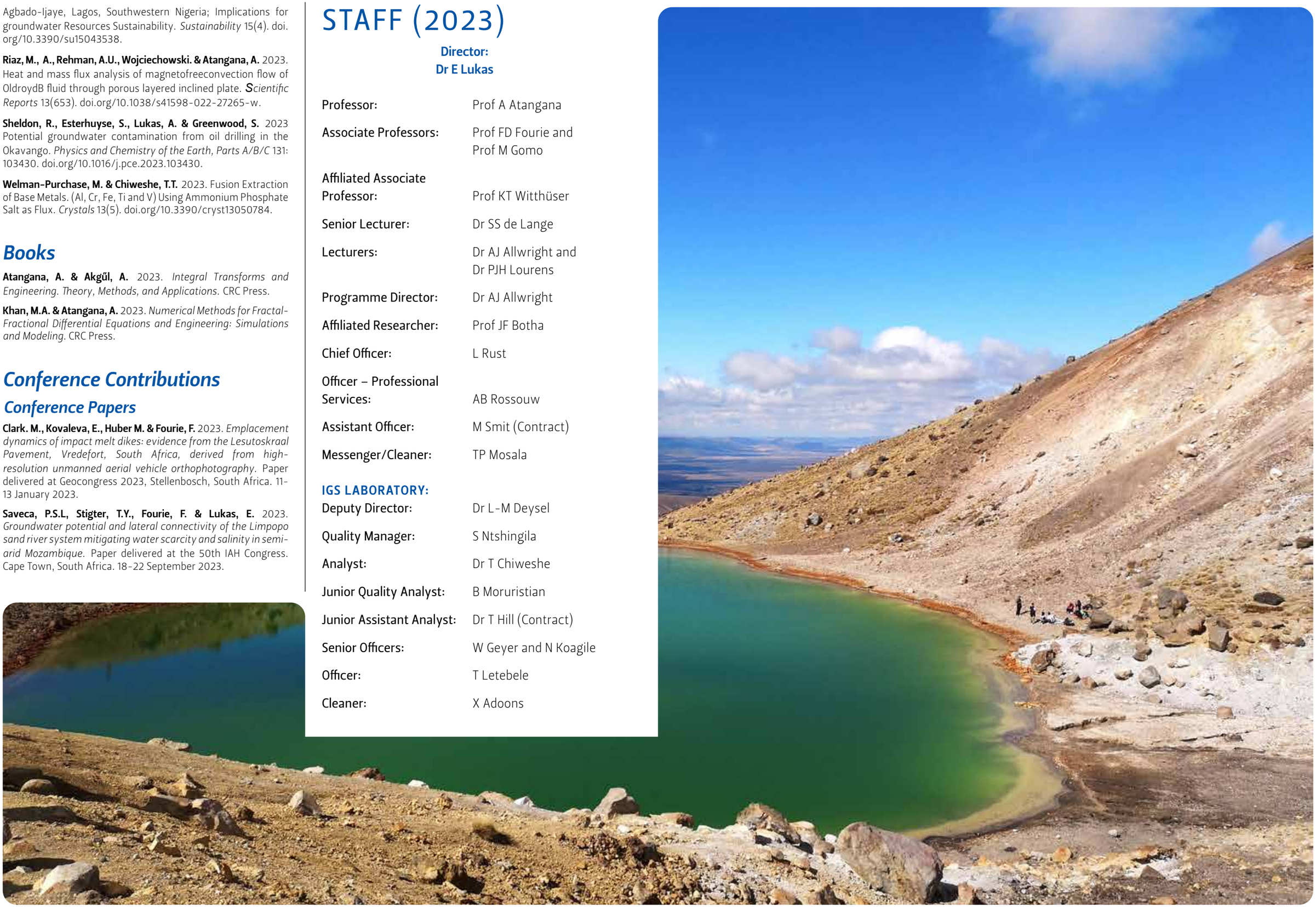
STAFF (2023)

Director:
Dr E Lukas

Professor:	Prof A Atangana
Associate Professors:	Prof FD Fourie and Prof M Gomo
Affiliated Associate Professor:	Prof KT Witthüser
Senior Lecturer:	Dr SS de Lange
Lecturers:	Dr AJ Allwright and Dr PJH Lourens
Programme Director:	Dr AJ Allwright
Affiliated Researcher:	Prof JF Botha
Chief Officer:	L Rust
Officer – Professional Services:	AB Rossouw
Assistant Officer:	M Smit (Contract)
Messenger/Cleaner:	TP Mosala

IGS LABORATORY:

Deputy Director:	Dr L-M Deysel
Quality Manager:	S Ntshingila
Analyst:	Dr T Chiweshe
Junior Quality Analyst:	B Moruristian
Junior Assistant Analyst:	Dr T Hill (Contract)
Senior Officers:	W Geyer and N Koagile
Officer:	T Letebele
Cleaner:	X Adoons



UFS **PARADYS** EXPERIMENTAL **FARM**

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

2023 was a very exciting year for the UFS Paradys Experimental Farm as we partnered with various companies in expanding the production capacity. Lindsay Zimmatic sponsored a new pivot for crop production, while Limagrain sponsored maize seed. This is to produce yellow maize and silage as feed for the animals on the farm, as well as for research purposes. This expanded our crop production area by another 15 hectares.

Twenty-five pregnant first lactation Jersey cows were purchased for the dairy to supply enough A2 milk to the dairy processing unit. We also procured walls for our silage bunker to increase the quality of silage we produce for our animals. This helps to prevent spoilage and to increase the longevity of the silage. The pig unit is currently undergoing renovations to create a state-of-the-art demonstration unit that is in line with what the pig industry requires. This unit will serve as baseline for production, training, and research.

Our cattle enterprise had a conception rate of 75% for the cows and 85% for the heifers. The total stud herd consists of 100 cows in production and a commercial herd of 50 production cows. Our dairy grew to 65 animals with 40 cows in milk and 30 replacement heifers.

The sheep had a conception rate of 86% and lambing percentage of 90%. The flock consists of 580 ewes in production.

RESEARCH AND INNOVATION

The UFS Paradys Experimental Farm has established a committee to oversee operations currently underway on the farm. This committee serves to streamline current research and development and manage key stakeholder relationships. The committee also oversees research conducted on the farm to ensure synergy between projects and provide assistance with the management of day-to-day activities and infrastructure.

Various ongoing research trials were conducted on the farm, such as:

Collection of data on the Afrikaner cattle breed

The data collected on this herd includes fertility information such as the age at which the animals reach puberty, the average fertility of the herd, as well as the growth information. All the animals are weighed regularly, and the information is used to analyse the quality and quantity of veldt fed beef. The animals are also given various production lick treatments to determine the effect this has on their growth and feed conversion as well as their gestation period. DNA is collected from all the animals born on the farm, in order to investigate genetic markers for growth, milk quality and quantity, weaning weight, maternal and reproductive traits.

Afrikaner heifers waiting for lick

The Afrikaner herd on the farm also acts as a genetic baseline for the Afrikaner breed as they are very genetically diverse and well adapted to the environment. Animals that were sold from the UFS Paradys Experimental Farm have adapted extremely well to other areas of the country, which is very rare. The Afrikaner as maternal line was investigated by crossbreeding them with Simmentaler and Simbra bulls. This was done to increase the weaning weight of the calves and provides an alternative market for selling weaners to feedlots. Currently an Angus bull is used as part of our terminal crossbreeding programme and the opportunity to evaluate some Afrigus cattle. The main herd has been selected to improve fertility and growth of the calves (higher weights), thereby ensuring optimal producing animals.

Collection of data on the dairy herd

The automated system in the dairy collects data on several trials that include daily milk production, weight of the animals twice a day, physical activity, and animals possibly on heat. By using artificial insemination (AI), respectable inter-calving periods and outstanding genetics are ensured. Also collected are the feed to milk conversion, the feeding of production animals for cost effective milk production, and the feeding of calves for early weaning and rapid growth.

Feeding trials on cattle and sheep

Since the Department of Animal Science obtained a GrowSafe automated feeding and weighing system on the UFS Paradys Experimental Farm, a few trials have been conducted.

Calibration of cattle prior to GrowSafe trial

For feedlot purposes, different types of feed are tested on the lambs to research the effect this has on the growth of the animals and feed conversion (amount of weight gained / amount of feed ingested). The feeding of bulls for slaughter is monitored in order to research the economic viability of feeding Afrikaner bulls for slaughter and determining their feed conversion. The animals on the farm are given various types of production supplements to research the effect on the animal's growth and condition and to determine the economic feasibility of supplementation during the winter.

Crop production trials

Various crop production trials are conducted on the UFS Paradys Experimental Farm, including the production of yellow maize under irrigation for increased yields. Sorghum and maize are planted under dry land conditions and under irrigitation to produce silage and to compare the cost effectiveness and quality of both sorghum and maize produced under different conditions. Sorghum is planted with various seed treatments to determine whether this has an effect on growth and production. Seed for all the trials is sponsored by Limagrain.

Germination of seed sponsored by Limagrain under Zimmatic pivot

Production Units

Kovsie Fermentation Institute

The installation of the Kovsie Fermentation Institute was completed at the end of 2023 and a test run was completed shortly thereafter. Several small issues with the system were identified and, once rectified, production should commence in early 2024. A canning and kegging plant as well as an additional fermenter were also acquired for the institute.

From the left, Barry Crous and Mark Jackson in the Kovsie Fermentation Institute

Canning line in the Kovsie Fermentation Institute

The recently acquired kegging plant in the Kovsie Fermentation Institute

Dairy Processing Unit

During 2023, the Dairy Processing Unit continued to process all the raw milk produced by the Jersey herd on the farm into dairy products, including full cream semi-hard natural cheese, full cream yoghurt, and Amasi. Almost 85 000 litres of milk were processed by the Paradys Dairy Processing Unit into almost 10 tons of cheese, nearly 1.6 tons of yoghurt, and 300kg of Amasi.

The dairy processing team was also expanded to five members during 2023. Food safety training is provided to the members to ensure they understand food safety and the importance of producing high-quality and safe food for the consumer.

The dairy cow herd was increased so that 40 cows were in milk, yielding higher amounts of daily production. The high butterfat and high solid content of the Jersey cow milk make for high-quality cheese and a high cheese yield. The full cream milk of the Jersey cows is not standardised but used as is, meaning Paradys Dairy Products have a high butterfat content compared to most commercial cheeses, full cream yoghurts, and Amasi.

New Jersey cows

The herb cheese range, consisting of eight different herb flavours (chilli, cumin, black pepper, bell pepper, caraway seeds, fenugreek, garlic, and onion) produced in round wheels of 4kg, was expanded to include two new flavours – coriander and biltong.

Herb cheeses

The yoghurt is provided as plain, vanilla, fruit cocktail, and pear caramel, and will soon be expanded to include strawberry and guava flavours.

Three health shops placed their trust in Paradys Dairy Products as we strive to provide as natural and healthy dairy products as possible. Also, our Jersey milk has the advantage of only A2 proteins, which provide better digestibility and fewer allergies to the consumer.

Small groups of students from the Department of Animal Science attended weekly practicals at the Dairy Processing Unit, which gave them hands-on training and experience in cheese and yoghurt

making and an appreciation of the world of milk processing. The Dairy Processing Unit also received regular visits from other departments of the University, groups outside of the University, home-schooling groups, as well as visitors from other countries.

During the annual Higher Education Facility Management Association (HEFMA) Conference held in October 2023 and hosted by the UFS Estates, Paradys Dairies was invited to be part of the function and provide a cheese festive table to the congress attendees.

Festive cheese table provided to delegates of HEFMA

Paradys Greenhouse

Plans for the establishment of the Paradys Greenhouse are progressing and requests for information (RFI) from industry have been completed. An off-grid solar system is to be installed and a tender process is expected to be launched at the end of February 2024, with building to commence in June 2024.

Science and Innovation Park

We are currently busy with the formalisation for funding for a laboratory setup. The current projects for incubation include a mushroom growth facility (Department of Genetics), the Paradys Insect R&D Farm (Department of Zoology and Entomology) and a SMART growth unit (Estates and UFS Paradys Experimental Farm collaboration)

Pig Production unit

The renovation of the old facility is nearing its completion, with additional equipment to be acquired pending industry partner inputs.

Pecan orchard

Dead trees are being replanted and the orchard is being enlarged.

Innovation on UFS Paradys Experimental Farm

In an effort to create a platform for the generation of third stream revenue, the Faculty has made significant investments in the transformation of the UFS Paradys Experimental Farm over the last five years. This highlights the Faculty's commitment to conduct research that has impact and is relevant to our agricultural and industrial partners, and to teaching and learning that is at the forefront of new developments in these fast-growing industries.

The activities on the farm are at the foreground of innovation and industry practice, using state-of-the-art equipment in collaboration with our external partners. The innovations at the UFS Paradys Experimental Farm have led to the creation of several innovative products and services and there is a growing demand for the commercialisation of these products and services by external stakeholders.

ACADEMIC CITIZENSHIP AND COMMUNITY ENGAGEMENT

The UFS Paradys Experimental Farm is committed to the community. As in previous years, various training courses are presented to the community – such as the correct handling of animals, breeding goals, vaccinations of animals, branding and marking of animals, stockmanship, practical days for schools, and short courses.

Several farmers' days were held on the farm for the general public and students for awareness, information about certain goods and services, and marketing, including lucerne (crop for cultivated pastures), pig production, branding of animals, agricultural engineering (irrigation systems), feed catalogue (various feeds and supplying companies), and an animal health week.

The Wool Processing Unit is increasingly active in community engagement, providing training and making products.

Bags made by the Wool Processing Unit

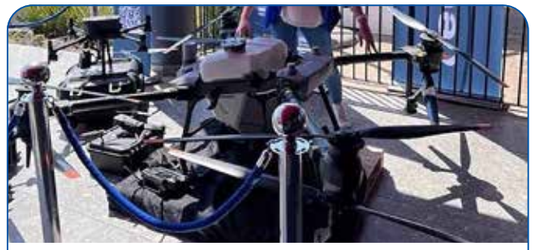
NATIONAL AND INTERNATIONAL COLLABORATION

The UFS Paradys Experimental Farm secured several key sponsorships and collaborative agreements in 2023, the most notable are:

- LimaGrain sponsored the seed that was planted on the farm during this season. Additionally, research trials were launched for the growth of animal feeds from sorghum and maize. The research trials are exceeding industry expectations and the UFS Paradys Experimental Farm will be evaluating the quality of the feed using cutting-edge research equipment to measure the impact on animal growth. Follow-up sponsorships and research trials have also been secured for the next growth season.

Sponsored seed by LimaGrain

- Rectron/DJI launched the Agricultural Drone Project entailing trials and training for industrial applications. The UFS Paradys Experimental Farm secured a sponsorship of an agricultural drone for exclusive use on the farm for research and applications in Agronomy and for teaching activities related to making sense of large agricultural data sets.



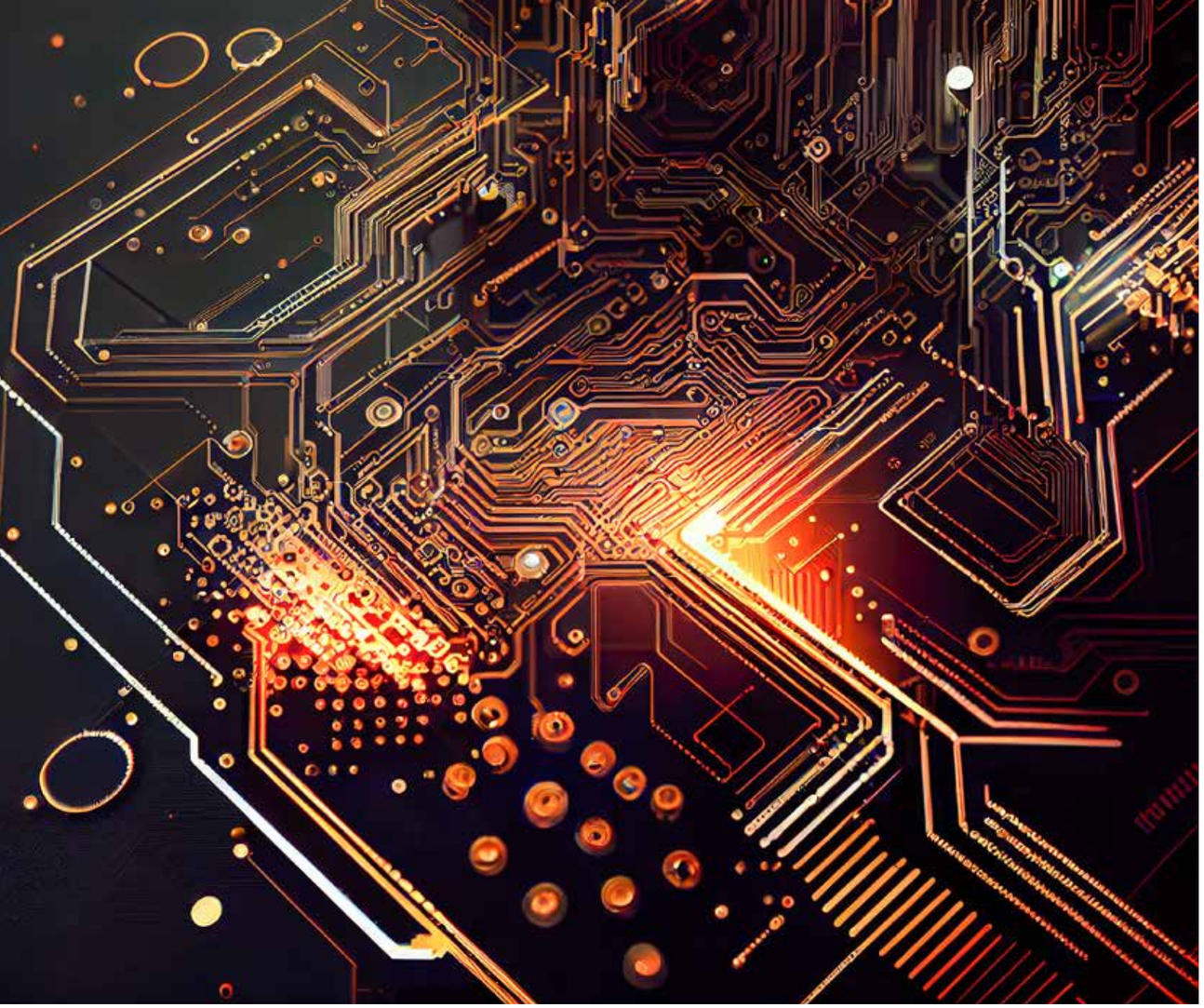
Agricultural Drone Project launched by Rectron/DJI

STAFF (2023)

Farm manager:
J Barnard

Lecturer:	Dr L Krüger
Research Assistants:	K Sibande, L Chavula and M Mokoena
Senior Assistant Officer:	AM Smith
Assistant Officers:	R Papa and K Salamane
Farm Workers:	TF Kubheka, LE Maqala, B Mateyesi, YS Motswari, KP Ramatekoane, J Soato and PM Somi

ACADEMIC
SUPPORT DIVISION



ELECTRONICS DIVISION

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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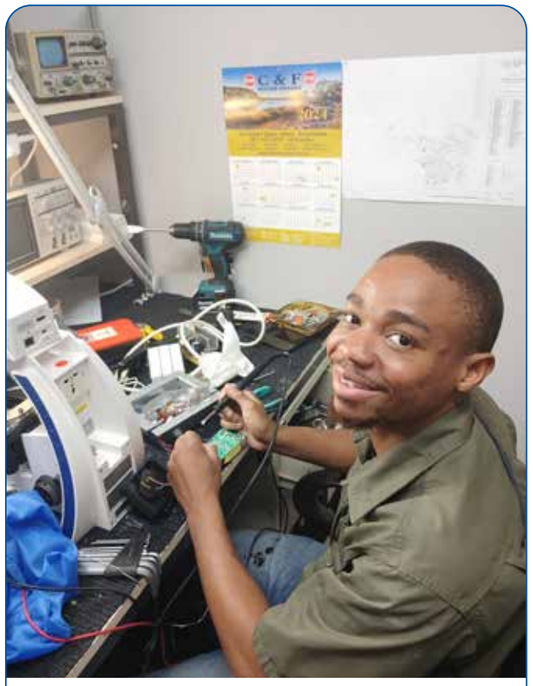
OVERVIEW OF 2023

2023 was a busy year for the Electronics Division. We received 27% more work requisitions than the previous year. The new personnel members adapted well to our environment and they are making good progress, although they still have much to learn. Alicia Kasper resigned in December and will be joining the Business School in February 2024. She will be missed, and we wish her luck with her future endeavours.

The Brewery project was successfully completed and the first brew produced. A few improvements still need to be made. We are looking forward to seeing the Brewery in full production. The scope of electronic work has changed over the years. We are seeing more and more consumer electronics sent to us for repairs (such as coffee machines, ice machines, washing machines, and dishwashers) and not just laboratory and research equipment. Previously repairs like these were sent to the electrical workshop and if they were unable to fix them, these appliances would be sent to outside companies. Many of these companies have closed down and we are being asked to repair these appliances as it is still more economical than to replace them.

WORK ACTIVITIES

A total of 639 work requisitions were received in 2023, representing 650 pieces of apparatus. Twenty-one (21) of these requisitions were for development and installation projects. Some were new and others were extensions of existing systems, as well as the upgrading of older systems, as shown in Tables 2 and 3. Of a possible 8 153 working hours (based on 7.5 hours per day per person present), 7 081 were actively used (i.e. 85.85%).



Elias Liee repairing a microscope

Table 1 illustrates the time spent on work for the 45 departments, divisions, and others that made use of the services of the Electronics Division in 2023.

Table 1: Use made of the Electronics Division (2023)

Client	Total Time Spent (Hours)	% Time Spent
1. Chemistry	875	12.36%
2. University Estates	815	11.51%
3. Physics	803	11.34%
4. Protection Services	740	10.45%
5. Microbiology	590	8.33%
6. Electronics	383	5.41%
7. Soil, Crop and Climate Sciences	337	4.76%
8. Animal Sciences	307	4.34%
9. Plant Sciences	210	2.97%
10. Geography	188	2.65%
11. Outside firms	170	2.40%
12. Office of the Dean of Natural & Agricultural Sciences	168	2.37%
13. Geology	162	2.29%
14. Institute for Groundwater Studies	154	2.17%
15. Brewery	132	1.86%
16. Architecture	115	1.62%
17. South African Doping Control Laboratory (SADoCol)	102	1.44%
18. Virology	72	1.02%
19. Microscopy	69	0.97%
20. Computer Science & Informatics	65	0.92%
21. Internal Administration	49	0.69%
22. Technical	48	0.68%
23. Mathematics & Applied Mathematics	47	0.66%
24. Engineering Sciences	45	0.64%
25. Geology	44	0.62%
26. Zoology and Entomology	43	0.61%
27. City and Regional Planning	40	0.56%

Client	Total Time Spent (Hours)	% Time Spent
28. Centre for Environmental Management	40	0.56%
29. Agricultural Economics	39	0.55%
30. Instrumentation	34	0.48%
31. Sustainable Food Systems & Development	31	0.44%
32. Drama and Theatre Arts	28	0.40%
33. Pharmacology	26	0.37%
34. Kovsie ACT	24	0.34%
35. Genetics	20	0.28%
36. Sport Sciences	16	0.23%
37. Office of the Dean Qwaqwa	12	0.17%
38. Science for the Future	9	0.13%
39. Industrial Psychology	7	0.10%
40. Haematology and Cell Biology	6	0.08%
41. Centre for Mineral Biochemistry	4	0.06%
42. Human Molecular Biology Unit	4	0.06%
43. National Control Laboratory	3	0.04%
44. Frik Scott Library	3	0.04%
45. Facilities Management	2	0.03%
Total	**5 215**	**100.00%**

A total of 6 017 hours was spent on maintenance (84.97%), 1 015 hours on development projects and installations (14.33%), and 49 hours on administration (0.7%).

Mark Jackson cutting PC boards

Work for the Faculty of Natural and Agricultural Sciences (NAS) amounted to 5 006 hours (70.70%), while 2 075 hours (29.30%) were spent on work for departments/divisions outside the Faculty.

The table below provides information on the projects completed in 2023 per department/division.

Table 2: Completed projects (2023)

Department/Division	Apparatus
Chemistry	1 x Strength Tester 1 x 2 Point Access Control upgrade - Biolab 1 x Door alarm/bell 1 x 4 Point Access Control upgrade - Clear view gates
Centre for Environmental Management	1 x Upgrade to Security Camera system
Centre for Microscopy	1 x TEM water chiller temperature monitor/alarm
Health Sciences	1 x Video Intercom
Office of the Dean (NAS)	1 x Completion of Brewery project 1 x Installation of security camera and alarm systems at Brewery
Physics	1 x Programmable water flow meter for deposition system 1 x Lighting system for Boyden museum
Plant Sciences	1 x Installation of security camera system at Climate Cabinet Building
Soil, Crop and Climate Sciences	1 x Rainfall Simulator 1 x Upgrade to manure bed experiment
University Estates	1 x 4 Point Access Control upgrade - Chemistry 1 x Boom gate Installation at Estates University Parking 1 x Boom gate Installation at Benito Kgotseng Building 1 x Solar Boom gate Installation at Pharmacology 2 x Boom gate Installation at Health Sciences parking 1 x 23 Point Access Control upgrade - Physics
Virology	1 x Installation of video intercom

By the end of 2023, there were five unfinished projects.

Table 3: Unfinished projects (2023)

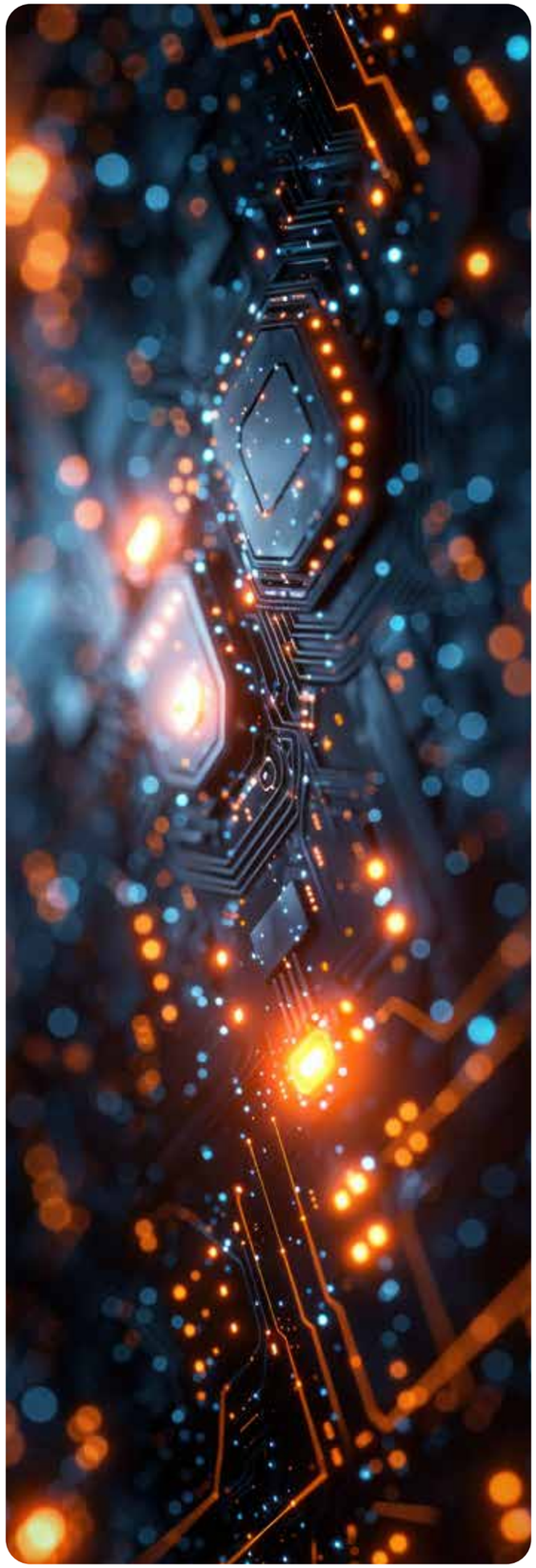
Department/Division/Campus	Apparatus
Centre for Microscopy	1 x TEM gas alarm system
Microbiology and Biochemistry	1 x O2 Monitor
Physics	1 x Microscope multi-colour ring light
Faculty of Health Sciences	1 x Fridge alarm for 4 fridges with remote monitoring
Soil, Crop and Climate Sciences	1 x Climate control of 4 mini tunnels

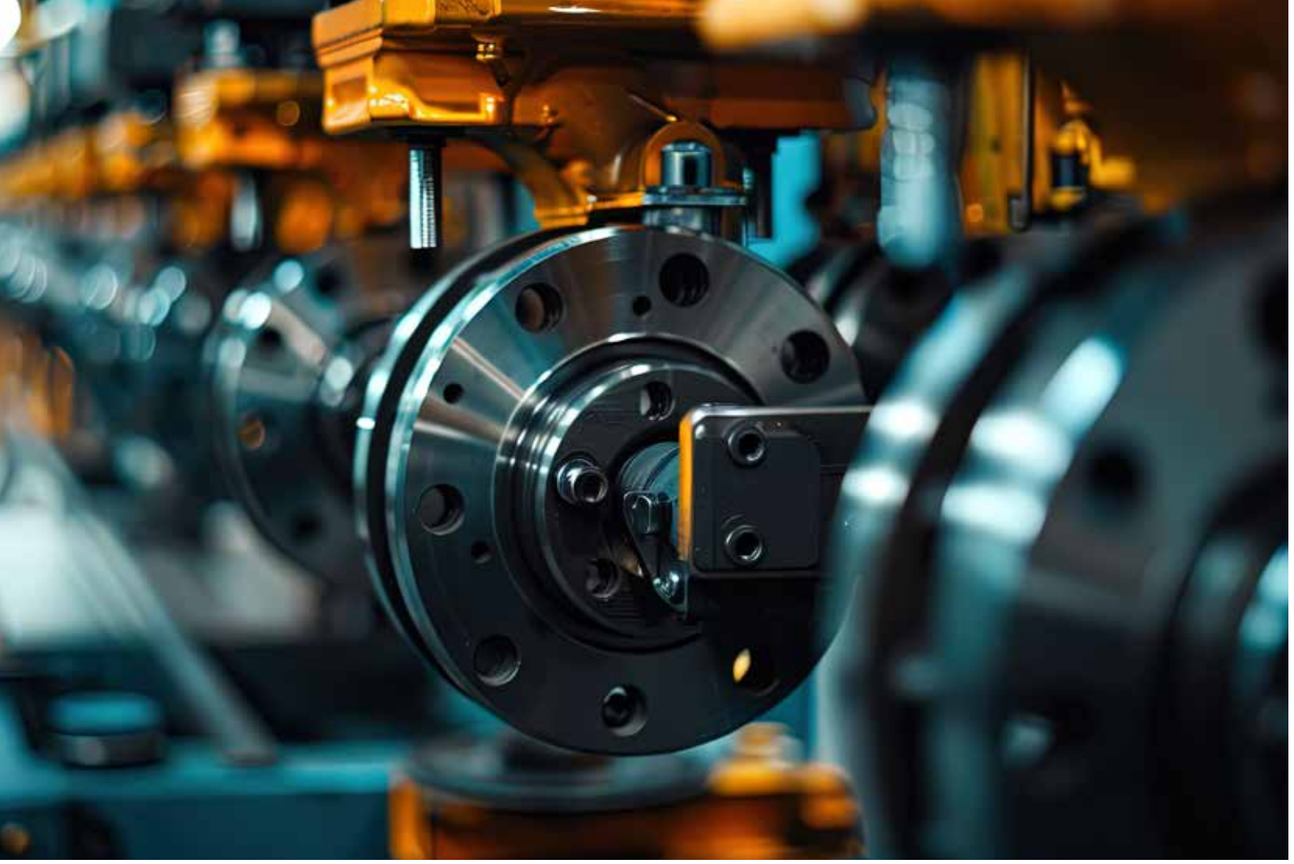
Virgil Afrikaner

STAFF (2023)

Head of Division:
I Basson

Assistant Head:	MH Jackson
Control Technician:	HJ Roodt
Technicians:	V Afrikaner and E Liee
Technical Assistant:	D de Koker
Secretary:	A Kasper (shared with the Instrumentation Division)





INSTRUMENTATION DIVISION

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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OVERVIEW OF 2023

2023 was a prosperous year for the Instrumentation Division. A couple of projects were successfully completed during the year, including the Brewery at the UFS Paradys Experimental Farm. A second fermenter, bottling and canning plant were bought and will be installed early in 2024.

Financially the Division is in a better position as the loan for the new CNC equipment was paid off. This provided the opportunity to buy new tools as the hand tools were old and in a bad condition. This will be an ongoing process as funds allow. We were able to buy a High Definition CNC Plasma cutter, which, although an expensive piece of equipment, will bring about huge savings for the University. It will pay for itself in no time as its running and cutting costs are much cheaper than that of the waterjet. The waterjet will remain an important piece of equipment, but in future it will mainly be used for non-ferrous cutting. I would like to thank all members of the team for their contribution that made the purchase of this instrument possible.

Alicia Kasper resigned in December and will be joining the Business School from 1 February 2024. She will be missed and we wish her luck with her future endeavours.

WORK ACTIVITIES

A total of 639 work requisitions were received in 2023 of which 26 were projects. Some were new projects and others were upgrades to older instruments and apparatus as reflected in Table 2. Of a possible 8 229 working hours (based on 7.5 hours per day per person present), 6 724 hours were actively used (i.e. 81.71%).

Table 1 below illustrates the time spent on work for the 39 departments, divisions, and others that made use of the services of the Instrumentation Division in 2023.

Table 1: Use made of the Instrumentation Division (2023)

Client	Total Time Spent (Hours)	% Time Spent
1. Physics	879	13.07%
2. Office of the Dean (NAS)	850	12.64%
3. Instrumentation	763	11.35%
4. Brewery	485	7.21%
5. Chemistry	459	6.83%
6. Soil, Crop and Climate Sciences	402	5.98%
7. Outside firms	369	5.49%
8. nimal Science	348	5.18%
9. Microbiology	328	4.88%
10. Science for the Future	200	2.97%
11. Institute for Groundwater Studies	197	2.93%
12. Sustainable Food Systems & Development	193	2.87%
13. Plant Science	151	2.25%
14. South African Doping Control Laboratory (SADoCoL)	130	1.93%
15. Centre for Environmental Studies	104	1.55%
16. Electronics	96	1.43%
17. Geology	92	1.37%
18. Engineering Sciences	89	1.32%
19. Kovsie ACT	73	1.09%
20. Internal Administration	54	0.80%
21. Centre for Microscopy	53	0.79%
22. Zoology and Entomology	52	0.77%
23. Virology	50	0.74%
24. Health Sciences	42	0.62%
25. Finance	40	0.59%
26. Pharmacology	40	0.59%
27. Exercise and Sport Sciences	35	0.52%
28. Medical Physics	34	0.51%
29. National Control Laboratory (NCL)	29	0.43%
30. Technical	28	0.42%
31. Genetics	21	0.31%
32. Provisioning	11	0.16%
33. Drama & Theatre Arts	7	0.10%
34. Economic & Management Sciences	6	0.09%
35. Theology & Religion	4	0.06%
36. Animal Research Centre	4	0.06%
37. Centre for Mineral Biochemistry	2	0.03%
38. University Estates	2	0.03%
39. Protection Services	2	0.03%
Total	**6 724**	**100.00%**

Lucas Odendaal (second from right) and Wicus Storm (right) with staff of the Department of Sustainable Food Systems and Development

Work for the Faculty of Natural and Agricultural Sciences (NAS) amounted to 5 616 hours (83.52%). A total of 1 180 hours (16.48%) was spent on work for departments/divisions outside the Faculty.

The table below provides a list of the completed projects in 2023 per department/division.

Table 2: Completed projects (2023)

Department/Division	Apparatus
Animal Science	1 x Roof for Growsafe project 1 x Rebuild fertilizer spreader
Basic Medical Sciences	3 x Skeleton stands
Centre for Environmental Management	4 x Tilting Retort stands
Centre for Microscopy	1 x Disassembled exhibition of TEM for demonstration purposes
Chemistry	1 x Tensile strength tester
Finance	1 x Rebuild rake for Lila Theron Trust
Genetics	13 x Insect catcher stand
Institute for Groundwater Studies	Camera box for borehole camera
Kovsie Act	10 x Alterations to ECO vehicles
Microbiology & Biochemistry	1 x Electric roll sift 1 x Stainless steel water distiller 8 x Refurbishing of shelf trolleys 1 x Steam sterilization tank 1 x Bag hoist on gantry
Office of the Dean (NAS)	3 x Roofing at Cheese Factory 1 x Completion of Brewery 1 x Roofing at piggery
Physics	1 x Upgrade to 60" Telescope balancing system 1 x Mini dome upgrade 1 x Giant Buzz wire for open day exhibit 1 x Floating head exhibit for open day
Science for the Future	1 x Sundial
Soil, Crop and Climate Sciences	1 x Rainfall Simulator 1 x Rebuild Mower 1 x Sediment filter for wet wall
Sustainable Food Systems & Development	1 x Rebuild of old felt making machine
Technical	2 x Rebuild extraction fans

Sandile Lethuli working on the HAAS Mill

The unfinished projects at the end of 2023, are reflected in Table 3 below.

Table 3: Unfinished projects (2023)

Department/Division	Apparatus
Science for the Future	1 x Pelton wheel 1 x Archimedes screw
Sustainable Food Systems & Development	1 x Manufacturing of roller felt machine
Virology	1 x Upgrade to BSL waste management system

Petrus Matlawane (left) and Wicus Storm

STAFF (2023)

Head of Division:
I Basson

Assistant Head:	BJ Crouse
Control Technicians:	NJ Kruger, S Lethuli and L Odendaal
Technical Assistants:	P Matlwane and WJR Storm
Technical Aide:	L Mokoena
Secretary:	A Kasper (shared with the Electronics Division)

ACKNOWLEDGEMENTS

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University of the Free State

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NATURAL AND
AGRICULTURAL SCIENCES

UFS