

ANNUAL REPORT 2022



“Water: The **elixir of life**, nourishing the **depths of discovery**”

VISION **130**
*Renew and Reimagine
for 2034*

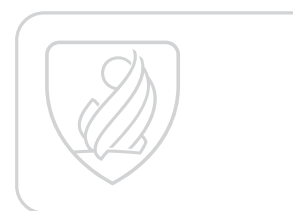
UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA



UFS
NATURAL AND
AGRICULTURAL SCIENCES

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

ANNUAL **REPORT**
20**22**



FACULTY CONTACT DETAILS

DEAN

PROF DANIE VERMEULEN
+27 51 401 2322
vermeulend@ufs.ac.za

VICE-DEAN: TEACHING AND LEARNING

PROF LIEZEL HERSELMAN
+27 51 401 2514
HerselmanL@ufs.ac.za

VICE-DEAN: RESEARCH AND POSTGRADUATE STUDIES

PROF SAMUEL ADELABU
+27 51 401 9927
AdelabuSA@ufs.ac.za

VICE-DEAN: AGRICULTURE

PROF JOHAN VAN NIEKERK
+27 51 401 3765
VniekerkJA@ufs.ac.za

ASSISTANT DEAN: QWAQWA CAMPUS

PROF ALIZA LE ROUX
+27 58 718 5327
LeRouxA3@ufs.ac.za

MARKETING MANAGER

ELFRIEDA VAN DEN BERG
+27 51 401 2531
vdberge@ufs.ac.za

TEACHING AND LEARNING MANAGER

ELZMARIE OOSTHUIZEN
+27 51 401 2934
oosthuizenem@ufs.ac.za

FACULTY MANAGER

TRACY ISAACS
+27 51 401 9423
Isaacstl@ufs.ac.za

PHYSICAL ADDRESS

Room 9A, Biology Building,
Bloemfontein Campus

POSTAL ADDRESS

University of the Free State
PO Box 339
Bloemfontein
9300
South Africa



NATURAL AND AGRICULTURAL SCIENCES

UFS

www.ufs.ac.za/nas

FOREWORD 4

Message from the Dean

AGRICULTURAL SCIENCES 8

Agricultural Economics 10
Animal Science 18
Soil, Crop and Climate Sciences 33
Sustainable Food Systems and Development 46

BUILDING SCIENCES 60

Architecture 62
Quantity Surveying and Construction Management 70
Urban and Regional Planning 80

NATURAL SCIENCES 88

Chemistry 90
Computer Science and Informatics 116
Engineering Sciences 128
Genetics 136
Geography 148
Geology 166
Mathematical Statistics and Actuarial Science 178
Mathematics and Applied Mathematics 184
Microbiology and Biochemistry 192
Physics 206
Plant Sciences 228
Zoology and Entomology 260

ACADEMIC CENTRES 292

Centre for Environmental Management 294
Centre for Microscopy 312
Disaster Management Training and Education Centre for Africa 318
Institute for Groundwater Studies 330
UFS Paradys Experimental Farm 340

ACADEMIC SUPPORT DIVISIONS 346

Electronics Division 348
Instrumentation Division 352

FACULTY STATISTICAL DATA 356

ACRONYMS 364

FOREWORD

The theme of this year's publication is 'Water: The elixir (a magical potion) of life, nourishing the depths of discovery'. We also had to nourish the depths of discovery in our approaches. A while ago I read an extract from the novella, *The Penelopiad*, by Canadian author Margaret Atwood, published in 2005 as part of the Canongate Myth Series. She wrote "Water does not resist. Water flows. When you plunge your hand into it, all you feel is a caress. Water is not a solid wall, it will not stop you. But water always goes where it wants to go, and nothing in the end can stand against it. Water is patient – dripping water wears away a stone. Remember that, my child. Remember you are half water. If you cannot go through an obstacle, go around it. Water does." That is exactly what we advocate in the Faculty – if a tree stands in your way, do not walk into it, but walk

around it. And that is what COVID-19 taught us. The terrible pandemic did not stop us, and like water, we worked around the obstacles and today we bear the fruits of our hard work. We explored the depths of our ingenuity to adapt in a changing world. This attitude makes this Faculty great!

Water is life, and it is magical. Why is a tasteless and odourless substance so important to life? Most of our body is water and we can only survive about five days without it. Water plays many important roles in the body, including flushing waste from the body, regulating body temperature, transportation of nutrients and is necessary for digestion. Drinking more water improves your mood, keeps you energised, boosts the immune system, flushes out toxins and boosts your brain

power. Water is essential for agriculture (comprises the most substantial use, including irrigation agriculture, which accounts for as much as 80 to 90 percent of total human water consumption); washing (washing and then rinsing both body and clothing is an essential part of good hygiene and health); transportation; heat exchange (both for cooling and heating); recreation; water industry (the water industry provides drinking water and wastewater services, including sewage treatment, to households and industry); industrial applications (processes such as mining, chemical processes, textile production and cooling of power plants use large amounts of water and often cause significant water pollution); food processing (where water plays many critical roles within the field of food science); medical use; and even religious practices (water is considered a purifier in many religions). It is of huge importance so we as a Faculty spend a great deal of effort on water research and there are many different directions our research can take. We have the skill and knowledge to address most of these directions. Thus, for the next few years we must establish ourselves as a major role player in water research, both locally and internationally.

2022 was a year that fostered much innovation in the ways we approached the staff's academic mindset. All of this was learnt from the previous two years, during which we had to move out of our comfort zones and employ lateral thinking. Staff really became innovative in their teaching methods and focused on student success, as we moved away from narrow and outdated teaching strategies. A number of new approaches to teaching were initiated and I want to commend the staff who adopted these techniques.

In 2022, we continued with and improved on the previous years' high research output. We had another good year and the projections for 2023 look even better, and I thank all the staff for their dedication. We had remarkable success over the last two years with the strategy we developed to assist staff in obtaining doctoral degrees. Several

staff graduated in 2022 and more will graduate in 2023 and 2024. As the staff who complete their PhD degrees increases, so do their scholarly publications.

As stated previously, the NRF rating system benchmarks the quality of our researchers against the best in the world. The number of rated scientists increased in 2022 from 90 to 107, with 13 newly rated researchers (five emerging researchers in the Y-category and eight established researchers in the C-category). Eight re-evaluated applicants were added to the list of rated researchers in Natural and Agricultural Sciences. Most of the students who graduated with a PhD in 2022 were supervised by rated scientists, which is an indication that experience cannot be replaced. Several staff were rewarded for their hard work. Prof Liesl van As (Zoology and Entomology) was promoted to Professor. Associate Professor promotions included Errol Cason (Animal Science), Francois Deacon (Animal Science), Ralph Clark (Geography/Afromontane), Adre Minnaar-Ontong (Plant Sciences), Rouxlene van der Merwe (Plant Sciences), Sandy Steenhuisen (Plant Sciences), Gert Ceronio (Soil, Crop and Climate Sciences), Elmarie Kotze (Soil, Crop and Climate Sciences) and Jan Swanepoel (Sustainable Food Systems and Development). Nine staff members were also promoted to Senior Lecturer level.

Several initiatives commenced or were continued during 2022, including:

- Developments at the Paradys Experimental Farm are slowly reaching the point where the farm can be a showcase for the University. The Dairy Processing Unit is fully operational and started with the production of yogurt at the end of 2022. The Dairy Processing Unit is a training facility for UFS students and uses the latest Austrian Giovanelli cheese-making equipment. The sheep and cattle facilities were moved and upgraded and currently host the Canadian GrowSafe™ research programme. The irrigation system was upgraded to operate as a wireless system and the fermentation unit is nearing completion to be operational in 2023.

Prof Danie Vermeulen,
Dean of the Faculty of
Natural and Agricultural
Sciences



- At the Centre for Microscopy, the installation of the transmission electron microscope (TEM) was completed and is now fully operational. The JEOL JIB 4000PLUS FIB installation was completed in March and installation of the HRTEM continued through most of 2022, because the various attachments to the system are manufactured by different companies. The National Equipment Programme of the NRF enabled us to install a new, state-of-the-art confocal laser scanning microscope at the Centre for Microscopy. According to the main supplier, JOEL, this centre is now one of the best-balanced electron microscope centres in the world.
- The Geology Department acquired a JEOL JXA-iSP100 Electron Probe Microanalyser (EMPA), the first of its kind to be installed in South Africa.
- A major highlight of 2022 was the design and manufacture of the Lengau Solar car with which we competed in the 2022 Sasol Solar Challenge for the first time. The UFS team completed the race without any major break downs and did us proud.
- The Department of Computer Science and Informatics continued to upgrade the new postgraduate laboratory to a hybrid laboratory.
- Engineering Sciences (EnSci) opened a new laboratory for circular economy-related research projects in cement and concrete. The research focuses on advanced concrete technology, specifically on green concrete and eco-friendly cementitious systems. EnSci obtained endorsement from the Engineering Council of South Africa (ECSA) to start a full new engineering programme, BEng (Agricultural and Biosystems Engineering). We are progressing well with the Department of Higher Education and Training (DHET) and Council of Higher Education (CHE) to complete the requirements to start the new programme in 2025.
- The laboratories at the Centre for Environmental Management underwent renovations and were split into a more functional Dendrochronology Lab and a Water Lab.

- The building of the Centre for Mineral Biogeochemistry, which is a node of the DSI BIOGRIP project, was completed.

International collaboration is of great importance to the Faculty. When reading the report, it is noticeable how many staff actively collaborated with international universities, and several agreements were signed with other universities. Meetings with various embassies in South Africa also created opportunities for us.

Regarding curriculum improvement, the new BSc Agric and BAgric curricula were finalised and fully implemented in 2023. The Department of Soil Crop and Climate Sciences initiated the phased implementation of the new undergraduate curricula. The second-year curriculum started with a renewed Soil Fertility module and an entirely newly developed module on Crop Development. Preparations were also made to teach new modules in Horticulture at third-year level in 2023. In addition, groundwork has been laid for a major investment in a state-of-the-art greenhouse at Paradys Experimental Farm for teaching in horticulture and research purposes. The Department of Quantity Surveying and Construction Management had two successful programme accreditation visits from the South African Council for Quantity Surveying Professions (SACQSP) and the South African Council for Property Valuation Professions (SACPVP). The SACQSP granted full accreditation for five years and the SACPVP for four years for all the reviewed courses. Architecture had a departmental professional validation visit from the South African Council for the Architectural Profession (SACAP) validation board. The Department was granted an unconditional validation for five years in three professional degrees, namely BArch, BArchHons and MArch(Prof).

Although there were numerous achievements from staff and students, I want to highlight just a few:

- Prof Hendrik Swart, holder of the SARChI Chair on Solid State Luminescent and Advanced Materials, received the prestigious Havenga Prize for Physical Sciences, awarded annually by

the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (SAAWK).

- Prof Paul Oberholster became the latest academic from the University of the Free State to be elected as a Member (among 28 other UFS scholars and scientists) of the Academy of Science of South Africa (ASSAf).
- Prof John Carranza from Geology won the 2022 William Christian Krumbein Award, which was granted by the International Association for Mathematical Geosciences (IAMG) for his 'Outstanding Contributions to Mathematical Geosciences'.
- Jamie Paule has been appointed as Public Relations Officer for the Grassland Society of Southern Africa (GSSA).
- Prof Nico Smit received an honorary award at the 57th GSSA Congress for his contributions to the Society over the past 35 years.
- Johan Barnard received the UFS Community Engagement Award in acknowledgement of all the community engagement projects that were conducted on the Paradys Experimental Farm.
- Dr Elmarie van der Watt was elected as Secretary of the South African Society of Crop Production (SASCP).
- Prof Angelinus Franke served as Editor-in-chief of the *South African Journal of Plant and Soil* and he was also the convenor of the NRF panel awarding NRF-ratings in the field of Earth Sciences.
- Cameron Ferreira was elected as Senior Vice-President of the Association of South African Quantity Surveyors (ASAQS).
- Dr Mariëka Gryzenhout was awarded special membership of the Arab Society for Fungal Conservation.
- Lt Col Anton Lucassen from the South African Police Service (SAPS) was the first student to obtain a PhD in Forensic Genetics since the introduction of this qualification at the UFS in 2010.
- Dr Abraham Matamanda was appointed as the Editor of the *Town Planning Journal*.
- Prof Tomas Vetric was appointed as an Editor of the *Iranian Journal of Mathematical Chemistry*.
- Prof Maryke Labuschagne was selected for

the 7th Edition of Science by Women for Africa programme: Visiting Senior Research Fellowships in Spanish Centres of Excellence. She spent six months at the Institute for Sustainable Agriculture in Córdoba, Spain. Prof Labuschagne again served as Speciality Chief Editor for *Frontiers in Sustainable Food Systems* (division Crop Biology and Sustainability) and served on the editorial boards of *Cereal Chemistry* and *Journal of Cereal Science*.

- Dr Lisa Rothmann was elected and appointed as the President-Elect of the American Phytopathology Society: African Division.

During 2022, two senior staff members, Prof Nico Smit and Prof Maléne Campbell, retired and we wish them a well-earned rest. Two academic departmental heads stepped down. In Chemistry, Prof Walter Purcell will be succeeded by Prof Deon Visser and Prof Koos Albertyn succeeded Prof Martie Smit in Microbiology and Biochemistry. Prof Abiodun Ogundeji was appointed Director of the Disaster Management Training and Education Centre for Africa (DiMTEC). Welcome to the new members of the Faculty Management. With gratitude, I want to make special mention of Prof Jannie Swarts who managed the large equipment strategy of the Faculty for the past two decades. His contribution was instrumental in striving to be the best in the country and on the African continent.

It is my pleasure to present to you our 2022 Annual Report and extend my sincere gratitude to the staff and students for their selfless commitment to make this Faculty and University exceptional. In 2021, we emerged from the restrictions of the pandemic, and in 2022 everything returned to normal. Eleanor Roosevelt once said that "*The future belongs to those who believe in the beauty of their dreams*". Let us not just dream of future success, but believe and play an integral part in the greatness of our Faculty and the UFS. This annual report is a testimony of the greatness that we strive towards.

Enjoy it!

AGRICULTURAL
SCIENCES



DEPARTMENT OF

AGRICULTURAL ECONOMICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

Prof Frikkie Maré
Department of Agricultural Economics

**Faculty of
Natural and Agricultural Sciences**
University of the Free State
PO Box 339 | Bloemfontein 9300
South Africa

T: +27 51 401 2824
F: +27 51 401 3473
E: MareFA@ufs.ac.za
W: www.ufs.ac.za/agricecon



Prof Frikkie Maré



Prof Nicky Matthews



Prof Yonas Bahta

OVERVIEW OF 2022

The Department of Agricultural Economics performed well during 2022, publishing 26 scientific papers, and our postgraduate student numbers increased. One of our Associate Professors and a Teaching Facilitator left us during the year, but we managed to appoint two new Lecturers. The 2022 academic year proceeded very normally after the disruptions of the previous two years due to COVID-19. A highlight of 2022 was that most academic conferences returned to face-to-face events and staff members could attend some local and international conferences in Denmark and Namibia.

ACHIEVEMENTS

Staff Achievements

Two staff members in the Department were promoted at the beginning of 2022. Both Prof Frikkie Maré and Prof Nicky Matthews were promoted from Senior Lecturer to Associate Professor. Prof Yonas Bahta received a C2 National Research Foundation (NRF)-rating, which brought the total number of NRF-rated staff in the Department to three.

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

- Chairperson Trophy for Service to Department: Dr WA Lombard
- HA Kotze Trophy for Outreach: Prof B Grové
- Theo Potgieter Trophy for Farmer Outreach: Prof FA Maré
- MF Viljoen Trophy for Research: Prof YT Bahta
- CS Blynnaut Trophy for Teaching and Learning: L von Maltitz
- LK Oosthuizen Trophy for Community Service: Prof EW Zegeye

Student Achievements

Lindie von Maltitz and some postgraduate students from the Department attended the AgBiz Congress at Sun City from 22 to 24 June 2022. The students participated in a four-person team in the student



Ryno Schoeman, Lindie von Maltitz, Ruth Hadebe and Heinrich Kotzé at the Agbiz Congress

case study competition, facilitated by the University of Stellenbosch. Heinrich Kotzé was a member of the winning team. The team had to argue on the feasibility of investing in the Karoo lamb. Ruth Hadebe was awarded the prize for Best Presenter at the student case competition.

Ruth Hadebe, a Masters' student in Agricultural Economics, also won the Master's category in the Flash Fact Competition on 14 June 2022. Her study on the economic value of root accessible water table information, aims to convince irrigation farmers to use the root accessible water table information.

Grace Smythe won the category for the best MSc dissertation at the 59th Annual Conference of the Agricultural Economics Association of South Africa (AEASA), held in Swakopmund, Namibia, from 2 to 5 October 2022, while Heinrich Kotzé won the category for the best final BSc Agricultural Economics student.

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

- Student ambassador trophy: R Hadebe
- Student assistant trophy: GP Heppel

TEACHING AND LEARNING

The Department offers three undergraduate programmes – BSc Agricultural Economics, BAgri Agricultural Economics and BAgri 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 2022 centred around three broad themes:

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

Prof Henry Jordaan's research focus is on water use along agri-food value chains to inform the sustainable use of water for food and fibre production in South Africa. The team is currently busy with a project exploring the social and economic impact that will result if the behaviour of water users is changed with the aim to use water more sustainably.

Dr Walter van Niekerk's primary research focus in 2022 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 optimisation of production aspects. In 2022, he completed his PhD, titled 'An estimation of the downstream economic implications of predation in the red meat industry of South Africa'. The predation of livestock in South Africa, and globally, by damage-causing animals or predators is not uncommon. He published two related articles – 'Downstream Economic Implications of Predation in the South African Red Meat Industry' and 'Shepherding is not a shot in the dark: Evidence of low predation losses from the Northern Cape Province of South Africa'. His research interests also include understanding the factors affecting lucerne hay production profitability within the industry and related sectors.

Dr WA Lombard, Dr Walter van Niekerk and Prof Yonas Bahta were invited speakers at the 2022 Namibian Agricultural Outlook Conference, held from 4 to 6 October in Windhoek, Namibia, where they presented their research on livestock theft and predation.

Prof Yonas Bahta's research team focuses mainly on 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, one Master's student and one Honours student.

Prof Edilegnaw Wale, Prof Henry Jordaan and Dr Janus Henning worked on a WRC project, 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 has been running since 2018 and currently involves one PhD and three Master's students. The project is expected to be completed in 2023.

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 secured funding from WRC to transfer the custodianship of SAPWAT from PICWAT Consulting to the UFS. The project is undertaken in collaboration with the UFS Department of Soil, Crop and Climate Sciences. During the project, the climate database will be upgraded to reflect current climatic conditions.

The 23rd International Farm Management Association (IFMA) Congress was held in Denmark, Copenhagen from 26 June to 1 July 2022. Prof Frikkie Maré, Prof Henry Jordaan, Prof Yonas Bahta and Dr WA Lombard attended the congress and presented papers on their research.



From the left, Dr WA Lombard, Prof EW Zegeye, Prof YT Bahta, P Madende, Prof FA Maré, MP Pilane, Dr HN van Niekerk and Dr E Mkuna in Swakopmund, Namibia, for the AEASA Conference

Prof Yonas Bahta, Prof Edilegnaw Wale, Prof Frikkie Maré, Dr Walter van Niekerk, Dr WA Lombard, Dr Eliaza Mkuna, Primrose Madende and Pascalina Pilane attended the AEASA conference held in Swakopmund Namibia from 2 to 5 October, presenting a number of papers on the work done by the Department.

Dr Joseph Musara (Postdoctoral Research Fellow) and Prof Yonas Bahta attended a six-day Research Innovation and Industrialization Week from 25 to 30 July at the University of Zimbabwe in Harare. The research week event was hosted under the theme 'University of Zimbabwe: Actualization of a Research - Innovation - Industrialization Ecosystem Model for Zimbabwe's Economic Development'. Dr Musara presented a paper titled 'Adoption of blended high yielding sorghum seed varieties and partial-organic fertilizer: implications for farm income in the drylands of Zimbabwe'. The presentation was classified under the 'Food systems and Heritage' thematic cluster and explored the income benefits of adopting farmer-initiated innovative climate-smart agriculture practices as a gateway out of rural poverty using the heritage-based approach.

Zimbini Coka, a Junior Lecturer in the Department, presented her research at the 10th Annual International Conference on Sustainable Development 2022 which took place from 19 to 20 September 2022. Her presentation, which she presented virtually, was titled 'Review of the Sustainable Development Goals: How South Africa has performed in partnerships for the goals through Virtual Farming'.

ENGAGED SCHOLARSHIP

As the Department is part of a very diverse agricultural sector, we are actively involved in a wide range of activities in the sector. The Department is dedicated to giving back to the farming community at large, by providing the agricultural sector with relevant information. During 2022, this was done in various ways, including farmer's days, farmer-arranged conferences, and 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, as well as the YouTube channel Plaas TV.

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) (JSE Agricultural Derivative Market) course. 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. The UFS is the only higher education institution that offers a course in this field to the industry. A total of four courses are normally presented, two in Afrikaans and two in English.

Prof Bennie Grové attended the South African Irrigation Institute (SABI) congress and Exhibition from 15 to 17 March in Gqeberha, Eastern Cape where he presented an invited paper in the session on 'Holistic water management practices and innovations. During the event he received the SABI silver medal to honour his research and contributions to the irrigation industry over a period of 20 years.



Prof Bennie Grové (right) receiving the SABI silver medal for his contribution to the irrigation industry, from Riana Lombard and Ian de Jager from SABI

Prof Yonas Bahta participated in a workshop titled 'One Food' held at Dinokeng Game Reserve in Gauteng from 31 October to 2 November. The aim of the workshop was to support food production, to build a lasting framework for future engagement and to provide input that would make an important contribution to developing 'One Food' in South Africa and forming the priorities for future years of the project. The theme of the workshop was 'One Food: Climate resilient, biodiverse, safe and sustainable food systems', and was facilitated by the UK's Foreign Commonwealth and Development Office, the Department of Environment, Food and Rural Affairs and the CSIR.

Petso Mokhatla was a speaker at farmer's information days hosted by the UFS Department of Agricultural Economics, together with ABSA bank and the Department of Agriculture and Land Reform. These were held in Xhariep (14 June in Jacobsdal) and Mangaung (24 June in Van Stadensrus). The theme of both sessions was 'Understand your money preparing for the upcoming crop production season: Consumer Financial Literacy'.

Zimbine Coka was invited to be part of the Adjudication Committee to assist the Free State Department of Agriculture and Rural Development

with the Youth in Agriculture, Forestry and Fisheries (YAFF) awards, which recognise young farmers contributing to the agricultural economy. The committee deliberated from 17 to 29 June, and the main event took place on 30 June 2022 at the Astoria Farm in Senekal.

Prof Frikkie Maré was invited as a guest speaker to the Eastern Cape's combined Red Meat Producers' Organisation (RPO) and National Wool Growers Association (NWGA) road shows. During the week of 23 to 27 May 2022 he spoke in Kareedouw, Jansenville and Adelaide on 'The beauty of our product'. Another round of the road show took place from 19 to 21 July 2022 in Stutterheim, Elliot, and Burgersdorp.

As the winner of the 2022 Veeplaas climate smart ambassador competition, Dr WA Lombard was one of the invited speakers at the 2022 Veeplaas Climate Smart Ambassador Farmers Day, held on James Faber's farm in the Barkly West area on 20 October 2022. The topic of the presentation was 'Carbon footprint and agricultural economics'.

POSTGRADUATE STUDENTS

In 2022, a total of 59 students were registered for the three Honours programmes offered by the Department, 17 students for a Master's degree and 7 for the PhD degree. Thirty-five students graduated with an Honours degree, and five students with a Master's degree.

Prof YT Bahta (left) and Prof FA Maré (right) with Dr HN van Niekerk



One of our staff members, Dr HN van Niekerk, graduated with his PhD. The title of his thesis was 'An Estimation of the Downstream Economic Implications of Predation in the South African Red Meat Industry'. His supervisors were Prof YT Bahta and Prof FA Maré.

Markus Monteiro, also a staff member in the Department, graduated with his Master's degree. The title of his dissertation, supervised by Prof Bennie Grové and Prof Nicky Mathews, was 'Economic Analysis of Alternative Maize Marketing Strategies Based on Technical Market Analysis'.

STAFF MATTERS

After thirteen years with the Department, Prof Abiodun Ogundeji left to join the Disaster Management Training and Education Centre for Africa (DiMTEC), as Director.

Lindie von Maltitz and Brent Jammer joined the Department as Lecturers, mainly presenting lectures on the South Campus.

Joseph Mawasha, a South Campus lecturer from our Department, left the UFS, to pursue another career.



Prof Abiodun Ogundeji

RESEARCH OUTPUTS

Research Articles

Abafe, E.A., Bahta, Y.T. & Jordaan, H. 2022. Exploring Biblioshiny for Historical Assessment of Global Research on Sustainable Use of Water in Agriculture. *Sustainability* 14(1): 651.

Bahta, Y.T. 2022. Nexus between coping strategies and household's agricultural drought resilience to food insecurity in South Africa. *Land* 11(6): 893.

Bahta, Y.T. 2022. Social vulnerability to agricultural drought: Insights from Northern Cape, South Africa. *Scientific African* 17: e01324.

Bahta, Y.T. & Musara, J.P. 2022. Quantifying the Impact of COVID-19 Relief Vouchers Schemes on Food Security: Empirical Evidence Insights from South Africa. *Land* 11(9): 1431.

Bahta, Y.T. & Myeki, V.A. 2022. The impact of agricultural drought on smallholder livestock farmers: empirical evidence insights from Northern Cape, South Africa. *Agriculture* 12(4): 442.

Ejovi, A.A., Bahta, Y.T. & Jordaan, H. 2022. Exploring Biblioshiny for historical assessment of global research on sustainable use of water in agriculture. *Sustainability* 14(17): 10651. DOI: 10.1371/journal.pstr.0000019.

Gcezegana, G., Peter, B., Rulashe, T. & Coka, Z. 2022. An investigation of a nexus between employee skills development and competence in the Eastern Cape Department of Education. *Africa's Public Service Delivery and Performance Review* 10(1): a651.

Gwara, S., Wale, E. & Odindo, A.O. 2022. Behavioral intentions to recycle human excreta in agriculture: Implications for research, policymaking, and development practice. *Nature Scientific Reports* 12(1): 5890.

Gwara, S., Wale, E. & Odindo, A.O. 2022. Psychometric analysis of the ecological dispositions of rural farming communities: Implications for human excreta reuse in agriculture. *PLOS Sustainability and Transformation* 1(6): e0000019.

Henning, J.I.F., Jammer, B.D. & Jordaan, H. 2022. Youth participation in agriculture, accounting for entrepreneurial dimensions. *The Southern African Journal of Entrepreneurship and Small Business Management* 14(1): 2071-3185.

Henning, J.I.F., Matthews, N., August, M. & Madende, P. 2022. Youths' perceptions and aspirations towards participating in the agricultural sector: A South African Case Study. *Social Sciences*, 11(5): 215.

Letseku, V. & Grové, B. 2022. Crop water productivity applied water productivity and economic decision making. *Water* 14(10): 1598. DOI: 10.3390/w14101598

Lombard, W.A. 2022. Comparison of the importance of beef price labelling aspects: An eye tracking approach. *Heliyon* 8(7): e09783.

Mkuna, E. & Wale, E. 2022. Explaining farmers' income via market orientation and participation: evidence from Kwazulu-Natal (South Africa). *Sustainability* 14: 14197.

Monteiro, M.A., Grové, B. & Matthews, N. 2022. Developing a moving average crossover strategy as an alternative hedging strategy in the South African maize market. *Agriculture* 12 (8): 1227.

Musara, J.P, Bahta, Y.T., Musemwa, L. & Manzvera, J. 2022. Rethinking blended climate smart agriculture practices for productivity and farm income gains in the drylands of Zimbabwe. *Frontiers in Sustainable Food Systems* 6: 939595.

Myeki, L., Bahta, Y.T. & Matthews, N. 2022. Exploring the growth of agricultural productivity in Africa: A Färe-Primont Index approach. *Agriculture* 12 (8): 1236.

Netshifhefhe, K. & Jordaan, H. 2022. The water footprint of biodiesel produced from sunflower in South Africa. *Water* 14(7): 1141.

Ncube, A. & Bahta, Y.T. 2022. Meeting adversity with resilience: Survival of Zimbabwean migrant women in South Africa. *Journal of International Migration and Integration* 23: 1011-1043.

Nohamba, S., Musara, J.P., Bahta, Y.T. & Ogundeji, A.A. 2022. Drivers of Postharvest Loss among Citrus Farmers in Eastern Cape Province of South Africa: A Zero-Inflated Poisson (ZIP) Regression Model Analysis. *Agriculture* 12: 1651.

Nyam, Y.S., Batha, Y.T., Oduniyi, O.S. & Matthews, N. 2022. Smallholder sheep farmers' perception of production constraints and competitiveness strategies in South Africa. *Scientific African* 16: e01192.

Ridoutt, B., Baird, D. & Hendrie, G.A. 2022. Diets with Higher Vegetable Intake and Lower Environmental Impact: Evidence from a Large Australian Population Health Survey. *Nutrients* 14(7): 1517.

Conference Contributions

Conference Papers/Posters

Bahta, Y.T., Lombard, W.A. & Jordaan, H. 2022. The effect of monetary policy on agricultural production of South Africa. Paper delivered at the 23rd International Farm Management Association (IFAMA), Congress, Copenhagen, Denmark. 26 June-01 July 2022.

Bahta, Y.T., Lombard, W.A. & Van Niekerk, H.N. 2022. Trade regimes and welfare in Lesotho. Paper delivered at the 23rd International Farm Management Association (IFAMA) Congress, Copenhagen, Denmark. 26 June-1 July 2022.

Bahta, Y.T. & Musara, J.P. 2022. Quantifying the Impact of COVID-19 Relief Vouchers Schemes on Food Security: Empirical Evidence Insights from South Africa. Paper delivered at the 59th Annual conference of the Agricultural Economics Association of South Africa (AEASA), Swakopmund, Namibia. 2-5 October 2022.

Jordaan, H. & Motaung, N.N. 2022. Sustainable Water Use for Tobacco Production. Paper delivered at the 23rd International Farm Management Association (IFMA) Congress, Copenhagen, Denmark. 26 June-1 July 2022.

Madende, P., Henning, J.I.F. & Jordaan, H. 2022. Accounting for heterogeneity among youth: A missing link in enhancing youth participation in agriculture. A South African case study. Paper delivered at the 59th Annual conference of the Agricultural Economics Association of South Africa (AEASA), Swakopmund, Namibia. 2-5 October 2022.

Musara, J.P., Bahta, Y.T., Musemwa, L. & Manzvera, J. 2022. Adoption of blended high yielding sorghum seed varieties and partial-organic fertilizer: implications for farm income in the drylands of Zimbabwe. Paper delivered at the Research Innovation and Industrialization Week, University of Zimbabwe, Harare, Zimbabwe. 25-30 July 2022.

Roodman C., Maré, F.A. and Grové, B. 2022. Establishing the Most Profitable Backgrounding Strategy for Different Weight Groups of Weaned Bonsmara Calves Based on Economic Margins. Paper delivered at the 23rd International Farm Management Association (IFAMA) Congress, Copenhagen, Denmark. 26 June – 01 July 2022.

Conference Proceedings

Bahta, Y.T, Lombard, W.A & Jordaan, H. 2022. The Effect of Monetary Policy on Agricultural Production of South Africa. In: 23rd IFMA (International Farm Management Association) Congress Copenhagen, Denmark, 26 June-1 July 2022. ISBN: 978-1-80518-000-5

Bahta, Y. T, Lombard, W.A & Van Niekerk, H.N. 2022. Trade Regimes and Welfare in Lesotho. In: 23rd IFMA (International Farm Management Association) Congress, Copenhagen, Denmark, 26 June-1 July 2022. ISBN: 978-1-80518-001-2.

Jordaan, H. & Motaung N.N. (2022) Sustainable Water Use for Tobacco Production. In: 23rd IFMA (International Farm Management Association)

Congress Copenhagen, Denmark, 26 June-1 July 2022. ISBN: 978-1-80518-003-6.

Roodman C., Maré, F.A. & Grové, B. 2022. Establishing the Most Profitable Backgrounding Strategy for Different Weight Groups of Weaned Bonsmara Calves Based on Economic Margins. In: 23rd IFMA (International Farm Management Association) Congress, Copenhagen, Denmark, 26 June-1 July 2022.

STAFF (2022)

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 and Dr WA Lombard
Lecturers:	B Jammer, P Mokhatla, P Pilane, Lindie von Maltitz and HN van Niekerk
Junior Lecturers:	Z Coka and MA Monteiro
Programme Director:	ES Jacobs
Researcher:	P Madende
Research Assistants:	P Bexashe, R Hadebe, GP Heppel, H Kotzé, B Mhlangu, E Moshugi, A Muller, R Schoeman, 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



CONTACT DETAILS

Prof Frikkie Nesor

Department of Animal Science

Faculty of Natural and Agricultural Sciences

University of the Free State
PO Box 339 | Bloemfontein
9300 South Africa

T: +27 51 401 9261

E: NesorFW@ufs.ac.za

W: www.ufs.ac.za/animal

OVERVIEW OF 2022

It has been a very busy and fruitful year for the Department of Animal Science, with several achievements by both staff and students. Two staff members were promoted to Associate Professors, namely Prof Errol Cason and Prof Francois Deacon (effective from 2023), and several others made their mark in the industry. On the academic front, both the new BSc Agric and B Agric curricula

were finalised and will be fully implemented in 2023.

The industry is extremely excited about the services that the Centre for Meat and Dairy Science are rendering and requests for services were even received from Namibia. The Dairy Processing Unit on the UFS Paradys Experimental Farm is fully operational and is currently producing excellent cheese. The Unit also started with the production of yogurt at the end of 2022. The developments at the Paradys Experimental Farm are slowly reaching the point where it can be a show case for the University. The sheep and cattle handling facilities were moved and upgraded, and the irrigation system was upgraded to operate as a wireless system. The feed store is completed with new doors and lambing pens fully installed. Procurement of new farm equipment and the second phase of the Container Park has also been completed. With everything slowly returning to normal after COVID-19, student practical classes were resumed and were carried out weekly on the farm. We are also very proud to say that 6 tons of maize per hectare were harvested in 2022. The Department of Animal Science acquired two automated feeding systems (GrowSafe™) in 2022 for both small and large stock on the Paradys Experimental Farm. This system is the most modern automated feeder system for measuring individual voluntary feed intake. Data on growth and feed intake is collected automatically on a continuous basis with minimum human intervention. The first trials will start running in early 2023.

Research units such as an intensive sheep, piggery and layer units, as well as a state-of-the-art hot house are some of the other developments that are currently being negotiated. These will hopefully all be completed by the end of 2023.

After several delays, the Kovies Brewery will be in full production early in 2023. The Department is grateful to the Instrumentation Division for their assistance in getting the brewery up and running.

ACHIEVEMENTS

Staff Achievements

Dr Rulien Grobler obtained her PhD in Animal Science. The title of her thesis was 'The genetic mechanisms and inheritance of the polled, scur and horn phenotypes of South African Bonsmara cattle'.

Jamie Pause has been appointed as Public Relations Officer for the Grassland Society of Southern Africa (GSSA). Jamie also received the award for the best research proposal poster for her PhD titled 'The influences of short duration, high density grazing and conventional, rotational grazing on soil, vegetation and animal parameters in the dry and mesic grasslands of South Africa' at the 57th Grassland Society of Southern Africa Congress held at Aldam Resort in Ventersburg from 25 to 29 July 2022.

Prof Nico Smit received an honorary award at the 57th GSSA Congress for his contributions to the society over the past 35 years.

Dr Francois Deacon served as Chairperson of the organising committee for the GSSA meeting that was held at Aldam on 25 July 2022. Dr Paul Malan

and Jamie Pause also served on the committee.

Dr Foch-Henri de Witt received the Khothatsa project award from the Centre of Teaching and Learning for 'Being an Inspiring Teacher'. He was nominated for this award by Thlapi Martha Chuene.

Dr Francois Deacon and Dr Errol Cason both received their NRF-Y2 rating and were promoted to Associate Professor, effective from January 2023.

Dr Christopher Rothman came second in the Flash Fact Competition.

Leon Kruger delivered an invited talk at the Sustainable Livestock Conference and Educational Tour 2022 in George, while Prof Frikkie Nesor, Prof Errol Cason, Leon Kruger and Johan Barnard delivered invited talks at the Aldam Stockman School.

Prof Arno Hugo was appointed to the Board of the South African Association of Food Science and Technology (SAAFoST).



Jamie Pause receiving the award for the Best Research Proposal Poster for her PhD at the 57th GSSA Congress, from the left, Prof Nico Smit, Jamie Pause and Dr Paul Malan

Student Achievements

Niki Kretzmann (BSc Agric Food Science specialising in Dairy Science) was awarded The Koeppen Memorial Scholarship for her Master's study, from SAAFoST.

Thlapi Martha Chuene and Dr Foch-Henri de Witt



Niki Kretzmann



TEACHING AND LEARNING

SIMBRA Training Course

Final year Animal Breeding students, along with some Faculty members, attended the Simbra training course held on 16 and 17 May 2022. 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.

Annual Sheep Digestibility Trail

The third-year BScAgric Animal Science students completed the annual sheep digestibility trial, sponsored by RCL feeds, as part of the practical work for the Fundamental and Experimental Animal Nutrition module. The practical was concluded with a braai.

Jacobsdal Dairy

On 15 September 2022, Dr Ockert Einkamerer and Dr Adri O'Neill took the BScAgric ANIN 4864 final year students to Jacobsdal Dairy where they were exposed to silage production, faecal counts and locomotion scoring for cattle.

Artificial insemination course

In 2022, an accredited artificial insemination course was registered at UFS with a great deal of interest from farmers, students and the public. Due to the outbreak of foot-and-mouth disease in 2021 and 2022, it was not possible to move animals or present this course. However, it will soon be advertised and the first three-day course, consisting of theory and practical sessions, will be held in July 2023, during the recess. Unfortunately, only 12 participants will be able to attend.

Fourth-year BScAgric Animal Science excursion

On 20 October 2022, the fourth-year BSc Agric Animal Science students participated in an excursion to the Food and Beverage Institute (FBI) in Bloemfontein. During this excursion, students received guidance on the correct cooking, preparation and presentation of meat, after which they each had to prepare their own.

Bachelor of Agriculture (BAgric)

The BAgric forms an integral part of the Department, with degrees in Animal Production Management and Wildlife Management. This is a practical 'hands-on' course, during which students are exposed to the different aspects of management of far animals and wildlife, either on the experimental farm or on private farms. Graduates with a BAgric degree can continue with

a BAgric (Honours) and later the MAgric in Animal Production Management or Wildlife Management. In a quest for constant renewal and improvement, the Department will expand the content of the BAgric and BAgric (Honours) degrees to accommodate separate sub-disciplines, such as Monogastric- and Ruminant Production Management as well as Wildlife Management.

A structured MAgric will be introduced in 2024, during which students will study the different aspects of advanced animal production management systems, extension services, sustainable food systems and economic management of animal production systems.

Practical training for Animal Science students

The Department of Animal Science launched a practical competency module for the second-year BAgric students (ANIG2602), with the main aim to teach prospective candidates basic animal handling and animal husbandry skills. Students have the opportunity to choose from a list of competencies required in order to graduate – such as techniques used for animal health evaluation, drenching and vaccinating of animals, mixing feeds and feeding animals, 'hand-mating', as well as hoof trimming.

Qualified personnel from the Paradys Experimental Farm are responsible for the training of the candidates, with support of staff from the Department of Animal Science. The graduates also have the opportunity to attend courses and workshops related to Animal Science as part of the programme. The programme will ultimately be rolled out to all Animal Science year groups (both BAgric and BSc Agric) and will allow the students to attain the minimum required practical skills set before any degree will be awarded.

RESEARCH AND INNOVATION

Animal Science

The Department of Animal Science obtained the GrowSafe™ automated feeding and weighing system for conducting research on beef and dairy cattle on the Paradys Experimental Farm. This system allows

for the automated determination of feed intake and weighing of the animals on a continuous basis. It consists of eight feeding nodes that are fixed on weighing cells which determine the feed an animal consumes every time it visits a node. It not only records the feed intake, but also when the animal eats and the time it spends eating. This opens the door for a new study field in animal feeding behavior and can assist feedlot operators to manage feeding time of finishing cattle to ensure optimum intake, minimise wastage, obtain maximum animal growth response and feedlot profits. Feed intake, and animal live weight are normally only measured on a weekly basis, whereas the GrowSafe™ system continuously measures the latter parameters providing more accurate data. In addition, less animals are required for research purposes as individual animal intake, weight gain and feed efficiency are measured, resulting in more repetitions allowing for accurate statistical evaluation of data.

The GrowSafe™ system will also be used for undergraduate training and teaching purposes to help graduates gain the necessary 'day-zero' skills and familiarise themselves with state-of-the-art equipment used in industry to generate reliable and applicable data.

A Daisy anaerobic in vitro incubator for conducting fermentation research simulating the ruminal environment of farm animals, was installed in the Nutrient Lab. This equipment is used to determine fermentability and protein bypass characteristics of feeds.



Participants at the Simbra course, writing a test



BScAgric sheep digestibility trial



ANIN4864 students at Jacobsdal Dairy



Fourth-year BSc Agric Animal Science Students at FBI



Near-infrared reflectance spectroscopy (NIRS)

The Animal Nutrition division received a near-infrared reflectance spectroscopy (NIRS) machine, which, when calibrated, uses infra-red light to determine the chemical composition of animal feed, fecal matter and feed raw materials. This is exciting and state-of-the-art equipment.

In 2022, the Animal Nutrition division, along with some colleagues from Breeding, Physiology and Food Science, successfully delivered seven MSc Agric dissertations – ranging from research on probiotics fed to sheep, urinary calculi development and management in finishing lambs and feeding oxidised hominy chop to lambs, to the effect of enzyme feed additives on broiler production. This research is very applicable to the formal feed industry and after publication will hopefully be implemented by feed companies and producers.

The Reproduction Physiology Laboratory of the Department of Animal Science aids in training undergraduate and postgraduate students in male and female reproduction physiology and specifically assisted reproduction technology. The aim is to eventually also provide a service to the commercial industry. Technology has permitted the development of image analysis systems that enable an exact differentiation between a rapid progressive spermatozoon and a slow one, which cannot be detected with the human eye. During 2022, a Sperm Class Analyzer (SCA) Microptic Evolution Veterinary Version 6.6 was purchased to conduct male fertility trials. This equipment, which will be installed early in 2023, is more reliable and scientifically acceptable in comparison to manual semen analyses.

A number of postgraduate research projects were undertaken in Animal Science, Animal Physiology, Animal Nutrition and Animal Management during 2022, such as:

- The stress responsiveness of habituated and non-habituated Merino type sheep during electro ejaculation.
- Effect of ω -3 lipid sources on layer performance and egg quality during peak production.
- Evaluating the efficacy of a nutritional

fat emulsifier on diet digestibility and production performance of broilers.

- The effect of lucerne (*Medicago sativa* L.) hay quality on the performance of finishing lambs.
- Genetic evaluation of Jersey cattle.
- Growth and slaughter characteristics of purebred South African Boran bulls in a feedlot system.
- Evaluating meat quality of wool and mutton type lambs produced on different production systems.
- The effect of a beta-agonist, sex and days on feed on feedlot performance and meat quality of beef.
- Genomic evaluation in different environments in the South African Holstein breed.
- Improving beef production systems in the communal and emerging sector through targeted interventions.
- Establishing genomic evaluations and their validation accuracies in South African Holstein and Jersey cattle.
- Productivity and implications of climate smart breeding strategies of the cow-calf production system.
- The effect of temperament and stress on production and immune response in sheep.

Genetics Laboratory

The Department of Animal Science recently installed a new laboratory for molecular DNA work. This state-of-the-art facility is fully equipped to carry



Genetics Laboratory

out DNA extraction procedures and includes a range of advanced equipment, such as a centrifuge, pH meter, polymerase chain reaction (PCR) machine, weight balances and agarose gel running equipment. These tools enable researchers to conduct a range of genetic analyses, such as PCR amplification and gel electrophoresis, providing valuable insights into the structure and function of DNA.

The new lab is a significant investment for the University and represents an important step forward in its research capabilities. With this new facility, 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.

Bioinformatics centre

A new bioinformatics centre has been established in the Department of Animal Science. The goal of the centre is to provide students and researchers with the necessary skills to conduct advanced analyses in genomics, proteomics and transcriptomics. The centre will offer courses in a variety of topics, including genome-wide association studies and variant calling.

One of the main objectives of the bioinformatics centre is to become a hub for national bioinformatic analysis. Animal science research often requires complex bioinformatic analyses that require specialised knowledge and tools. This centre will offer the necessary support to researchers in the field of animal sciences, helping them to conduct analyses more efficiently and effectively. With this centre, the Animal Science Department hopes to become a leader in the field of bioinformatics, supporting research efforts in animal science across South Africa and beyond.

Centre for Meat and Dairy Science

The new Centre for Meat and Dairy Science started its activities in 2022. The overall aim of the Centre is to develop high level manpower and skills for the South African meat and dairy industry. Graduates from this Centre will assist industry in becoming more efficient by optimising processes, developing new products,

improving quality and shelf life, as well as reducing wastage and in the process contributing to national food security.

A ‘farm to fork’ approach is followed with meat and dairy science training at the UFS and research and teaching in the Centre focuses on the interaction between three focus areas – production, fresh and processed products. The Centre presents short courses for potential entrepreneurs in the fields of meat and dairy science.

The Centre for Meat and Dairy Science is busy with advanced chemical, microbiological and physical analyses for high profile companies in the meat and dairy industries. There is the potential for selling the expertise of this Centre in Africa to assist in the development of meat and dairy processing industries and to recruit more postgraduate students from African countries.

A highlight was the approval and planning of a new meat processing facility that will be constructed in 2023.

The following research projects (mostly funded by the Meat and Dairy Industry) were completed during 2022:

- The effect of castration age on meat quality of finishing Mutton Merino lambs.
- Can the meat (nutrient value) from rejected ‘Wet Carcass Syndrome’ lamb carcasses, be recovered for human consumption?
- The effect of different sodium reduction strategies on the chemical, microbial and sensory quality of dried traditional South African beef products.
- Evaluating meat quality of wool and mutton type lambs produced on different production systems.
- The effect of natural preservatives and plant extracts on the chemical, microbial and sensory quality of fresh sausages.
- Evaluation and validation of methods for the detection of psychrotolerant bacteria and proteolytic enzymes in milk.
- To establish an indicator to confirm cold ultraviolet sterilisation in milk.

The Centre for Meat and Dairy Science is planning a research collaboration with Dr Patrick Bayambas from the EM Gabon University on the effect of diet on lipid composition of earthworms. The aim of this research will be to evaluate earthworms as a feed source for farm animals.

In 2022, the Meat Science division produced 14 internationally peer-reviewed research articles as well as one poster and one oral presentation at a national congress.

Rangeland and Wildlife Science

Rangeland and Wildlife Science can fundamentally be considered as one, especially with regard to management and conservation efforts. They are mutually co-dependent. In both divisions we had successes with existing and ongoing projects, farmers' days, ministerial high-level panel contributions, public and invited talks and a huge interest from the public sector on what we do. We have four MSc students and four PhD students currently enrolled under these disciplines. The postgraduate cohort includes one student from Canada and one from Namibia. In addition, we are hosting a collaborative postdoctoral research fellow from Austria.

Wildlife studies and projects cover a large variety of subjects and topics related to springbuck, kudu, ostrich, gemsbok, zebra, wildebeest, giraffe and rhino, but also habitat-related studies on kapokbos, slangbos, tree thinning, bush encroachment, etc. We are actively participating in projects with SANParks, the Nature

Conservation Agency in the Free State and Northern Cape, and the private sector, such as Wildlife Ranching South Africa (WRSA), the Southern African Wildlife Management Association (SAWMA) and the GSSA.

Two Wildlife Science PhD studies continued in 2022 – one on 'The long-necked animals: Searching for a million years of similarities', and the other on 'A critical view of captive lions (Panthera leo) and the captive lion breeding industry in South Africa'.

Unfortunately, Prof Nico Smit, one of our key players in wildlife, retired, but will thankfully still be contributing with an ongoing wildlife-collar project in the Kalahari for another few years.

The 2023 SAWMA conference (to be held in Golden Gate National Park in September 2023) will be hosted and organised by personnel from the UFS.

Grassland Science

The Grassland Science division bade farewell to Prof Nico Smit, who retired during 2022. He was a Professor in the Department for the past 23 years and an NRF-rated scientist for most of his career. Prof Smit is probably the most experienced Savanna Biome expert in southern Africa. His retirement is a great loss to the Department.

Members of the Grassland Science division formed the larger part of the organising committee for the 57th Congress of the GSSA, which was held at the Aldam Resort in the Free State from 25 to 29 July 2022. Representatives of the division made 15 contributions



Photo | Hesté de Beer



UFS delegates at the 57th Annual Congress of the Grassland Society of Southern Africa GSSA, back row from the left, Marnus Smit, Dr Paul Malan, Prof Nico Smit, Prof Francois Deacon, Mart-Mari Myburgh and Ruan Higgs; front row, from the left, Jamie Paulse, Rinae Mukwevho, Wanda Madikizela, Carlah Jacobs and Heike Oosthuysen

to the Congress in the form of posters and oral presentations. Amongst the contributions was a special session on Regenerative Grazing, which is also currently the main focus of the research in the division.

An MSc research project was undertaken in the field of Grassland Science in 2022, on the topic 'Quantifying the chemical composition of Themeda triandra Forsk, under two grazing management systems'.

ENGAGED SCHOLARSHIP

In the first semester of 2022, Leon Krüger presented three short courses on faecal egg counts, and one three-day course on small stock diseases, at the Paradys Experimental Farm. All the courses were booked to full capacity, confirming the need for such courses. Krüger also presented the faecal egg count course to 30 representatives of Zoetis, a large animal health company, on 27 and 28 July 2022.

The Centre of Meat and Dairy Science continued to perform analytical and meat quality work for the Meat Industry, including determining the total meat content of processed meat products and the tenderness and marbling of fresh meat cuts.

NATIONAL AND INTERNATIONAL COLLABORATION

While attending the WCGALP 2022 conference in Rotterdam, Prof Frikkie Nesor, Dr Errol Cason, Michiel van Niekerk and Matthew Kinghorn visited longtime collaborator, Prof Vincent Ducrocq, at INRAE.

Dr Michael MacNeil was appointed as an Affiliated Professor in the Department of Animal Science and is currently co- and external supervisor for two PhD students in the Department. Dr MacNeil has been active in animal breeding and genetics research for almost 40 years and worked at two

USDA-ARS stations – the US Meat Animal Research Center (1980 to 1988) and the Fort Keogh Livestock and Range Research Laboratory (1988 to 2011). He continues a very active research career today as an independent consultant (Delta G) and has a strong presence in graduate education.

Prof Arno Hugo is planning a research collaboration with Dr Patrick Bayambas from the EM Gabon University on the effect of diet on lipid composition of earthworms. The aim of this research will be to evaluate earthworms as a feed source for farm animals. This research is part of a Memorandum of Understanding (MOU) between the University of the Free State and the EM Gabon University in Gabon.

Prof Francois Deacon and Dr Willem Daffue paid a visit to Pakistan and the Himalayas in August 2022 for a new initiative to rewild Pakistan with rhino and to determine the existing status of brown bear. On invitation they presented lectures in Islamabad to stakeholders, NGO's and government officials on the way forward. An official MoU between the UFS and the Pakistan Government was compiled to re-introduction of the Indian one-horned rhinos to a sanctuary in Pakistan.

Part of the time spent in the Himalayas was to search for suitable brown bear habitats as well as signs of last remaining individuals. An official project on accurate census and population status data for



Visiting INRAE, from the left, Michiel van Niekerk, Prof Frikkie Nesor, Prof Vincent Ducrocq, Matthew Kinghorn and Dr Errol Cason

the brown bears as well as collaring these bears to understand their survival and home range needs, will be finalised soon. It is expected that both the rhino and bear movement patterns will depend upon the availability and distribution of resources in the mountains. Although the focus is on habitat structure, the expectations re that the bear and rhino movement patterns will be determined not only by food resources, but also by climatic conditions, water location, terrain, slope and vegetation thickness. Ranging patterns and positions on habitat maps will be plotted and will help to evaluate how ecological, biological and social factors influence their movements and population structures. In combining different biological disciplines, behavioural, endocrinological and genetic information will be gathered to gain a better insight into the interesting and flexible behavioural patterns, survival skills, health status and factors that may affect it as well as the metabolic aspects seen in for both species.

POSTGRADUATE STUDENTS

Twelve (12) students were enrolled at Honours level in 2022, with 35 at Master's level and 16 at PhD level.

In 2022, a total of 32 students graduated at Honours level:

- Bachelor of Science Honours in Agriculture majoring in Animal Science: 1
- Bachelor of Agriculture Honours majoring in Agricultural Management: 20

- Bachelor of Agriculture Honours majoring in Wildlife Management: 1
- Bachelor of Agriculture Honours majoring in Animal Production Management: 10

Mari-Su de Villiers graduated with the Master of Science in Agriculture majoring in Wildlife Science, Bhaveni Bhika Kooverjee graduated with the Master of Science in Agriculture majoring in Animal Science and Karin-Louise van Rooyen graduated with the Master of Science.

POSTDOCTORAL RESEARCH FELLOWS

In 2022, the Department of Animal Science hosted two postdoctoral research fellows – Dr Barbara Elizabeth (Lize) van Wyngaard and Dr Christopher Rothman.

STAFF MATTERS

Dr Ayanda Maqhashu was appointed as a Lecturer in the Department of Animal Science, and both Dr Francois Deacon and Dr Errol Cason were promoted to Associate Professor (effective from 2023).

Prof GN Smit retired on 31 July 2022, after 23 years at the UFS.

Dr Rulien Grobler, Lecturer, and Dr Foch-Henry de Witt, Senior Lecturer, resigned at the end of 2022.

Prof Francois Deacon (far left) and Dr William Daffue (second from the right) with rangers at the Baltoro glacier in the Deosai National Park in Pakistan

RESEARCH OUTPUTS

Research Articles

Akinmoladun, O., Fon, F., Mpendulo, C., Hugo, A., Falowo, A. & Nantapo, C. 2022. Fatty acid profile, oxidative stability of lipids and sensory attributes of water restricted Xhosa goat meat supplemented with vitamin C. *Animal Production Science* 62(1): 67-77.

Bhika Kooverjee, B., Soma, P., Van der Nest, M., Scholtz, M.M. & Neser, F.W.C. 2022. Selection Signatures in South African Nguni and Bonsmara Cattle Populations Reveal Genes Relating to Environmental Adaptation. *Frontiers in Genetics* 13 June: 909012:1-909012:11.

Deacon, F., Daffue, W., Nel, P. & Higgs, R.W. 2022. Effective Field Immobilisation and Capture of Giraffe (*Giraffa camelopardalis*). *Animals* 12: 1290-1 - 1290-10.

De los Rios, A., Garrido-Benavent, I., Limón, A., Cason, E.D., Maggs-Kölling, G., Cowan, D. & Valverde, A. 2022. Novel lichendominated hypolithic communities in the Namib Desert. *Microbial Ecology* 83: 1036-1048.

De Wit, M., Nkoi, V.F., NematsHEMA, Thusi, N., Hugo, A., Coetzer, G.M., Ceronio, G.M. & Fouche, H.J. 2022. Effect of nitrogen fertilization and season (year) on cactus pear seed oil content and fatty acid composition. *Acta Horticulturae* 1343(36): 283-290.

Ducrocq, V.P., Cadet, A., Patry, C., Van der Westhuizen, L., Van Wyk, J.B. & Neser, F.W.C. 2022.

Two approaches to account for genotypebyenvironment interactions for production traits and age at first calving in South African Holstein cattle. *Genetics Selection Evolution* 54: 43-1 - 43-8.

Gonzalez-Prendes, R., Ginja, C., Kantanen, J., Ghanem, N., Kugonza, D., Makgahlela, M.L., Groenen, M. & Crooijmans, R. 2022. Integrative QTL mapping and selection signatures in Groningen White Headed cattle inferred from whole-genome sequences. *PLoS One* 17(e0276309): 1-19.

Harris, R., Lau Vetter, M., Van Heerden, E., Cason, E.D., Vermeulen, J., Taneja, A., Kieft, T., DeCoste, C., Laevsky, G. & Onstott, T. 2022. FISHTAMB, a FixationFree mRNA Fluorescent Labeling Technique to Target Transcriptionally Active Members in Microbial Communities. *Microbial Ecology* 84: 182- 197.

Hugo, A., Du Toit, A., Venter, S. & Mpemba, O.S. 2022. The influence of basic cooking methods on texture attributes of 'Morado' nopalitos. *Acta Horticulturae* 1343: 369-375.

Hugo, A., Mpemba, O.S., Du Toit, A., Venter, S. & De Wit, M. 2022. Relationship between quality characteristics of cactus pear nopalitos for use as an alternative vegetable source in South Africa. *Acta Horticulturae* 1343: 531-538.

Hugo, A., Van Wyngaard, B.E., Strydom, P., De Witt, F., Kanengoni, A. & Pohl-Albertyn, C.H. 2022. The effect of dietary *Echium* oil supplementation on the fatty acid profile, omega-3 fatty acid content and subcutaneous fat quality of pork. *Livestock Science* 257: 104833-1 - 104833-8.

Kgari, R., Muller, C., Dzama, K. & Makgahlela, M.L. 2022. Estimation of Genetic Parameters for Heifer and Cow Fertility Traits Derived from On-Farm AI Service Records of South African Holstein Cattle. *Animals* 12: 2023-1 - 2023-11.

Linde, D., Van Marle-Koster, E., Du Toit, C., Scholtz, M.M. & Schokker, D. 2022. Rumen microbial diversity of Bonsmara cattle using amplicon sequencing during a 120-day growth trial. *South African Journal of Animal Science* 5 (2): 148-161.

Mabunda, R., Makgahlela, M.L., Nephawe, K. & Mtileni, B. 2022. Evaluation of Genetic Diversity in Dog Breeds Using Pedigree and Molecular Analysis: A Review. *Diversity-Basel* 14: 1054-1 - 1054-24.

Makhalemele, B.L., De Wit, M., Truter, M., Du Toit, A., Fouche, H.J., Hugo, A. & Venter, S. 2022. Morphological and physico-chemical properties of nopalitos from twenty cactus pear cultivars. *Acta Horticulturae* 1343: 387-394.

Makhalemele, B.L., De Wit, M., Truter, M., Du Toit, A., Hugo, A. & Venter, S. 2022. The nutritional evaluation of nopalitos from six South African cactus pear cultivars. *Acta Horticulturae* 1343: 377-385.

Mbumba, N.W., Labuschagne, M.T., Siwale, J. & Hugo, A. 2022. Diversity in seed protein content, selected minerals, oil content and fatty acid composition of the Southern African Bambara groundnut germplasm collection. *Journal of Food Composition and Analysis* 109: 104477-1 - 104477-11.

Mdyogolo, S., MacNeil, M., Neser, F.W.C., Scholtz, M.M. & Makgahlela, M.L. 2022. Assessing accuracy of genotype imputation in the Afrikaner and Brahman

cattle breeds of South Africa. *Tropical Animal Health and Production* 54: 90-1 – 90-12.

Moloantoa, K.M., Khetsha, Z., Van Heerden, E., Castillo Hernandez, J.C. & Cason, E.D. 2022. Nitrate Water Contamination from Industrial Activities and Complete Denitrification as a Remediation Option. *Water* 14: 799-1 – 799-31.

Mpemba, O.S., Du Toit, A., De Wit, M., Venter, S. & Hugo, A. 2022. Edible characteristics of two nopalito cultivars compared to selected popular vegetables. *Acta Horticulturae* 1343: 409-415.

Mphaphathi, M.L., O'Neill, H.A. & Nedambale, T. 2022. Effect of two Different Permitting and Combination of Cryoprotectants on Cattle Oocytes Maturation Rate Following Brilliant Cresyl Blue Exposure. *American Journal of Animal and Veterinary Sciences* 17(2): 101-107.

Mushanganyisi, D.D., De Wit, M., Du Toit, A., Du Toit, L., Bothma, C., Hugo, A. & Venter, S. 2022. Functional properties of cactus pear mucilage: gelling and spherification. *Acta Horticulturae* 1343: 505-510.

Mwanza, E.P., Hugo, A., Charimba, G. & Hugo, C.J. 2022. Pathogenic Potential and Control of Chryseobacterium Species from Clinical, Fish, Food and Environmental Sources. *Microorganisms* 10: 895-1 – 895-16.

Nkadimeng, M., Van Marle-Koster, E., Nengovhela, N. & Makgahlela, M.L. 2022. Understanding beef cattle production practices and associated factors constraining performance: a survey of smallholder farmers in South Africa. *Journal of Agriculture and Rural Development in the Tropics and Subtropics / JARTS* 13(1): 131-145.

Nkadimeng, M., Van Marle-Koster, E., Nengovhela, N., Ramukhithi, F.V., Mphaphathi, M., Rust, J. & Makgahlela, M.L. 2022. Assessing Reproductive Performance to Establish Benchmarks for Small-Holder Beef Cattle Herds in South Africa. *Animals* 12: 3003-1-17.

Notter, D., Heidaritabar, M., Burke, J., Shiralu, M., Murdoch, B., Morgan, J., Morota, G., Sonstegard, T., Becker, G., Spangler, G., Macneil, M. & Miller, J. 2022. Single Nucleotide Polymorphism Effects on Lamb Fecal Egg Count Estimated Breeding Values in Progeny-Tested Katahdin Sires. *Frontiers in Genetics* 13: 866176-1-12.

Pambuka, G.T., Kinge, T., Ghosh, S., Cason,

E.D., Nyaga, M.M. & Gryzenhout, M. 2022. Plant and Soil Core Mycobiomes in a Two-Year Sorghum–Legume Intercropping System of Underutilized Crops in South Africa. *Microorganisms* 10(2079): 1-16.

Potgieter, G., Cason, E.D., DeFlaun, M., Jacobs, K. & Van Heerden, E. 2022. Management and Stimulation of High Metabolic Rates of Biomes to Effectively Remediate Mine Drainage. *Journal of Human, Earth and Future* 3(2): 204-212.

Pyoos-Daniels, G.M., Scholtz, M.M., MacNeil, M., Theunissen, A. & Nesor, F.W.C. 2022. Alternative measures of cow–calf efficiency for Afrikaner, Bonsmara, Nguni, Angus and Simmental sired calves. *Animal Production Science* 62(7): 668-675.

Sako, T., O'Neill, H.A. & Sedumedi, T. 2022. Meat quality characteristics of Tankwa goats from Carnarvon, Northern Cape. *South African Journal of Animal Science* 52(4): 409-420.

Sander, W.J., Kemp, G., Hugo, A., Pohl-Albertyn, C.H. & O'Neill, H.G. 2022. Rotavirus-Mediated Prostaglandin E2 Production in MA104 Cells Promote Virus Attachment and Internalisation, Resulting in an Increased Viral Load. *Frontiers in Physiology* 13(805565): 1-13.

Sigwela, V.N., De Wit, M., Du Toit, A. & Hugo, A. 2022. Application of betalain extracts as colouring foods to food products. *Acta Horticulturae* 1343: 463-472.

Sigwela, V.N., De Wit, M., Du Toit, A. & Hugo, A. 2022. Extraction and stability of betalains extracted from beetroot tubers and the fruit of eight cactus pear cultivars. *Acta Horticulturae* 1343: 309-315.

Tembela, N., Mukumbo, F., Hugo, A. & Jaja, I. 2022. Effect of Different Fat and Moringa oleifera Leaf Meal (MOLM) Inclusion Levels on Proximate Composition, Fatty Acid Profile, and Lipid Oxidation of Chicken Droëwors. *International Journal of Food Science* 6736935:1-9.

Tonjock, K., Ghosh, S., Cason, E.D. & Gryzenhout, M. 2022. Characterization of the Endophytic Mycobiome in Cowpea (*Vigna unguiculata*) from a Single Location Using Illumina Sequencing. *Agriculture-Basel* 12(333): 1-15.

Van der Walt, Daffue, W., Goedhals, J., Van der Merwe, S. & Deacon, F., 2022. A Preliminary Study on the Siphon Mechanism in Giraffe (*Giraffa camelopardalis*). *Animals* 12(3348): 1-18.

Conference Contributions

Conference Papers/Posters

Augustyn, W.C, Einkamerer, O.B., Hugo, A. & O'Neill, H.A. 2022. *Growth performance and carcass characteristics of early castrated, late castrated and intact South African Mutton Merino lambs.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26-28 September 2022.

Bhika Kooverjee, B., Soma, P., Van der Nest, M., Scholtz, M.M. & Nesor, F.W.C. 2022. *Preliminary results: Structural variant discovery in Nguni and Bonsmara crossbred cattle using whole genome sequencing.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26-28 September 2022.

Cason, E.D., Van Wyk, J.B., Vermeulen, P.D. & Nesor, F.W.C. 2022. *Genetic characterization of Dexter cattle in Southern African.* Poster presented at the 73rd Annual meeting of the European Federation of Animal Science, Porto, Portugal. 4-9 September 2022.

Deacon, F., Malan, P.J., Smit, Z.M. & Smit, G.N. 2022. *Herbaceous biomass production of species and vegetation types during and after drought on Witsand Nature Reserve.* Poster presented at the Annual Kimberley Biodiversity Research Symposium, Kimberley, South Africa. 9 November 2022.

De Villiers, M., Müller, L., & Janecke, B.B. 2022. *Population density and diet of leopards (Panthera pardus) in non-protected land, Western Cape.* Paper delivered at the South African Wildlife Management Association 51st Annual Conference, Hluhluwe, South Africa. 4-9 September 2022.

Grobler, R., Visser, C. & Van-Marle-Köster, E. 2022. *Genetic heterogeneity of the POLLED locus in South African Bonsmara beef cattle.* Paper delivered at the 73rd Annual meeting of the European Federation of Animal Science, Porto, Portugal. 4-9 September 2022.

Hlatshwayo, A.S., Malan, P.J. & Buza, M. 2022. *Vegetation species composition, soil seed bank and biomass production of a semi-arid communal rangeland of Matabeleland South Province, Zimbabwe.* Poster presented at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25-29 July 2022.

Januarie, D.A., Cason, E.D. & Nesor, F.W.C. 2022. *Genetic characterization of the indigenous Sanga cattle of Namibia.* Paper delivered at the 73rd Annual meeting of the European Federation of Animal Science, Porto, Portugal. 4-9 September 2022.

Madikizela, W., Malan, P.J. & Paulse, J.W. 2022. *Quantification of Grazing gradients of different grazing systems.* Poster presented at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25-29 July 2022.

Madikizela, W., Malan, P.J. & Paulse, J.W. 2022. *The quantification of grazing gradients of conventional and high-density, grazing systems.* Poster presented at the RUFORUM 18th Annual General Meeting Scientific Conference, Harare, Zimbabwe. 12-16 December 2022.

Mafolo, K.S., Macneil, M., Nesor, F.W.C. & Makgahlela, M.L. 2022. *Multibreed genomic predictions in South African Holstein and Jersey dairy cattle.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26-28 September 2022.

Malan, P.J. 2022. *What is Regenerative Grazing?* Paper delivered at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25-29 July 2022.

Maiwashe, A. 2022. *Practical application of BLUP/EBV's in grazing livestock systems.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26-28 September 2022.

O'Neill, H.A., Skele, N., Augustyn, W.C., Einkamerer, O.B. & Hugo, A. 2022. *Carcass composition of early castrated, late castrated and intact South African Mutton Merino lambs.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26-28 September 2022.

Paulse, J.W., Malan, P.J. & Smit, G.N. 2022. *Exploring the different facets of regenerative grazing in semi-arid grassland in South Africa.* Paper delivered at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25-29 July 2022.

Paulse, J.W., Malan, P.J. & Smit, G.N. 2022. *The comparative effects 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 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25–29 July 2022.

Scholtz, M.M., Nesor, F.W.C. & MacNeil, M. 2022. *The development of a biological index for cow-calf efficiency for beef cattle.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26–28 September 2022.

Skele, N., Augustyn, W.C., Einkamerer, O.B., Hugo, A. & O'Neill, H.A. 2022. *Carcass composition of early castrated, late castrated and intact South African Mutton Merino lambs.* Paper delivered at the 53rd Annual South African Society of Animal Sciences (SASAS) Congress 2022, Pietermaritzburg, South Africa. 26–28 September 2022.

Smit, Z.M., Deacon, F., Malan, P.J. & Smit, G.N. 2022. *Changes in Herbaceous cover and species composition on Witsand Nature Reserve after above average rainfall seasons following a prolonged drought.* Paper delivered at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25–29 July 2022.

Van Zyl, G. & Paulse, J.W. 2022. *Platform presentation: Regenerative grazing – a Farmer's Perspective.* Paper delivered at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25–29 July 2022.

Visser, C., Malan, P.J., Paulse, J.W. & De Witt, F. 2022. *The influence of short duration high density grazing and conventional rotational grazing on the nutritive value of Themeda Triandra in semi-arid grassland of South Africa.* Poster presented at the 57th Congress of the Grassland Society of Southern Africa, Aldam Resort, South Africa. 25–29 July 2022.

Conference Proceedings

Cason, E.D., Alom, J., Barnard, J., Fair, M.D., Vermeulen, P.D. & Nesor, F.W.C. 2022. Preliminary investigation into the association of members of the rumen biome with production traits in Afrikaner cattle. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Cason, E.D., Barnard, J., Vermeulen, P.D. & Nesor, F.W.C. 2022. Possible association of members of

the rumen bacterial microbiome with production traits in Afrikaner cattle. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Januarie, D.A., Cason, E.D. & Nesor, F.W.C. 2022. Genetic characterization of the indigenous Sanga cattle of Namibia. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Kinghorn, M.G, Cason, E.D., Ducrocq, V.P. & Nesor, F.W.C. 2022. Comparison of Random Regression Test-Day Models for Production Traits of South African Jersey Cattle. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Kooverjee, B., Soma, P., Nesor, F.W.C., Van der Nest, M. & Scholtz, M.M. 2022. Copy number variation analysis in Nguni and Bonsmara crossbred cattle. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Maiwashe, A. 2022. New insights into the computation of the inverse of the numerator relationship matrix for genotyped animals. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Mdyogolo, S., Macneil, M., Nesor, F.W.C., Scholtz, M.M. & Makgahlela, M.L. 2022. Differentiated genomic regions in the Afrikaner and Brahman cattle of South Africa reveal parallel adaptive mechanisms. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Pyoos-Daniels, G.M., Macneil, M., Scholtz, M.M., Seshoka, M.M., Weepener, H. & Nesor, F.W.C. 2022. Plasticity of breed direct and individual heterosis effects in beef cattle under extensive conditions. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Scholtz, M.M., Macneil, M., Chadyiwa, M. & Nesor, F.W.C. 2022. Genetic analysis of traits needed to optimize improvement in beef cow-calf efficiency

in Afrikaner cattle. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Soma, P., Bhika Kooverjee, B. & Scholtz, M.M. 2022. Runs of homozygosity in Nguni and Bonsmara cattle populations. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Van Niekerk, M., Nesor, F.W.C., Van Wyk, J.B. & Ducrocq, V.P. 2022. Inclusion of average rainfall in genetic evaluation of SA Holsteins to mitigate genotype by environment interaction. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.

Zwane, A., Nxumalo, K., Makgahlela, M.L., Köster, E. & Maiwashe, A. 2022. Functional analysis of selective sweeps to identify phenotypic traits in South African Nguni cattle. In: *Proceedings of the 12th World Congress on Genetics Applied to Livestock Production (WCGALP)*, Rotterdam, The Netherlands. 3–8 July 2022.



STAFF (2022)

**Head of Department:
Prof FWC Nesor**

Professors:	Prof A Hugo, Prof FWC Nesor and Prof GN Smit
Affiliated Professors:	Prof FB Bercovitch, Dr VPJ Ducrocq, Prof JPC Greyling, Dr M MacNeil, Prof ML Makgahlela and Prof MM Scholtz
Senior Lecturers:	Dr ED Cason, Dr F Deacon, Dr FH de Witt, Dr OB Einkamerer, Dr MD Fair, Dr J Myburgh, Dr HA O'Neill and Dr A Maqhashu
Lecturers:	Dr R Grobler, Dr A Hattingh, Dr BB Janecke, GC Josling, L Krüger and Dr PJ Malan
Junior Lecturers:	G Janse van Rensburg and JW Paulse
Programme Director:	Dr M Fair
Research Fellows:	Prof HO de Waal, Prof HA Snyman and Prof JB van Wyk
Farm Manager:	J Barnard
Technicians:	E Roodt and JAM van der Merwe
Senior Assistant Officer:	Dr Q Kruger
Officers:	NAK Green and KR Moopelwa
Secretary:	I Auld
Technical Assistants:	NK Long and SA Rowles
Cleaners:	N de Bruin, TA Dumisi and J Lamle



DEPARTMENT OF

SOIL, CROP AND CLIMATE SCIENCES

FACULTY OF NATURAL AND
AGRICULTURAL SCIENCES

CONTACT DETAILS

Prof Angelinus Franke

Department of Soil, Crop and Climate Sciences

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339

Bloemfontein

9300 South Africa

T: +27 51 401 9437

E: FrankeAC@ufs.ac.za

W: www.ufs.ac.za/scc

OVERVIEW OF 2022

In 2022, the Department started with the phased implementation of the new undergraduate curricula. The renewed second-year curriculum started with a renewed Soil Fertility module and an entirely newly developed module on Crop Development. Preparations were also made to teach new modules in Horticulture at third-year level in 2023. In addition, groundwork has been laid for a major investment in a state-of-the-art greenhouse at Paradys Experimental Farm for teaching in horticulture and for research purposes. At Kenilworth Experimental Farm, a security fence was constructed in 2022 and a new planter was purchased to facilitate the implementation of field

trials. The Department continues to implement a diverse research portfolio funded by government agencies and private sector partners.

In 2022, Cowan McLean was appointed as a Lecturer in Soil Science and Prof Tesfay Weldeslassie started as an Associate Professor in Agronomy, coming from the University of Fort Hare. Linda de Wet took up the role of Programme Director in the Department.

ACHIEVEMENTS

Staff Achievements

Three staff members were promoted in 2022 (effective from 1 January 2023). Dr Gert Ceronio and Dr Elmarie Kotze were promoted from Senior Lecturer to Associate Professor and Nozi Radebe was promoted from Officer to Senior Officer.

Prof Linus Franke was promoted to full professor in 2021 and delivered his inaugural lecture in May 2022.

Dr Jerry Dlamini and Dr Phumudzo Tharaga obtained their PhDs in 2022.

Dr Elmarie van der Watt was elected as secretary of the South African Society of Crop Production (SASCP).

Student Achievements

Bertus Nel received the SASCP Gold Medal for the best Agronomy student as well as the Omnia award.

Meandri van Oudtshoorn van Rheede was the recipient of the prize for the best final year student in Agrometeorology.



Dr Elmarie Van der Watt presenting Bertus Nel with the SASCP Gold medal award

TEACHING AND LEARNING

In 2022, the implementation of the revised undergraduate curricula was initiated, with a new module on Crop Development presented for the first time to second-year students. In addition, preparations were made to initiate two new modules in Horticulture at third-year level, to commence in 2023.

The fourth-year BSc/Honours students presented their research projects in the SCCS 4808 and 6808 modules at the end of the year in. At the end of the day, a small function for both the students and personnel was held.



2022 final year SCCS 4808 and 6808 students

The fourth-year class of CROP 4814 visited the facilities of Agraforum SA in May 2022 as part of one of their practical modules.

Soil biology and Soil physics students at Kenilworth Experimental Farm



Soil biology and soil physics fourth-year students participated in an excursion to Kenilworth Experimental Farm during the second semester. The day focused on visual assessment of soil physical and biological properties and how this relates to soil quality status and sustainable crop production under rain-fed and irrigated conditions.

CCSC7900 (Climate modelling and quantitative analysis) was presented for the first time as part of the structured MSc specialising in Climate Change. Students received access to the UFS High Performance Cluster and were introduced to scientific programming and data manipulation

The CLIM3724/3764 students went on an excursion to the Naval Hill Planetarium in Bloemfontein and enjoyed a presentation by Prof Matie Hoffman.

RESEARCH AND INNOVATION

Dr Elmarie van der Watt continued with her project on natural product screening to identify plants producing potential fungicides, pharmaceuticals, insecticides and herbicides, and produced some encouraging results. These included the repellent activity of plant extracts against red spider mites (*Tetranychus urticae*), grasshoppers and other insects on several crops. Screening of cactus pear (*Opuntia ficus-indica*) as potential bio-products and isolation of bio-active compounds was also started with Dr Gesine Coetzer. Dr van der Watt, together with Prof Linus Franke, visited their PhD student Eleanor Magwaza in March 2022 at CYMMIT in Zimbabwe.



Prof Linus Franke (third from right), Dr Elmarie van der Watt (second from right) and PhD student, Eleanor Magwaza (right), together with members of CYMMIT in Zimbabwe (March 2022)

Elmarie also started collaborative projects with the Central University of Technology (CUT) on the effect of different biostimulants on the production of kale and tomatoes under different stress conditions.

Dr Barnard continued his involvement in two Water Research Commission- (WRC) - funded projects. The first project aims to develop and apply a bioeconomic model to economically improve the conjunctive use and management of irrigation water and root-accessible water tables. The year focused on finalising inverse modelling procedures to calibrate the two soil-crop-water simulation models (AquaCrop and SWAP) used in the project. In March, the second WRC-funded project, 'SAPWAT change of custodianship and climate database upgrade' started. SAPWAT is a decision-making tool (software) for estimating crop water requirements. During this first year, the project team received training during several workshops, from Dr PS van Heerden, the current custodian of the tool. In addition, the source code and database were discussed and transferred to the project team.

Field trial research at the Kenilworth Experimental Farm, with the main aim of training postgraduate candidates in Agronomy continues to address

industry-related challenges. Trials vary in size from a mere 0.018 ha to 3.6 ha, which includes planting date, water harvesting, nitrogen fixation, fertilization, as well as crop rotation and soil tillage trials. Both the crop water productivity on sorghum, as well as planting date trials, were completed. Data on the latter project was published in the November 2022 issue of SA Grain. The outcomes of this research led to a continuation of the field trials as well as newly established field trials with the primary aim of determining the 'critical' latest planting date. This project still forms part of the 'Climate Resilience Consortium' that includes the UFS, the Agricultural Research Council (Grain Crops Institute) and the University of Pretoria.

The Bloemfontein long-term experiment (LTE) that includes crop rotation and tillage practices was established successfully in November 2020. This LTE will continue for at least four seasons to complete the first cycle, but the long-term goal is to continue the trial for at least four full cycles, or longer if possible. The experiment is currently in the third season of the first four-year cycle. A year ago, the initiative was expanded to a new site at Kroonstad in collaboration with Trio High School. The field trial is currently in its second season, with the first season having produced some surprisingly high yields – maize as high as 10 t ha⁻¹, sunflower >3.5 t ha⁻¹ and soya beans >4.5 t ha⁻¹.



Maize and soya beans in the long-term trial at the Trio High School, Kroonstad

Collaboration was also established with researchers from the North-West University, who will lead

research on nematodes on both projects. Both projects are funded by the Maize Trust. The expansion of field trials necessitated the acquisition of new equipment, such as a new planter which was funded by the UFS Faculty of Natural and Agricultural Science Dean's Office.



New Monosem 4-row no-till planter

Prof Franke continued research to resource use efficiencies of potato-based rotation in the western Free State (Christiana area), in collaboration with Prof Martin Steyn from the University of Pretoria. He also initiated research on hybrid potato varieties and in 2022, hybrid potato varieties were grown and tested for the first time in South Africa. This research is conducted in collaboration with Solynta, a company in the Netherlands, and co-funded by a grant from DSI-NRF.

The project on soil carbon dynamics in rangelands as affected by management, funded by the Regional University Alliance for Capacity Building in Agriculture (RUFORUM), continued in 2022. A meeting organised by RUFORUM was attended by some members of the Department in December in Zimbabwe, together with three MSc students who benefited from the project. Prof Franke also visited the congress of the European Association for Potato Research in July in Krakow, Poland. He presented findings from his research on water use by potato in irrigated production systems.

Prof Johan van Tol is involved in two WRC-funded projects. The first is a collaborative effort with the Institute of Natural Resources (INR) and South African Biodiversity Institute (SANBI) to develop improved guidelines for hydro-pedological surveys in wetland assessments. Prof Van Tol is leading this project, which is administrated by the INR. Prof Van

Tol is a principal researcher on the second project which aims to create a hydrological soil map for South Africa. This project is a joint effort between North-West University, UFS, Stellenbosch University and SANParks.

Prof Van Tol, together with collaborators from the UFS Afromontane Research Unit (ARU), EURAC and GLOMOS, are establishing a Long-Term Socio-Ecological Research (LTSER) platform in the northern Maloti-Drakensberg. This team presented a joint paper at the Southern African Mountain Conference in March 2022 and is busy with a publication on the state of degradation in the northern highlands of Lesotho.

Research on soil health is also being conducted by Prof Van Tol, Cowan Mc Lean and several other students. The focus is on establishing soil health status, restoration plans and carbon sequestration potential with the focus on protected areas. Field visits to the Kruger National Park, Marakele National Park, Royal Natal Park and Zuka Private Game Reserve were conducted.

Dr Weldemichael Tesfahuney continued research on sunn hemp cover crop management under in-field rainwater harvesting (IRWH) to measure the crop physiological parameters. A PhD research project on

water and radiation use of a sunn hemp intercrop in a maize-based cropping system was completed. Dr Tesfahuney established an EMS on the West Campus, with a grant from the large equipment fund from the Dean's Office.

ENGAGED SCHOLARSHIP

Prof Linus Franke served as Editor-in-Chief of the *South African Journal of Plant and Soil*. He was the convenor of the NRF panel awarding NRF-ratings in the field of Earth Sciences, and also served on the evaluation committee selecting the young farmer of the year in the Free State on behalf of Free State Agriculture.

Neo Mathinya and Prof Franke organised a mini-symposium at the UFS on the future of smallholder farming in South Africa, together with Prof Ken Giller and Dr Gerrie van de Ven from Wageningen University in the Netherlands. The symposium resulted in the establishment of a forum for research on smallholder farming at the UFS, aiming to bring together various groups across departments and faculties involved in research on smallholder farming systems.

Dr Johan Barnard (left) and Prof Elmarie Kotzé (right) with participants at the Bloemfontein training session for emerging farmers as part of the Agribusiness Transformation Programme sponsored by Standard Bank



Prof Weldeslassie and Prof Van Tol both served as Associate Editors of the *South African Plant and Soil Journal*.

Prof Elmarie Kotzé and Dr Johan Barnard continued their annual training sessions for the Agri-Transformation Programme sponsored by Standard Bank. The sessions were presented in Bloemfontein, Kroonstad, Bethlehem and Jan Kempdorp and attended by emerging farmers. Topics presented included soil water storage, water management in rain-fed and irrigated crop production systems, irrigation water quality, soil quality/health, soil degradation hazards and visual soil assessment.

Dr Stephan Steyn acted as external moderator for all the modules comprising the BSc Honours in Meteorology at the University of Pretoria. These included Numerical Weather Prediction, Satellite Meteorology, Radar Meteorology, Mesoscale Meteorology, Tropical and Extra-tropical Meteorology, and Research Project. Dr Steyn also contributed to an article in News24 on 13 April titled 'Not normal: Experts unpack what may have caused the devastating flooding in KwaZulu-Natal'. He was interviewed by Radio 702 on 23 January about the La Niña phenomenon, and RSG on 9 November about climate change impacts in agriculture and the potential role of conservation agriculture.

NATIONAL AND INTERNATIONAL COLLABORATION

Research projects were undertaken in collaboration with private sector partners such as Agraforum, SAB, AB-InBev, Kynoch, Grain SA and Potatoes SA. Moreover, funding is received from other organisations such as the WRC and RUFORUM.

Prof Elmarie Kotzé and Prof Johan van Tol are involved in the supervision of two PhD students with a cotutelle agreement with the University of Bourgogne, France, working on soil and water related research in the montane fire climax grasslands of Cathedral Peak in the Drakensberg, South Africa.

Prof Van Tol is collaborating with researchers from

the United States Department of Agriculture-Agricultural Research Service (USDA-ARS) in Texas and Aarhus University in Denmark, to improve model predictions following a hydro-pedological approach. A joint training workshop was held in September 2022, followed by two joint presentations at the International Kirkham Conference in Skukuza.

Neo Mathinya continued her sandwich PhD with Wageningen University in the Netherlands. She is expected to hand in her thesis by the end of 2023.

POSTGRADUATE STUDENTS

In 2022, a total of nine students were enrolled for the Honours degree, 36 for MSc and 24 for PhD.

In terms of graduations, Lawrence Chabalala, Adriaan Esterhuizen, Zuné du Plessis, Zane Barnard, Jan-Dirk Marx, Maletsatsi Mohapi, Shereen Maluleke and Rose Seboko graduated with an MSc degree.

Three PhD degrees were conferred in 2022:

Machakaire, Allan Tatenda Batsirai

Thesis: Resource use efficiencies of irrigated potato production systems in a semi-arid climate.

Supervisor: Prof AC Franke

Co-supervisor: Prof JM Steyn

Matikiti, Anniah

Thesis: Intensification of cocoyam (*Colocasia esculenta* L. Schott) production for sustainable livelihoods in Zimbabwe

Supervisor: Dr GM Coetzer

Co-supervisor: Dr J Allemann

Mamera, Matthew

Thesis: Assessing pollution and managing faecal sludge through biochar applications in Phuthaditjhaba, South Africa

Supervisor: Prof JJ van Tol

Co-supervisor: Dr MP Aghoghovwia

POSTDOCTORAL RESEARCH FELLOWS

The Department hosted two postdoctoral research fellows in 2022, namely Dr Isaac Gura from Zimbabwe, and Dr Achamyeeh Mengistu from Ethiopia.



Lindsay Banda

STAFF MATTERS

Lindsay Banda started as a horticulturist in 2022. She is in the process of finalising her PhD in Horticulture at the University of Stellenbosch.

Cowan McLean was appointed as a Lecturer in Soil Science. He is currently working on his PhD at the UFS.



Cowan McLean

Prof Tesfay Weldeslassie was appointed as Associate Professor in Agronomy in the Department, coming from the University of Fort Hare.

Dr Tinashe Dirwai resigned from the Department in December 2022 to take up a position with the International Water Management Institute (IWMI) in Zimbabwe.

Prof Cornie van Huyssteen retired in March 2022 and Dr Makhosazana Aghovghovwia left the Department when she emigrated to Canada.



Prof Tesfay Weldeslassie

Edwin Moeti also left the Department.

Linda de Wet took over the role of Programme Director in the Department from Dr Elmarie van der Watt in 2022.

Prof Van Tol, Prof Ceronio and Dr Barnard, together with the Prof Grové from the Department of Agricultural Economics, entered a team in the annual Faculty of Natural and Agricultural Sciences Golf Day held at Schoeman Park Golf club. The team came second, as evident from the near hole-in-one by Prof Ceronio in what was an enjoyable day amongst colleagues.

Gert Ceronio (left) and Johan van Tol (right) competing in the Golf Day at Schoeman Park Golf Club



RESEARCH OUTPUTS

Research Articles

- Aghoghovwia, M.P., Hardie, A. & Rozanov A.** 2022. Characterisation, adsorption and desorption of ammonium and nitrate of biochar derived from different feedstocks. *Environmental Technology* 43 (5): 774-787.
- Barnard, J.H. & Du Preez, C.C.** 2022. Spatial characterization of total salt in non-saline soil solutions through electromagnetic induction. *Catena* 216:106395-1-106395-13.
- Bello, Z.A., Van Rensburg, L.D., Dlamini, P., Tfwala, C.M. & Tesfahuney, W.** 2022. Characterisation and Effects of Different Levels of Water Stress at Different Growth Stages in Malt Barley under Water-Limited Conditions. *Plants (Basel)*. 11(5):578.
- Bouma, B., Bonfante, A., Basile, A., Van, Tol J.J., Hack-Ten Broeke, M., Mulder, M., Heinen, M., Rossiter, D., Poggio, L. & Hirmas, D.** 2022. How can pedology and soil classification contribute towards sustainable development as a data source and information carrier?. *Geoderma* 424: 1-11.
- Ceronio, G.M. & Du Preez, C.C.** 2022. Is application of commercial potassium humates beneficial to soil and wheat?. *South African Journal of Plant and Soil* 39: 123-131.
- Chichongue, O.J., Van Tol, J.J., Ceronio, G.M., Du Preez, C.C. & Kotze, E.** 2022. Short-Term Effects of Tillage Systems, Fertilization, and Cropping Patterns on Soil Chemical Properties and Maize Yields in a Loamy Sand Soil in Southern Mozambique. *Agronomy-Basel* 12: 1534-1-1534-18.
- Chimonyo, V., Chibarabada, T., Choruma, D., Kunz, R., Walker, S., Massawe, F., Modi, A. & Mabhaudhi, T.** 2022. Modelling Neglected and Underutilised Crops: A Systematic Review of Progress, Challenges, and Opportunities. *Sustainability* 14: 13931-1-13931-21.
- Coetzer, G.M. & Fouche, H.J.** 2022. Importance of the selection of plant material for sustainable cactus pear production in South Africa. *Acta Horticulturae* 1343: 145-154.
- De Wit, M., Nkoi, V.F., Nematshema, H.A., Coetzer, G.M., Ceronio, G.M. & Fouche, H.J.** 2022. Effect of nitrogen fertilization and season (year) on cactus pear seed oil content and fatty acid composition. *Acta Horticulturae* 1343: 283-290.

- Dlamini, J.C., Cardenas, L., Tesfamariam, E., Dunn, R., Evans, J., Hawkins, J., Blackwell, M. & Collins, A.** 2022. Soil CO₂ emissions in cropland with fodder maize (*Zea mays* L.) with and without riparian buffer strips of differing vegetation. *Agroforestry Systems* 96: 983-995.
- Dlamini, J.C., Cardenas, L., Tesfamariam, E., Dunn, R., Evans, J., Hawkins, J., Blackwell, M. & Collins, A.** 2022. Soil N₂O and CH₄ emissions from fodder maize production with and without riparian buffer strips of differing vegetation. *Plant and Soil* 477: 297-318.
- Dlamini, J.C., Cardenas, L., Tesfamariam, E., Dunn, R., Evans, J., Hawkins, J., Blackwell, M. & Collins, A.** 2022. Soil N₂O and CH₄ emissions from fodder maize production with and without riparian buffer strips of differing vegetation. *Plant Soil and Environment* 477: 297-318.
- Dlamini, J.C., Cardenas, L., Tesfamariam, E., Dunn, R., Hawkins, J., Blackwell, M., Evans, J. & Collins, A.** 2022. Soil methane (CH₄) fluxes in cropland with permanent pasture and riparian buffer strips with different vegetation. *Journal of Plant Nutrition and Soil Science* 185(1): 132-144.
- Dlamini, J.C., Cardenas, L., Tesfamariam, E., Dunn, R., Loick, N., Charteris, A., Cocciaglia, L., Vangeli, S., Blackwell, M., Upadhyay, H., Hawkins, J., Evans, J. & Collins, A.** 2022. Riparian buffer strips influence nitrogen losses as nitrous oxide and leached N from upslope permanent pasture. *Agriculture, Ecosystems and Environment* 336:108031-1-108031-14.
- Du Preez, C.C., Lebenya, R.M. & Van Huyssteen, C.W.** 2022. Change in total carbon stocks eight years after afforestation of a sub-humid grassland catchment with *Pinus* and *Eucalyptus* species. *New Forests* 53: 267284.
- Dzvene, A.R., Tesfahuney, W., Walker, S. & Ceronio, G.** 2022. Effects of intercropping sunn hemp into maize at different times and densities on productivity under rainwater harvesting technique. *Frontiers in Sustainable Food Systems* 6:1009443-1-1009443-17.
- Dzvene, A.R., Tesfahuney, W., Walker, S., Fourie, A., Botha, C. & Ceronio, G.** 2022. Farmers' knowledge, attitudes, and perceptions for the adoption of in-field rainwater harvesting (IRWH) technique in Thaba Nchu, South Africa. *African Journal of Science, Technology, Innovation and Development* 14(6):1458-1475.

- Elumalai, V., Rajmohan, N., Sithole, B., Li, P, Uthand, S. & Van Tol, J.J.** 2022. Geochemical evolution and the processes controlling groundwater chemistry using ionic ratios, geochemical modelling and chemometric analysis in uMhlathuze catchment, KwaZulu-Natal, South Africa. *Chemosphere* 312: 137179-1-137179-12.
- Franke, A.C. & Akinnuoye-Adelabu, D.B.** 2022. The beneficial effects of insect pollination and biochar seed Coating on Okra (*Abelmoschus esculentus*) seed quality at varying temperature conditions. *Agriculture-Basel*, 12: 1690-1-1690-17.
- Franke, A.C. & Kotze, E.** 2022. High-density grazing in southern Africa: Inspiration by nature leads to conservation?. *Outlook on Agriculture* 51(1): 67-74.
- Gura, I., Mnkeni, P., Du Preez, C.C. & Barnard, J.H.** 2022. Dataset on the interaction effects of tillage, crop rotations and residue management on overall soil quality. *Data in Brief* 43: 108456-1-108456-7.
- Gura, I., Mnkeni, P., Du Preez, C.C. & Barnard, J.H.** 2022. Short-term effects of conservation agriculture strategies on the soil quality of a Haplic Plinthosol in Eastern Cape, South Africa. *Soil & Tillage Research* 220: 105378-1-105378-13.
- Haj-Amor, Z., Tesfay, A., Kim, D.G., Bouri, S., Lee, J., Ghiloufi, W., Yang, Y., Kang, H., Jhariya, M.K., Banerjee, A. & Lal, R.** 2022. Soil salinity and its associated effects on soil microorganisms, greenhouse gas emissions, crop yield, biodiversity and desertification: A review. *Science of The Total Environment* 843: 156946
- Harrison, R.L., Van Tol, J.J. & Suchet, P.** 2022. Hydropedological Characteristics of the Cathedral Peak Research Catchments. *Hydrology* 9(189): 1-20.
- Harrison, R.L., Van Tol, J.J. & Toucher, M.** 2022. Using hydropedological characteristics to improve modelling accuracy in Afromontane catchments. *Journal of Hydrology-Regional Studies* 39: 100986-1-100986-15.
- Julich, S., Moorcroft, M. & Feger, K. & Van Tol, J.J.** 2022. The impact of overgrazing on water fluxes in a semi-arid watershed – The suitability of watershed scale modeling in a data scarce area. *Journal of Hydrology-Regional Studies* 43: 101178-1-101178-14.
- Jumman, A., Van Heerden, P., Van Antwerpen, R., Van Rensburg, L.D., Adendorff, F.M., Radzilani, T. & Searle, A.** 2022. The knowledge levels, perceptions,

- and practices of irrigation farmers in the context of soil salinity management in the South African sugarcane industry. *Irrigation and Drainage* 71: 381-393.
- Loke, P.F., Heine, H., Rhode, O., Kotze, E. & Du Preez, C.C.** 2022. Tillage and its temporal effects on soil organic matter and microbial characteristics in the semi-arid central South Africa. *Soil Research* 60(3): 294-309.
- Loke, P.F., Kotze, E. & Du Preez, C.C.** 2022. Soil Organic Matter Storage in Irrigated Tsitsikamma Dairy Farms with Minimum Tilled Pasture Mixtures: Case Studies. *Agriculture-Basel* 12: 858-1-858-21.
- Malongweni, S.O. & Van Tol, J.J.** 2022. Fire, Herbivores, and Vegetation Type Shape Soil Biochemistry in Sodic Patches of a Semi-Arid Savanna Ecosystem. *Land* 11: 1148-1-1148-14.
- Mamera, M., Van Tol, J.J. & Aghoghovwia, M.P.** 2022. Treatment of faecal sludge and sewage effluent by pinewood biochar to reduce wastewater bacteria and inorganic contaminants leaching. *Water Research* 221: 118775-1-118775-11.
- Mararakanye, N., Le Roux, J.J. & Franke A.C.** 2022. Long-term water quality assessments under changing land use in a large semi-arid catchment in South Africa. *Science of the Total Environment* 818: 151670-1-151670-14.
- Mardamootoo, T. & Du Preez, C.C.** 2022. Integrating Source and Transport Factors with Best Management Practices to Derive an Index for Assessing Phosphorus Mobilization Risks from Mauritius Sugarcane Fields. *Journal of Geoscience and Environment Protection* 10: 181-201.
- Mathinya, V.N., Franke A.C., Van de Ven, G. & Giller, K.** 2022. Productivity and constraints of small-scale crop farming in the summer rainfall region of South Africa. *Outlook on Agriculture* 51: 139-154.
- Mazwi, Q., Coetzer, G.M., Fouche, H.J. & Ceronio, G.M.** 2022. The role of nitrogen fertilizer on 'Morado' cactus pear as a potential fodder crop. *Acta Horticulturae* 1343: 87-95.
- Sakumona, M., Allemann, J. & Van der Watt, E.** 2022. Physiological responses of spring wheat cultivars grown in warm and cool ecotopes. *Tropical Agricultural Research & Extension* 25: 53-64.
- Scholtz, R., Donovan, V., Strydom, T., Wonkka, C., Kreuter, U., Rogers, W., Taylor, C., Smit, I., Govender,**

N., Trollope, W., Fogarty, D., Twidwell, D. 2022. High-intensity fire experiments to manage shrub encroachment: lessons learned in South Africa and the United States. *African Journal of Range & Forage Science* 39: 148-159.

Seetseng, K.A., Van Rensburg, L.D., Barnard, J.H. & Du Preez, C.C. 2022. Influence of water application levels and plant densities on the plasticity of canola in the central Free State, South Africa. *South African Journal of Plant and Soil* 39: 77-84.

Smit, E. & Van Tol, J.J. 2022. Impacts of Soil Information on Process-Based Hydrological Modelling in the Upper Goukou Catchment, South Africa. *Water* 14: 407-1-407-15.

Smit, I., Joubert, M., Smit, K., Van Wilgen, N., Strydom, T., Baard, J. & Herbst, M. 2022. Fire as friend or foe: The role of scientists in balancing media coverage of fires in National Parks. *African Journal of Range & Forage Science* 39: 136-147.

Tesfuhoney, W.A., Mengistu, A.G., Van Rensburg, L.D. & Walker, S. 2022. Estimating soil water evaporation as influenced by “dry-and green-mulch” cover beneath maize canopy. *Physics and Chemistry of the Earth* 128: 103270-1-103270-12.

Tesfuhoney, W.A., Swart, W.J., Van Rensburg, L.D., Wolmarans, K., Walker, S. & Chung, H. 2022. Soil microbial activity as influenced by crusted runoff strip length and mulch cover under in-field rainwater harvesting (IRWH). *Physics and Chemistry of the Earth* 128: 103258-1-103258-9.

Tesfuhoney, W.A., Van Rensburg, L.D. & Walker, S. 2022. Estimating soil water evaporation as influenced by “dry-and green-mulch” cover beneath maize canopy. *Physics and Chemistry of the Earth* 128: 103270.

Tharaga, P.C, Tesfuhoney, W.A, Coetzer, G.M., Savage, M.J. 2022. Evapotranspiration of a rain-fed sweet cherry orchard in Eastern Free State, South Africa. *Acta Horticulturae* 1335: 119-126.

Theron, S., Archer, E., Midgley, S. & Walker, S. 2022. Exploring farmers' perceptions and lessons learned from the 2015-2018 drought in the Western Cape, South Africa. *Journal of Rural Studies* 95: 208-222.

Tlomatsana, L.S., Loke, P.F., Kotze, E. & Aghoghovwia, M.P. 2022. Aggregate dynamics and intra-aggregate carbon contents as influenced by long-term wheat production management in semi-arid South Africa. *South African Journal of Plant and Soil* 39: 94-101.

Van Antwerpen, R. 2022. Development and assessment of an updated tool for the design of soil and water conservation structures in the sugar industry of South Africa. *Agricultural Engineering International: CIGR Journal*.

Van der Westhuizen, H., Du Preez, C.C. & Snyman, H.A. 2022. Rangeland Degradation Impacts on Vegetation Cover, Soil Properties and Ecosystem Functioning in an Arid and Semi-Arid Climate, South Africa. *Journal of Geoscience and Environment Protection* 10: 10-32.

Van Huyssteen, C.W. & Johnson, T.L. 2022. The physical, chemical, mineralogical, and hydrological properties of three different wetland types in the Kruger National Park. *Wetlands Ecology and Management* 30: 695-713.

Van Jaarsveld, C., Zharare, G., Smit, M. & Du Preez, C.C. 2022. Availability of Residual and/or Applied Inorganic Phosphorus for Sugarcane Uptake and Growth in a Post-Mined Reconstituted Soil. *Journal of Geoscience and Environment Protection* 10: 112-127.

Van Tol, J.J. & Van Zijl, G. 2022. South Africa needs a hydrological soil map: a case study from the upper uMngeni catchment. *Water SA* 48: 335-347.

Van Zyl, H.J. & Du Preez, C.C. 2022. Impact of liming on extractable phosphorus, exchangeable base cations, and effective cation exchange capacity of eastern Free State soils. *South African Journal of Plant and Soil* 39: 351-359.

Van Zyl, H.J. & Du Preez, C.C. 2022. Liming guidelines for soils under wheat cropping in the eastern Free State, South Africa. *South African Journal of Plant and Soil* 39: 340-350.

Van Zyl, H.J. & Du Preez, C.C. 2022. Response of wheat cultivars with varying acid tolerances to liming of eastern Free State soils. *South African Journal of Plant and Soil* 39: 360-369.

Visser, M., Barnard, A. & Du Preez, C.C. 2022. Impact of preceding crop sequences on wheat growth and development under conservation agriculture in the eastern Free State, South Africa. *South African Journal of Plant and Soil* 39: 56-65.

Weldeslassie, T.A., Mhlwa, A.V., Abd Elbasit, M.A. & Newete, S.W. 2022. The impact of Tamarix invasion on the soil physicochemical properties. *Scientific Reports* 12(1): 1-11.

Zuma-Netshiukhwi, G.N.C. & Steyn, A.S. 2022. Evaluation of the standardized precipitation index in Kestel, Eastern Free State, South Africa. *International Journal of Multidisciplinary Research and Development* 9(5): 50 - 60.

Chapters in Books

Harrison, R.L. 2022. Digital Soil Mapping for hydropedological purposes of the Cathedral Peak research catchments, South Africa. In: *Remote Sensing of African Mountains – Geospatial Tools Toward Sustainability*. S. Adedun, A. Ramoelo, A. Olusola & E. Adagbasa (Eds). Springer. pp. 193-214.

Mathinya, N.V., Clark, V.R., Van Tol, J.J. & Franke, A.C. 2022: Resilience and Sustainability of the Maloti-Drakensberg Mountain System: A Case Study on the Upper uThukela Catchment. In: *Human-Nature Interactions. Exploring nature's values across landscapes*. L. Misiune, D. Depellegrin & L.E. Vigl (Eds). Springer Nature, Switzerland. pp. 155-167.

Van Antwerpen, R. 2022. A review of field management practices impacting root health in sugarcane. In: *Advances in Agronomy (Volume 173)*. D. Sparks (Ed). Academic Press. pp. 79-162. 978-0-323-98955-8.

Conference Contributions

Conference Papers/Posters

Bieger, K., Schürz, C., Navarro, E.M., Gómez, A.S., Van Tol, J. & Arnold J.G. 2022. *Zonal calibration of SWAT+ models using soft data in R*. Paper delivered at the Kirkham Conference, Skukuza, South Africa. 28 August-2 September 2022.

Khetsa, Z.P., Sedibe, M.M., Pretorius, R.J. & Van Der Watt, E. 2022. *Biostimulants improve the leaf micro-morphology and essential oil biosynthesis of simulated hail-damaged Pelargonium graveolens (L'Hér.)*. Paper delivered at the 31st International Horticultural Congress (Physiological responses to abiotic stress), Anger, France. 14-20 August 2022.

Khetsa, Z.P., Sedibe, M.M., Pretorius, R.J. & Van Der Watt, E. 2022. *Recovery Response of simulated hail-damaged Rose Geranium (PELARGONIUM GRAVEOLENS L'Hér "Bourbon") to different mixtures of agricultural plant growth regulators*. Paper delivered at Combined Congress 17-23 January 2022

Mathinya, V.N., Franke, A.C., Van de Ven, G. & Giller, K.E. 2022. *Rich without Reach: Water resources dynamics of rural farming communities at the foothills of the Drakensberg Mountain*. Paper delivered at the Southern African Mountain Conference, Champagne Sports Resort, South Africa. 14-17 March 2022.

Mushunje, A., Assefa, M.T & Weldeslassie, T.A. 2022. *Determinants of Collective Action and Participation Intensity in Irrigation Water Management in Weshu River Irrigation System, Southern Rift Valley of Ethiopia*. Paper delivered at the 59th Annual Conference of AEASA, Swakopmund, Namibia. 2- 5 October 2022.

Van Tol, J., Niedrist, G., Schneiderbauer, S., Delves, J., Hilpold, A., Szarzynski, J. & Clark, V. *Establishing A Long-Term Socioecological Research Platform in the Maloti-Drakensberg: The Need, Focus and Lessons from the international community*. Paper delivered at the Southern African Mountain Conference, Champagne Sports Resort, South Africa. 14-17 March 2022.

Walker, S. 2022. Application of water-energy-food nexus framework tools at different scales: preliminary assessment. Paper delivered at the 24th ICID Congress & 73rd IEC Meeting, Adelaide, Australia 3-10 October 2022.

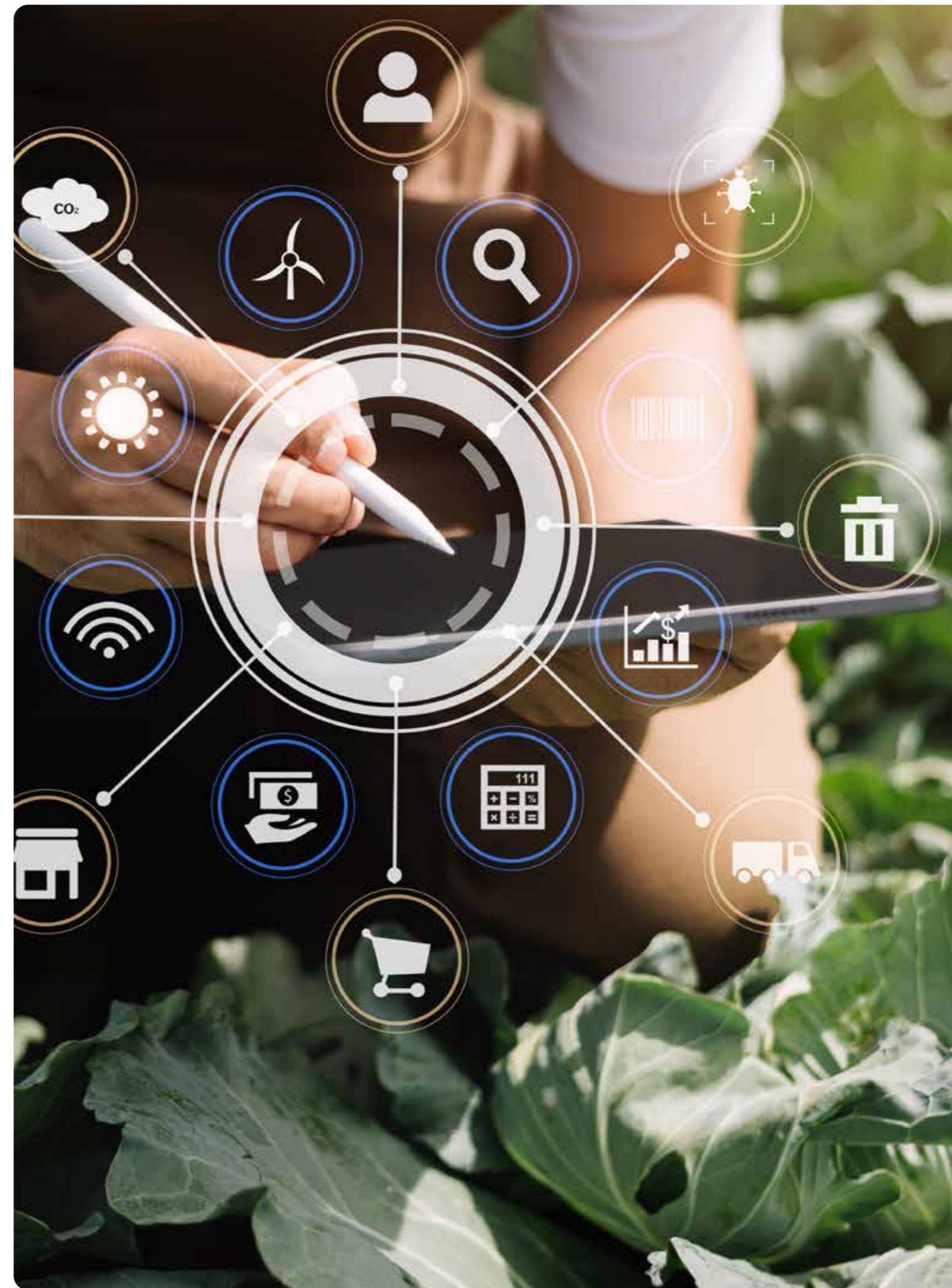




STAFF (2022)

Head of Department:
Prof AC Franke

- Professors:** Prof AC Franke and Prof CW van Huyssteen
- Associate Professor:** Prof JJ van Tol and Prof TA Weldeslassie
- Affiliated Professors:** Prof CC du Preez and Prof S Walker
- Senior Lecturers:** Dr J Barnard, Dr G Ceronio, Dr G Coetzer, Dr E Kotzé and Dr E van der Watt
- Lecturers:** Dr M Aghoghovwia, L Banda, L de Wet, J Dlamini, VN Mathinya, C Mc Lean, Dr AS Steyn, P Tharaga and Dr WA Tesfuhoney
- Programme Director:** L de Wet
- Senior Officers:** L Henning and BE Tshabang
- Officer:** N Radebe
- Senior Assistant Officers:** R Etzebeth, A Moffat and DE Terblanche
- Messenger:** E Moeti
- Cleaner:** T Mlobeli
- Service Workers:** G Madito, G Mokoena, E Nthoba and E Yokwane



DEPARTMENT OF

SUSTAINABLE FOOD SYSTEMS AND DEVELOPMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

Prof Johan van Niekerk

Department of Sustainable Food Systems and Development

Faculty of Natural and Agricultural Sciences

University of the Free State
PO Box 339 | Bloemfontein
9300 South Africa

T: +27 51 401 3765

E: VniekerkJA@ufs.ac.za

W: www.ufs.ac.za/sfsd

OVERVIEW OF 2022

The year 2022 was marked with growth, success and innovation for the Department of Sustainable Food Systems and Development. After successfully combining two separate academic entities (Consumer Sciences and Sustainable Agriculture) in 2020, our newly forged Department managed to develop into an entity to be reckoned with, in a fairly short period. Faced with mounting challenges of food systems being the contributor of a third of global greenhouse gas emissions, coupled with food systems failing 768 million starving people worldwide, and the contributing volatile global shocks of conflicts worldwide (such as the war in Ukraine, the aftermath of COVID-19 and increasing extreme weather conditions), it has become more imperative than ever to transition food systems to a nature-

positive infrastructure that nourishes and feeds everyone. Our Department was guided by adapting and excelling at this during 2021 and 2022.

Our primary focus remains creating a natural link that provides the potential for training, development and research from a food systems perspective; our innovative advancement and community engagement led to growth and placed the UFS and the Faculty on the world stage. Our Department still places a strong emphasis on the development of sustainable food systems, developing leading research and capacity, promoting leadership and creating partnerships to benefit the local and national agribusiness sector – positioning the Faculty and the UFS as a fundamental role-player to research challenges that impact on sustainable food development in Africa. With the continuous dedication of our academic and support staff, the Department submitted and received approval in 2022 for a degree in Sustainable Food Systems, which will provide an entire new feeding stream and progression within the Faculty.

ACHIEVEMENTS

Staff Achievements

Prof Johan van Niekerk was appointed as committee member for the Agricultural Extension Qualification Standard Working Group by the Council for Higher Education (CHE) for assessment of national standards and reviews on 23 February 2022

Anathi Makamane, a Lecturer in Agricultural Extension, received the University Staff Doctoral



Anathi Makamane presenting at the SASAE Conference

Programme (USDP) grant from the Department of Higher Education and Training. The R500 000 funding she received as part of the grant will be used to pursue her PhD studies in 2022 and 2023, to investigate the capacity of Extension and Advisory Services in supporting farmers to adapt to climate change.

During the annual South African Society for Agricultural Extension (SASAE) conference in October 2022, Makamane presented a paper on the 'Determinants of Climate Smart Agriculture (CSA) technology adoption by smallholder food crop farmers in the Mangaung Metropolitan Municipality', for which she won the best scientific paper award. Her presentation identified the need for scientific research in the field of extension and identified possible partnerships with the Agricultural Department of the Western Cape.

Student Achievements

Almaré de Bruin received the Dean's Medal as the overall best achiever in the fourth-year group in the Faculty of Natural and Agricultural Sciences. Almaré developed a raisin spread for children in her Honour's year, and she is currently enrolled for her MSc in Consumer Science, in which she will apply her knowledge to improve nutrition conditions for impoverished communities.



Almaré de Bruin, winner of the 2021 Dean's Medal for the best achiever in the fourth-year group

TEACHING AND LEARNING

During the 2022 academic year, 27 Consumer Science degrees were awarded, of which 11 were with distinction.

The Department developed a new degree, that received accreditation by the Department of Higher Education and Training (DHET) in 2022. The Bachelor of Sustainable Food Systems (NQF level 7) qualification will be presented from January 2024.

RESEARCH AND INNOVATION

With the support of the Centre for Graduate Support, Anathi Makamane organised a three-day writing retreat from 6 to 8 May 2022 for all academic staff members in the Department. The sole purpose of the retreat was to prepare academic articles intended for publishing in peer-reviewed journals. To date, five articles have been produced and submitted.



Anathi Makamane, Ayanda Zulu, Alina Ntsiapane, Dr Alba du Toit, Onele Mpemba, Kirsty Green and Dr Natasha Cronje participating in the writing retreat

In 2022, research in the Department focused on the following key areas:

Cactus pear research

Research in the field of Innovative Food Solutions encompasses the investigation into all the human food

applications of cactus pears (*Opuntia ficus-indica* and *O. robusta*). Currently the focus is on the functionality of mucilage, a hydrocolloid extracted from the cladodes, in food products such as edible films, as well as on the oil extracted from the cactus pear fruit seeds. This oil is an essential component in the cosmetic and nutraceutical industries.

The research group of Prof Maryna de Wit contributed 17 presentations at the X International Congress on Cactus Pear and Cochineal, held in Joao Pessoa, Brazil from 26 to 29 September 2022.

Grain SA: Nixtamalization

It is estimated that South Africa, together with Nigeria, Ethiopia, Tanzania, Malawi, Kenya, Zambia, Uganda, Ghana, Mozambique, Cameroon, Mali, Burkina Faso, Benin, Democratic Republic of the Congo, Angola, Zimbabwe, Togo and Cote d'Ivoire, contributes up to 96% of the total maize production in Sub-Saharan Africa. Despite being the second largest crop grown in South Africa, maize is considered the most important cereal because it forms part of a primary staple food amongst South African consumers. In addition to being consumed directly as food, maize is processed into many different food items, including maize meal, porridge, cornflakes and snacks.

Maize is also an essential dietary staple in Mexico, where over 600 products are made from maize, with about half being made from nixtamalized maize. Nixtamalization is a processing technology involving the alkaline cooking of maize kernels with a calcium hydroxide solution. The maize kernels are then soaked in the solution, washed thoroughly and processed into tortillas, tamales and snacks. Nixtamalized grains have several benefits over unprocessed grains, including reducing mycotoxins, increasing the availability of calcium and niacin, reducing phytic acid levels and improving the protein quality in maize.

Grain SA and the Department of Sustainable Food Systems and Development are working together to introduce the process of nixtamalization to South Africans – in a South African context and by incorporating it into the traditional cultures and recipes. In 2022, a recipe book was developed for courses that demonstrate how to use nixtamalized

maize in various well-known recipes. Master's and PhD students are currently working on this project to develop products, determine the nutritional value, and use sensory analyses to determine the consumer acceptability of the products.

ENGAGED SCHOLARSHIP

Childline Training initiative

Based on the published success of the two 300 m² food tunnels on the Bloemfontein Campus, Childline reached out to the UFS for guidance on launching their own food tunnels. With the assistance of Doretha Jacobs and Carien Denner-Vorster, several concrete boxes were built by UFS students and planted with a variety of vegetables. This initiative was extended to the Maryke Holtzhausen farm outside of Bloemfontein, and vegetables planted on the farm will be used by Childline for additional food supply. Students assisted throughout 2022 and will continue to be involved with the maintenance and cleaning of the vegetable gardens.



Students preparing vegetable boxes, from the left, Relebohile Maranyana, Thandiswa Mthiyane, Kristie Morupana and Anele Naloyi



Training at Childline Mangaung, front from the left, Prof Rouxlene van der Merwe (UFS), Carien Denner-Vorster (UFS) and Constance Mthukwane; back row, from the left, Bianca Maritz, Charmaine Taaibosch, Wilhelmina Weitz, Ingrid Maseilane and Marlize Ramsdem

The student involvement led to Childline requesting further assistance to train their staff at various Childline sites across the Free State. Prof Rouxlene van der Merwe, from the Department of Plant Sciences, and Carien Denner-Vorster, from our Department, compiled a training manual and training took place from 25 to 27 October 2022 at three of the Childline offices in Mangaung where they take care of and prepare meals for children in need. Gardens were built at each site and planted with vegetables.

Free State Residential Care Centre (VNSCare)

Students from the Sensory Lab invested their time and creativity in upgrading the dining hall, the sensory room and the garden at the VNSCare. Students enrolled in the Consumer Science degree are committed to contributing to their local community by weekly service delivery initiatives.

UFS food tunnels

In 2022, we experienced the best year since inception of the UFS food tunnels project in 2020, with a total of 2863,5 kg of vegetables being harvested

by students. With all students back on campus, each UFS residence took ownership of their own vegetable box by continuously monitoring the growth and health of their vegetable plants.



With crops grown in the food tunnels, from the left, Annelize Visagie (Head of Food Environment at UFS Student Affairs), Carien Denner-Vorster and Prof JW Swanepoel (Department of Sustainable Food Systems and Development) and Prof Rouxlene van der Merwe (Department of Plant Sciences)



Gilbert Augustine, from Kopsie Act, in the pumpkin patch

Together with Kovsie Act and their volunteers, vegetable boxes were rebuilt and a new area for a pumpkin patch was built outside the food tunnels – which has already produced its first crop. We started to experiment with new types of vegetables to test their popularity with the students receiving food parcels.

A Spring Day celebration was held with Thabo Olivier, a food security activist from Bloemfontein. He presented a motivational talk on why it is important to start growing your own food and the importance of community gardens.

community engagement projects and showcasing their own work. First-year students presented exhibitions on children's clothing, the second-year students presented a modelling show in cocktail attire and the third-year students created their own clothing time capsules.



Participants in the sewing skills classes presented to UFS staff members by Doretha Jacobs, from the left, Khanyisile Sika, Anathi Makamane, Lize van Wyngaard, Eileen Roodt, Rita Opperman, Charlene Williams, Lindie von Maltitz, Andrehette Verster and Makhosozana Aghoghovwia

Sewing skills

Doretha Jacobs teaches sewing and design modules to students in the Department; however, in March 2022, she began presenting classes to a group of 35 staff members interested in developing sewing skills. Starting with a self-enrichment workshop during the lunch hour of staff, her first goal with the classes was to empower people to sew and be creative. As a bonus, they also fostered engagement between staff from different departments. Staff attended sessions on pattern reading, stitching and setting up of the sewing machines, fitting an invisible zip, making a cord, applique work and do-it-yourself bias binding. This initiative succeeded in generating funds for the Department, which were used as seed funding for new student projects. Students benefitted from the workshops, by using funding to implement

NATIONAL AND INTERNATIONAL COLLABORATION

Texas Tech student exchange

Texas Tech University, in collaboration with the UFS, continue to enhance the global reputation by integrating international education, research and engagement on global issues, and by facilitating intercultural understanding for students, faculty, staff and the greater community. The study abroad programme at the UFS aligns with the mission and goals of Texas Tech University and the Department hosted the Texas Tech nutrition study abroad programme participants. From 22 May to 8

June 2022. The students were able to experience activities in the Sensory Lab and the Simulation Lab and participated in an excursion to the UFS Paradys Experimental Farm. They received intensive information on sustainable agriculture, food systems and the nutrition landscape in South Africa.



Exchange students from Texas Tech University hosted by the Department of Sustainable Food Systems and Development

RUFORUM

The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) wool project continued to flourish in 2022, building on the strong foundation laid in the previous years. The focus of the project remains to transform communal wool growers' production from an underachieving enterprise to a profitable, sustainable and renewable venture to enhance the livelihoods of communal wool producers.

The project developed a stream of additional income by incorporating a felt product production section from the wool that is bought from the local community. This part of the project does not form part of the original agreement and is indicative of the project's growth and the interest in the initiative. To date there are seven ladies from the local community employed on a permanent basis. They

perform a variety of tasks from operating the sewing machines, washing and cleaning of wool and making felt skins. UFS staff are involved with training of the community members and product development.



Elizabeth Mnwana and Laletara Sarah Lenong, two of the community ladies involved in the RUFORUM project

This centralised infrastructure hub not only supports wool production and processing, but also creates capacity and assists farmers and the community to develop commercial market engagements. The community members sold products to conference participants (as welcoming gifts), local markets, the Bloem Show, KovsieGear and UFS departments bought felt products (combined with shweshwe) for people from other countries visiting the campus.

Some of the products produced by participants in the project



We are grateful for the continuous support of RUFORUM, and future prospects include investing in a larger felting machine to increase production of felting material, as well as increasing the capacity for spinning and weaving as there is a demand for woven carpets.

Standard Bank Agri-business Transformation programme

The Standard Bank Agribusiness Transformation project, conducted in collaboration with the UFS and the Department of Agriculture and Rural Development, entered its fifth year in 2023. Over the past four years, an average of between 25 and 30 smaller commercial farmers were selected to be part of the programme and a total of 118 farmers have been trained since 2019 in farm management and practical mixed farming. Three clusters (in Bloemfontein, Kroonstad and Bethlehem [including Qwaqwa areas]) have been running a cohort each year in the Free State. In 2022 a cluster in the Northern Cape (Vaalharts area) was added, consisting of 18 farmers.

During the nine different sessions, the farmers developed their own business plan applicable to her/his farm – based on the work completed in the sessions – and submitted their plans during the last session of 2022. Each 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 become a larger commercial farmer. The 2022 group (Cohort 4) received their certificates in April 2023. During 2023, the cohorts from the previous two years will still be involved in the mentorship programmes, during which different lecturers will help them with a variety of aspects on their farms to ensure growth and sustainability.

The success rate of the project, measured from the first to the fourth year, stands at just over 90% – meaning that more than 90% of the farmers grew their farm activities or added new activities to their farms. Some farmers added agro-processing activities, such as making juice from spinach, bottling water from boreholes on the farm, or canning vegetables like beetroot, beans, etc. The overall success of the programme lies in the passion

of the lecturers to transfer skills and assist the farmers to be successful, as well as the dedication of the farmers themselves to learn and be successful commercial farmers.

POSTGRADUATE STUDENTS

During the 2022 academic year, 60 students obtained their Post Graduate Diploma in Sustainable Agriculture (four with distinction) and 12 students graduated with an Honours in Consumer Science, of whom four passed with distinction.

A total of 49 students completed the structured Master of Sustainable Agriculture (MSA) and graduated, while six students graduated with a Master's in Consumer Science, namely Lericia Foord, Melissa Louw, Matseliso Maetsi Monnapula, Vyelwa Nkoi, Sisipho Rebe and Ayanda Buyisiwe Zulu.

PhD degrees were conferred on the following eight candidates in 2022:

Hove, Mthintwa Tawande (Sustainable Agriculture)

Thesis: Driving pro poor value chain development leveraging on NGO-Private sector partnerships. The case of Zimbabwe.

Supervisor: Dr JH Ngwenya

Levendal, Carol (Sustainable Agriculture)

Thesis: A foundation in Agricultural Extension Science is a prerequisite for agricultural advisors to improve the livelihood of the beneficiaries of their extension and advisory services support in the Western Cape.

Supervisor: Prof JA van Niekerk

Mahopo, Tjale Cloupas (Sustainable Agriculture)

Thesis: Development of an Agricultural Food Enterprise Model in Rural Towns in Limpopo, South Africa.

Supervisor: Dr CN Nesamvuni

Ndwambi, Khuthadzo (Sustainable Agriculture)

Thesis: The Application of the Geographical Information System for the Development of the Comprehensive Subtropical Fruit Suitability Model: A Case Study of Vhembe District, Limpopo Province of South Africa.

Supervisor: Prof AE Nesamvuni

Thobejane, Kholofelo (Sustainable Agriculture)

Thesis: The impact of empowering women farmers towards sustainable agriculture in the Gauteng Province of South Africa.

Supervisor: Prof JA van Niekerk

Van Rooyen, Brandon (Sustainable Food Systems)

Thesis: Evaluation of native cactus pear mucilage as a functional food ingredient at industrial scale. (2020-2022)

Supervisor: Prof M de Wit

Venter, Phillip (Sustainable Agriculture)

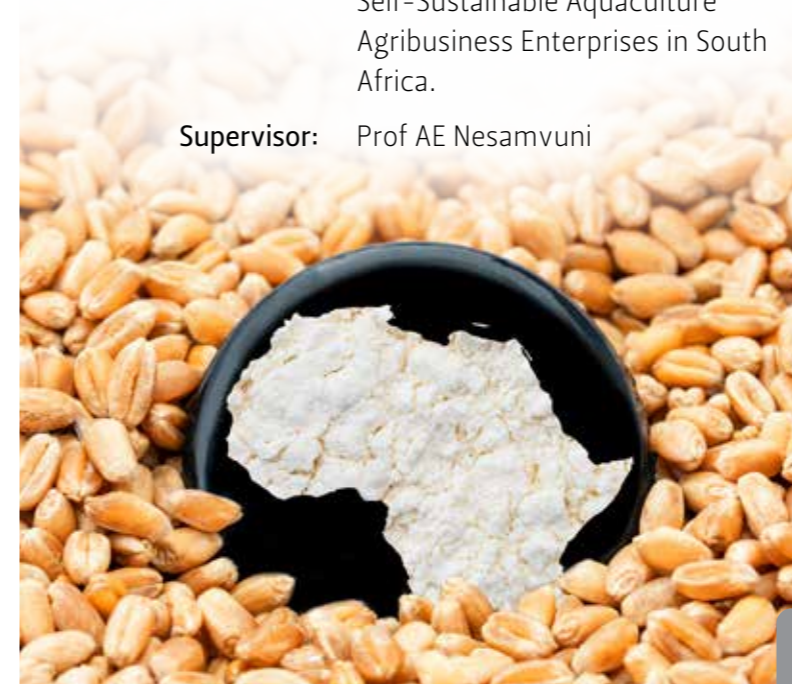
Thesis: The Sustainability of new generation future commercial farmers in South Africa, a North-West Province in South Africa case study.

Supervisor: Prof JA van Niekerk

Webb-Brown, Bernadette (Sustainable Agriculture)

Thesis: Creating a Model to Develop Self-Sustainable Aquaculture Agribusiness Enterprises in South Africa.

Supervisor: Prof AE Nesamvuni



RESEARCH OUTPUTS

Research Articles

Brown-Webb, B., Nesamvuni, A.E., De Bruyn, M. & Van Niekerk, J.A. & Pillay, P. 2022. Assessing the Critical Success Factors for Aquaculture Enterprise Development in South Africa. *Technium of Social Science Journal* 29(1): 438-457.

Brown-Webb, B., Nesamvuni, A.E., De Bruyn, M., Van Niekerk, J.A. & Pillay, P. 2022. Assessing the impacts of COVID-19 on the aquaculture industry in South Africa, using the marine mussel farming sector as a case study. *Technium of Social Science Journal* 29(1): 363-380.

De Wit, M. 2022. An overview of the agro-industrial applications of cactus pears: a South African perspective. *Acta Horticulturae*. 1343: 361-368. DOI: 10.17660/ActaHortic.2022.1343.46

De Wit, M., Nkoi, V., Nematshema, K., Thusi, N., Hugo, A., Coetzer, G.M., Ceronio, G.M. & Fouché, H. J. 2022. Effect of nitrogen fertilization and season (year) on cactus pear seed oil content and fatty acid composition. *Acta Horticulturae* 1343: 283-290. DOI: 10.17660/ActaHortic.2022.1343.27

Du Toit, A., Mpemba, O.S., De Wit, M., Venter, S.L., Hugo, A. 2022. The influence of basic cooking methods on texture attributes of 'Morado' nopalitos. *Acta Horticulturae* 1343: 369-375. DOI: 10.17660/ActaHortic.2022.1343.47.

Ibiyemi, T.E. & Oldewage-Theron, W. 2022. A review of food and nutrition security in Nigeria. *African Journal of Food, Agriculture, Nutrition and Development* 22(1).

Landini, F., Turner, J.A, Davis, K., Percy, H. & Van Niekerk, J. 2022. International Comparison of extension agent objectives and construction of typology. *The Journal of Agricultural Education and Extension* 28 4): 415-437.

Lee, H., Moyo, G., Ibiyei, T., Peng, L.L., Najam, W. & Oldewage-Theron, W. 2022. Impact of COVID-19 on food security status of college students in West Texas. *Epidemiology International Journal* 6 (special issue 1).

Makhalemele, B. L., De Wit, M., Truter, M.M., Du Toit, A., Fouché, H.J., Hugo, A. & Venter, S.L. 2022. Morphological and physico-chemical properties of nopalitos from twenty cactus pear cultivars.

Acta Horticulturae 1343: 387–394. DOI: 10.17660/ActaHortic.2022.1343.49.

Makhalemele, B. L., De Wit, M., Truter, M.M., Du Toit, A., Hugo, A. & Venter, S.L. 2022. The nutritional evaluation of nopalitos from six South African cactus pear cultivars. *Acta Horticulturae* 1343: 377–385. DOI: 10.17660/ActaHortic.2022.1343.48.

Malczyk, S., Steyn, N.P., Nel, J.H., Eksteen, G., Drummond, L., Oldewage-Theron, W., Faber, M., Van Stuijvenberg, M.E. & Senekal, M. 2022. Mean \pm standard deviation intake values for 1–<10-year old South African children for application in the assessment of the inflammatory potential of their diets using the DII[©] method: Developmental research. *Nutrients*, 14: 11. DOI: 10.3390/nu14010011

Mavhungu, T.J., Nesamvuni, A.E., Tshikolomo, T., Mpandeli, N.S. & Van Niekerk, J. 2022. Productivity and profitability of sweet potato (*Ipomoea batatas* L.), dry bean (*Phaseolus Vulgaris*) and maize (*Zea mays* L.) as selected field crops in irrigated smallholder agricultural enterprises (ISAEs) in Vhembe District, Limpopo Province, South Africa. *Technium of Social Science Journal* 29(1): 683–699.

Mahopo, T.C., Nesamvuni, C.N., Nesamvuni, A.E., De Bruyn, M. & Van Niekerk, J. 2022. Socioeconomic characteristic of street food vending enterprises in the Vhembe district, Limpopo province. *Technium Social Sciences Journal* 29(1): 419–437.

Mahopo, T.C., Nesamvuni, N.C., Nesamvuni, A.E., De Bruyn, M., Van Niekerk, J. & Ambikapathi, R. 2022. Operational Characteristics of Women Street Food Vendors in Rural South Africa. *Frontiers in Public Health* 10.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. Characterization of mucilage proteins and carbohydrates responsible for capacity and stability of foam food systems. *Acta Horticulturae* 1343: 473–480. DOI: 10.17660/ActaHortic.2022.1343.59.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. Correlation of *Opuntia ficus-indica* Mill. and *O. robusta* mucilage yield to different physico-chemical characteristics. *Acta Horticulturae* 1343: 497–504. DOI: 10.17660/ActaHortic.2022.1343.62.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Opuntia cladode* mucilage:

proteins. *Acta Horticulturae* 1343: 401–408. DOI: 10.17660/ActaHortic.2022.1343.51.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Opuntia ficus-indica* Mill. and *O. robusta* cladode mucilage: carbohydrates. *Acta Horticulturae* 1343: 511–518. DOI: 10.17660/ActaHortic.2022.1343.64.

Mkhize, X., Oldewage-Theron, W., Napier, C., Duffy, K. & Mthembu, B.E. 2022. Introducing grain legumes for crop diversification and sustainable food production systems amongst urban smallholder farmers: a food and nutrition security project in KwaZulu-Natal, South Africa. *Agroecology and Sustainable Food Systems* 46(6): 791–814.

Moyo, G., Egal, A.A. & Oldewage-Theron, W. 2022. Exploring the prevalence of multiple forms of malnutrition in children 6–18 years living in the Eastern Cape, South Africa. *South African Journal of Clinical Nutrition*. DOI: 10.1080/16070658.2022.2061109

Mpemba, O.S., Du Toit, A., De Wit, M., Venter, S.L. & Hugo, A. 2022. Edible characteristics of two nopalito cultivars compared to selected popular vegetables. *Acta Horticulturae* 1343: 409–415. DOI: 10.17660/ActaHortic.2022.1343.52.

Mpemba, O.S., Du Toit, A., De Wit, M., Venter, S.L. & Hugo, A. 2022. Relationship between quality characteristics of cactus pear nopalitos for use as an alternative vegetable source in South Africa. *Acta Horticulturae* 1343: 531–538. DOI: 10.17660/ActaHortic.2022.1343.67.

Mushanganyisi, D., De Wit, M., Du Toit, A., Du Toit, L., Bothma, C., Hugo, A. & Venter, S.L. 2022. Functional properties of cactus pear mucilage: gelling and spherification. *Acta Horticulturae* 1343: 505–510. DOI: 10.17660/ActaHortic.2022.1343.63.

Najam, W., Walsh, C. & Oldewage-Theron, W. 2022. Nutrition knowledge, attitudes, beliefs, and practices among adults in urban and rural areas in the Free State, South Africa. *Journal of Nutrition Education and Behavior* 54(7) (Suppl): S24.

Nesamvuni, A.E., Ndwambi, K., Tshikolomo, K.A., Lekalakala, G.R., Raphulu, T.R., Petja, M.B. & Van Niekerk, J. 2022. Small-Holder Farmers Knowledge and Information on The Impact of Climate Variability & Extremes on Livestock Production in Limpopo & Mpumalanga Provinces. *Technium Journal of Social Sciences* 27(1): 854–869.

Nesamvuni, A.E., Tshikolomo, T., Lekalakala, G.R., Petja, B.M. & Van Niekerk, J.A. 2022. A framework to monitor and evaluate the vulnerability of smallholder livestock farmers: a case study of Limpopo & Mpumalanga Provinces. *Technium of Social Science Journal* 29(1): 732–752.

Nesamvuni, A.E., Tshikolomo, K., Mpandeli, N.S., De Bruyn, M., Hlophe-Ginindza, S., Van Niekerk, J. 2022. Demography of smallholder agricultural women and youth enterprises and their association with the cultivation of the tomato (*Solanum Lycopersicum*) vegetable crop. *Technium Social Sciences Journal* 29(1) 700–711.

Nesamvuni, A.E., Tshikolomo, K.A., Mpandeli, N. S., De Bruyn, M., Hlophe-Ginindza, S. & Van Niekerk, J. 2022. Perceptions on irrigation water supply and utilization by smallholder agricultural enterprises in Vhembe district of Limpopo Province, South Africa. *Technium Journal of Social Sciences* 2(1): 968–979.

Nkoi, V., De Wit, M., Van Biljon, A. & Van Niekerk, J.A. 2022. Comparison and integration of cactus mucilage protein and soy protein in functional food systems. *Acta Horticulturae* 134: 425–434. DOI: 10.17660/ActaHortic.2022.1343.54.

Oldewage-Theron, W. & Grobler C. 2022. Vitamin D status of the elderly in the Vaal region, South Africa. *South African Journal of Clinical Nutrition*. DOI: 10.1080/16070658.2022.2041887.

Qwabe, Q., Swanepoel, J.W., Zwane, E.M. & Van Niekerk, J.A. 2022. Nexus between the invisibility of agricultural extension services and rural livelihoods development: Assertions from rural farming communities. *South African Journal for Agricultural Extension* 50(2): 26–41.

Ranwedzi, N.E., Nesamvuni, A.E. & Van Niekerk, J. 2022. Pioneers of African initiated churches (AIC) as actors of development: A case of Paulos Matsea Mureri of the United African Apostolic Church (UAAC) and community development. *Technium Social Science Journal* 29(1): 712–731.

Sigwela, V.N., De Wit, M., Du Toit, A. & Hugo, A. 2022. Application of betalain extracts as colouring foods to food products. *Acta Horticulturae* 1343: 463–472. DOI: 10.17660/ActaHortic.2022.1343.58.

Sigwela, V.N., De Wit, M., Du Toit, A. & Hugo, A. 2022. Extraction and stability of betalains extracted from beetroot tubers and the fruit of eight cactus pear cultivars. *Acta Horticulturae* 1343: 309–315. DOI:

10.17660/ActaHortic.2022.1343.39.

Solontsi, M., Magubela, M.P., Van Niekerk, J.A., Swanepoel, J.W. & Jordaan, G. 2022. Nutritive value of four lucerne cultivars planted in two soil types at Bathurst Research station, Eastern Cape Province, South Africa, case study. *Agricultural Sciences* 13(10): 1048–1056.

Solontsi, M., Magubela, M.P., Van Niekerk, J.A., Swanepoel, J.W. & Jordaan, G. 2022. Productivity evaluation of four *Medicago sativa* cultivars under two water regimes (irrigated and non-irrigated) and two soil types at Bathurst Research station in the Eastern Cape Province, South Africa. *Agricultural Sciences* 13(3): 438–447.

Tarrisse, A., De Wit, M. & Van Niekerk, J.A. 2022. The potential of spineless cactus as a drought tolerant energy crop for biogas production: a geographic analysis of potential impact depending on water use efficiency (WUE) and mean annual rainfall (MAR) in South Africa. *Acta Horticulturae* 1343: 197–206.

Tshikolomo, K.A., Nesamvuni, A.E., Petja, M.B., Van Niekerk, J. & Mpandeli, N. S. 2022. Livestock Farmer Demography and Adaptive Capacity to Climate Change and Variability in Limpopo and Mpumalanga Province of South Africa. *Technium Journal of Social Sciences* 27(1): 870–898.

Van Niekerk, J., Von Maltitz, L. & Davis, K. 2022. Investigating process skills and competency gaps in undergraduate agricultural extension curriculum in selected South African Universities. *South African Journal for Agricultural Extension* 50(2): 57–80.

Van Rooyen, B., De Wit, M. & Osthoff, G. 2022. Functionality of native mucilage from cactus pears as a potential functional food ingredient at industrial scale. *Acta Horticulturae* 1343: 481–488. DOI: 10.17660/ActaHortic.2022.1343.60

Van Rooyen, B., De Wit, M. & Osthoff, G. 2022. Gelling potential of native cactus pear mucilage. *Acta Horticulturae* 1343: 489–496. DOI: 10.17660/ActaHortic.2022.1343.61.

Chapters in Books

Nesamvuni, A.E., Bokosi, J., Tshikolomo, K.A., Mpandeli, S.M. & Nesamvuni, C.N. 2022. Tea Value Chains Viability in Limpopo Province of South Africa: A Cost-benefit Analysis. In: *Sustainable Agricultural Value Chain*. H. Alem (Ed). IntechOpen (ISBN: 978-1-83969-756-2).

Conference Contributions

Conference Papers/Posters

Comte, J.-C., Artur, L., Bharucha, Z., Chirindja, F., Day, R., Dube, J., Franchi, F., Geris, J., Hussey, S., Makaya, E., Matano, A., Mustafa, S., Nesamvuni, E., Olabode, O., Rohse, M., Taylor, S., Tirivarambo, S. & Van Loon, A. 2022. *Adaptation to floods and droughts in (semi) arid transboundary basins: insights, barriers and opportunities drawn from socio-hydrogeological research in the Limpopo river basin, Southern Africa.* Paper delivered at the EGU General Assembly 2022, Vienna, Austria. 23-27 May 2022.

Najam, W., Walsh, C. & Oldewage-Theron, W. 2022. *Nutrition knowledge, attitudes, beliefs, and practices among adults in urban and rural areas in the Free State, South Africa.* Paper delivered at the Society of Nutrition Education and Behaviour (SNEB) Conference. Atlanta. 29-31 July 2022.

Van Rooyen, B., De Wit, M., Osthoff, G. & Van Niekerk, J. 2022. *Emerging innovative strategies for cactus pear (Opuntia spp.) crop management in the horticultural sector.* Paper delivered at the 31st International Horticultural Congress (IHC2022), Angers, France. 14-20 August 2022.

Conference Proceedings

De Wit, M. 2022. An overview of the agro-industrial applications of cactus pears: a South African perspective. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 361-368.

De Wit, M., Nkoi, V., Nematshema, K., Thusi, N., Hugo, A., Coetzer, G.M., Ceronio, G.M. & Fouché, H. J. 2022. Effect of nitrogen fertilization and season (year) on cactus pear seed oil content and fatty acid composition. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 283-290.

Du Toit, A., Mpemba, O.S., De Wit, M., Venter, S.L., Hugo, A. 2022. The influence of basic cooking methods on texture attributes of 'Morado' nopalitos. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 369-376.

Makhalemele, B. L., De Wit, M., Truter, M.M., Du Toit, A., Fouché, H.J., Hugo, A. & Venter, S.L. 2022. Morphological and physico-chemical properties of nopalitos from twenty cactus pear cultivars. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 387-394.

Makhalemele, B. L., De Wit, M., Truter, M.M., Du Toit, A., Hugo, A. & Venter, S.L. 2022. The nutritional evaluation of nopalitos from six South African cactus pear cultivars. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 377-386.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. Characterization of mucilage proteins and carbohydrates responsible for capacity and stability of foam food systems. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 473-480.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. Correlation of *Opuntia ficus-indica* Mill. and *O. robusta* mucilage yield to different physico-chemical characteristics. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 497-504.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Opuntia cladode* mucilage: proteins. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 401-408.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Opuntia ficus-indica* Mill. and *O. robusta* cladode mucilage: carbohydrates. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 511-518.

Mpemba, O.S., Du Toit, A., De Wit, M., Venter, S.L. & Hugo, A. 2022. Edible characteristics of two nopalito cultivars compared to selected popular vegetables.

In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 409-416.

Mpemba, O.S., Du Toit, A., De Wit, M., Venter, S.L. & Hugo, A. 2022. Relationship between quality characteristics of cactus pear nopalitos for use as an alternative vegetable source in South Africa. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 531-538.

Mushanganyisi, D., De Wit, M., Du Toit, A., Du Toit, L., Bothma, C., Hugo, A. & Venter, S. L. 2022. Functional properties of cactus pear mucilage: gelling and spherification. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 505-510.

Nkoi, V., De Wit, M., Van Biljon, A. & Van Niekerk, J.A. 2022. Comparison and integration of cactus mucilage protein and soy protein in functional food systems. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 425-434.

Sigwela, V.N., De Wit, M., Du Toit, A. & Hugo, A. 2022. Application of betalain extracts as colouring foods to food products. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 463-472.

Sigwela, V.N., De Wit, M., Du Toit, A. & Hugo, A. 2022. Extraction and stability of betalains extracted from beetroot tubers and the fruit of eight cactus pear cultivars. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 309-316.

Tarrisse, A., De Wit, M. & Van Niekerk, J.A. 2022. The potential of spineless cactus as a drought tolerant energy crop for biogas production: a geographic analysis of potential impact depending on water use efficiency (WUE) and mean annual rainfall (MAR) in South Africa. In: *Proceedings of the X International*

Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 197-206.

Van Rooyen, B., De Wit, M. & Osthoff, G. 2022. Functionality of native mucilage from cactus pears as a potential functional food ingredient at industrial scale. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 481-488.

Van Rooyen, B., De Wit, M. & Osthoff, G. 2022. Gelling potential of native cactus pear mucilage. In: *Proceedings of the X International Congress on Cactus Pear and Cochineal: Cactus the New Green Revolution in Drylands*, João Pessoa, Paraíba, Brazil, September 26-29. *Acta Hortic.* 1343: 489-496.



STAFF (2022)

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,
A Makamane,
Dr N Tinta,
Dr I van der Merwe and
Dr JF Vermaas

**Affiliated Lecturers/
Researchers:** 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 Nesor,
VF Nkoi, Dr BD Nkosi,
W Pretorius,
PZ Swart,
Dr K Thobejane,
J van den Berg,
H van der Merwe,
Dr BB van Rooyen,
Prof CJ van Rooyen,
AB Zulu and
Prof EM Zwane

Junior Lecturers: A Makamane and
Z Swart

Programme Director: Dr I van der Merwe

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

Senior Officers: A Calitz, G Green and
D Jacobs

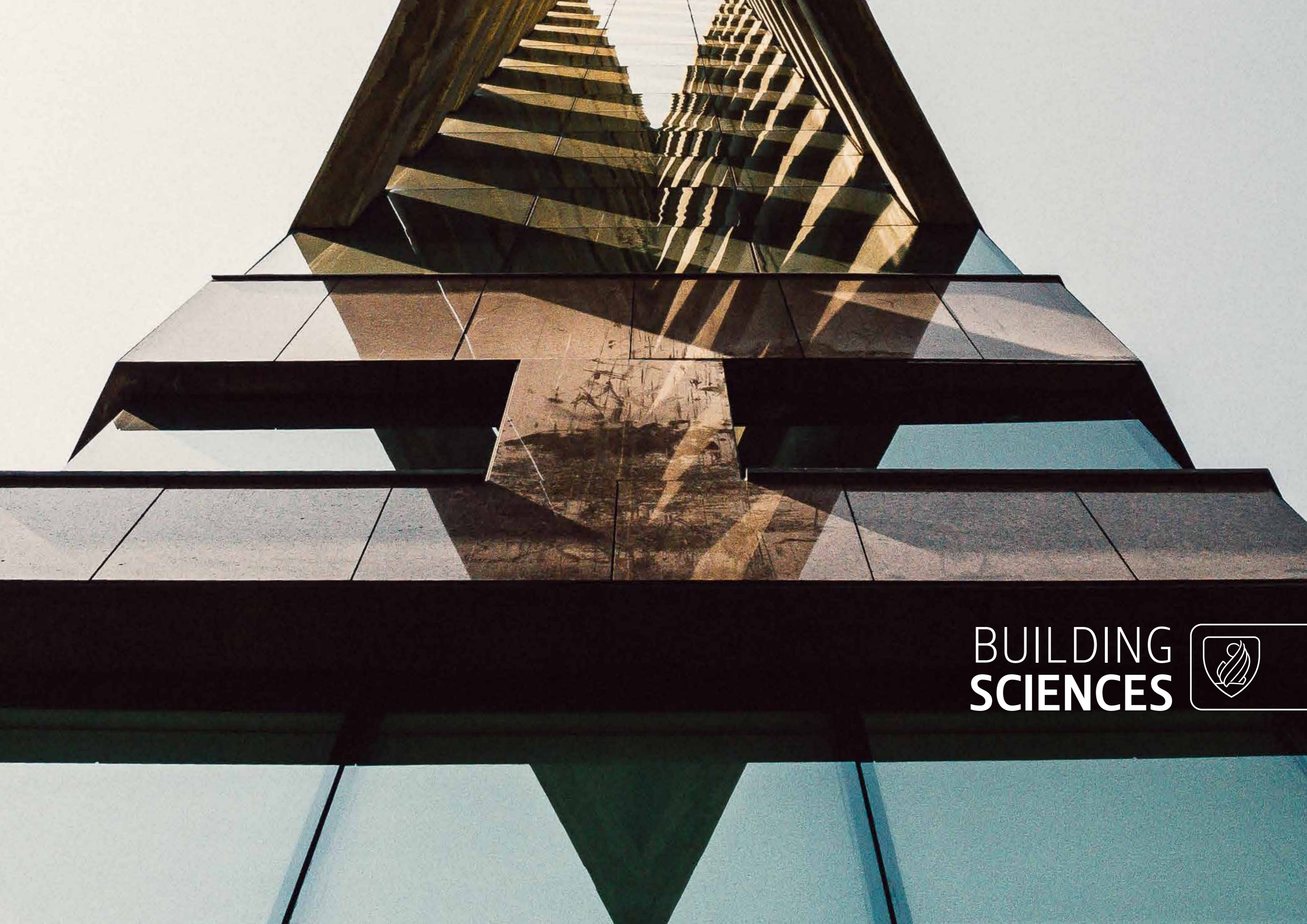
Officers: R Coetzee and
C Denner

Assistant Officers: S Mocwana and
R Smith

**Senior Assistant
Officer:** W van der Walt

NRF Intern: KS Matlhoko





**BUILDING
SCIENCES**



DEPARTMENT OF ARCHITECTURE

FACULTY OF NATURAL AND
AGRICULTURAL SCIENCES

CONTACT DETAILS

Prof Jonathan Noble

Department of Architecture

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339

Bloemfontein

9300 South Africa

T: +27 51 401 2332

F: +27 51 401 7139

E: NobleJA@ufs.ac.za

W: www.ufs.ac.za/architecture

OVERVIEW OF 2022

A leading event of 2022 was our departmental professional validation visit from the South African Council for the Architectural Profession (SACAP) validation board. The Department was granted an ‘unconditional validation’ – which lasts for five years – for our three professional degrees, namely BArch, BArchHons and MArch(Prof). The board applauded “the efficient manner in which the school [managed...] the validation process [and the way ...] in which the school responded to the challenge of the COVID-19 lockdown.” The board also commended the “breadth and depth of the transformation agenda and curriculum changes led by the Head of Department, Professor Jonathan Noble” (SACAP validation board report, 22 April 2022).

In 2022, the Department of Architecture was granted funding through the Dean’s Office for the purchase of three 3D printers. The new 3D printers have been installed on the upper level, adjacent to the laser cutter, serving our new digital fabrication laboratory. Digital fabrication and rapid prototyping are in the process of being integrated into our teaching curriculum.

In December 2022, Dr Heather Dodd was the first candidate to have graduated from our newly formed practice-based PhD programme.

ACHIEVEMENTS

Staff Achievements

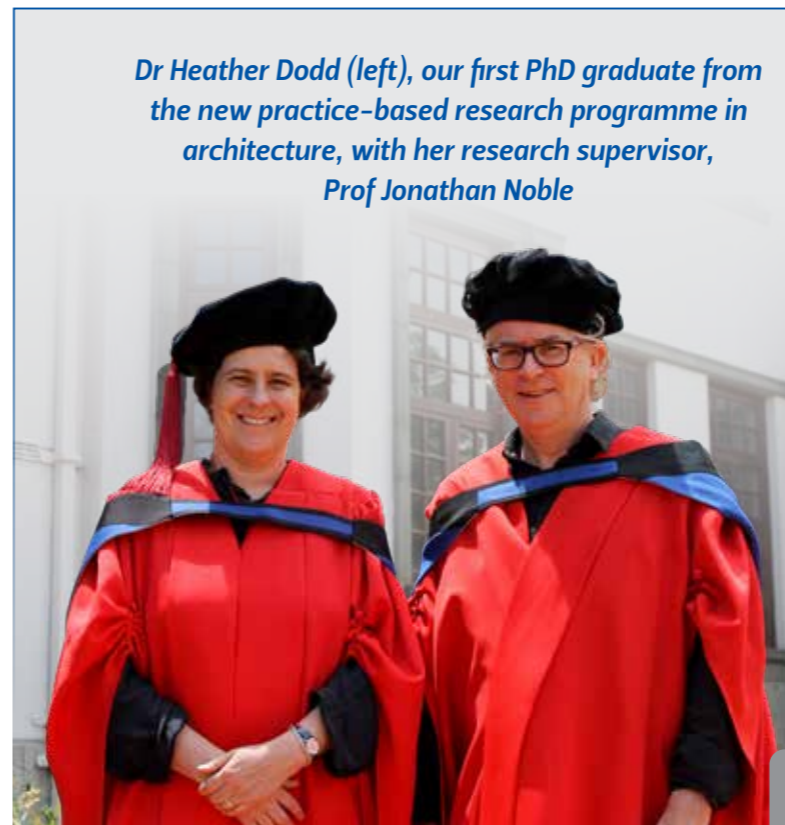
In October 2022, Prof Gerhard Bosman received a 20-Year Service, Community Engagement Award in recognition of outstanding commitment, excellence and service.

The Earth Unit Programme received a Community Engagement Award in the category: Long-term University-Community Flagships. The Earth Unit was established in the Department in 1996 to act as vehicle to connect students to small scale building projects where service-learning could be facilitated.

Student Achievements

The first graduate from the new practice-based PhD programme, Dr Heather Dodd, was publicised by Loenie Bolleers’ web-based news report, of 9 December. In Dr Dodd’s words: “I believe that the programme has enormous potential in building a body of knowledge in the architectural profession in this country and I would like to laud Prof Noble and the UFS for embarking on this programme... I believe that Prof Noble has done an excellent job in reaching out to similar programmes in Australia and to academics from abroad who have been very supportive of this programme... In this way, he has grounded the programme in our South African context but opened it up to global connections”.

Dr Heather Dodd (left), our first PhD graduate from the new practice-based research programme in architecture, with her research supervisor, Prof Jonathan Noble



The following students won the annual Corobrik Student of the Year Awards, for the Free State in 2022:

1st prize | Ané Meyer
2nd prize | Waldo Coetzer
3rd prize | Vicko Venter
Brick Award | Thembi Lepesa

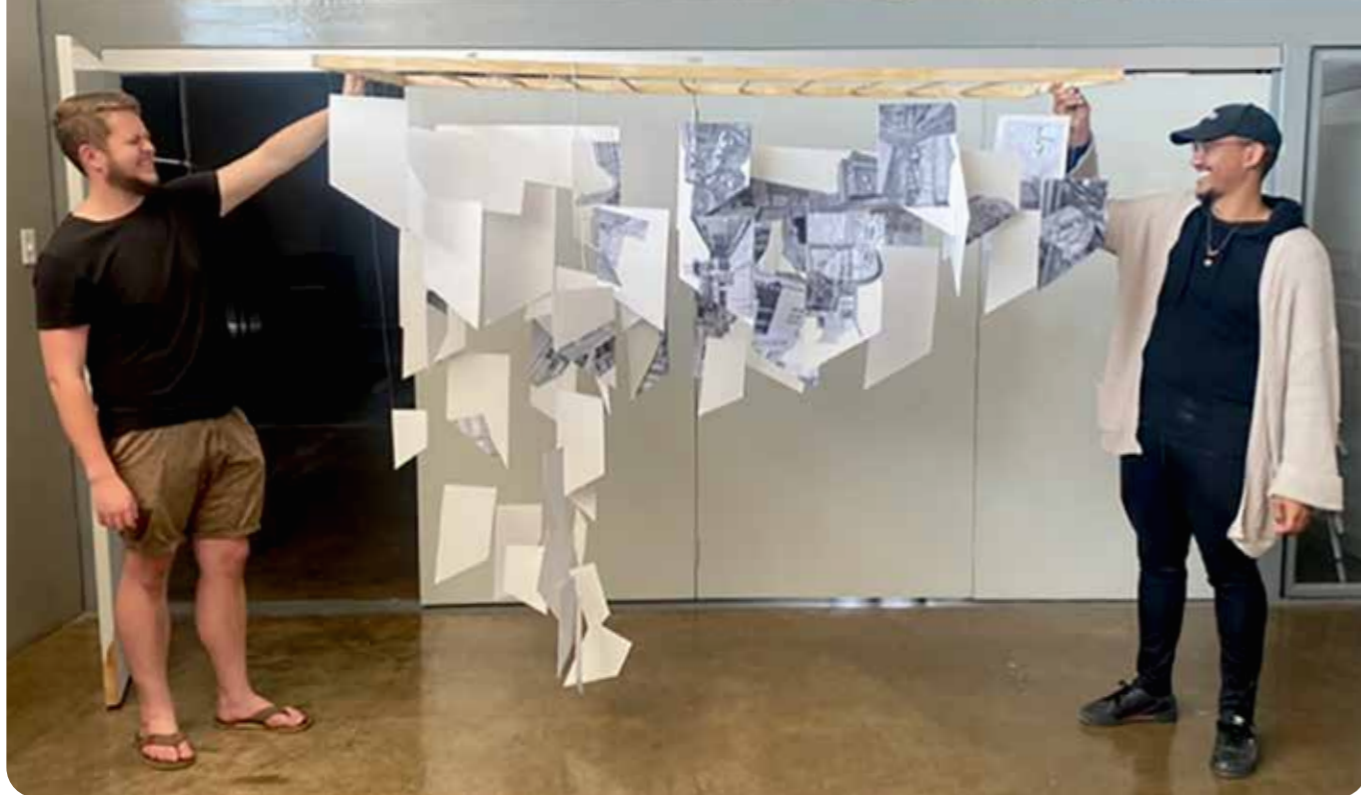
TEACHING AND LEARNING

New Undergraduate Representation Modules

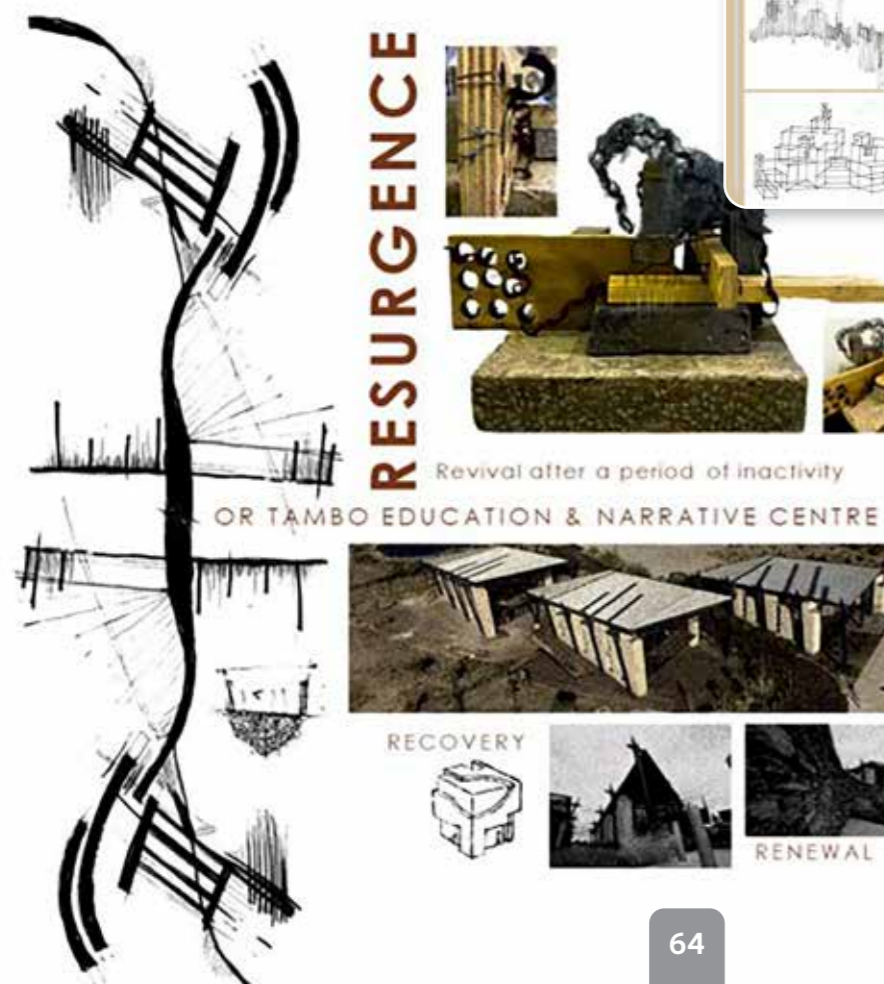
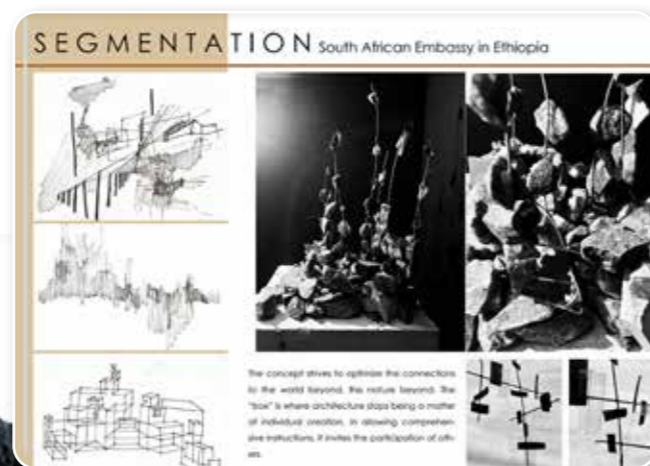
Prof Noble has led the process toward establishing two new undergraduate modules – Architectural Representation 1 (ARCR1506) and Architectural Representation 2 (ARCR2602). These modules will integrate, extend and rationalise content that was formerly taught across a range of support modules that introduce graphic presentation techniques, photography, descriptive geometry and computer-aided design. Contemporary digital media requires the integration of hand drawing with digitised scans, digital photography with digital modelling, and image processing with digital graphic layout platforms. The new modules achieve this integration, together with an emphasis upon three-dimensional computer-aided design modelling, computer rendering, animation and digital fabrication (for example via laser cutting and 3D printing, which were not previously taught). The new representation modules will bring our undergraduate curricula up to date in terms of current and evolving digital design and presentation methods, ensuring that our degree produces the graduate attributes that are required of contemporary professional practice.

Vertical History–Theory Studio

The vertical studio of 2022 involved a ‘practice-in-pedagogy’ workshop, that was coordinated by Phadi Mabe and hosted by an award-winning architecture practice, MMA Design Studio, as part of the undergraduate Histories & Theories of Architecture modules (HTRC1506, HTRC2606, HTRC3706). The ‘practice-in-pedagogy’ workshop is an unconventional mode of learning that



Some of the products of the Vertical History-Theory Studio included in the Sophia Gray Memorial Lecture and Exhibition 2022



Revival after a period of inactivity OR TAMBO EDUCATION & NARRATIVE CENTRE



situates celebrated practitioners at the forefront of creative research and learning. The workshop exposed undergraduate students to new design methodologies derived from the field of professional practise, within an African context. Students from the three year-groups (first- to third-year) had to collaborate and interpretively decode the spatial oeuvre of Mphethi Morojele (owner and founder of MMA Design Studio) and reflect upon the insights that were gained. The workshop proved to be a success, producing conceptual models that were included in Morojele's 33rd Sophia Gray memorial exhibition.

UFS Learning and Teaching Conference

Jako Olivier and Jan Hendrik Nel participated in the annual UFS Learning and Teaching Conference hosted between 14 and 16 September 2022. Their presentation, titled 'The act of storytelling as the substance for architectural learning and teaching', reflected their attempt to transform the first-year architectural design course, prior to, during and after the national lockdown.



Student visit to the Basotho Cultural Village near Phuthaditjhaba, as part of the ACE research project, led by Prof Gerhard Bosman



RESEARCH AND INNOVATION

Digital Fabrication

The formation of our new digital fabrication laboratory is almost complete, and is intended to provide teaching and creative research support for our students – especially the MArch(Prof) dissertation year. The laser cutter and 3D printer will feature in the new Architectural Representation 2 module (ARCR2602).

Service Learning

The Architecture Care and Engagement (ACE) research project conducted three Construction tours (CONS2600) in June 2022 to the Basotho Cultural Village (BCV) near Phuthaditjhaba. The two student groups (consisting of between of 15 to 18 students) visited and participated for three days on different parts of an assignment that included organisational tasks, collection of raw material, measuring up of existing homesteads and the preparation of wall surfaces and plaster panels. The partnership with the BCV provided a workplace for practical earth plaster restoration and Basotho Litema wall decoration design and application. The ACE project also used the opportunity to interview Litema artists to establish current perceptions of this Eastern Free State rural art and practice. The students struggled with the cold, wet conditions but enjoyed interacting with the museum staff at the BCV. The Earth Unit hopes to conduct similar tours in 2023 to rural areas in the eastern Free State.



Arts Research Africa

Prof Noble presented at the 2nd international Arts Research Africa Conference (ARA 2022) that was hosted by the University of the Witwatersrand. His paper titled 'Practice-based Research in Architecture at UFS' attempts to unpack the creative research methods that are currently evolving within the practice-based PhD research programme for architecture at UFS.

ENGAGED SCHOLARSHIP

Sophia Gray Memorial Lecture and Exhibition

The 33rd Sophia Gray Memorial Lecture was hosted on the 25 August 2022 by the Department of Architecture. Mphethi Morojele, the owner and founder of MMA Design Studio, a medium-size award-winning architecture and design studio based in Johannesburg, presented this year's event at the Fairview Conference Auditorium in Bloemfontein.



Prof Jonathan Noble (left) and Mphethi Morojele

Morojele's presentation, titled 'Changing Landscape: practices and pedagogy', provided an in-depth overview of his creative work that has been recognised both locally and abroad for engaging African landscapes through a contemporary interpretation of indigenous knowledge and cultural practices. After his presentation and extended questions from an enthusiastic audience, guests departed to the Oliewenhuis Art Museum for the official opening of Mphethi's beautifully curated exhibition, displaying award-winning projects such as Freedom Park, Maropeng Cradle of Humankind, and the African Leadership Academy located in Johannesburg.

View the complete lecture and access the posters of the exhibition here <https://www.sophiagray.co.za/>

The opening of the exhibition at Oliewenhuis Art Museum



Oliewenhuis Fine Art Friday

Jako Olivier and Jan Hendrik Nel were invited to engage in a public talk at Oliewenhuis Art Museum on 9 September 2022. During this public engagement, titled 'From Paper to Places: experiential stories from Morojele's Human Cradle to Freedom', the participants reflected on the intent and meaning of Mphethi Morojele's exhibited projects in relation to personal experiences during visits to his work.

NATIONAL AND INTERNATIONAL COLLABORATION

Adjunct Professor Jeremy Smith



New Zealand-based architect, Dr Jeremy Smith, joined the Department of Architecture as an Adjunct Professor

Multi-award-winning New Zealand based architect, Dr Jeremy Smith, was granted an Adjunct Professorship in Architecture at UFS, 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 and was formerly an Adjunct

Associate Professor at the University of Auckland. He has extensive experience as an examiner for the University of Auckland and Victoria University of Wellington and since 2020 he has served as an international adviser to the Saveetha College of Architecture and Design in Chennai, India. Practising as a principle and partner since 2005, Dr Smith's design work has received international acclaim via numerous awards. We anticipate that Prof Smith will make a valuable contribution to the future success of our new design-based research programme, will

boost the Departments' international profile and will prove to be a worthy ambassador for the UFS.

iKuDI Project

The iKUDI Project supports curriculum internationalisation in the Department. During March and April 2022, Gerhard Bosman facilitated a Collaborative Online International Learning (COIL) event, together with students and lecturers at three international universities. Thirty-seven BArchHons students collaborated online with students from Akita International University, Japan, and the University of Siena, Italy.

A further 12-week COIL event was led by Gerhard Bosman and Phadi Mabe, in collaboration with Art and Art History students from the Colorado State University in the USA. Posters produced from the COIL, together with *litema* plaster panels, were exhibited from 6 to 9 December 2022 at the World Science Forum, Science for Social Justice exhibition in Cape Town at the Cape Town International Convention Centre (CTICC). The same exhibition will be open in May 2023 at the Gregory Allicar Museum of Art of the Colorado State University.

Prof Gerhard Bosman and a fellow participant at the World Science Forum, Science for Social Justice exhibition in Cape Town, at which he presented his collaborative research on *litema* wall art



POSTGRADUATE STUDENTS

In September, Dr Ariana van Heerden presented the keynote address at the 2nd PhD Symposium of 2022, with her fascinating lecture concerning neuroscience and creativity, titled 'Enjoying your headspace: the creative and flow brain states of practicing architects'.

In terms of numbers of postgraduate students in 2022, at BArchHons level, 37 students were enrolled and all graduated, and at the MArch (Prof) level 32 students were enrolled, of whom 31 have graduated. One student was enrolled for the MArch (Research) and another for the MArch with Design. Three students were enrolled for the PhD and will receive their studies in 2023. A further 17 were enrolled for the new practice-based PhD with Design, with Helen Dodd completing her studies and becoming the first candidate to be conferred with the PhD with Design. Her supervisor was Prof Jonathan Noble.

STAFF MATTERS

Ntetleng Orepa Mosidi joined the full-time staff as a Lecturer in January 2022.

Dr Jeremy Smith formally joins the Department as Adjunct Professor, commencing January 2023.

RESEARCH OUTPUTS

Research Articles

Auret, H.A. 2022. Rescripting colonial landscapes: the Prince's Rose Garden in Bloemfontein. *South African Journal of Art History* 37(1): 12-30.

Bosman, G. 2022. Art and landscape: a rural letsema celebration. *South African Journal of Art History* 37(1): 31-47.

De Santi, C., DeBoer, M., Bosman, G. & Citter, C. 2022. International Multidisciplinary Collaboration on Four Continents: an experiment in fostering diverse cultural perspectives. *The Journal of Language and Teaching Technology* IV: 11-18.

Conference Contributions

Conference Papers/Posters

Auret, H.A. 2022. *Rescripting colonial landscapes: the Prince's Rose Garden in Bloemfontein*. Paper delivered at the 16th Annual Conference of the South African Journal of Art History - Landscape, Cityscape, Seascape. Bloemfontein, South Africa. 10-11 June 2022.

Bosman, G. 2022. *Art and landscape: a rural letsema celebration*. Paper delivered at the 16th Annual Conference of the South African Journal of Art History - Landscape, Cityscape, Seascape. Bloemfontein, South Africa. 10-11 June 2022.

Bosman, G. 2022. *Basotho litema home decoration: a rural celebration for culturally significant architecture in the Free State*. Paper delivered at the National Congress of the South African Society for Cultural History, Riebeeck-Kasteel, South Africa. 16-17 September 2022.

Bosman, G. 2022. *Relevant service-learning for transformation in architecture learning and teaching*. Paper delivered at the Conference on Sustainable Built Environments (SBE2022), Grabouw, South Africa. 28-30 March 2022.

Noble, J. 2022. *Practice-based Research in Architecture at UFS*. Paper delivered at Arts Research Africa 2022 Conference, Wits University, Johannesburg. 14-16 September 2022.

Olivier, J. & Nel, J.H. 2022. *Life Narratives as Sites of Architectural Learning and Teaching: Reflecting on Meaningful Characters and Places in Uncertain Times*. Transformative Teaching Focus on Pedagogy 2022 (Virtua). AMPS, Florida State University, University of Dundee, Yayed University. 15-17 November 2022.

STAFF (2022)

Head of Department:
Prof JA Noble

Professor:	Prof JA Noble
Associate Professor:	Prof G Bosman
Senior Lecturers:	Dr HA Auret, MM Bitzer, JL du Preez and A Wagener
Lecturers:	P Mabe, N Mosidi, JH Nel, H Raubenheimer and DPG van der Merwe
Junior Lecturer:	Jl Olivier
Contract Lecturers:	S. Diedericks, K McDonald, Prof JD Smit and P Smit
Programme Director:	JL du Preez
Research Fellow:	Prof WH Peters
Adjunct Associate Professor:	Dr T Hardman
Secretary:	Y Nienaber
Assistant Officers:	Z Bronkhorst, LT Keswa and MQ Myeni (Professional Services)
Messenger:	TJ Mohatlane



DEPARTMENT OF QUANTITY SURVEYING AND CONSTRUCTION MANAGEMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Prof Kahilu Kajimo-Shakantu

Department of Quantity Surveying and
Construction Management

Faculty of Natural and Agricultural Sciences

University of the Free State
PO Box 339 | Bloemfontein 9300 South Africa

T: +27 51 401 2248 / 3322

E: KajimoshakantuK@ufs.ac.za

W: www.ufs.ac.za/qscm

OVERVIEW OF 2022

Following on from 2020 and 2021, which was marred by the global COVID-19 pandemic, the year 2022 was ushered in with high expectations of adaptation to the post-COVID “new normal” way of life and doing business. Therefore, there was a great deal of catch-up, introspection and reflection required in order to address any gaps which might have surfaced during the COVID-19 restrictive period.

The Department was confronted with a number of challenges throughout the year, including staff illnesses and a shortage of personnel. However, through an assertive team mind-set, the Department overcame these challenges and continued to provide high-quality education to its students. By leveraging technology and collaboration, the Department maintained its commitment to excellence and ensured that its programmes continued to meet the needs of its students and the industry.

The highlight of 2022 for the Department was the successful undertaking of two programme accreditation visits – from the South African Council for Quantity Surveying Professions (SACQSP) in September and the South African Council for Property Valuation Professions (SACPVP) in October. Programme accreditation is critical to ensure that the Department’s programmes

meet the rigorous minimum standards set by the professional bodies. The Department was proud to receive positive feedback on its curriculum design, teaching and assessment practices, programme governance, quality assurance processes, student support services, quality of learning facilities and research outputs, among other criteria used for the assessment.

Quantity Surveying and Construction Management staff, UFS staff and visiting accreditation panel members of the SACQSP on 30 September 2022



The SACQSP granted full accreditation for five years to the following programmes:

- BSc Quantity Surveying residential (full-time).
- BSc Honours Quantity Surveying residential (full-time).
- BSc Quantity Surveying compact learning (part-time).
- BSc Honours Quantity Surveying residential (full-time).

In accordance with its re-accreditation cycle, the SACPVP also granted full accreditation for four years to the Master in Land and Property Management Development (MLPM) degree programme (Valuation / Property Studies specialisation).



Quantity Surveying and Construction Management staff, UFS staff and visiting accreditation panel members of the SACPVP on 12 and 13 October 2022

The Department of Quantity Surveying and Construction Management welcomed a diverse group of international students in 2022, the majority of whom were postgraduate students. Their involvement added considerable value to the Department’s diversity profile, which contributed to a more dynamic and varied learning and research environment. The value of their prior knowledge and different experiences was reflected mostly through publications on topics that extended beyond the borders of South Africa. Overall, the quality and quantity of research outputs for the Department improved in 2022 compared to the previous year.

Despite the challenges of the past two years, 2022 proved to be a year of

progress and learning for the Department. Valuable insights and lessons were gained during this time, and the Department remains well-positioned to continue its legacy of producing highly skilled, knowledgeable and sought-after graduates. To this end, the Department makes meaningful contributions to addressing the country's critical skills shortage through the built environment programmes it offers. The start of the year was difficult, but eventually the staff succeeded in reconnecting with one another and creating a conducive day-to-day workflow to ensure efficient performance by staff and students. As such, the efforts of every staff in the Department are much appreciated. Teamwork always triumphs!

ACHIEVEMENTS

Staff Achievements

Cameron Ferreira was elected as Senior Vice-President of the Association of South African Quantity Surveyors (ASAQS)



Cameron Ferreira

Student Achievements

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

- The Association of South African Quantity Surveyors prize for Best first-year student in the BSc (Quantity Surveying) programme – Godwill Thato Pule.
- The Association of South African Quantity Surveyors prize for Best second-year student in the BSc (Quantity Surveying) programme – Milne Botha.
- The Association of South African Quantity Surveyors prize for Best third-year student in the BSc (Quantity Surveying) programme – Yolandi De Beer.
- The Association of South African Quantity Surveyors prize for Best fourth-year student in the BSc Honours (Quantity Surveying) programme – Marcel Engelbrecht.
- Bell John prize for Best all-round year student in any year of study (Quantity Surveying) – Yolandi De Beer.

- Department of Quantity Surveying and Construction Management Prize for Best second-year student in BSc Construction Management – Luan Broere.
- Department of Quantity Surveying and Construction Management Prize for Best third-year student in BSc Construction Management – Ragare Kopano Maphutha.
- Department of Quantity Surveying and Construction Management Prize for Best Honours student in BSc Construction Management – Zonja Stapelberg.
- Department of Quantity Surveying and Construction Management Prize for Best student Research Project in the Honours programme – Zonja Stapelberg
- Department of Quantity Surveying and Construction Management Prize for Best student Research Mini Dissertation in the MLPM Programme – Abongile Mntu.

TEACHING AND LEARNING

The Department offers a number of built environment-related programmes in Quantity Surveying, Construction Management and Real Estate Management (Property Studies). Within each of these main areas, there are numerous professional and career opportunities that can be followed in both the public and private sectors, and not limited to the construction sector.

As the lockdown isolation regulations eased in 2022, more face-to-face interactions started to become evident. The return of students to campus for face-to-face interactions was a welcome relief, especially for those modules that had proved very challenging to deal with through online approaches during the lockdown period. Student exposure to practical tasks, especially site excursions which had halted during the COVID-19 lockdown, resumed. This provided opportunities for students to draw better links between theory in classroom learning and practice (workplace).



Quantity Surveying and Construction Management students on site visit

The year 2022 revealed that hybrid approaches would be the preferred modes of operation in the new normal, going forward. The Department's focus was on ensuring that both the staff and students were geared for high levels of flexibility and adaptation required for excellent execution of blended learning approaches. The aftermath of the COVID-19 restrictions required the Department to incorporate innovative solutions, technologies and practices to improve performance in all areas. This is part of the lessons which COVID-19 taught us – despite all its ugliness, the pandemic had a silver lining, as it presented a learning opportunity for all to embrace change and think more creatively, outside the box! Above all, the Department learnt that resilience and adaptability are key, not only to survive, but also to thrive.

Both the residential and compact learning programmes offered by the Department generally improved in terms of quality and depth of instruction to the benefit of students in both delivery modes. Furthermore, the Department was thrilled to see the strengthening of work-integrated learning modules as the second-year module was rolled out following on the first-year year pilot study of 2021. This entailed more regular construction-site visits for students. This practical approach to teaching and learning provides students with valuable real-world experiences which positions them strategically for success in their future careers. 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 taking into account the imperatives of the Fourth Industrial Revolution (4IR).

The undergraduate programmes offered in 2022 included the BSc Construction Management and BSc Quantity Surveying undergraduate degrees compact learning (part-time), as well as the BSc Construction Economics and Management degree residential learning (fulltime).

In 2022, the numbers of students enrolled in these undergraduate programmes were:

- BSc Construction Economics and Management: 24
- BSc Construction Management and BSc Quantity Surveying residential (full-time): 50
- BSc Construction Management and BSc Quantity Surveying compact learning (part-time): 43

RESEARCH AND INNOVATION

Three research groups which previously received funding from the Faculty Central Research Fund, continued with their work throughout year.

Dr Christopher Amoah and Prof Kahilu Kajimo-Shakantu continued their research project titled 'Assessment of the satisfaction level of Reconstruction and Development Programme (RDP) housing beneficiaries in South Africa'. The study's primary objective is to assess the level of satisfaction of RDP housing beneficiaries to inform the improvement of housing delivery. Two further articles were published from this research in 2022.

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'.

Alfred Deacon's research group also carried on with the research on construction contract management. One article from this research was submitted for publication.

ENGAGED SCHOLARSHIP

Prof Kahilu Kajimo-Shakantu was invited as a

keynote speaker to the 11th Sustainable Education and Development Research Conference (formerly known as the Applied Research Conference in Africa), in Kumasi, Ghana in August 2022. The title of her keynote address was 'Upgrading Infrastructure and Retrofitting Industries to make them Sustainable' – in line with the Sustainable development goals (SDGs) 2030.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Kahilu Kajimo-Shakantu collaborated with peers from the Central University of Technology (CUT) and other UFS departments. She was the Project Leader of a team which received a CUT and UFS joint Multi-Inter- and Trans- (MIT) disciplinary collaborative research grant as seed funding for research relevant to both institutions. The title of the research is 'An Evaluation of Alternative Building Technologies (ABT) for Sustainable Affordable Housing in the Free State'; the grant was awarded for the period August 2022 to July 2023.

At the 2022 graduation ceremonies, the following degrees were conferred:

BScHons (Construction Management):	9
BScHons (Quantity Surveying):	30
MLPM (Project Management):	4
MLPM (Property Valuation):	6

In our Master's programme, the MSc (Quantity Surveying) degree was conferred on S Truter (with distinction) and F Swart, while N Halatedzi attained the MSc (Construction Management).

Rhinsai Abigail Dhliwayo graduated with a PhD (Construction Management), for her thesis 'An Integrated Procurement Model for Public Sector Projects in Zimbabwe'. Her main supervisor was Prof Kahilu Kajimo-Shakantu.

POSTDOCTORAL RESEARCH FELLOWS

Sadly, the contract for our Postdoctoral Fellow, Dr Timothy Ayodele, from Nigeria, came to an end in 2022. The Department appreciates the contributions

made by Dr Ayodele as a post doc in the Department by enriching the research endeavours and mentoring of postgraduate students. He was dedicated to undertaking research work, mainly in the area of Innovative technology in construction, construction sustainability and real estate development finance and education and co-authored a number of publications during the reporting year.

STAFF MATTERS

The Department was delighted and proud of Elza van der Walt, our Department Secretary, who received a 30-Year Long Service award at the UFS. Her commitment and contributions are much appreciated.



Elza van der Walt

The Department was pleased to welcome two additional support staff

Prof Kahilu Kajimo-Shakantu



POSTGRADUATE STUDENTS

The Department offers postgraduate degrees at Honours, Master's and Doctoral levels, majoring in Quantity Surveying and Construction Management. It also offers the Master's by research and the PhD in Property Science. Included in 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 2022 was:

BSc Hons:	76
MLPM:	47 (for both specialisations)
MSc:	9
PhD:	7

Quantity Surveying and Construction Management students during the UFS April Graduation



members, with Andile Madiehe joining as a Senior Assistant Officer and Athenkosi Mosimanegape as Officer.

Dr Fredrick Simeh resigned during the year. The Department is grateful for his contribution and wish him well in his future endeavours.

RESEARCH OUTPUTS

Research Articles

Akinlolu, M., Haupt, T.C., Edwards D.J. & Simeh, F. 2022. A bibliometric review of the status and emerging research trends in construction safety management technologies. *International Journal of Construction Management* 22(14): 2699–2711.

Amoah, C., Bamfo-Agyei, E. & Simeh, F. 2022. The COVID-19 pandemic: the woes of small construction firms in Ghana. *Smart and Sustainable Built Environment* 11(4): 1099–1115.

Amoah, C. & Bikitsha, L. 2022. Emerging contractor's management and planning skills to overcome business risk factors. *International Journal of Building Pathology and Adaptation* 40(4): 670–689.

Amoah, C., Kajimo-Shakantu, K. & Van Schalkwyk, T. 2022. The level of participation of the end-users in the construction of the RDP houses: the case study of Manguang municipality. *International Journal of Construction Management* 22(5): 949–960.

Amoah, C., Van Schalkwyk, T. & Kajimo-Shakantu, K. 2022. Quality management of RDP housing construction: myth or reality? *Journal of Engineering, Design and Technology* 20 (5): 1101–1121.

Ayodele, T.O. 2022. Factors influencing the adoption of real option analysis in RED appraisal: an emergent market perspective. *International Journal of Construction Management* 22(6): 1042–1052.

Ayodele, T.O., Ekemode, B.G. & Kajimo-Shakantu, K. 2022. Bridging the gap in real estate enterprise: the impact of mentoring on entrepreneurial intentions of real estate students in Nigeria. *Property Management* 40(4): 484–509.

Ayodele, T.O. & Kajimo-Shakantu, K. 2022. Challenges and drivers to data sharing among stakeholders in the South African construction industry. *Journal of Engineering, Design and Technology* 20(6): 1698–1715.

Ayodele, T.O., Kajimo-Shakantu, K., Gbadegesin, J.T., Babatunde, T.O. & Ajayi, C.A. 2022. Exploring investment paradigm in urban office space management: perspectives from coworking space investors in Nigeria. *Journal of Facilities Management* 20(1):19–31.

Ayodele, T.O., Ogunbayo, O.T., Kajimo-Shakantu, K. & Babatunde, T. 2022. Coworking space practices: assessing space users' preferences and challenges in Ibadan, Nigeria. *Journal of Corporate Real Estate* 24(4): 256–272.

Bikitsha, L. & Amoah, C. 2022. Assessment of challenges and risk factors influencing the operation of emerging contractors in the Gauteng Province, South Africa. *International Journal of Construction Management* 22(11): 2027–2036.

Janeke, B. & Els, M.M. 2022. An exploratory study of the impact of a pilot work-readiness programme on quantity surveying students. *Journal of Construction* 15(1):47–55.

Mazele, O. & Amoah, C. 2022. The causes of poor infrastructure management and maintenance in South African municipalities. *Property Management* 40(2): 192–206

Mwamvuni, H.D.J., Amoah, C. & Ayesu-Koranteng, E. 2022. Causes of road projects' delays: a case of Blantyre, Malawi. *Built Environment Project and Asset Management* 12(2): 293–308.

Opawole, A., Olojede, B. & Kajimo-Shakantu, K. 2022. Assessment of the adoption of 3D printing technology for construction delivery: A case study of Lagos State, Nigeria. *Journal of Sustainable Construction Materials and Technologies* 7(3): 184–197.

Opawole, A., Olojede, B., Oshin, F. & Yusuf, A. 2022. Assessment of the level of awareness of intelligent buildings in Lagos State, Nigeria. *Acta Structilia* 29(2): 116–149.

Raliile, M.T., Haupt, T.C. & Kajimo-Shakantu, K. 2022. A Study on Knowledge, Attitudes and Commitment of Managers Within Construction Firms Towards the Recent Construction Health and Safety Legislation Changes. *Journal of Construction* 14(3): 21–31.

Simeh, F. & Amoah, C. 2022. COVID-19 guidelines incorporated in the health and safety management policies of construction firms. *Journal of Engineering, Design and Technology* 20(1): 6–23.

Simeh, F., Bamfo-Agyei, E. & Amoah, C. 2022. Barriers to the implementation of COVID-19 safety regulations: insight from Ghanaian construction sites. *Journal of Engineering, Design and Technology* 20(1): 47–65.

Conference Contributions

Conference Papers/Posters

Amoah C. & Bikitsha, L. 2022. *Strategies for business sustenance in the highly competitive construction industry: Emerging contractor's perspective.* Paper delivered at the World Building Congress 2022: Building Our Future, Melbourne, Australia. 27–30 June 2022.

Kajimo-Shakantu, K., Thomas, F. & C. P. Mukumba. 2022. *Challenges Associated with Tender Documentation during Contract Management on Public Sector Projects.* Paper delivered at the 8th International Conference on Development and Investment in Infrastructure Building Smart, Resilient, and Sustainable Infrastructure in Developing Countries, Johannesburg, South Africa. 6–7 October 2022.

Kajimo-Shakantu, K. Sepadile, T. & Ayodele, T. O. 2022. *Exploring the Viability of Green Building to Raise Green Bonds in The South African Property Market.* Paper delivered at the 8th International Conference on Development and Investment in Infrastructure Building Smart, Resilient, and Sustainable Infrastructure in Developing Countries. Johannesburg, South Africa. 6–7 October 2022.

Kenny, D.W., Ayesu-Koranteng, E., Amoah, C., & Adeniran, A. 2022. *The Use of Prefabrication in Building.* Paper delivered at the World Building Congress 2022: Building Our Future, Melbourne, Australia. 27–30 June 2022.

Liebenberg, G. & Els, M.M. 2022. *The Impact of the 4th Industrial Revolution on Quantity Surveying Education in South Africa: A Qualitative Overview on Soft Skill Requirements.* Paper delivered at the 8th International Conference on Development and Investment in Infrastructure Building Smart, Resilient, and Sustainable Infrastructure in Developing Countries, Johannesburg, South Africa. 6–7 October 2022.

Conference Proceedings

Ayodele, T.O., Akinlabi, O.W., & Kajimo-Shakantu, K. 2022. Investment Performance and Integration Analysis of Indirect Real Estate and Other Listed Assets. In: *Proceeding of the African Real Estate Society 21st Annual Conference – Theme: Redefining the Future of Real Estate in Africa (AfRES).* Accra, Ghana, 6–9 September 2022. L.A. Asante & E.K. Gavu (Eds). AFRES. pp.129–146.

Ayodele, T.O. & Kajimo-Shakantu, K. 2021. Data Sharing in the Construction Industry: Exploring the Willingness of Industry Stakeholders in South Africa. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Building Smart, Resilient and Sustainable Infrastructure in Developing Countries.* Livingstone, Zambia. 6–7 October 2022. I. Musonda & E. Mwanaumo (Eds). DII. pp. 130–154.

Bremer, T. & Coetzee, M. 2022. The influence of different personality types relating to the Quantity Surveyor within a design team to facilitate effective communication in the Construction Industry. In: *Proceedings of the 16th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development: A Second Look.* Lanseria, South Africa, 26–27 September 2022. T.C. Haupt, P. Chigangacha & M. Akinlolu (Eds). ASOCSA. pp. 382–394.

Bremer, T. & Mhinga, R.S. 2022. An Exploration into the Perceptions of Social Sustainability in the Built Environment Amongst Project Managers. In: *Proceedings of the 16th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development: A Second Look.* Lanseria, South Africa, 26–27 September. T.C. Haupt, P. Chigangacha & M. Akinlolu (Eds). ASOCSA. pp. 1–10.

Bruhns, G. & Deacon, H.A. 2021. Building Information Modelling in South Africa: Quantity Surveyors Perspective. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Building Smart, Resilient and Sustainable Infrastructure in Developing Countries.* Livingstone, Zambia. 6–7 October 2022. I. Musonda & E. Mwanaumo (Eds). DII. pp. 449–462.

Du Plessis, J. & Amoah, C. 2022. Affordable Student Accommodation: A Perspective of Tertiary Students. In: *Proceedings of the International Structural*

Engineering and Construction; State-of-the-art Materials and Techniques in Structural Engineering and Construction, Leipzig, Germany. 20-25 June 2022. K. Holschemacher, U. Quapp, A. Singh & S. Yazdani (Eds). ISEC Press. pp. 1-6.

Kajimo-Shakantu, K., Mukumba, C.P. & Koalane, T. 2022. Emerging Black Businesses Participation in the South African Public Sector Property Management Portfolio In: *Proceedings of the 16th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development: A Second Look*. Lanseria, South Africa, 26-27 September 2022. T.C. Haupt, P. Chigangacha & M. Akinlolu (Eds). ASOCSA. pp. 83-90.

Kajimo-Shakantu, K., Tshwane, K. & Ayodele, T.O. 2022. Green Building Valuation in The South African Residential Property Sector: Influencing Factors and Barriers to Implementation. In: *Proceeding of the African Real Estate Society 21st Annual Conference – Theme: Redefining the Future of Real Estate in Africa (AfRES)*. Accra, Ghana, 6-9 September 2022. L.A. Asante & E.K. Gavu (Eds). AFRES. pp. 285-305.

Mazele, O. & Amoah, C. 2022. Poor Management and Maintenance of Municipal Infrastructure on Socioeconomic Development. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Building Smart, Resilient and Sustainable Infrastructure in Developing Countries*. Livingstone, Zambia. 6-7 October 2022. I. Musonda & E. Mwanaumo. (Eds). DII. pp. 155-173.

Mukumba C. P., Amoah, C. & Mbelembe, W. 2022. Construction Project Finance for Success: SME Perspective. In: *Proceedings of the 16th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development: A Second Look*. Lanseria, South Africa, 26-27 September 2022. T.C. Haupt, P. Chigangacha & M. Akinlolu (Eds). ASOCSA. pp. 34-42.

Muleya, F., Tembo, K.C., Kaunda, C. & Ngoma, G. 2022. Affordable Student Accommodation: A Perspective of Tertiary Students. In: *Proceedings of the International Structural Engineering and Construction; Achieving Technical Excellence with Data Analytics in Materials, Structural Engineering and Construction*. Sydney, Australia. 20-25 June 2022. S. Vimonsatit, H. Askarinejad, A. Singh & S. Yazdani (Eds). ISEC Press. pp. 1-6.

Phalane, K.G. & Els, M.M. 2022. Impact of Ethics

and Professional Conduct on the Quality of Services Rendered by Construction Project Managers. In: *Proceedings of the 16th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development: A Second Look*. Lanseria, South Africa, 26-27 September 2022. T.C. Haupt, P. Chigangacha & M. Akinlolu (Eds). ASOCSA. pp. 191-198.

Raliile, M.T. & Haupt, T.C. 2022. Application of Artificial Intelligence for Construction Workers Wellbeing in South Africa. In: *Proceedings of the 15th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development*. Durban, South Africa, 27-28 September 2021. T.C. Haupt, F. Simpeh, A. Amoah, Z. Armoed & M. Akinlolu (Eds). Springer. pp.125-135.

Raliile, M.T. & Haupt, T.C. 2022. A Study on Knowledge, Attitudes and Commitment of Managers Within Construction Firms Towards the Recent Construction Health and Safety Legislation Changes. In: *Proceedings of the 15th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development*. Durban, South Africa, 27-28 September 2021. T.C. Haupt, F. Simpeh, A. Amoah, Z. Armoed & M. Akinlolu (Eds). Springer. pp. 425-437.

Raliile, M.T., Haupt, T.C. & Kajimo-Shakantu, K. 2022. Assessing the Mental Well-being of the Construction Workforce in South Africa using the World Health Organisation (WHO-5) Wellness Index Measure. In: *Proceedings of the 16th Built Environment Conference Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster & Development: A Second Look*. Lanseria, South Africa, 26-27 September 2022. T.C. Haupt, P. Chigangacha & M. Akinlolu (Eds). ASOCSA. pp. 76-82.

Raliile, M.T., Haupt, T.C. & Kajimo-Shakantu, K. 2022. Occupational Stress, Organizational Culture and Coping among the Construction Workforce in South Africa. In: *Proceeding of the International Conference on the Leadership And Management of Projects in the digital age (IC:LAMP 2022)*. Al Eker, Bahrain, 27-28 November 2022. G. Aouad & A. Al Khajapp (Eds). Applied Science University. pp. 513-520.

Raliile, M.T., Haupt, T.C. & Kajimo-Shakantu, K. 2022. Work Conditions and Psychological Stressors among the Construction Workforce in South Africa.

In: *Proceeding of the 7th International Project and Construction Management Conference (IPCMC2022)*. Istanbul, Turkey, 20-22 October 2022. C. Budayan & S. Kivrak (Eds). Yildiz Technical University, Faculty of Civil Engineering, Department of Civil Engineering. pp.1448-1459.

Robbertse, C. & Amoah, C. 2022. Project Manager's Leadership Styles Affecting Construction Productivity. In: *Proceedings of the International Structural Engineering and Construction; State-of-the-art Materials and Techniques in Structural Engineering and Construction*. Leipzig, Germany. 20-25 June 2022. K. Holschemacher, U. Quapp, A. Singh & S. Yazdani (Eds). ISEC Press. pp.1-6.

Van der Linde, C. & Amoah, C. 2022. The Impact of Project Cost Management on Contractual Disputes in South Africa. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Building Smart, Resilient and Sustainable Infrastructure in Developing Countries*. Livingstone, Zambia. 6-7 October 2022. I. Musonda & E. Mwanaumo (Eds). DII. pp 558-573.

Venter, B., Ngobeni, S.P. & Du Plessis, H.B. 2022. South African Building Information Modelling and Organizational Size-A Quantity Surveyor's perspective. In: *Proceedings of the Development and Investment in Infrastructure International Conference; Building Smart, Resilient and Sustainable Infrastructure in Developing Countries*. Livingstone, Zambia. 6-7 October 2022. I. Musonda & E. Mwanaumo (Eds). DII. pp 433-448.

STAFF (2022)

**Head of Department:
Prof K Kajimo-Shakantu**

Associate Professor: Prof K Kajimo-Shakantu

Senior Lecturers: Dr C Amoah and Dr F Simpeh

Lecturers (Permanent): T Bremer, AH Deacon, H du Plessis, M-M Els, C Ferreira and PM Oosthuizen

Lecturers (Contract): D Huggett, MT Raliile, R Schaaf, R Seedat, C Skibbe, Dr L Spencer, L Stott, W Strydom, and J Swartz

Facilitator: C Mukumba

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

Dr Kgosi Mocwagae

Department of Urban and Regional Planning

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339

Bloemfontein

9300 South Africa

T: +27 51 401 2795

E: mocwagaeks@ufs.ac.za

W: www.ufs.ac.za/urp

OVERVIEW OF 2022

The Department of Urban and Regional Planning is one of 11 planning schools in South Africa that was established in 1975 as a postgraduate department. The Department currently offers two Honours, three Master's and two PhD programmes, with eight Short Learning Programmes (SLPs). In 2022, the Department hosted students from neighbouring countries such as Lesotho, Namibia and Zimbabwe.

ACHIEVEMENTS

Staff Achievements

Prof Verna Nel was invited to present a guest lecture for the Commission on the Geography of Governance at the International Geographical Union (IGU) in Paris. Her presentation, 'Did COVID-19 Bypass Africa?', demonstrated how COVID-19 accounted for most deaths in the African continent as compared to others.



Prof Verna Nel presenting at the IGU in Paris

Student Achievements

Thomas Sekyi-Ampah, at the age of 74, completed his PhD in Urban and Regional Planning. He achieved this after nine years of study, demonstrating dedication and resilience. Supervised by Prof Verna Nel, the title of his thesis was 'System for Municipalities with Traditional Leaders: A Case Study of Alfred Nzo District Municipality, Eastern Cape'.



Prof Verna Nel and PhD graduate Dr Thomas Sekyi-Ampah

TEACHING AND LEARNING

Each year, the students studying for the Bachelor of Spatial Planning Honours with specialisation in

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



Human Settlements, visit informal settlements in Mangaung. During the visits, the students must assess the spatial planning, or the absence thereof, and the social circumstances of the inhabitants of these settlements. In 2022, the students, led by Thomas Stewart and Dr Kgosi Mocwagae, visited the Phomolong informal settlement on the outskirts of Bloemfontein.

In 2022, the Free State Department of Human Settlements appointed the Department to facilitate the training of human settlements' officials, ranging from administrative clerks to directors. The group consisted of 42 participants from Free State provincial offices and municipalities. The training, consisting of four short learning programmes, have been offered in block weeks from 28 November 2022 and are scheduled for completion in May 2023.



Human Settlements Training students on Naval Hill during a trip on 1 December 2022

ENGAGED SCHOLARSHIP

In 2022, Dr Kgosi Mocwagae served as a member of the Pixley ka Seme District Municipal Planning Tribunal in the Northern Cape pertaining

to development applications for eight local municipalities in the district. He also participated in Matjhabeng Local Municipal Planning Tribunal where he serves as deputy chairperson in the Free State. the Tribunal considered development applications for the towns of Allanridge, Hennenman, Odendaalsrus, Ventersburg, Virginia and Welkom.

Members of the Department were involved in the Applied Regional Planning Project, titled 'Planning for the sustainable integration of human settlements and transport at a regional scale: A Case Study of the N8 Corridor from Bloemfontein to Ladybrand'. As part of the overall project, Dr Kgosi Mocwagae facilitated a field trip for Master of Urban and Regional Planning (Professional) students from Bloemfontein to Phuthaditjhaba through the Mangaung, Mantsopa, Setsoto, Dihlabeng and Maluti-a-Phofung municipalities on 25 and 26 May 2022. Dr Mocwagae, Prof Thulisile Mphambukeli and Thomas Stewart accompanied 13 students for the service-learning component of their Urban Project and Applied Regional Planning Project. The project entailed a review of the Thabo Mofutsanyana District Development Model. We were hosted in Ladybrand on 25 May by Malefu Mabalane, the Town Planner in the Mantsopa Local Municipality, and by Selby Lengoabala from Thabo Mofutsanyana District Municipality, on 26 May in Phuthaditjhaba.



Selby Lengoabala from Thabo Mofutsanyana District Municipality presenting to the Master of Urban and Regional Planning (Professional) students

On 10 June and 12 August 2022, Thomas Stewart, Dr Anita Venter and Dr Malefetsane Mokoena, along with one PhD and five Bachelor of Spatial Planning Honours (Human Settlements) students, attended a service-learning opportunity in Nyakallong Township, Allanridge. The point of interest was a natural pan (small lake) adjacent to the Township which has significant mine dumps from gold/uranium mining activities from the 1950s. In addition, there have been sewage pump stations that have been submerged leading to a water level rise that affects 81 households.



A demolished house submerged in the natural pan in the Nyakallong Township

Thomas Stewart facilitating a plenary session at the 2022 Housing and Human Settlements National Practitioner Forum International Seminar



NATIONAL AND INTERNATIONAL COLLABORATION

The University of Zambia (UNZA), in partnership with the Network of Excellence on Land Governance in Africa (NELGA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), invited academic staff and Master's and PhD students from across African universities and research institutions to participate in the scientific writers' workshop. The fully funded workshop took place in Zambia from 25 to 28 October 2022. Three of our PhD students, Abongile Mgwele, Jennilee Kohima and Willoughby Zimunya, attended and presented their research at the workshop.



PhD student and staff member, Abongile Mgwele (above) and PhD student Willoughby Zimunya (below) presenting at the University of Zambia



Thomas Stewart was invited to the launch of the Global Action Plan Framework on Informal Settlements and Slums, convened by the Government of South Africa and the United Nations Human Settlements Programme (UN-Habitat), on 16 and 17 October 2022 in Pretoria. The focus of the launch was on how to integrate the urgently needed response to informal settlements and slums in the global debate of accelerating the implementation of the Sustainable Development Goals and the New Urban Agenda.

POSTGRADUATE STUDENTS

In 2022, the following postgraduate students were enrolled in the Department of Urban and Regional Planning:

- Bachelor of Spatial Planning Honours: 36
- Bachelor of Spatial Planning Honours specialising in Human Settlements: 17
- Master of Urban and Regional Planning (Professional): 16
- Master of Urban and Regional Planning (Research): 4
- Master of Human Settlements: 1
- PhD in Urban and Regional Planning: 20
- PhD in Human Settlements: 1

In 2022, a total of 18 students graduated with the Bachelor of Spatial Planning Honours. Gerda Bezuidenhout, Bernette Kriek, Gavaza Makamu, Madisemelo Palo and Albertina Shatiwa passed with distinction. Two students graduated with a Bachelor of Spatial Planning Honours specialising in Human Settlements.

In the Master of Urban and Regional Planning (Professional), 18 students graduated. The Master of Urban and Regional Planning (Research) was completed by Stephanus Minnie (with distinction).

In 2022, two Doctor of Philosophy (Urban and Regional Planning) degrees were conferred:

Charisa, Innocent

Thesis: Infusing Disaster Resilience Thinking and Practice into Rural Settlement Planning, Development, and Management in Zimbabwe.

Supervisors: Prof V Nel and Prof J Chakwizira

Sekyi-Ampah, Thomas

Thesis: Towards a Sustainable and Transformative Spatial Governance System for Municipalities with Traditional Leaders: A Case Study of Alfred Nzo District Municipality, Eastern Cape.

Supervisor: Prof V Nel

Two of our PhD students, Lucia Khetsi and Natal Buthelezi, were fortunate enough to attend and present at the annual IGU Commission on Geography of Governance (ICU-CGoG) International Conference, held in Mexico City from 29 to 31 August 2022., with the theme 'Local Governance in a Time of Global Emergencies'. Khetsi's presentation was titled 'Informal Governance: Insights from Windhoek's Informal Settlements', while Buthelezi presented on 'Climate Change disaster risk reduction and management systems in vulnerable urban communities of South Africa'.



Lucia Khetsi (above) and Natal Buthelezi (below) presenting at the IGU-CGoG International Conference in Mexico City



POSTDOCTORAL RESEARCH FELLOWS



Postdoctoral Fellow Dr Johannes Bhanye

In 2022, the Department hosted one Postdoctoral Fellow – Dr Johannes Bhanye, from Zimbabwe

STAFF MATTERS

Prof Málene Campbell, the Head of Department, retired at the end of December 2022, and Prof Thulisile Mphambukeli resigned in June 2022.

Prof Yandisa Mashalaba was appointed as Associate Professor in November 2022.

Dr Kgosi Mocwagae was appointed as the new Head of Department, commencing duties in January 2023.

RESEARCH OUTPUTS

Research Articles

Chirisa, I., Mutambisi, T., Chivenge, M., Mabaso, E., Matamanda, A.R. & Ncube, R. 2022. The urban penalty of COVID-19 lockdowns across the globe: manifestations and lessons for Anglophone sub-Saharan Africa. *GeoJournal* 87: 815-828.

Chirisa, I. & Nel, V. 2022. Conflicts, Confrontations, and Conduits in Rural Environments: Is Resilience at Work in Gokwe South Rural District? *International Journal of Rural Management* 19(3): 09730052211065943. DOI: 10.1177/09730052211065943.

Chirisa, I. & Nel, V. 2022. Resilience and climate change in rural areas: a review of infrastructure policies across global regions. *Sustainable and Resilient Infrastructure* 7(5): 380-390.

Chirisa, I. & Nel, V. 2022. Socio-ecological Dynamics Within Rural Settlements: Evidence from Mbire District in Zimbabwe. *Journal of Land and Rural*

Studies 10(2): 220-239.

Denoon-Stevens, S.P., Andres, L., Jones, P., Melgaço, L., Massey, R. & Nel, V. 2022. Theory versus practice in planning education: The view from South Africa. *Planning Practice & Research* 37(4): 509-525.

Denoon-Stevens, S. P., Andres, L., Nel, V. & Jones, P. 2022. Unpacking planners' views of the success and failure of planning in post-apartheid South Africa. *Cities* 130: 103867.

Dunn, M.M., Matamanda, R.A. & Nel, V.J. 2022. Broken bridges over troubled waters: COVID-19 and the urban poor residing in Dinaweng informal settlement, Bloemfontein, South Africa. *South African Geographical Journal* 104(3): 309-327.

Gbadegesin, J., Marais, L., Von Maltitz, M., Cloete, J., Lenka, M., Rani, K., Campbell, M., Denoon-Stevens, S., Venter, A., Koetaan, Q. & Pretorius, W. 2022. Student housing satisfaction at a South African University. *Journal of Student Affairs Research and Practice* 59(5): 559-579.

Jones, P., Andres, L., Denoon-Stevens, S. & Melgaco Silva Marques, L. 2022. Planning out abjection? The role of the planning profession in post-apartheid South Africa. *Planning Theory* 21(1): 35-55.

Marais, L., Burger, P., Campbell, M., Denoon-Stevens, S. & Van Rooyen, D. 2022. Coal and energy in South Africa: Considering a just transition. (Book Note). *The Journal of Australian Political Economy* 89: 158-159.

Massey, R.T. & Denoon-Stevens, S.P. 2022. Health and wellbeing in urban South Africa: an overview. *South African Geographical Journal* 104(3): 271-275.

Matamanda, A.R., Mafuku, S.H. & Bhanye, J.I. 2022. The Potential of Chinhoyi as a Fast-Growing Secondary City in Addressing Urban Challenges in Zimbabwe. *Journal of Asian and African Studies* (Online). DOI: 10.1177/00219096221137660.

Matamanda, A.R., Mandebvu-Chaora, C. & Rammile, S. 2022. The interplay between urban agriculture and spatial (In) justice: Case study analysis of Harare, Zimbabwe. *Land Use Policy* 115: 106029.

Matamanda, A.R., Mphambukeli, T.N. & Chirisa, I. 2022. Exploring water-gender-health nexus in human settlements in Hopley, Harare. *Cities & Health*. DOI: 10.1080/23748834.2022.2136557.

Matamanda, A.R., Nel, V., Leboto-Khetsi, L. and Dunn, M. 2022. Risk communication in an informal

settlement during COVID-19: Case of Dinaweng, Bloemfontein South Africa. *Urban Governance* 2(2): 296-304.

Musosa, L., Shekede, M.D., Gwitira, I., Chirisa, I., Tevera, D. & Matamanda, A.R. 2022. Auditing the spatial and temporal changes in urban cropland in Harare metropolitan Province, Zimbabwe. *African Geographical Review* (Online). DOI: 10.1080/19376812.2022.2128834.

Books/Chapters in Books

Matamanda, A.R., Chirisa, I., Rammile, S. & Marais, M. 2022. *Housing and Technology: Special Focus on Zimbabwe*. Vol. 37 of Book Series: SpringerBriefs in Environment, Security, Development and Peace. Cham: Springer.

Matamanda, A.R., Kohima, J.M., Nel, V. & Chirisa, I. 2022. Climate Change Adaptation and Planning Education in Southern Africa. In: *Planning Cities in Africa: Current Issues and Future Prospects of Urban Governance and Planning*. Urban Book Series. G.A. Gebregiorgis, S. Greiving, A.H. Namangaya & W.J. Kombe (Eds). Cham: Springer International Publishing. pp: 103-117.

Matamanda, A.R., Nel, V., Chanza, N., Leboto-Khetsi, L., Mangara, F. & Paradza, P. 2022. The Political Economy of COVID-19 Pandemic: Lessons Learned from the Responses of Local Government in Sub-Saharan Africa. In: *Local Government and the COVID-19 Pandemic: A Global Perspective*. Local and Urban Governance book series. C.N. Silva (Ed). Cham: Springer International Publishing. pp: 103-128.

Nel, V. & Lewis, M. 2022. The South African Local Government and Municipal Planning Responses to COVID-19. In: *Local Government and the COVID-19 Pandemic: A Global Perspective*. Local and Urban Governance book series. C.N. Silva (Ed). Cham: Springer International Publishing. pp: 667-686.

Conference Contributions

Conference Papers/Posters

Bhanye, J. 2022. *Associational life and belonging among migrants during the Covid-19 pandemic: An ethnographic study among Malawian farm labourers in Zimbabwe*. Paper delivered at The Food System in the (Post-) Pandemic World: Disruptions, Vulnerability, Resilience, and Alternative 9ISA RC 40

Mini-Conference, Leipzig, Germany. 19-21 October 2022.

Bhanye, J. 2022. *Emerging forms of authority in land access: The occult and witchcraft among Malawian migrants in Zimbabwe.* Paper delivered at Navigating Complex Pluriversal Relations: Indigeneity, Natural Resources Governance and Intercontinental Relations in the 21st century, Pretoria, South Africa. 5-7 July 2022.

Bhanye, J. 2022. *Informal sociality and belonging among migrants during the Covid-19 pandemic: A case study of Malawian diaspora in Zimbabwe.* Paper delivered at the CODESRIA Academic Writing Workshop for Young Scholars and Early Career Researchers [online]. 9-10 June 2022.

Bhanye, J. 2022. *This settlement is just a launch pad to move to the city': Perception of place and migration aspirations among young migrants in the diaspora.* Paper delivered at the Conference for Planning Students & Young Graduates. Johannesburg, South Africa. 24-25 October 2022.

Bhanye, J. & Mugo, M. 2022. *ChemCity Eco-Industrial Park: lessons, opportunities and challenges for future sustainable industrial infrastructure development in South Africa.* Paper delivered at the African Infrastructure Futures, Cape Town, South Africa. 21-23 November 2022.

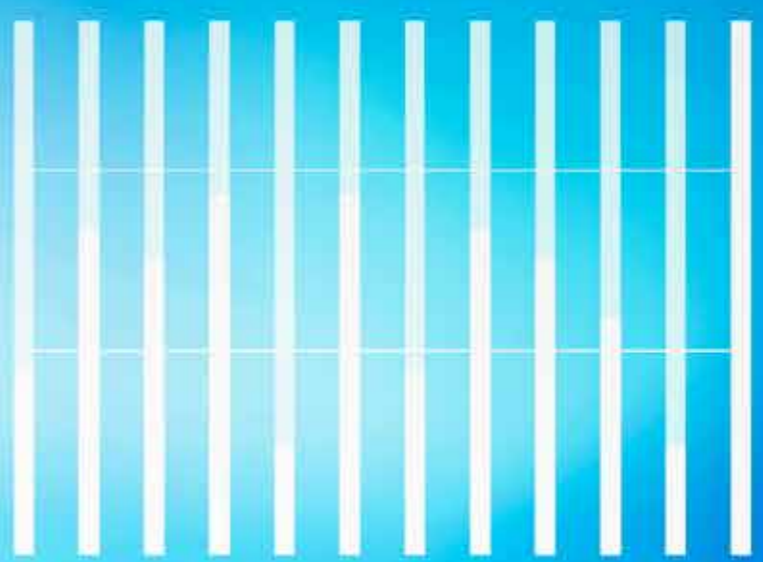
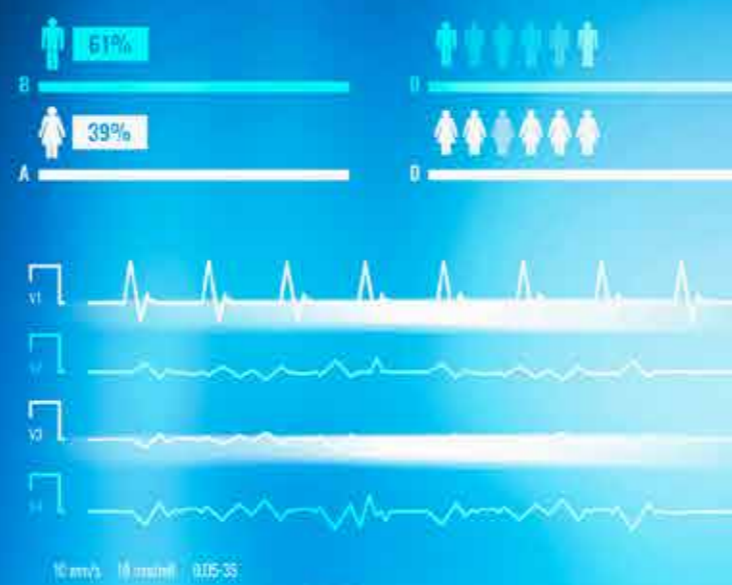
Rammile, S. 2022. *Healthy People, exploring the intersection of toponyms and identity, considering how they affect urban liveability.* Paper delivered at the 58th ISOCARP World Planning Congress: From Wealthy to Healthy Cities - Urbanism and Planning for the Well-Being of Citizens, in Search of a new Planning Agenda for Urban Health, Socio-Spatial Justice and Climate Resilience, Brussels, Belgium. 3-6 October 2022.

STAFF (2022)

**Head of Department:
Prof MM Campbell**

- Professor:** Prof V Nel
- Associate Professors:** Prof MM Campbell and Prof Y Mashalaba
- Senior Lecturers:** Dr H Booysen (Contract), Dr K Mocwagae, Dr T Mphambukeli, T Stewart and Dr A Venter (Contract)
- Lecturers:** MA Mgwele, Dr M Mokoena (Contract) and S Ramile
- Programme Director:** Dr K Mocwagae
- Senior Assistant Officer:** T Ntsiu
- Secretary:** R Hugo
- Student Assistant:** N Malatji
- Research Fellows (Affiliated):** Dr S Denoon-Stevens and Prof I Chirisa





NATURAL
SCIENCES



DEPARTMENT OF CHEMISTRY

FACULTY OF NATURAL AND
AGRICULTURAL SCIENCES

CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Prof Deon Visser

Department of Chemistry

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2497

E: visserhg@ufs.ac.za

W: www.ufs.ac.za/chemistry

QWAQWA CAMPUS

Dr Mfiso Mngomezulu

Department of Chemistry

Faculty of Natural and Agricultural Sciences

University of the Free State

Private Bag X13 | Phuthaditjhaba 9866

South Africa

T: +27 58 718 5135

E: MngomezuluME@ufs.ac.za

W: www.ufs.ac.za/chemistry

OVERVIEW OF 2022

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 231 students in total. The Qwaqwa Campus caters to 230 local residential students and specialises in Polymer Science research. In comparison, the Bloemfontein Campus teaches approximately 700 undergraduate students and

conducts research in all four classic divisions of Chemistry, namely Analytical, Inorganic, Organic, and Physical Chemistry. In 2022, the postgraduate students on the Bloemfontein Campus included 11 Honours, 32 MSc and 28 PhD students, and 9 Postdoctoral associates from India, Nigeria, Sudan, Ethiopia, Morocco, Spain, Cameroon, and South Africa. The Qwaqwa Campus hosted four Honours, thirteen MSc and two PhD students, and one Postdoctoral associate.

With the COVID-19 pandemic something of the past, the 2022 academic year took off and ended in a better academic state than the year before. All the modules were formally assessed and conducted face-to-face. 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 needed to be better. However, serious efforts to remediate this have been taken since October 2022, with visits between Chemistry colleagues of the two campuses to stimulate collaboration. All the Qwaqwa colleagues, except one, now all have PhD degrees and are expected to have higher outputs in the future.

The Department had a very successful external review in August. Some of the points raised by the panel have already been initiated.

I would like to acknowledge our personnel for their sacrifice, commitment and loyalty, which ensured the successful completion of the 2022 academic year. During this period, we also succeeded in producing 97 accepted publications in internationally accredited journals, while six PhD and ten 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

Dr Anke Wilhelm and Prof Alice Brink attended the internationally renowned course, 'Wellcome Connecting Science Course: Practical Aspects of Small Molecule Drug' at the Wellcome Genome

Campus, Cambridge in June 2022 Prof Brink continued as a Fellow of the South African Department of Higher Education and Training (DHET): Future Professors Programme (FPP) – a flagship programme of the DHET, comprising 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.

Dr Eleanor Müller, Dr Anke Wilhelm and Dr Marietjie Schutte-Smith were selected for the UFS Industrial Mentorship Programme. This programme uses people with industrial experience to help younger researchers drive projects to commercialisation.



**Prof Jeanet
Conradie**
Photo: Digipix

Prof Jeanet Conradie was ranked amongst the top 2% of scientists in the world on the lists published by Stanford University on 10 October 2022, in both the single-year data set and in terms of career-long data.

Dr Maretha du Plessis was one of the recipients of the 2022 Khotatsa Awards during the annual UFS Teaching and Learning awards ceremony for her excellence in teaching.

Dr OT Alexander received the Emerging Researcher award from the Qwaqwa Campus Research Committee.

Student Achievements

PhD student Lenard Carroll (Moskaleva research group) was selected to deliver an oral presentation at a prestigious international Psi-K 2022 conference held in Lausanne, Switzerland, from 22 to 25 August 2022. Kgalaletso Otukile, another PhD student from the Moskaleva research group, received the best poster prize at the South African Chemical Institute (SACI) conference held in Stellenbosch from 8 to 13 January 2022.

Nandi Mateyise, supervised by Dr MM Conradie and co-supervised by Prof J Conradie, received the award for the best MSc student in Chemistry in 2021 at the Faculty of Natural and Agricultural Sciences Academic Awards Ceremony held on 20 April 2022.

Hannah van Dyk, from the Inorganic Division, was awarded First Place in the MSc Poster Presentation category at the SACI National Young Chemists' Symposium in October 2022 Johannesburg.

Francois Jacobs, a PhD in Inorganic Chemistry, was awarded a full bursary for attending the Legacy of START: Synchrotron Techniques for African Research and Technology in October 2022 in Cape Town, South Africa.



**Dr Maretha du Plessis, recipient of the 2022
Khotatsa Award (South Campus), and
Dr Engela van Staden (Vice-Rector: Academic)**

Four students from the Department of Chemistry participated in the Suid-Afrikaanse Akademie vir Wetenskap en Kuns student symposium in Natural Sciences (Studentesimposium in die Natuurwetenskappe 2022) in November in Pretoria, South Africa. Francois Jacobs, Christo van Staden, and Leandri Liebenberg won student oral presentation awards at the symposium.

Adelaide Mashweu (PhD student) and Francois de Beer (MSc student) visited the Vrije Universiteit Brussel (Belgium) as exchange students, where they performed research on peptide synthesis.



Adelaide Mashweu (PhD student) and Francois de Beer (MSc student) who visited the Vrije Universiteit Brussels (Belgium) as Exchange students

TEACHING AND LEARNING

The lecturers in the Department of Chemistry completed all 43 modules presented on the three campuses in 2022. The averages and pass rates for all the modules have improved on the 2021 results, indicating how vital face-to-face teaching is for Chemistry.

During 2022, the teaching of Chemistry modules on the South Campus was managed by Dr Rina Meintjes, assisted by three full-time facilitators, Dr Maretha du Plessis, Dr Bernadette van Tonder and Christelle de Klerk. They also managed the Chemistry first-year Extended Programme teaching activities for 99 students on the Qwaqwa Campus. Two hundred and thirty-one students enrolled at the beginning of 2022 for the first-year Chemistry modules for the BSc Extended Programme. Lydia Siegert acted as laboratory manager of the multi-disciplinary laboratory on the South Campus and trained the South Campus students in the practical aspects of Chemistry.

Teaching on the Qwaqwa Campus involves the theory and practical aspects of all four classic Chemistry disciplines, from the first- to the third year, for approximately 66 first-year students, 48 second-year students and 53 third-year students. At the beginning of 2022, 99 new students were

enrolled for the first-year Chemistry modules for the BSc Extended Programme on the Qwaqwa Campus. The Honours course had an enrolment of three students, which involved the teaching of subjects applicable to Polymer Science. The performance on the Qwaqwa Campus in most modules is above average, and the only concern is the two first-year modules with a less than 50% pass rate. The Department will endeavour to improve the success rate in these modules. The departmental throughput rate at the Honours level continues to be exceptional.

The Inorganic Chemistry Division is headed by Prof Deon Visser, the Physical Chemistry Division by Dr Ernie Langner, the Analytical Chemistry Division by Prof Karel von Eschwege and the Organic Chemistry Division by Dr Susanna Bonnet.

RESEARCH AND INNOVATION

Analytical Chemistry Division

Prof Karel von Eschwege (NRF C2-rating) continued in his main field of research in aspects of photochromic and photo-catalytic compounds with potential applications in sensors of diverse kinds and in the renewable energy sector, where these dye compounds are used as, amongst others, photocatalysts in the electro-photoreduction of H₂O or CO₂ to H₂ or CO. He also supervises a PhD project in collaboration with the University of Pretoria, investigating particulate matter pollution in Bloemfontein and the larger Free State area. A Master's project entails new methods of carbon nanotube and graphene syntheses. Prof Von Eschwege, on an ongoing basis, receives and accommodates analysis requests from the private sector, including the mining, medical and renewable energy sectors and the motor industry.

Dr Rebotsamang Shago focuses on synthesising and characterising macrocycles and their application in wastewater purification. The characterisation of these compounds is done through different instruments, such as SEM and elemental analysis. Their rate of absorbance for selected heavy metals is also tested.

The other part of the Analytical Chemistry Division is managed by Prof Walter Purcell, under whose leadership the 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 and include minerals such as zircon, tantalite, ilmenite monazite and UG2 platinum group element (PGE) ores. These projects are conducted in collaboration with industrial partners, such as Kumba Iron Ore. 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 Mpho Mathebula, Professional Officer for Analytical Chemistry, preparing chemicals for the practicals

First-year students doing Chemistry practicals on the South Campus



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 (Y-rated). The research is supported by Dr Pennie Mokolokolo as Chief Officer – Professional Services.

The Inorganic Chemistry Department produced 14 articles and 24 conference contributions, mostly in international papers and journals. Three PhD students and three MSc students graduated in 2022.

Prof Deon Visser, Dr Marietjie Schutte-Smith and Prof Elizabeth Erasmus, from Physical Chemistry, started a new Materials Chemistry group focusing on developing nanomaterials applications that could positively impact the community. They also collaborated with Prof Katinka de Wet from the Department of Sociology. Their current focus is on developing safe, biodegradable sanitary materials for females, anti-bacterial paints for applications in the healthcare and food industry and nanoparticle applications in medicines. Since starting this group, they have attracted three three MSc, as well as one Postdoctoral fellow. Over and above NRF-funding for rated researchers allocated to Prof Visser, the group also managed to obtain funding from Avacare Health.

Other research areas of Dr Schutte-Smith and Prof Visser include rhenium(I), gold(I), silver(I) complexes as antimicrobial and anti-cancer complexes. Seven oral presentations and five poster presentations were delivered by the students of Prof Visser and Dr Schutte-Smith, and two students won presentation prizes during these conferences.

Prof Johan Venter's research is focused on fundamental organometallic studies of mainly platinum group metals with catalytic application. His

studies provide a better insight into the intricate role of ancillary ligands through 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. Prof Venter was co-author of an invited contribution at the 33rd European Crystallographic Meeting (ECM33) in Versailles, France, in August 2022. He visited the research group of Prof Landman at the University of Pretoria, and collaborated with Prof Belay at the University of Bahir Dar in Ethiopia continues, and a co-authored paper appeared in the Swiss online journal *Inorganics*.

The Brink Research Group researches radiopharmaceutical drug development, incorporating the interoperable usage of chemical and macromolecular crystallography, as well as research within the field of homogeneous catalysis. During 2022, the research was supported by grants from NRF Competitive Support for Y-rated Researchers and the UFS-CUT Interdisciplinary Grant. Students from the Brink group attended and presented research at the: Studentesimposium in die Natuurwetenskappe (Pretoria); The Legacy of START: Synchrotron Techniques for African Research and Technology (Cape Town); SACI National

Young Chemists' Symposium (Johannesburg); International FreeStatePhyChem-2022 Symposium (Bloemfontein) and at the International Organic Chemistry Symposium (UFS-VUB Joint Symposium 2022, Bloemfontein). Students received bursary awards (FJF Jacobs) and conference presentations awards (FJF Jacobs and H van Dyk). The research group was generously provided with several hours of synchrotron beam time at the DIAMOND Light Source, UK, from the GCRF START Program. Prof Brink continued as a Fellow of the South African Department of Higher Education and Training: Future Professors Programme (FPP) and presented a seminar lecture at the Cambridge Crystallographic Data Center (Cambridge University, UK).

Physical Chemistry Division

The Physical Chemistry Division is divided into six distinct and separate research groups, which are led by Prof Jannie Swarts, Prof Jeanet Conradie, Prof Lyudmila Moskaleva, Prof Lizette Erasmus, Dr Ernie Langner and Dr Eleanor Müller.

The Swarts Research Group researched gold-metalloocene complexes intended for heterogeneous catalysis, collaborating with Syngaschem BV at the Dutch Institute for Fundamental Energy Research (DIFFER) at the Eindhoven University of Technology. Kinetic studies involving the reduction of nickel and copper tripeptides with complex cyanides of iron, tungsten, and molybdenum were conducted. Ferrocene-containing phthalocyanines with liquid crystalline properties and polymers with biomedical applications were studied. Prof Swarts received an international research award from Syngaschem BV and he also held an NRF Rated Researcher grant.

The Conradie Research Group consisted of two PhD students, two MSc students and two Postdoctoral fellows. The research in the Conradie Group focuses on the synthesis, characterization, 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. Their research resulted in 45 high-quality publications in 2022. Prof Conradie held an NRF CPRR research grant (Competitive Grant for Rated Researcher).

With the help of Prof Jannie Swarts, a Malvern



Zetasizer Particle Analyser was acquired at the end of 2022. With this instrument, under the custodianship of Dr Ernie Langner, it will be possible to characterise nanoparticles in terms of their size-distribution and concentration as well as determine their stability in suspension for a variety of solvents.

Prof Lyudmila Moskaleva received an NRF grant for 2022-2023 within the IRG - China / South Africa Research Cooperation Programme for her project 'The development of efficient Cu-based catalysts for CO₂ (photo-)electro reduction, undertaken in collaboration with the group of Prof Z-J Zhao from Tianjin University, China. She also held an NRF grant for 2021-2023 with Prof R Ramakrishnan from Tata Institute of Fundamental Research in Hyderabad, India, funded jointly by NRF and DST (India). In addition she continued a collaborative project within the Research Unit NAGOCAT funded by the German Research Foundation (DFG). Prof Moskaleva's group currently consists of two PhD students (plus one co-supervised at Universität Bremen), one MSc student and two Postdoctoral fellows. Their research focuses on 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 two groups of heterogeneous catalysts (gold-based alloys and rare-earth oxides) and electrocatalysis (oxygen reduction reaction and CO₂ reduction). Recently, a new direction was started on the mechanistic studies and modelling of rate constants of combustion reactions.

The research group of Prof Lizette Erasmus consisted of two PhD students, three MSc students and one Postdoctoral fellow. The research in the Erasmus Group focuses on materials science and heterogeneous catalysis. Projects during 2022 included (i) Grubbs catalyst investigations on stability, electrochemical characterisation, (ii)

Participants at International Organic Chemistry Symposium (UFS-VUB Joint Symposium 2022, Bloemfontein)

Front (seated) Hannah van Dyk, Francois de Beer and Catherine Kaschula

Middle, from the left: Adelaide Mashweu, Bathabile Makhathini, Kennedy Ngwira, Vladimir Azov and Susan Bonnet

Back, from the left: David Maier, Ulrich Hennecke, Wade Petersen, Dumisani Kama, François Jacobs and Clive Oliver

(Absent: Anke Wilhelm, a speaker from the UFS)



Morphology controlled Nanocrystals as model heterogeneous catalysts and (iii) Pristine and doped Titanium dioxide as photocatalysts for anti-bacterial application.

Dr Ernie Langner's research group comprised four PhD students and three MSc students. Two of the PhD students and two of the MSc students graduated in December 2022. One of the PhD students presented posters at two local conferences.

Two distinct series of Framework Materials formed part of the research in the Langner Group and resulted in several highlights. Firstly, the Aluminium-, Titanium- and Zirconium-based carboxylate metal-organic frameworks proved to be excellent adsorbents of organic contaminants in wastewater; secondly, the ligand-exchanged nano-sized Zn- and Co-based zeolitic imidazolate frameworks (ZIFs) showed superior catalytic performance in the fixation of CO₂ to form cyclic carbonates; and thirdly, a series of metal exchanged ZIFs showed good photocatalytic activity in contaminant dyes' wastewater adsorption and degradation. These research results were published in six peer-reviewed international journal papers in 2022. During 2022, Dr Langner was also a co-supervisor for one PhD student and one MSc student. Some of the research done by the PhD student was published in three peer-reviewed international journal papers in 2022.



Dr Refilwe Matshitse, Dr Langer and Prof Swarts with the Malvern Zetasizer Ultra

Dr Eleanor Müller's research concentrates on anti-cancer agents and the synthesis of possible chemotherapeutic drugs and drug carriers. Possible anti-cancer drugs include synthetic organometallic compounds, as well as complexes containing natural compound fragments. Drug carriers in the form of polymers, nano-particles 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. Cell-line testing is also performed in a number of collaborative projects with other researchers in the Department and the University. She publishes under her maiden name Eleanor Fourie.

Organic Chemistry Division

The Organic Chemistry Division consists of three distinct research foci – Phytochemistry (Dr Susanna Bonnet and Dr Anke Wilhelm), Homogenous catalysis (Dr Charlene Marais) and supramolecular chemistry (Prof Vladimir Azov).

In the Phytochemistry Group, Dr Bonnet investigated the development of commercial drugs and phytomedicines from indigenous knowledge to treat and sedate patients suffering from psychotic diseases. Access to bioassays through ChanPharm, an Austrian pharmaceutical company, to identify GABA(A) modulators, continued to offer an ideal opportunity to investigate African traditional medicine used to treat psychosis, to 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 in

Dr Susan Bonnet and Dr Anke Wilhelm from Organic Chemistry with the new Teledyne ISCO CombiFlash NextGen 300+



progress. In collaboration with the wattle industry, Dr Bonnet is also running projects on the investigation of black wattle bark extract (sulfomethylation, aminomethylation, sulfitation, carboxylation, etc.).

Dr Wilhelm manages the zebrafish bioassay in the Department of Chemistry. Her main research focus is on the isolation of active GABAergic compounds utilising a larval zebrafish locomotor bioassay. The established collaboration with ChanPharm investigates the GABAergic activity of South African botanicals in the search of novel anti-epileptic drugs.

The Marais Group focuses on homogeneous catalysis in synthesizing flavonoids, stilbenoids, and other compounds with potential biological activities. Dr. Charlene Marais received NRF-Thuthuka funding for her project on synthesising a natural substance that has the potential as a drug against diabetes in the synthesising flavonoids, stilbenoids and other compounds with potential biological activities. Dr Charlene Marais received NRF-Thuthuka funding for her project on synthesising a natural substance that has the potential as a drug against diabetes.

Projects of the group of Prof Vladimir Azov cover the broad area of supramolecular chemistry, molecular self-organization, and redox- and light-controllable molecular receptors, devices, and materials. The current project involves the synthesis of redox-active tetrathiafulvalene derivatives and of non-canonical amino acids with donor and acceptor groups. Prof Azov is also involved in collaborative projects aimed at studying weak interactions in molecular crystals, investigating complex formation and gas phase reactivity using mass spectrometry methods, and developing stereoselective heterogeneous catalysts.

Other Research Activities

Dr Rudi Swart, as Manager of the Nuclear Magnetic Resonance (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.

In August 2021, a new research group, the Small Molecule Unit, was established to concentrate on commercial projects and to improve third-stream

income. The unit is headed by Dr Anwar Noreljaleel, and Dr Az-Eddine El Mansouri was appointed as a Postdoctoral fellow. Agreements are being drafted with an industrial partner in the USA.

ENGAGED SCHOLARSHIP

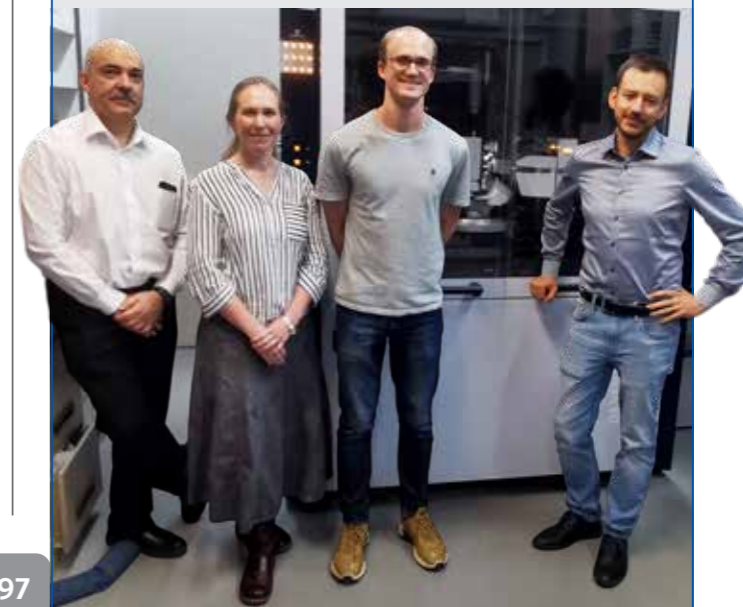
Most members of the Department acted as external reviewers for various chemistry journals and the NRF. They served on Faculty and UFS committees, while others contributed as external examiners for several universities at undergraduate and postgraduate levels and represented the UFS on international research councils. Departmental members also acted as Panel Members during the 2022 CHE Institutional Audit reporting, coordinated by Prof Visser, Dr Schutte-Smith and Dr Wilhelm.

With regard to the specific divisions, staff members were involved in the following ways:

Inorganic Chemistry

Dr Dumisani Kama and an Inorganic PhD student, Francois Jacobs, presented the UFS Crystallographic Refinement School to postgraduate students from Chemistry.

Some members of the Inorganic Chemistry Division with representatives from Bruker. From the left, Pari Antalis (Bruker), Prof Alice Brink and Francois Jacobs and Dr Tobias Stürzer (Bruker AXS GmbH Germany)



Prof Brink served on the Editorial Board for Crystallographic Reviews and was invited by the NRF as a panel member reviewer for NRF-Thuthuka funding applications. In association with Bruker SA, Prof Brink hosted the Bruker Advanced Crystallographic Training Course at the Roodt Crystallographic Laboratory in association with the NRF NEP Grant (October 2022).

Professor Visser acted as a reviewer for *Inorganic Chemistry*, *Journal of Molecular Structure*, *Molecules* and *Polyhedron*.

Organic Chemistry

Dr Anke Wilhelm was invited by the NRF to act as a reviewer and a panel member in the five-year evaluation of the South African Research Chairs Initiative (SARChI) of two renowned scientists. Prof Azov was also involved in the evaluation of several NRF rating applications, as well as serving as a member of NEP and SARChI panel meetings.

The Organic Chemistry staff acted as reviewers for the following internationally acclaimed journals: *Journal of Natural Products*, *Journal of Organic Chemistry*, *Phytochemistry*, *Phytochemistry Letters*, *Natural Product Communications*, *South African Journal of Chemistry*, *Chemistry - A European Journal*, *Chemical Communications*, *Chemical Physics Letters*, *Molecules*, *Tetrahedron Letters*, *Molecular Liquids*, *Molecules*, *Chemical Engineering*

Journal, *Russian Chemical Reviews* and *Mendeleev Communications*.

All staff made contributions as external examiners for a number of universities at undergraduate and postgraduate levels.

Physical Chemistry

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

Dr Langner reviewed three articles (two for *JOIPM* and one for *Nature Communications*) and acted as internal examiner for an MSc and external examiner for a PhD thesis.

Prof Erasmus acted as a reviewer for several international journals and as the Physical Chemistry Editor of the *South African Journal of Chemistry*. She also made contributions as internal examiner (for UFS students) and external examiner for other universities at postgraduate levels.

Dr Müller acted as a reviewer for articles in *Inorganica Chimica Acta*, *Inorganic Chemistry*, *Transition Metal Chemistry* and *Journal of Electroanalytical Chemistry*. She also made contributions as 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*, *PCCP*, *The Journal of Physical Chemistry C*, and *New Journal of Chemistry*. She serves on the Editorial Board of *Scientific Reports*.

Prof Conradie was a reviewer for several international journals and the Physical Chemistry Editor of the *South African Journal of Chemistry*.

Physical Chemistry hosted the International FreeStatePhyChem Symposium on 18 November 2022, organised by Dr Langner and Prof Moskaleva. The symposium was aimed at fostering the interest and engagement of students in Physical Chemistry research. This year's focus was on Computational Chemistry. UFS students and staff from the Departments of Chemistry and Physics presented their research in oral and poster presentations. International and national keynote speakers delivered invited talks.

Analytical Chemistry

Dr Shago served as a reviewer and moderator in several NRF funding instruments.

Prof Von Eschwege was a reviewer for various Elsevier and RSC journals and an external examiner of local and overseas PhD theses. He reviewed NRF funding applications for projects across the entire renewable energy domain. Due to his expertise, he serves in a constant advisory capacity to companies in the renewable energy sector.

Qwaqwa Campus

The Department of Chemistry on the Qwaqwa Campus visited Kgola-Thuto Secondary School for a motivational cum exhibition session.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Von Eschwege continued collaborating with the Laser Research Institute at the Physics Department at Stellenbosch University (femtosecond laser spectroscopy), and the University of Pretoria Medical

Faculty (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. He appointed a research fellow from the Federal University Oye-Ekiti, Nigeria.

Prof Visser and Dr Schutte-Smith focus part of their research on developing anti-cancer and anti-bacterial compounds involving metals such as gold, silver and rhenium. For this research, they collaborate with Dr Gilles Gasser from ParisTech, France, Prof Justin Wilson, from Cornell University, USA, and Prof Olihile Sebolai, from the UFS Department of Microbiology and Biochemistry.

Prof Brink continued collaborating with Prof John Helliwell from the University of Manchester. Their research practice of promoting the sharing of raw diffraction images correctly stored in repositories and linked to the publication to ensure the safe guarding of metadata – was highlighted in June 2022 by the International Union of Crystallography data-sharing policy as a mandate for all IUCr journals. Additional collaborators involved in the research projects include Dr Colin Levy and Dr Mathew Cliff (Manchester Institute of Biotechnology), Prof Dirk Opperman (Biochemistry, UFS), and Prof Ted Kroon (Physics, UFS). An interdisciplinary collaboration with Prof T Makhafola (Central University of Technology) and Prof Nick Gerasimchuk (Missouri State University) is ongoing.

Dr Ernie Langner collaborated nationally with Dr Kobus van der Walt (Central University of Technology) on the development of polypropylene powders for laser sintering. Internationally, he collaborated internationally with members of COST Action CA21101 COSY – Workgroup 3: A European Collaborative project. Dr Langner also collaborated with Prof Dusko Dudic (University of Belgrade, Serbia) on ZIF nanoparticles in composites with sensing abilities.

Prof Erasmus collaborated internally with Prof Visser (Inorganic Chemistry) and Prof Hendrik Swart (Department of Physics). She also collaborated internationally with Prof JW Niemantsverdriet from SynCat@DIFFER in the Netherlands, working on Frustrated Lewis Pairs. Dr Müller also collaborated with Prof Niemantsverdriet.

Students and staff from the Departments of Chemistry and Physics and guest speakers during the FreeStatePhyChem Symposium-2022



Prof Moskaleva collaborated with researchers from NAGOCAT research unit funded by the German Research Foundation (DFG). She also collaborated with Prof R Ramakrishnan from Tata Institute of Fundamental Research in Hyderabad, India, funded jointly by NRF and DST (India), on combustion chemistry and data science, with Prof Zhi-Jian Zhao from Tianjin University, China, funded jointly by NRF and MOST (China), on the development of efficient Cu-based catalysts for CO₂ (photo-)electro reduction and with Prof María-Pilar de Lara Castells from CISC, Madrid, on a Spanish National Research project with the focus on the computational studies supported subnanometric clusters of coinage metals and with members and co-leaders of Working Group 3 of COSY Action CA21101 COSY – A European Collaborative project. Within the Department, she collaborated with Prof Visser, in the Inorganic Chemistry Division.

Professor Conradie collaborated internationally with Prof Abhik Ghosh (Department of Chemistry and Centre for Theoretical and Computational Chemistry, University of Tromsø), Prof JH Potgieter (Wits and Manchester Metropolitan University), Karl M Kadish (University of Houston), Prof Elisa Tomat (The University of Arizona), Prof Sanjib Kar (National Institute of Science Education and Research (NISER) and Homi Bhabha National Institute, India), Dr Jean Jules (Fifen University of Ngaoundere,) and Prof Fridolin Nya Tchangnwa (University of Maroua).

The Marais/Bezuidenhout group collaborated with Chemical Process Technologies, Pretoria, Wildlife Pharmaceuticals, Nelspruit, and PETLabs Pharmaceuticals to analyse and synthesise compounds with medical applications.

Dr Bonnet and Dr Wilhelm continued collaboration with Prof Sophia Khom-Steinkellner from the University of Vienna, and Dr Lucie Rarova, from Palacky University in the Czech Republic. Nationally they collaborated with Dr Leon van Kralingen from the Wattle Industry, Pietermaritzburg, on projects involving the derivatisation of wattle tannin extracts for industrial applications, and with Dr Richard Burghoff from the Institute for Commercial Forestry Research, University of KwaZulu-Natal, on a grant received from Forestry Sector Innovation Fund.

Prof Azov started a new collaboration with Vrije Universiteit Brussel in Belgium, funded by the joint

NRF/FWO grant, aimed at the synthesis of unnatural amino acids containing donor and acceptor groups for materials and biomedical applications. He also participates in a large international collaboration involving scientists from several universities (University of Leipzig, Purdue University, PNNL) related to the gas phase chemistry of dodecaborate. In addition, he collaborates with Prof Vande Velde (University of Antwerp) and Dr M Zeller (Purdue University) on crystallography of organic molecules.

The Chemistry Department continued collaboration with Insect Science in Tzaneen, Limpopo, regarding the synthesis of environment friendly pesticides.

Prof Purcell collaborated with Prof Herman Potgieter from the School of Chemical and Metallurgical Engineering at Wits, where he is also a visiting professor, and with Prof Hendrik Swart, from the UFS Department of Physics, Justine Magson, from the UFS Department of Geology, Kumba Iron Ore and various industrial partners.

Prof Purcell, Dr Alba Gómez-Arias (Postdoctoral Fellow) and Dr Julio Castillo-Hernandez (UFS Microbiology and Biochemistry) successfully submitted an ERAMIN3 application to the European

**Dr Alba Gómez-Arias (Postdoctoral Fellow)
on the surface of Palaborwa Mining Company
Phalaborwa**



Commission (EU) Horizon Europe. The research, to extract REE from mine tailings using chemical and micro-biological processes, will be undertaken in collaboration with researchers from Chile, Spain and Portugal.

OTHER ACTIVITIES

For the second year, Prof Jannie Swarts oversaw the large equipment programme of the Faculty of Science, a great task that he fulfilled with perseverance and commitment. For the Chemistry Department, a new Particle Analyser was acquired.

The SA Precious Metal Permit is managed by E Andrews and supported by the Inorganic Division on behalf of the University.

Prof Azov organised the International Organic Chemistry Symposium at the University of the Free State held on 20 June 2022. Several renowned

chemists from South Africa and abroad joined the symposium and presented lectures on their research. Several UFS postgraduate students also participated with oral and poster contributions.

POSTGRADUATE STUDENTS

Eleven (11) Honours, 32 MSc, and 28 PhD students were enrolled in t2022 in the Department of Chemistry on the Bloemfontein Campus, while at the Qwaqwa Campus, four Honours, 13 MSc and two PhD students were enrolled.

Ten MSc students graduated in 2022 – M Mudau (Nanoscience), Z Bezuidenhout (*cum laude*), K Ehlers, R Jordaan (*cum laude*), SY Gawe (Nanoscience), J Blignaut (*cum laude*), LA Bosman (*cum laude*), SN Mncwangi, NN Nzhadzhaba and G Swart (*cum laude*).

The Chemistry Postgraduate students of 2022

Front, from the left: H van Dyk, J Blignaut, N Nzhadzhaba, M Visser, S Khoza, J Nambooze, K Otukile, R Mogale. A Jayiya and L Liebenberg

Middle, from the left: F de Beer, N Kheswa, A Tlhaole, V Mzinjani, B Makhathini, D van der Westhuizen, W Smith, J Faber, U du Plessis, FJF Jacobs and, R Jordaan.

Back, from the left: DIH Maier, Tshehla, A Ntsila, M Mogashoa, B Kalimashe, C van Staden, C Matthews, T Krause, OA Odewole, O Olaniyan, C Jacobs and D Rajak



The PhD was conferred on the following candidates in 2022:

Mogale, Refilwe

Thesis: Aluminium- and Zirconium-based Metal-Organic Frameworks with azobenzene and stilbene dicarboxylate ligands for use in wastewater treatment

Supervisor: Dr EHG Langner

Morerwa, Zanele Gift

Thesis: Water-Soluble Rhodium(I) Model Catalysts

Supervisor: Prof A Brink

Co-supervisor: Prof A Roodt

Mphuthi, Lehlohonolo Ernest

Thesis: Synthesis, Characterization and Metal exchange of ZIF-8 and ZIF-67 nanoparticles for catalytic applications

Supervisor: Dr EHG Langner

Redgard, Shaun

Thesis: Solid State of Kinetic Study of Diolefin Complexes of Platinum Group Elements

Supervisor: Prof A Roodt

Co-supervisor: Prof JA Venter

Swart, Marthinus Rudi

Thesis: Investigation of the physical properties of active Grubbs' catalysts and its influence on the product distribution of the metathesis reaction

Supervisors: Prof E Erasmus and Dr C Marais

Viljoen, Johannes Augustinus

Thesis: A Crystallographic investigation of multidentate ligand hafnium (IV) halido complexes

Supervisor: Prof A Roodt

Co-supervisor: Prof HG Visser

Dr Kovo Akpomie was appointed as Affiliated Researcher at the end of 2022.

Dr Refilwe Matshitse was appointed as an Officer in the Chemistry Department on the Bloemfontein Campus.

Prof Visser was appointed Head of the Department for Chemistry at the end of 2022 when Prof Purcell stepped down.

Daniel Fish, Technical Aid in the Physical Chemistry Division, retired at the end of 2022 after 38 years of service.

Dr Orbett Alexander resigned as Lecturer in Inorganic Chemistry at the Qwaqwa Campus at the end of 2022.

Dr MR Swart and Dr MW Mathebula obtained their Doctoral degrees in 2022. Dr Swart was appointed

Lecturer in Organic Chemistry and NMR Administrator on 1 October 2022.

Three staff members on the Qwaqwa Campus are pursuing their MSc and PhD degrees.



Department of Chemistry (Bloemfontein Campus) 2022

Back, from the left: Prof K von Eschwege, Dr MR Swart, Prof JA Venter, Prof HG Visser, Dr E Langner, Prof V Azov and Dr A Noreljaleel

Middle, from the left: M Meyburgh, Dr M Conradie-Bekker, Prof E Erasmus, Dr E Muller, Dr R Shago, Dr P Mokokolo, Dr A Wilhelm, Dr S Bonnet, Prof A Brink, Dr C Marais and Dr R Matshitse

Front, from the left: E Andrews, L Siegert, Dr R Meintjies, R Wales, Prof L Moskaleva, Prof W Purcell, D Fish, P Maxhaka, and Dr M Mathebula



POSTDOCTORAL RESEARCH FELLOWS

The Department of Chemistry hosted nine Postdoctoral Fellows in 2022:

- Dr Kovo Akpomie (Nigeria)
- Dr Mohammed Abdelaziz Elkhidir Elmakki (Sudan)
- Dr Az-eddine El Mansouri (Morocco)
- Dr Alba Gomez-Arias (Spain)
- Dr Alhadji Malloum (Cameroon)
- Dr Cameron Matthews (South Africa)
- Dr Dilip Rajak (India)
- Dr David Ugwu (Nigeria)
- Dr Thandeka Tshabalala (South Africa)

STAFF MATTERS

After their retirement, Prof Jannie Swarts, Prof Andreas Roodt and Prof Jeanet Conradie were appointed Research Fellows in the Department for three years, starting in 2022.

Some successful postgraduates and their supervisors during the April 2022 graduation

*Back, from the left, Prof JA Venter; Prof A Roodt and Prof HG Visser
Front, from the left, Dr S Redgard, Z Bezuidenhout (MSc cum laude) and Dr JA Viloen*



RESEARCH OUTPUTS

Research Articles

Abraha, Y.W., Tsai, C.-W. & Langner, E.H.G. 2022. De novo syntheses of multi-linker Zn- and Co-based ZIFs with application in CO₂ fixation. *Microporous and Mesoporous Materials* 346: 112319. DOI: 10.1016/j.micromeso.2022.112319.

Abraha, Y.W., Tsai, C.-W. & Langner, E.H.G. 2022. Scalable synthesis of mixed-linker (Zn) ZIFs and their application in CO₂ adsorption and fixation. *Journal of Porous Materials* 30: 149-162. DOI: 10.1007/s10934-022-01326-x.

Adegoke, K.A., Oyedotun, K.O., Ighalo, J.O., Amaku, J.F., Olisah, C., Adeola, A.O., Iwuozor, K.O., Akpomie, K.G. & Conradie, J. 2022. Cellulose derivatives and cellulose-metal-organic frameworks for CO₂ adsorption and separation. *Journal of CO2 Utilization* 64: 102163. DOI: 10.1016/j.jcou.2022.102163.

Adeleke, V.T., Madlala, N E., Adeniyi, A.A. & Lokhat, D. 2022. Molecular Interactions Associated with Coagulation of Organic Pollutants by 2S Albumin of Plant Proteins: A Computational Approach. *Molecules* 27(5): 1685. DOI: 10.3390/molecules27051685.

Adeniyi, A.A., Adeniyi, J.N., Nlooto, M & Singh, P. 2022. Probing New Antileukemia Agents That Target FLT3 and BCL-2 from Traditional Concoctions through a Combination of Mass Spectrometry Analysis and Consensus Docking Methods. *Appl. Sci.* 12(22): 11611. DOI: 10.3390/app122211611.

Adeniyi, J.N., Adebayo A. Adeniyi, A.A., Moodley, R., Nlooto, M., Ngcobo, M., Gomo, E. & Conradie, J. 2022. Unravelling the drug ability of MSI2 RNA recognition motif (RRM) protein and the prediction of their effective antileukemia inhibitors from traditional herb concoctions. *Journal of Biomolecular Structure & Dynamics* 40: 2516-2529. DOI: 10.1080/07391102.2020.1840442.

Akpomie, O.O., Ejechi, B.O., Banach, A.M., Adewuyi, I., Ayobola, E.D., Akpomie, K.G., Ghosh, S. & Ahmadi, S. 2022. Biogenic amine production from processed animal and plant protein-based foods contaminated with *Escherichia coli* and *Enterococcus faecalis*. *Journal of Food Science and Technology* 59(12): 4880-4888. DOI: 10.1007/s13197-022-05576-0.

Alebachew, N, Murthy, H.C., Bedassa Abdissa, Demissie, T.B., Von Eschwege, K.G, Langner,

E.H.G. & Coetsee-Hugo, L. 2022. Synthesis and characterization of CuO@S-doped g-C₃N₄ based nanocomposites for binder-free sensor applications†. *RSC Adv.* 1: 29959-29974. DOI: 10.39/ d2ra04752g.

Amaku, J.F., Ogundare, S.A., Akpomie, K.G. & Conradie, J. 2022. Pentaclethra macrophylla stem bark extract anchored on functionalized MWCNT-spent molecular sieve nanocomposite for the biosorption of hexavalent chromium. *International Journal of Phytoremediation* 24(3): 301-310. DOI: 10.1080/15226514.2021.1937930.

Amaku, J.F., Ogundare, S.A., Akpomie, K.G., Ngwu, C.M. & Conradie, J. 2022. Enhanced chromium (VI) removal by *Anacardium occidentale* stem bark extract-coated multiwalled carbon nanotubes. *International Journal of Environmental Science and Technology* 19: 4421-4434. DOI: 10.1007/s13762-021-03364-5.

Azov, V.A., Mueller, L. & Makarov, A.A. 2022. Laser ionization mass spectrometry at 55: Quo Vadis? *Mass Spectrom. Rev.* 41: 100-151. DOI: 10.1002/mas.21669.

Belay, A.N., Venter, J.A., Alexander, O.T. & Roodt, A. 2022. Synthesis, Single crystal X-ray structure, spectroscopy and substitution behavior of niobium(V) complexes activated by chloranilate as bidentate ligand. *Inorganics* 10: 166. DOI: 10.3390/inorganics10100166.

Bouba, M.O., Nya, F.T., Malloum, A., Conradie, J. & Ndjaka, J.M. 2022. DFT investigation of Percyanation effect of coronene molecule: Comparative study with their Perhalogenated counterparts. *Polymer Bulletin* 79: 9663-9684. DOI: 10.1007/s00289-021-03967-5.

Boukar, O., Fifen, J.J., Malloum, A., Nsangou, M., Ghalila, H. & Conradie, J. 2022. Solvation energies of ferrous ion in methanol at various temperatures. *Journal of Molecular Liquids* 360: 119460. DOI: 10.1016/j.molliq.2022.119460.

Brink, A., Jacobs, F.J.F. & Helliwell, J.R. 2022. Trends in coordination of rhenium organometallic complexes in the Protein Data Bank. *IUCrJ.* 9: 180-193. DOI: 10.1107/S2052252522000665.

Chiyindiko, E., Conradie, J. & Langner, E.H.G. 2022. Reduction data obtained from cyclic voltammetry of benzophenones and copper-2-hydroxyphenone complexes. *Data* 7: 183. DOI: 10.3390/data7120183.

Chiyindiko, E., Langner, E.H.G. & Conradie, J. 2022. Cyclic voltammetry data of 2-hydroxybenzophenones and related molecules. *Chemical Data Collections* 40: 100897. DOI: 10.1016/j.cdc.2022.100897.

Chiyindiko, E., Langner, E.H.G. & Conradie, J. 2022. Electrochemical behaviour of 2-hydroxybenzophenones and related molecules. *Results in Chemistry* 4: 100332, Part of special issue: SI: Advances in Electrochemistry. DOI: 10.1016/j.rechem.2022.100332.

Chiyindiko, E., Langner, E.H.G. & Conradie, J. 2022. Electrochemical behaviour of copper(II) complexes containing 2-hydroxyphenones. *Electrochimica Acta* 424: 140629. DOI: 10.1016/j.electacta.2022.140629.

Chiyindiko, E., Langner, E.H.G. & Conradie, J. 2022. Spectroscopic Behaviour of Copper(II) Complexes Containing 2-Hydroxyphenones. *Molecules* 27(18): 6033. DOI: 10.3390/molecules27186033.

Chrzanowska, M., Katafias, A., Van Eldik, R. & Conradie, J. 2022. Electronic effects on the mechanism of the NAD⁺ coenzyme reduction catalyzed by non-organometallic ruthenium(II) polypyridyl amine complex in the presence of formate. *RSC Advances* 12: 21191. DOI: 10.1039/d2ra01890j.

Conradie, J. 2022. DFT Study of bis(1,10-phenanthroline)copper complexes: molecular and electronic structure, redox and spectroscopic properties and application to Solar Cells. *Electrochimica Acta* 418: 140276. DOI: 10.1016/j.electacta.2022.140276.

Conradie, J. 2022. Electronic and structural data of 4'-substituted bis(2,2';6'2''-terpyridine)manganese in mono-, bis-, tris- and tetra-cationic states from DFT calculations. *Data in Brief* 42: 108221. DOI: 10.1016/j.dib.2022.108221.

Conradie, J. 2022. Polypyridyl copper complexes as dye sensitizer and redox mediator for Dye-Sensitized Solar Cells (mini-review on invitation for Special Issue on: 'Electrocatalysis in energy conversion and storage systems'). *Electrochemistry Communications* 134: 107182. DOI: 10.1016/j.elecom.2021.107182.

Conradie, J. 2022. Redox chemistry of bis(terpyridine) manganese(II) complexes – a molecular view. *Journal of Electroanalytical Chemistry* 913: 116272. DOI: 10.1016/j.jelechem.2022.116272.

Conradie, J. 2022. Redox chemistry of tris(β-

diketonate)cobalt(III) complexes – a molecular View. *Journal of The Electrochemical Society* 169: 046522. DOI: 10.1149/1945-7111/ac6705.

Conradie, J., Alemayehu, A.B. & Ghosh, A. 2022. Iridium(VII)-Corrole Terminal Carbides Should Exist as Stable Compounds. *ACS Organic & Inorganic Au* 2: 159. DOI: 10.1021/acsorginorgau.1c00029.

Conradie, J. & Erasmus, E. 2022. XPS photoelectron lines, satellite structures and Wagner plot of Cu(II) β-diketonato complexes explained in terms of its electronic environment. *Journal of Electron Spectroscopy and Related Phenomena* 259: 14724. DOI: 10.1016/j.elspec.2022.147241.

Conradie, J., Vazquez-Lima, H., Alemayehu, A.B. & Ghosh, A. 2022. Comparing Isoelectronic, Quadruple-Bonded Metalloporphyrin and Metalloporphyrin Dimers: Scalar-Relativistic DFT Calculations Predict a > 1-eV Range for Ionization Potential and Electron Affinity. *ACS Phys. Chem Au* 2(2): 70-78. DOI: 10.1021/acspchemau.1c00030.

Conradie, M.M. 2022. UV-Vis Spectroscopy, Electrochemical and DFT Study of Tris(β-diketonato) iron(III) Complexes with Application in DSSC: Role of Aromatic Thienyl Groups. *Molecules* 27(12): 3743. DOI: 10.3390/molecules27123743.

Da-yang, T.E., Fifen, J.J. & Conradie, J. Conradie, M.M. 2022. Structures, Temperature effect, Binding and Clustering Energies of Cu₂+(MeOH)_n=1-8 clusters and extrapolations. *Journal of Molecular Liquids* 360: 119439. DOI: 10.1016/j.molliq.2022.119439.

Dennis, C.R., Van Zyl, G.J., Fourie, E., Basson, S.S. & Swarts, J.C. 2022. The oxidation of the uranium(IV) tetrachloride by the octacyanotungstate(V) and the octacyanomolybdate(V) ions in perchloric acid medium: A kinetic study. *Reaction Kinetics, Mechanisms and Catalysis* 135: 2915-2927. DOI: 10.1007/s11144-022-02297-5.

Elmakki, M.A.E., Alexander, O.T., Venter, G.J.S., Venter, J.A. & Roodt, A., 2022. Structural study of model rhodium(I) carbonylation catalysts activated by indole-2-/indoline-2-carboxylate bidentate ligands and kinetics of iodomethane oxidative addition. *Inorganics* 10: 25. DOI: 10.3390/inorganics10120251.

Elmakki, M.A.E., Alexander, O.T., Venter, J.A. & Roodt, A. 2022. The crystal structure of (carbonato κ²O)(2-oxopyridin-1(2H)-olato-κN) tris(trimethylphosphine)-rhodium(III) water solvate,

C₁₅H₃₃NO₅P₃Rh. *Zeitschrift für Kristallographie - New Crystal Structures* 237(6). DOI:10.1515/ncrs-2022.-0345.

Elmakki, M.A.E., Gafoor, W.A., Alexander, O.T., Venter, J.A. & Roodt, A. 2022. The crystal structure of dicarbonyl(N-nitroso-N-oxido-phenylamine-κ²O,O)rhodium(I), C₈H₅N₂O₄Rh. *Zeitschrift für Kristallographie - New Crystal Structures* 238(1). DOI: 10.1515/ncrs-2022.-0488.

Eze, S.I., Ibeji, C.U., Akpan, E.D., Ezeorah, C.J., Okpareke, O.C., Groutso, T., Atiga, S., Akpomie, K.G. & Ekowo, L.C. 2022. Corrosion performance of Schiff base derived from 2, 5-dimethoxybenzaldehyde: X-ray structure, experimental and DFT studies. *Chemical Papers* 76: 5187-5200. DOI: 10.1007/s11696-022-02244-7.

Fatoba, A.J., Adeleke, V.T., Maharaj, L., Okpeku, M., Adeniyi, A.A. & Adeleke, M.A. 2022. Design of a Multiepitope Vaccine against Chicken Anemia Virus Disease. *Viruses* 14: 7. DOI: 10.3390/v14071456.

Ferreira, H., Conradie, M.M. & Conradie, J. 2022. Kinetic study of the oxidative addition reaction between methyl iodide and [Rh(imino-β-diketonato)(CO)(PPh)₃] complexes, utilizing UV/vis and IR Spectrophotometry, NMR spectroscopy and DFT calculations. *Molecules* 27: 1931. DOI: 10.3390/molecules27061931.

Ferreira, H., Conradie, M.M. & Conradie, J. 2022. Redox behaviour of imino-β-diketonato ligands and their rhodium (I) complexes. *Results in Chemistry* 4: 100517. DOI: 10.1016/j.rechem.

Foadin, C.S.T., Nya, F.T., Malloum, A. & Conradie, J. 2022. Data of electronic, reactivity, optoelectronic, linear and non-linear optical parameters of doping graphene oxide nanosheet with aluminium atom. *Data in brief* 41: 107840. DOI: 10.1016/j.dib.2022.107840.

Foadin, C.S.T., Nya, F.T., Malloum, A. & Conradie, J. 2022. Enhancement of absorption capacity, optical and non-linear optical properties of graphene oxide nanosheet. *Journal of Molecular Graphics and Modelling* 111: 108075. DOI: 10.1016/j.jmgm.2021.108075.

Ghosh, A. & Conradie, J. 2022. Porphyrine. *ACS Omega* 7(44): 40275. DOI: 10.1021/acsomega.2c05199.

Ghosh, A. & Conradie, J. 2022. Twist-Bent Bonds Revisited: Adiabatic Ionization Potentials Demystify

Enhanced Reactivity. *ACS Omega* 7(42): 37917-37921. DOI: 10.1021/acsomega.2c05074.

Gomez-Arias, A., Yesares, L., Diaz, J., Carballo, M. A., Maleke, M., Saez, R., Van Heerden, E., Vermeulen, D., Nieto, J. & Hernandez, C.J. 2022. Mine waste from carbonatite deposits as potential rare earth resource: Insight into the Phalaborwa (Palabora) Complex. *Journal of Geochemical Exploration* 232(106884): 1-13. DOI: 10.1016/j.gexplo.2021.106884.

Hlahla, J.M., Mafa, M., Van der Merwe, R., Alexander, O.T., Duvenhage, M., Kemp, G. & Moloi, M. 2022. The Photosynthetic Efficiency and Carbohydrates Responses of Six Edamame (Glycine max. L. Merrill) Cultivars under Drought Stress. *Plants* 11(3)/ DOI: 10.3390/plants11030394.

Ighalo, J.O., Amaku, J.F., Olisah, C., Adeola, A.O., Iwuozor, K.O., Akpomie, K.G., Conradie, J., Adegoke, K.A. & Oyedotun, K.O. 2022. Utilisation of Adsorption as a Resource Recovery Technique for Lithium in Geothermal Water. *Journal of Molecular Liquids* 365: 120107. DOI: 10.1016/j.molliq.2022.120107.

Ishwarlall, T.Z., Okpeku, M., Adeniyi, A.A. & Adeleke, M.A. 2022. The Search for a Buruli Ulcer Vaccine and the Effectiveness of the Bacillus Calmette-Guérin Vaccine. *Acta Trop.* 228: 106323. DOI: 10.1016/j.actatropica.2022.106323.

Iwuozor, K.O., Akpomie, K.G., Conradie, J., Adegoke, K.A., Oyedotun, K.O., Ighalo, J.O. Amaku, J.F., Olisah, C. & Adeola, A.O. 2022. Aqueous phase adsorption of aromatic organoarsenic compounds: A review. *Journal of Water Process Engineering* 49: 103059. DOI: 10.1016/j.jwpe.2022.103059.

Jacobs, C. & Erasmus, E. 2022. Morphology and Oxidation State Dependent Glucose Sensing Properties of Cu-Oxide Nanocrystals. *Anal. Bioanal. Electrochem.* 14(11): 998-1010.

Kapp, L.E., Schutte-Smith, M., Twigge, L. & Visser, H.G. 2022. Synthesis, characterization and DNA binding of four imidazo[4,5-f]1,10-phenanthroline derivatives. *Journal of Molecular Structure* 1247: 131235. DOI: 10.1016/j.molstruc.2021.131235.

Khambule, S.P., Motloung, S.V., Motaung, T.E., Koao, L.F., Kroon, R.E. & Malimabe, M.A. 2022. Tuneable blue to orange phosphor from Sm³⁺ doped ZnAl₂O₄ nanomaterials. *Results in Optics* 9: 100280. DOI: 10.1016/j.rio.2022.100280.

Ma, X., Rohdenburg, M., Knorke, H., Kawa, S., Liu,

J.K.-Y., Aprà, E., Asmis, K.R., Azov, V.A., Laskin, J., Jenne, C., Kenttämä, H.I. & Warneke, J. 2022. Binding of saturated and unsaturated C₆-hydrocarbons to the electrophilic anion [B₁₂Br₁₁]⁻: a systematic mechanistic study. *Phys. Chem. Chem. Phys.* 24: 21759-21772. DOI: 10.1039/d2cp01042a.

Mabuea, B.P., Swart, H.C. & Erasmus, E. 2022. Photocatalytic decomposition of an Azo dye using transition-metal-doped tungsten and molybdenum carbides. *ACS Omega* 7: 23401-23411. DOI: 10.1021/acsomega.2c01727.

Mafa, M.S., Rufetu, E., Alexander, O.T., Kemp, G. & Mohase, L. 2022. Cell-Wall Structural Carbohydrates Reinforcements Are Part Of The Defence Mechanisms Of Wheat Against Russian Wheat Aphid (Diuraphisnoxia) Infestation. *Plant Physiology and Biochemistry* 179: 168-178. DOI: 10.1016/j.plaphy.2022.03.018.

Malimabe, M.A., Motloung, S.V., Motaung, T.E., Swart, H.C., Dejene, F.B. & Koao, L.F. 2022. Influence of ZnO: Ce³⁺/Eu³⁺ doped and co-doped nanopowders on the properties of poly(ε-caprolactone) nanocomposites. *Journal of Luminescence* 251: 119134. DOI: 10.1016/j.jlumin.2022.119134.

Malloum, A. & Conradie, J. 2022. Data to Understand the Nature of Non-Covalent Interactions in the Thiophene Clusters. *Data in Brief* 40: 107818. DOI: 10.1016/j.dib.2022.107818.

Malloum, A. & Conradie, J. 2022. Dimethylformamide clusters: noncovalent bondings, structures and temperature-dependence. *Molecular Physics* 120(18): e2118188. DOI: 10.1080/00268976.2022.

Malloum, A. & Conradie, J. 2022. Dimethylsulfoxide (DMSO) Clusters Dataset: DFT Relative Energies, Non-Covalent Interactions, and Cartesian Coordinates. *Data in brief* 42: 108024. DOI: 10.1016/j.dib.2022.108024.

Malloum, A. & Conradie, J. 2022. Molecular Simulations of the Adsorption of Aniline From Waste-Water. *Journal of Molecular Graphics and Modelling* 117: 108287. DOI: 10.1016/j.jmgm.2022.108287.

Malloum, A. & Conradie, J. 2022. Non-Covalent Interactions in Small Thiophene Clusters. *Journal of Molecular Liquids* 347: 11830. DOI: 10.1016/j.molliq.2021.118301.

Malloum, A. & Conradie, J. 2022. Non-Covalent Interactions in Dimethylsulfoxide (DMSO) Clusters

and DFT Benchmarking. *Journal of Molecular Liquids* 350: 118522. DOI: 10.1016/j.molliq.2022.118522.

Malloum, A. & Conradie, J. 2022. Potential Energy Surface of the Thiophene Pentamer and Non-Covalent Interactions. *International Journal of Quantum Chemistry* 122: e26840. DOI: 10.1002/qua.26840.

Malloum, A. & Conradie, J. 2022. Structures, Binding Energies and Non-Covalent Interactions of Furan Clusters. *Journal of Molecular Graphics and Modelling* 111: 108102. DOI: 10.1016/j.jmgm.2021.108102.

Malloum, A. & Conradie, J. 2022. Structures, QAIM Analysis Dataset for Non-Covalent Interactions in Furan Clusters. *Data in Brief* 40: 107766. DOI: 10.1016/j.dib.2021.107766.

Manicum, A.E., Schutte-Smith, M., Malan, F.P. & Visser, H.G. 2022. Steric and electronic influence of Re(I) tricarbonyl complexes with various coordinated β-diketones. *Journal of Molecular Structure* 1264: 133278. DOI: 10.1016/j.molstruc.2022.133278.

Mateyise, N.G.S., Conradie, M.M. & Conradie, J. 2022. DFT studies of the redox behavior of oligo(aza)pyridines and experimental CVs of 4'-substituted terpyridines. *Results in Chemistry* 4: 100667. DOI: 10.1016/j.rechem.2022.100667.

Matowane, G.R., Ramorobi, L.M., Mashele, S.S., Bonnet, S.L., Noreljaleel, A.E.M., Swain, S.S., Makhafola, T.J. & Chukwuma, C.I. 2022. Complexation potentiated promising anti-diabetic and anti-oxidative synergism between ZN(II) and ferulic acid: A multimode study. *Diabetes Med.* 39(9): e14905. DOI: 10.1111/dme.14905.

Matowane, G.R., Ramorobi, L.M., Mashele, S.S., Bonnet, S.L., Noreljaleel, A.E.M., Swain, S.S., Makhafola, T.J. & Chukwuma, C.I. 2022. Novel Caffeic Acid - Zinc Acetate Complex: Studies on Promising Antidiabetic and Antioxidant Synergism Through Complexation. *Med Chem.* 19(2): 147-162. DOI: 10.2174/1573406418666220620144601.

Messi, A.N., Bonnet, S.L., Owona, B.A., Wilhelm, A., Kamto, D.E., Ndongo, J.T., Siwe-Noundou, X., Poka, M., Demana, P.H., Krause, R. W. M., Mbing, J.N., Pegnyemb, D.E. & Bochet, C.G. 2022. In Vitro and In Silico Potential Inhibitory Effects of New Biflavonoids from *Ochna rhizomatosa* on HIV-1 Integrase and Plasmodium falciparum. *Pharmaceutics* 14(1701): 1-17. DOI: 10.3390/pharmaceutics14081701.

Mogale, R., Akpomie, K.G., Conradie, J. & Langner, E.H.G. 2022. Dye adsorption of aluminium- and zirconium-based Metal Organic Frameworks with azobenzene dicarboxylate linkers. *Journal of Environmental Management* 304: 114166. DOI: 10.1016/j.jenvman.2021.114166.

Mogale, R., Akpomie, K.G., Conradie, J. & Langner, E.H.G. 2022. Isoreticular aluminium-based metal-organic frameworks with structurally similar organic linkers as highly efficient dye adsorbents. *Journal of Molecular Structure* 1268:133648. DOI: 10.1016/j.molstruc.2022.133648.

Mogale, R., Conradie, J. & Langner, E.H.G. 2022. Trans-cis Kinetic Study of Azobenzene-4,4'-dicarboxylic Acid and Aluminium and Zirconium Based Azobenzene-4,4'-dicarboxylate MOFs. *Molecules* 27: 1370. DOI: 10.3390/molecules27041370.

Moherane, L., Alexander, O.T., Schutte-Smith, M., Kroon, R.E., Mokolokolo, P.P., Biswas, S., Prince, S., Visser, H.G. & Manicum, A.E. 2022. Polypyridyl coordinated rhenium (I) tricarbonyl complexes as model devices for cancer diagnosis and treatment. *Polyhedron* 228: 116178. DOI: 10.1016/j.poly.2022.116178.

Moji, R.G., Motloung, S.V., Motaung, T.E. & Koao, L.F. 2022. Characterization of the incorporated SiO₂ co-doped with Sr²⁺ and Tb³⁺ phosphors into PLA polymer matrix. *Journal of Molecular Structure* 1263: 133176. DOI: 10.1016/j.molstruc.2022.133176.

Mosoabisane, M.F.T., Luyt, A.S. & Van Sittert C.G.C.E. 2022. Comparative experimental and modelling study of the thermal and thermos-mechanical properties of LLDPE/wax blends. *Journal of Polymer Research* 29: 296. DOI: 10.1007/s10965-022-03136-w.

Mphuthi, L.E., Maseme, M.R. & Langner, E.H.G. 2022. Ti(IV)-Exchanged Nano-ZIF-8 and Nano-ZIF-67 for Enhanced Photocatalytic Oxidation of Hydroquinone. *Journal of Inorganic and Organometallic Polymers and Materials* 32(7): 2664-2678. DOI: 10.1007/s10904-022-02327-8.

Mtshali, Z., Von Eschwege, K.G. & Conradie, J. 2022. Redox Data of Tris(polypyridine)manganese(II) Complexes. *Data* 7(9): 130. DOI: 10.3390/data7090130.

Ojo, F.K., Adejoro, I.A., Lori, J.A., Oyenehin, O. & Akpomie K.G. 2022. Indole derivatives as organic corrosion inhibitors of low carbon steel in HCl

medium: Experimental and theoretical approach. *Chemistry Africa* 5: 943-956. DOI: 10.1007/s42250-022-00378-5.

Olisah, C., Adeola, A.O., Iwuozor, K.O., Akpomie, K.G., Conradie, J. Adegoke, K.A., Oyedotun, K.O., Ighalo, J.O. & Amaku, J.F. 2022. Research progress on the evaluation of Dirty Dozen Chemicals (DDCs) in the African environment. *Chemosphere* 308: 136371. DOI: 10.1016/j.chemosphere.2022.136371.

Omitola, O.B., Abonyi, M.N., Akpomie, K.G. & Dawodu K.G. 2022. Adams-Bohart, Yoon-Nelson, and Thomas modeling of the fix-bed continuous column adsorption of amoxicillin onto silver nanoparticle-maize leaf composite. *Applied Water Science* 12: 94. DOI: 10.1007/s13201-022-01624-4.

Otunola, B.O, Aghoghowia, M.P, Thwala, M., Gómez-Arias, A., Jordaan, R., Hernandez, C. & Ololade, O.O. 2022. Influence of Clay Mineral Amendments Characteristics on Heavy Metals Uptake in Vetiver Grass (*Chrysopogon zizanioides* L.Roberty) and Indian Mustard (*Brassica juncea* L. Czern). *Sustainability* 14(10): 5856. DOI: 10.3390/su14105856.

Pieterse, T., Marais, C. & Bezuidenhout, B.C.B. 2022. Ring-closing metathesis in flavonoid synthesis, part 1: flavenes. *Arkivoc*, part v: 98-113. DOI: 10.24820/ark.5550190.p011.733.

Pieterse, T., Marais, C. & Bezuidenhout, B.C.B. 2022. Ring-closing metathesis in flavonoid synthesis, part 2: neoflav-3-enes. *Arkivoc*, part v: 217-231. DOI: 10.24820/ark.5550190.p011.759.

Rajak, D.K., Jordaan, R., Gomez-Arias, A. & Purcell, W. 2022. Extractive metallurgy of columbite-tantalite ore: A detailed review. *Minerals Engineering* 190: 107917. DOI: 10.1016/j.mineng.2022.107917.

Ramorobi, L.M., Matowane, G.R., Mashele, S.S., Bonnet, S.L., Noreljaleel, A.E.M., Swain, S.S., Makhafola, T.J. & Chukwuma, C.I. 2022. Bioactive synergism between zinc mineral and p-coumaric acid: A multi-mode glycemic control and antioxidative study. *Journal of Food Biochemistry* 46(10): e14360. doi.org/10.1111/jfbc.14360.

Sahu, K., Angeloni, S., Conradie, J., Villa, M., Nayak, M., Ghosh, A., Ceroni, P. & Sanjib Kar, S. 2022. NIR-Emissive, Singlet-Oxygen-Sensitizing Gold Tetra(thiocyano)corroles. *Dalton Trans.* 51: 13236-13245. DOI: 10.1039/D2DT01959K.

Schutte-Smith, M. & Visser, H.G. 2022. Crystal and molecular structures of fac-[Re(Bid)(PPh₃)(CO)₃] [Bid is tropolone (TropH) and tribromotropolone (TropBr₃H)]. *Acta Cryst. C*78: 351-359. DOI: 10.1107/S205322962200465X.

Sinha, M.K., Jordaan, R. & Purcell, W. 2022. Hydrometallurgical Recovery of Manganese from Ferruginous Manganese Ore by Reductive Acid Leaching with Sodium Dithionite. *Journal of Sustainable Metallurgy* 8: 783-794. DOI: 10.1007/s40831-022-00529-5.

Swart, G., Fourie, E. & Swarts, J.C. 2022. Ferrocene-Bearing Dodecylphthalocyanines: Synthesis, Spectroscopic and Electrochemical Behavior. *Inorganic Chemistry* 61 (34): 13306-13321. DOI: 10.1021/acs.inorgchem.2c01101.

Swart, G., Fourie, E. & Swarts, J.C. 2022. Octakis(dodecyl)phthalocyanines: Influence of Peripheral versus Non-Peripheral Substitution on Synthetic Routes, Spectroscopy and Electrochemical Behaviour. *Molecules* 27(5): 1529. DOI: 10.3390/molecules27051529.

Van Dyk, H., Jacobs, F.J.F., Kroon, R.E., Makhafola, T.J. & Brink, A. 2022. Characterisation, structural investigations and biological activity of substituted salicylidene-based compounds. *J. Mol. Structure* 1276: 134737-134750. DOI: 10.1016/j.molstruc.2022.134737.

Van der Westhuizen, D., Howlett-Downing, C., Molnár, P., Boman, J., Wichmann, J. & Von Eschwege, K.G. 2022. Atmospheric fine particulate matter (PM_{2.5}) in Bloemfontein, South Africa. *Int Journal of Environmental Analytical Chemistry* (Online): 1-16. DOI: 10.1080/03067319.2022.2154664.

Visser, M., Pieterse, T., Twigge, L., Marais, C. & Bezuidenhout, B.C.B. 2022. Universele metodiek vir die sintese Van flavonoïede en benzo[b]furane. *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 41(1): 141. DOI: 10.36303/SATNT.2022.41.1.961.

Von Eschwege, K.G. & Conradie, J. 2022. Review of DFT-simulated and experimental electrochemistry properties of the polypyridyl Row-1 Mn, Fe & Co, and Group-8 Fe, Ru and Os MLCT complexes. *Electrochemistry Communications* 136(107225): 1-7. DOI: 10.1016/j.elecom.2022.107225.

Wilhelm, A., Bonnet, S.L., Twigge, L., Rarova, L., Stenclova, T., Visser, H.G. & Schutte-Smith, M.

2022. Synthesis, characterization and cytotoxic evaluation of chalcone derivatives. *Journal of Molecular Structure* 1251: 132001. DOI: 10.1016/j.molstruc.2021.132001.

Zhu, J., Li, S., Zhuang, Z., Gao, S., Hong, X., Pan, X., Yu, R., Zhou, L., Moskaleva, L.V., Mai, L. 2022. Ultrathin Metal Silicate Hydroxide Nanosheets with Moderate Metal-Oxygen Covalency Enables Efficient Oxygen Evolution. *Energy & Environmental Materials* 5(1): 231-237. DOI: 10.1002/eem2.12155.

Conference Contributions

Conference Papers/Posters

Abraha Y.W., Tsai, C-W. & Langner, E.H.G. 2022. Scaleable synthesis of mixed-linker (Zn) ZIFs and their application in CO₂ adsorption and fixation. Poster presented at the 32nd Annual Conference of the Catalysis Society of South Africa (CATSA), Champagne Sports Resort, Central Drakensberg, South Africa. 13-16 November 2022.

Abraha Y.W., Tsai, C-W. & Langner, E.H.G. 2022. Scaleable synthesis of mixed-linker (Zn) ZIFs and their application in CO₂ adsorption and fixation. Poster presented at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Akpomie, K.G., Ofomatah, A.C., Chukwumeka-Okorie, H.O., Ani, J.U., Agbo, S.C., Odewole, O.A., Ojo, F.K., Alum, O.L. & Conradie, J. 2022. Equilibrium isotherm investigation on the sequestration of ciprofloxacin from solution via adsorption onto yam peel powder. Paper delivered at the 5th International Conference and Training Workshop on Energy for Sustainable Development in Africa (ICTWSEDA), National Centre for Energy Research and Development, University of Nigeria Nsukka, Nigeria. 17-19 May 2022.

Azov, V.A., Hennecke, U., Martin, C., Ballet, S., De Beer, F.J. & Mashweu, A.R. 2022. Stabilizing peptide nano-structures using non-canonical amino acids with donors and acceptors. Invited lecture delivered at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Bosman, L., Kama, D.V & Brink, A. 2022. Rhodium(I) complexes as model catalysts for methanol

carbonylation. Poster presented at SACI National Young Chemists' Symposium (Virtual) Johannesburg, South Africa. 3-4 October 2022.

Bosman, L., Kama, D.V. & Brink, A. 2022. *Schiff base Rhodium(I) complexes as model catalysts for homogeneous catalysis*. Poster presented at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Brink, A. 2022. *A Complex Journey for a Multi-nuclear Theranostic Agent*. Invited Lecture delivered at the Joint live/virtual seminar lecture, Cambridge Crystallographic Data Centre (CCDC), Cambridge University, United Kingdom. 23 June 2022.

Brink, A. 2022. *Exploring Rabbit-holes for the Wonderland of Radiopharmaceuticals*. Paper delivered at the Conference of the Department of Higher Education and Training: National Collaboration Project: Future Professors Programme Phase One. Stellenbosch University, South Africa. 3-6 November 2022.

Carroll, L. & Moskaleva, L. 2022. *Computational modelling of catalysis on nanoporous gold: Self-organisation and reactivity of surface oxygen using AIMD simulations*. Paper delivered at Psi-k 2022, Lausanne, Switzerland. 22-25 August 2022.

Carroll, L. & Moskaleva, L. 2022. *Nanoporous gold catalysis modelling: Self-organisation and reactivity of surface oxygen using AIMD simulations*. Paper delivered at the NanoAfrica Conference 2022., Cape Town, South Africa. 26-28 October 2022.

Carroll, L. & Moskaleva, L. 2022. *Self-organization of oxygen atoms and restructuring of Au(221), with and without Carbon Monoxide*. Paper delivered at CAMOM 2022. Conference (Hybrid Conference). 19-21 September 2022.

Carroll, L. & Moskaleva, L. 2022. *Studying the self-organization of oxygen atoms on stepped model nanoporous gold surfaces with and without additional adsorbates*. Paper delivered at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Cele, S.A., Matthews, C. & Moskaleva, L.V. 2022. *Computational modelling of the prototypical photocatalyst: a zeolite encapsulated TiO₂-supported Cu₅ cluster*. Poster presented at the 32nd Annual Conference of the Catalysis Society of South

Africa (CATSA), Champagne Sports Resort, Central Drakensberg, South Africa. 13-16 November 2022.

Cele, S.A., Matthews, C. & Moskaleva, L.V. 2022. *Computational modelling of the prototypical photocatalyst: a zeolite encapsulated TiO₂-supported Cu₅ cluster*. Poster presented at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Cele, S.A., Matthews, C. & Moskaleva, L.V. 2022. *Computational modelling of the prototypical photocatalyst: a zeolite encapsulated TiO₂-supported Cu₅ cluster*. Microtalk delivered the Centre for High Performance Computing National Conference (CHPC 2022), Pretoria, South Africa. 30 November-2 December 2022.

Conradie, J. 2022. *Redox Chemistry of Benzophenones*. Invited keynote address delivered at the International Society of Electrochemistry (ISE). Regional Meeting, Prague, Czech Republic. 15-19 August 2022.

Conradie, J., Mateyise, N.G.S. & Conradie, M.M. 2022. *Redox Chemistry of Polypyridines*. Poster presented at the International Society of Electrochemistry (ISE). Regional Meeting, Prague, Czech Republic. 15-19 August 2022.

Conradie, J., Mateyise, N.G.S. & Conradie, M.M. 2022. *CV and DFT of terpyridine ligands*. Poster presented at the 3rd Commonwealth Chemistry Posters, Royal Society of Chemistry (Online). 28-29 September 2022.

Conradie, J. & VonEschwege, K.G. 2022. *DFT-simulated and experimental electrochemistry properties of the polypyridyl Row-1 Mn, Fe & Co, and Group-8 Fe, Ru and Os MLCT complexes*. Paper delivered at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Conradie, M.M. 2022. *Photophysical Properties of Tris(beta-diketonato)iron(III) Complexes - Influence of Aromatic Thienyl Groups*. Paper delivered at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

De Beer, F.J & Azov, V.A. 2022. *Synthesis of amino acids with donor and acceptor substituents by means of Pd-catalyzed coupling reactions*. Poster presented at the International Organic

Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

De Beer, F.J. & Azov, V.A. 2022. *Synthesis of Amino Acids with Donor and Acceptor Substituents utilising Pd-catalyzed coupling reactions*. Paper delivered at the 32nd Annual Conference of the Catalysis Society of South Africa (CATSA), Champagne Sports Resort, Central Drakensberg, South Africa. 13-16 November 2022.

De Beer, F.J., Bertouille, J., Mashweu, A.R., Martin, C., Ballet, S., Hennecke, U. & Azov, V.A. 2022. *Incorporation of acceptor amino acids into an amphiphilic peptide sequence*. Paper delivered at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Du Plessis, U., Visser, H.G. & Schutte-Smith, M. 2022. *Fotoluminesensie en die voorlopige toetsing Van anti-mikrobiale aktiwiteit Van Rhenium(I) trikarboniel komplekse en bimetaal verbindings*. Paper delivered at the Studentesimposium in die Natuurwetenskappe, Pretoria, South Africa & Virtual. 3-4 November 2022.

Jacobs, F.J.F. & Brink, A. 2022. *Klein organometaalverbindinge na proteïene - die geheim Van molekules in fundamentele kristalruimtes*. Paper delivered at the Studentesimposium in die Natuurwetenskappe, Pretoria, South Africa. 3-4 November 2022.

Jacobs, F.J.F. & Brink, A. 2022. *Rhenium organometallic complexes in proteins for targeted cancer treatment*. Paper delivered at The Legacy of START: Synchrotron Techniques for African Research and Technology, Cape Town, South Africa. 6-8 October 2022.

Jacobs, F.J.F. & Brink, A. 2022. *Small organic to protein - molecular trends applicable to radiopharmaceutical development*. Paper delivered at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Jacobs, F.J.F, De Beer, F.J., Kama, D.V. & Azov, V.A. 2022. *Chlorinated and iodinated alanine derivatives in the crystal phase: polar interactions vs. halogen bonds*. Poster presented at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Kama, D.V., Brink, A., Alberto, R. & Roodt, A. 2022.

The hidden versatility of diphosphinoamine chelating ligands. Paper delivered at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Kenfack, G.M.D., Nya, F.T., Bouba, M.A., Malloum, A. & Conradie, J. 2022. *Optoelectrical, electronic and thermodynamic DFT study of a carbon nanoring and its derivative - HPC application as a computational chemistry resource*. PhD Student Microtalk delivered the Centre for High Performance Computing National Conference (CHPC 2022), Pretoria, South Africa. 30 November-2 December 2022.

Khokho, E.C.Y., Nya, F.T., Malloum, A. & Conradie, J. 2022. *DFT calculation of the electronic, linear and non-linear optical properties of the 2,5,8,11,14,17-hexa-tert-butyl-hexa-peri-hexabenzocoronene molecule and its derivatives molecules functionalized with one and two potassium atoms: influence of doping*. PhD Student Microtalk at delivered the Centre for High Performance Computing National Conference (CHPC 2022), Pretoria, South Africa. 30 November-2 December 2022.

Liebenberg, L., Visser, H.G. & Schutte-Smith, M. 2022. *Alkylamino auroenes and its rhenium(I) tricarbonyl complexes as potential anticancer agents*. Poster presented at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Liebenberg, L., Visser, H.G. & Schutte-Smith, M. 2022. *Die sintese en evaluasie Van 'n reeks amino-ouroonderivate en hul rhenium(I) trikarbonielkomplekse as moontlike antikankermiddel*. Paper delivered at the Studentesimposium in die Natuurwetenskappe, Pretoria & Virtual. 3-4 November 2022.

Liebenberg, L., Visser, H.G. & Schutte-Smith, M. 2022. *The synthesis and evaluation of a series of aminoaurone derivatives and its rhenium(I) tricarbonyl complexes as possible pharmaceutical agents*. Poster presented at at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Makhathini, B., Bezuidenhoudt, B.C.B. & Marais, C. 2022. *Strategies towards the synthesis of a stilbene-related substituted -butenolide natural product*. Poster presented at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Malloum, A. & Conradie, J. 2022. *Simulations of Aniline Adsorption: Solvent and Temperature effects*. Paper delivered at the 1st International Congress on Advanced Computational Modelling of Materials (CAMOM), University of Pretoria, South Africa (and online). 18–22 September 2022.

Mashweu, A.R. & Azov, V.A. 2022. *Synthesis of unnatural amino acids with acceptor and donor moieties starting from asparagine and glutamine*. Paper delivered at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Mashweu, A.R., De Beer, F.J., Bertouille, J., Martin, C., Ballet, S., Hennecke, U. & Azov, V.A. 2022. *P-STAC: Stabilizing Peptide NanoStructures with Tetrathiafulvalene-based Donors and Acceptors*. Poster presented at the 24th Merck Organic Chemistry Symposium (MOCS), Blankenberge, Belgium. 1–2 December 2022.

Matthews, C. 2022. *Energy and charge density analysis of non-covalent interactions within conformers of bis(2-pyridylmethyl)amine, using ab initio coupled-cluster and MP2 theory: a molecular tailoring approach*. Microtalk delivered at the Centre for High Performance Computing National Conference (CHPC 2022), Pretoria, South Africa. 30 November–2 December 2022.

Matthews, C., Van Staden, C., Kroon, R.E., Moskaleva, L.V., Otukile, K.P., Kama, D.V., Schutte-Smith, M. & Visser, H.G. 2022. *A Python script for evaluating 3D 'Tolman cone angle'-based steric descriptors of N-substituents and their modulation of the Au.. Au distance of dinuclear gold complexes with PNP-ligands*. Paper delivered at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Moskaleva, L.V. 2022. *Ab initio molecular dynamics study of the role of oxide-metal interface in catalytic reactions*. Invited lecture delivered at the COSYES Summer Meeting, Madrid, Spain. 2–3 June 2022.

Moskaleva, L.V. 2022. *Computational Studies of Oxidation Catalysis on nanoporous Gold*. Invited lecture delivered at the Symposium of the Research Unit NAGOCAT, Soderstorf, Germany. 30 May–1 June 2022.

Moskaleva, L.V., Carroll, L.L., Olaniyan, O. & Li, S. 2022. *Formation and catalytic activity of 1D chains of*

gold oxide from density functional theory. Keynote lecture delivered at the 32nd Annual Conference of the Catalysis Society of South Africa (CATSA), Champagne Sports Resort, Central Drakensberg, South Africa. 13–16 November 2022.

Mtshali, Z., Conradie, J. 2022. *Computational calculations of tris(bipyridine)nickel molecules, using Density Functional Theory*. MSc Student Microtalk delivered at the Centre for High Performance Computing National Conference (CHPC 2022), Pretoria, South Africa. 30 November–2 December 2022.

Mtshali, Z., Von Eschwege, K.G. & Conradie, J. 2022. *Redox behavior of first row group 7, 8 and 9 transition metal complexes containing substituted bipyridines and phenanthrolines*. Poster presented at the 3rd Commonwealth Chemistry Posters, Royal Society of Chemistry (Online). 28–29 September 2022.

Mzinjani, V., Azov, V.A. & Langner, E.H.G. 2022. *Amphiphile-coated magnetic iron oxide nanoparticles for the extraction of contaminants from the aqueous media*. Poster presented at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Nzhadzhaba, N.N., Schutte-Smith, M. & Visser, H.G. 2022. *Synthesis, characterisation, luminescence and cytotoxicity of Rhenium and it's N,N'-bidentate ligands*. Paper delivered at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Nzhadzhaba, N.N., Schutte-Smith, M. & Visser, H.G. 2022. *Synthesis, characterising, luminescence and cytotoxicity of Rhenium(I) tricarbonyl complexes bearing N,N'- bidentate ligands*. Paper delivered at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Olaniyan, O., Carrol, L., Li, S., Loginova, A. & Moskaleva, L.V. 2022. *Static and dynamic DFT study of CO oxidation by O chains on gold and determination of electrocapillary Coupling Coefficient for Au(111) with adsorbed O atoms*. Poster presented at the Symposium of the Research Unit NAGOCAT, Soderstorf, Germany. 30 May–June 2022.

Olaniyan, O. & Moskaleva, L.V. 2022. *Electrocapillary coupling coefficient of Au(221) with adsorbed oxygen atoms: a first-principles study*. Paper delivered at the

International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Oosthuizen, U., Schutte-Smith, M. & Visser, H.G. 2022. *Photoluminescence of Rhenium(I)tricarbonyl complexes and its preliminary anti-microbial activity*. Poster presented at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Oosthuizen, U., Visser, H.G. & Schutte-Smith, M. 2022. *Study of Rhenium and Gold complexes as anticancer and anti-microbial agents*. Paper delivered at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Otukile, K., Kandpal, S., Matthews, C., Chakraborty, S., Moskaleva, L. & Ramakrishnan, R. 2022. *Accurate Thermochemistry of Selected Hydrocarbon Combustion Reactions by DFT and Composite Quantum Chemistry Methods*. Paper delivered at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Otukile, K., Kandpal, S., Matthews, C., Chakraborty, S., Moskaleva, L. & Ramakrishnan, R. 2022. *DFT vs. Composite Methods: Search for an Accurate and Inexpensive Approach to Generate a Database of Energies and Rate Constants of Combustion Reactions*. Poster presented at Psi-k 2022, Lausanne, Switzerland. 22–25 August 2022.

Otukile, K., Kandpal, S., Matthews, C., Chakraborty, S., Moskaleva, L. & Ramakrishnan, R. 2022. *Performance of DFT and Composite Methods on the Hydrocarbon and Molecular Oxygen Reactions Thermodynamics and Kinetics*. Poster presented at the 32nd Annual Conference of the Catalysis Society of South Africa (CATSA), Champagne Sports Resort, Central Drakensberg, South Africa. 13–16 November 2022.

Purkait, K., Kapp, L.E., Schutte-Smith, M., Visser, H.G. & Gasser, G. 2022. *Exploring the structure-activity relationship of Rhenium(I)-tricarbonyl complexes of 1H-imidazo[4,5-f][1,10]phenanthroline derivatized ligands*. Poster presented at the 16th European Biological Inorganic Chemistry Conference (EuroBIC), Grenoble, France. 17–21 July 2022.

Roodt, A., Venter, J.A. & Redgard, S. 2022. *NMR, Kinetic-mechanistic and SC-XRD study of carbon dioxide capturing model molecular materials*. Poster

presented at the 33rd European Crystallographic Meeting (ECM33), Versailles, France. 23–27 August 2022.

Teimouri, S., Potgieter, J.H., Billing, C. & Conradie, J. 2022. *Indium and Gallium Extraction Using Ionic liquids: Theoretical Investigation with DFT*. PhD Student Microtalk at delivered at the Centre for High Performance Computing National Conference (CHPC 2022), Pretoria, South Africa. 30 November–2 December 2022.

Tshehla, P.K. & Azov, V.A. 2022. *Synthesis of redox-responsive tetrathiafulvalene derivatives with amphiphilic properties to be used in soft materials*. Poster presented at NanoAfrica2022, Cape Town, South Africa. 26–28 October 2022.

Van Dyk, H., Brink, A., Mokolokolo, P.P., Jacobs, F.J.F., Kroon, R.E. & Makhafola, T.J. 2022. *Nitro Salicylidene Compounds: Cytotoxicity, luminescence, and structural manipulation of model N,O bifunctional chelators*. Poster presented at SACI National Young Chemists' Symposium (Virtual) Johannesburg, South Africa. 3–4 October 2022. **Awarded First Place in the MSc Poster Presentation category.**

Van Dyk, H., Brink, A., Mokolokolo, P.P., Jacobs, F.J.F., Kroon, R.E. & Makhafola, T.J. 2022. *Synthesis, Characterization & Biological Activity of Functionalized Salicylidene Compounds*. Poster presented at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

Van Staden, C., Schutte-Smith, M., Kama, D.V. & Visser, H.G. 2022. *Argentophilic vs. Auophilic Interactions in Identical Dimeric Diphosphine Complexes*. Poster presented at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Van Staden, C., Schutte-Smith, M., Moskaleva, L., Kama, D.V. & Visser, H.G. 2022. *Development of the T-angle as a solid state cone angle for the quantification of the steric bulk in bis(diphenylphosphino)amine gold(I) complexes*. Paper delivered at the SACI Central section Young Chemists Symposium (Virtual). 19 August 2022.

Van Staden, C., Schutte-Smith, M., Moskaleva, L., Kama, D.V. & Visser, H.G. 2022. *Die ontwikkeling Van die T-hoek as 'n metode vir die kwantifisering Van die steriese massa in bis(difenielfosfen) amien goud(I) komplekse*. Paper delivered at the

Studentesimposium in die Natuurwetenskappe, Pretoria, South Africa & Virtual. 3-4 November 2022.

Von Eschwege, K.G. & Conradie, J. 2022. *DFT and Electrochemistry*. Paper delivered at the International FreeStatePhyChem-2022 Symposium, University of the Free State, Bloemfontein, South Africa. 18 November 2022.

Wilhelm, A., Ehlers, K. & Bonnet, S.L. 2022. *GABAergic and larval zebrafish locomotor activity of *Bolusanthus speciosus* and *Asparagus laricinus**. Paper delivered at the International Organic Chemistry Symposium, University of the Free State, Bloemfontein, South Africa. 20 June 2022.

STAFF (2022)

**Head of Department:
Prof W Purcell**

BLOEMFONTEIN CAMPUS:

Distinguished Professors: Prof J Conradie, Prof A Roodt and Prof JC Swarts

Professors: Prof VA Azov, Prof A Brink, Prof E Erasmus, Prof L Moskaleva, Prof W Purcell, Prof JA Venter, Prof HG Visser and Prof KG von Eschwege

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: Dr RF Shago and Dr MR Swart (NMR Manager)

Junior Lecturer: L Nkabit

Researcher/Assistant: Dr A Noreljaleel

Research Associates: Prof BCB Bezuidenhoudt and Prof KJ Swart

Programme Director: Prof JA Venter (Physical Sciences)

Chief Officers (Professional Services): Dr MM Conradie and M Meyburgh

Senior Officers (Professional Services): MP Coetzee, T Swarts and R Wales (Finances)

Officers (Professional Services): Dr MW Mathebula, Dr R Matshitse, Dr PP Mokolokolo and Dr MR Swart

Senior Assistant Officer: E Andrews

Technical Aid Assistants: ID Fish, J Mafahle, LP Maxhaka, GI Nkotshana and E Tau

QWAQWA CAMPUS:

Subject Head: Dr M Mngomezulu (Acting) / RG Moji

Senior Lecturer: Dr JP Mofokeng

Lecturers: Dr OT Alexander, MA Malimabe, Dr M Mngomezulu, Dr M Sibeko and TA Tsotetsi

Junior Lecturers: M Mbongo and R Moji

Officers (Professional Services): CE Clarke-König, P Leche and MFT Mosoabisane

Senior Assistant Officer: MA Motsoeneng

SOUTH CAMPUS:

Lecturer/Coordinator: Dr R Meintjes

Facilitators: C de Klerk, Dr M du Plessis, L Siegert and B van Tonder

Laboratory Manager: L Siegert

Technical Aid Assistant: T Shago and LM Rasekoai

DEPARTMENT OF

COMPUTER SCIENCE AND INFORMATICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Prof Eduan Kotzé

Department of Computer Science and Informatics

Faculty of Natural and Agricultural Sciences

University of the Free State
PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 3703

E: kotzeje@ufs.ac.za

W: www.ufs.ac.za/csi

QWAQWA CAMPUS

Ben Mase

Department of Computer Science and Informatics

Faculty of Natural and Agricultural Sciences

University of the Free State
Private Bag X13 | Phuthaditjhaba 9866
South Africa

T: +27 58 718 5089

E: maseemb@ufs.ac.za

W: www.ufs.ac.za/csi

OVERVIEW OF 2022

The Department of Computer Science and Informatics continued to grow, with our undergraduate and postgraduate student numbers increasing. This resulted in our laboratories being utilised to their full capacity. We are continuing the upgrade of our new postgraduate laboratory to a hybrid laboratory, with a corresponding venue on the Qwaqwa Campus to facilitate real-time

Honours lectures between the two campuses. Two successful Advisory Board meetings were held in 2022 and valuable input from industry members has been implemented where possible.

ACHIEVEMENTS

Staff Achievements

Prof Lizette de Wet was awarded the Best Reviewer Award for the Information Systems track at the South African Institute of Computer Scientists and Information Technologists (SAICSIT) 2022 Conference, held from 18 to 20 July 2022 in Cape Town.

Dr Ruth Wario was the runner-up for the UFS Research in Learning and Teaching: Emerging Teaching and Learning Award.

The UFS Library and Information Services have adopted the Best Assignment project (now called the Library and Information Science Honours and Undergraduate Research Seminar [LIS-HURS]) as one of the flagship projects conducted in collaboration with faculties. A group of our third-year students won the 2021/22 LIS-HURS Competition, following in the footsteps of the 2020/21 winners who were also students from our Department. Rouxan Fouché was awarded the floating trophy for the lecturer of the LIS-HURS winning team.

Student Achievements

One of our PhD students, Bennie Botha, won the award for 'Innovating my Curriculum through the use of Technology and/or Online Tools' at the annual UFS Learning and Teaching Conference, held on the Bloemfontein Campus

from 14 to 16 September 2022. The title of his presentation was 'Organs in your face: Students' experiences of immersive virtual reality'. The goal of this innovation was to advance nursing students' perception and understanding of the human reproductive system using immersive virtual reality anatomy. The nursing students indicated that they enjoyed the use of immersive virtual reality much more than a plastic model or a cadaver and that they preferred this method of enhanced learning about the human reproductive anatomy.



Bennie Botha

An Extended Reality (XR) Showcase took place on 16 of March 2022 at the UFS Library on the Bloemfontein Campus. The main purpose of the event, organised by Bennie Botha, was to showcase the XR achievements already reached at the UFS. Speakers from other South African universities and industry also took part to allow the UFS to learn from their XR experiences. Botha and his

PhD supervisor, Prof Lizette de Wet, both presented during the event. Botha presented the introduction to the session and also reported on VR initiatives in the School of Nursing. Prof De Wet reported on Virtual Reality (VR) research and student involvement in Human-Computer Interaction (HCI) Research in the Department of Computer Science and Informatics.



Rouxan Fouché with the award

Two of our graduates, Thapelo Dlavane and Thabiso Mokoena, were accepted for the FNB Graduate Programme. The Graduate Programme allows FNB to select and employ promising graduates to launch their careers without the need for previous experience. They are given the responsibility to run with projects from day one, surrounded by a support group to help maximise their potential and to achieve their goals.

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 there are between four- and five thousand students registered for these modules in an academic year. ECLA was updated with functionality to enable lecturers to mark assessments submitted remotely. Continuous expansions and updates are being applied to improve and expand functionality, and major updates have included online assessments, submissions and automation. The ECLA laboratory was upgraded with dividers between the computer stations, similar to our other undergraduate laboratories.



ECLA Laboratory



RESEARCH AND INNOVATION

Blockchain Technology

The Blockchain Technology research area, which falls in the 4IR domain and is led by Dr Wynand Nel, continued its research on alternative consensus algorithms for blockchain systems. This project focuses on the proof-of-work consensus algorithm of Bitcoin and creating alternative algorithms that can dramatically reduce the energy requirement of the Bitcoin network. The project forms part of The UFS Interdisciplinary Centre for Digital Futures (ICDF). Dr Nel and Bezuidenhout co-presented a paper at the 5th National Global Change Conference, titled 'Smart Resource Trading Using Blockchain Technology'. A PhD, two MSc and three Honours students continued their work in this field.

Computer Science Education

The Computer Science Education (CSE) research group, under the guidance of Prof Liezel Nel, continued its work on the 'decoding' of Computer Science education and the unique challenges experienced by students in mastering discipline-specific concepts. This long-term project focuses

on the identification and evaluation of unique, discipline-specific strategies that could be utilised by instructors to improve the teaching and learning of various fundamental Computer Science concepts. One PhD student completed his thesis while one Master's and three more PhD students are currently working on CSE-related projects.

Business Intelligence and Text Mining

The Business Intelligence and Text Mining (BITM) research group, led by Prof Euan Kotzé, continued working on natural language processing problems, including general text classification, stylometry (authorship), as well as conversational agents. Prof Kotzé also worked on a machine learning solution for genre classification in an archival context, with specific reference 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 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 will be published by CRC Press (Taylor & Francis Group) in early 2023.

Eye-Tracking

Prof Tanya Stott continued the collaborative eye-tracking research. The current project investigates gaze movements while reading, both source code and narrative text.

Human-Computer Interaction

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

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



Dr Burgert Senekal

Bennie Botha, who is affiliated with the School of Nursing on the Bloemfontein Campus, is one of Prof De Wet's PhD students who is applying VR in the data collection and evaluation stages of his studies. The purpose of this PhD research is to determine if different combinations of VR technologies could reduce or prevent the onset of Cybersickness when navigating through a clinical virtual hospital ward. Two types of technologies were used as part of the research – a VR headset and controllers, as well as an omnidirectional

treadmill used in combination with a VR headset and controllers. As Cybersickness could be attributed to a sensory mismatch (imbalance between the sensory systems used in the perception of motion), it is argued that the participant walking on the treadmill while using the headset and controllers, could alleviate this sensory mismatch problem and, therefore, the onset of Cybersickness.



Treadmill being used in combination with a headset and controllers

Internet-of-Things

Prof Paul Kogeda worked on projects related to Internet of Things (IoT), addressing various challenges that society is facing today, such as water resource management, sewerage and waste management, and health issues. He also does agricultural-, network- and home automation-related research.

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, amongst others, business activities/operations, by incorporating other relevant technologies, including IoT, mobile Internet, mobile edge and cloud computing.

Research on the Qwaqwa Campus

Dr Andronicus Akinyelu's areas of research interest include deep learning, machine learning and computer vision. He developed deep learning-based techniques for COVID-19 diagnosis and gaze estimation on mobile devices. The research studies were published in two accredited ISI journals. He is currently exploring recent deep learning algorithms, including Capsule Neural Network and Vision Transformers. He aims to apply the two algorithms to medical imaging and agricultural problems, such as brain tumour diagnosis, lung cancer diagnosis, and improved crop disease diagnosis. Dr Akinyelu is also working on a community development project to empower young learners with knowledge, skills and competencies associated with industry 4.0 digital transformation concepts. Another objective is to train young learners how to write computer programs that can build robots capable of performing intelligent tasks.

Gavin Dollman developed a deep learning-based drone ortho mosaic land cover classifier as part of the development of a deep learning predictive model for prospecting for new fossil sites from the Elliot Formation in South Africa. He presented his research findings at the Southern African Conference for Artificial Intelligence Research (SACAIR). The conference has a strong focus on growing a network of talented students working in AI from across Africa.

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

Adebola Musa is exploring Information and Communications Technology (ICT) interventions in the transport sector. His other research interests include Recommender Systems, Machine Learning and Artificial Neural Networks.

Dr Ruth Wario's research focuses on HCI and educational technologies. One of her Master's students is developing an application to aid in sign language hand gesture recognition.

merSETA Grants

merSETA is currently funding the Research Capacity Building project for postgraduate students in the Department. The purpose of the funding for the first project (R7.4 million over three years) is to build the research capacity of the Department by expanding our postgraduate programme. We met all the deadlines and delivered our second commitment of ten Honours students and two Master's students at the end of 2022. For 2023, ten new Honours students will be registered and the two current Master's students will continue with their studies.

ENGAGED SCHOLARSHIP

Information Technology Service Learning (ITSL) Project

In the Information Technology Service-Learning module, second-year students in the Department of Computer Science and Informatics present computer literacy training to community members. This includes MS Word and MS Excel training in the form of short learning programmes (SLPs). The ITSL project is organised and presented annually by



Ben Mase



Dr Ruth Wario

Rouxan Fouché, assisted by the Love Life Youth Development organisation.

In 2022, the ITSL project was successfully implemented at the Love Life Youth Development centre from August to December 2022. Students enrolled for the service-learning module at the UFS produced computer literacy training videos and assignments shared with the Botshabelo Love Life youth centre facilitators weekly. Video recordings were used for training as face-to-face contact was not possible due to the distance from the Bloemfontein Campus. The training videos and assignments were presented to the ITSL participants during their chosen sessions. The Love Life Youth Development centre facilitators, known as 'groundbreakers', provided onsite support in the participants' home language and provided feedback for improving the training every week.

After completing the ITSL project, 150 members of the Botshabelo community completed both the MS Word and MS Excel training and received certificates from the Department during a graduation ceremony.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Eduan Kotzé continued to work with Prof Walter Daelemans at the Computational Linguistics and Psycholinguistics (CLiPS) research centre of 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, as well as conversational agents.

Dr Burgert Senekal and Dr Oluwafemi Oriola (from Nigeria) continued their fellowship with Prof Eduan Kotzé's research group, and Dr Christa van Staden continued her fellowship with Prof Liezel Nel's research group.



Dr Oluwafemi Oriola

and students being away from campus for a long time to attend the WIL and missing valuable lecture time. In the light of the many negotiations and logistics and the fact that three academic departments would need to be involved, at Prof Kotzé's suggestion, it was agreed that a steering committee should be established, and should include the following members representing all three departments and members of the Advisory Board:

Jaco Marais (Group leader; Department of Computer Science and Informatics), Jan Blomerus (Department of Mathematical Statistics and Actural Science), Edgard Ngounda (Department of Mathematics and Applied Mathematics), Tony van der Linden (BBD – Advisory Board member) and Dr Ettiene Vos (IBM – Advisory Board member)

During the sixth meeting of the Advisory Board held on 31 October 2022, industry members presented their views on how Industry can become involved in research and research activities. This should focus on practical industry problems to be addressed through research involving staff and students. In addition, there are substantial amounts of data available in the industry that could be used for research purposes. An agreement on the use of industry data has been established, outlining approval and authorisation from relevant parties. A follow-up meeting will be held early next year, to facilitate input from other industry members and the Dean, Prof Danie Vermeulen, to ensure that collaboration on research projects can be finalised as soon as possible.

Industry members were invited to participate in the annual NAS prize-giving ceremony; BBD, IBM and SAS accepted the invitation.

Student Workshop

In partnership with BBD Software Development, we hosted a student workshop from 24 to 25 October 2022. The two-day event consisted of workshop sessions teaching students in-demand industry skills. The workshop series also included a 'Tech Community meet-up', offering students the opportunity to network with IT professionals and businesses located in Bloemfontein. Each company delivered a talk on tech-related projects they are



Dr Christa van Staden

OTHER ACTIVITIES

Advisory Board

The fifth meeting of our Industry Advisory Board took place on 15 June 2022. Jaco Marais gave feedback on the Work-Integrated-Learning (WIL) discussions from the previous meeting and how the Department can incorporate WIL within the curriculum. A new second-semester module, CSIS3784 Computer Science and Informatics WIL, has been created and will be available for registration in 2024. It is a 16-credit module with 160 notional hours and 40 contact hours (e.g. 1 week - 8 hrs/day; 2 weeks - 4 hrs/day; 3 weeks - 2 hrs/day). Marais discussed this with Elzmarie Oosthuizen, the Faculty Learning and Teaching Manager, who suggested that the 2-week option will work best, but other options are also available.

In the ensuing discussion, concerns were raised, particularly in terms of Intellectual Property issues



Staff and students taking part in the fun day for Honours students

working on and what they look for in potential employees. The two-day workshop ended with a pizza night event that was hosted by the BBD team.

Fun day for Honours students

To help the Honours students get to know each other and network, the Department organised a fun day for all Honours students and staff. Both staff and students took part in a plethora of activities, including paintball target shooting, adventure golf, putt-putt, and go-karting. The highlight of the day was the Paintball Retribution Challenge. This long-standing challenge between staff members and Honours students in the Department, started a few years ago when a group of brave Honours students challenged staff members to a paintball duel.

POSTGRADUATE STUDENTS

One of the reasons why 2022 will be remembered in the Department of Computer Science and

Informatics, is the record number of postgraduate students (12 PhD, seven Master's and 41 Honours students).

Our Honours students have the option of completing their degree over two years, and in 2022 the Honours cohort consisted of a record number of 41 students, of which 33 were first-time Honours registrations. Of the 41 registered students, 28 were enrolled in the Honours programme in Computer Science and Informatics, five in Data Science and eight in the BCIS (B-degree in Computer Information Systems) programme.

The Department also had a record number of 23 Honours project students who completed their project year modules successfully and who presented and defended their projects at the annual Honours Project Day that took place in November 2022. The increase in project students annually, involves a heavier workload for each project supervisor in the Department. As project supervision is very 'labour intensive', involving many hours dedicated to the project students, the staff are to be commended for their efforts.

POSTDOCTORAL RESEARCH FELLOWS

Dr Aliyu Olubumni, from Nigeria, continued her postdoctoral fellowship in 2022 under the supervision of Prof Eduan Kotzé. They are working on personalised conversational agents.



Dr Aliyu Olubumni



Dr Andronicus Akinyelu

STAFF MATTERS

Dr Fani Radebe resigned and Ben Mase was appointed as Subject Head on the Qwaqwa Campus. Dr Andronicus Akinyelu joined the Department on that campus as a Lecturer.

Jason Stallenberg joined the Department as the Technical Assistant on the Bloemfontein Campus, and Dr Wynand Nel was promoted to Senior Lecturer.

Daniël Wium and Prof Paul Kogeda resigned and the vacant positions will be advertised in 2023.

RESEARCH OUTPUTS

Research Articles

Akinyelu, A.A. & Blignaut, P.J. 2022. Convolutional neural network-based technique for gaze estimation on mobile devices. *Frontiers in Artificial Intelligence* 4: 796825. DOI: 10.3389/FRAI.2021.796825.

Akinyelu, A.A. & Blignaut, P.J. 2022. COVID-19 diagnosis using deep learning neural networks applied to CT images. *Frontiers in Artificial Intelligence* 5: 919672. DOI: 10.3389/frai.2022.919672.

Akinyelu, A.A., Zaccagna, F., Grist, J.T., Castelli, M. & Rundo, L. 2022. Brain tumour diagnosis using machine learning convolutional neural networks, capsule neural networks and vision transformers, applied to MRI: A survey. *Journal of Imaging* 2022 8(205): 1-40. DOI: 10.3390/jimaging8080205.

Atsa'am, D.D. & Wario, R. 2022. A lone wolf vs. an affiliated terrorist: Knowledge inference on who poses more danger to the tourist. *International Journal of Cyber Warfare and Terrorism* 12(1): 1-9. DOI: 10.4018/IJCWT.304045.

Atsa'am, D.D. & Wario, R. 2022. Association rules extraction from the Coronavirus disease 2019: Attributes on morbidity and mortality. *International Journal of Healthcare Information Systems and Informatics* 17(1). 1-10. DOI: 10.4018/IJHISI.302652.

Atsa'am, D.D. & Wario, R. 2022. Association rules on attributes of illicit drugs, suspect's demographics and offence categories. *Journal of Drug Issues* 2022 0(0): 1-10. DOI: 10.1177/00220426221140010.

Atsa'am, D.D. & Wario, R. 2022. Association rules on

the COVID-19 variants of concern to guide choices of tourism destinations. *Current Issues in Tourism* 25(10): 1536-1540. DOI: 10.1080/13683500.2021.1951182.

Atsa'am, D.D. & Wario, R. 2022. 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:10.1504/IJMEI.2021.10038841.

Atsa'am, D.D. & Wario, R. 2022. Hierarchical cluster analysis of the morbidity and mortality of COVID-19 across 206 countries, territories and areas. *International Journal of Medical Engineering and Informatics* 14(2): 125-133. DOI:10.1504/IJMEI.2020.10033328.

Atsa'am, D.D. & Wario, R. 2022. Segmentation of African countries based on infection and death rates of COVID-19 before vaccination: A rigid population to source for workforce amidst the pandemic? *Scientific African* 18 (2022): e01430: 1-8. DOI: 10.1016/j.sciaf.2022.e01430.

Atsa'am, D.D., Wario, R. & Balogun, O.S. 2022. Antenatal care visits: A moderator of the association between a mother's age and the neonate's birth weight. *International Journal of Childbirth* 12(1): 15-22. DOI: 10.1891/IJC-2021-0019.

Bezuidenhout, R. & Nel, W. 2022. Embedding tamper-resistant, publicly verifiable random number seeds in permissionless blockchain systems. *IEEE Access* 10: 33912-33925. DOI: 10.1109/ACCESS.2022.3165616.

Bezuidenhout, R., Nel, W. & Maritz, J. 2022. Defining decentralisation in permissionless blockchain systems. *The African Journal of Information and Communication* 29: 1-24. DOI: 10.23962/ajic.i29.14247.

Ezugwu, A.E., Ikotun, A.M., Oyelade, O.O., Abualigah, L., Agushaka, J.O., Eke, C.I. & Akinyelu, A.A. 2022. A comprehensive survey of clustering algorithms. State-of-the-art machine learning applications, taxonomy, challenges and future research. *Engineering Applications of Artificial Intelligence* 110(2022): 1-43. DOI: 10.1016/j.engappai.2022.104743.

Holmqvist, K., Örbom, S.L., Hooge, I.T.C., Niehorster, D.C., Alexander, R.G., Andersson, R., Benjamins, J.S., Blignaut, P., Bouwer, A., Chuang, L.L. et al. 2022. Eye-tracking: empirical foundations for a minimal reporting guideline. *Behaviour Research Methods* 2022: 1-53. DOI: 10.3758/s13428-021-01762-8.

Holmqvist, K., Örbom, S.L. & Zemblys, R. 2022. Small head movements increase and colour noise in data from five video-based P-CR eye-trackers. *Behaviour Research Methods* 54: 845-863. DOI: 10.3758/s13428.021.01648.9.

Park, S.Y., Holmqvist, K., Niehorster, D.C., Huber, L. & Viranyi, Z. 2022. How to improve data quality in dog eye-tracking. *Behaviour Research Methods Online*: 1-24. DOI: 10.3758/s13428.022.01788.6.

Senekal, B. 2022. Die mede-outeurskapnetwerk in die Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie. *Die Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 41(1): 106-114. DOI: 10.36303/SATNT.2022.41.1.930.

Senekal, B. 2022. Wat eet Afrikaners? 'n Verkenning van die bestanddeel-resep-netwerk in Afrikaanse resepte. *Litnet Akademies* 2022 19(3): 648-670. DOI: 10.56273/1995-5928/2022/j19n3f1.

Ssengonzi, C., Kogeda, O.P. & Olwal, T.O. 2022. A survey of deep reinforcement learning application in 5G and beyond network slicing and virtualization. *Array* 14 (2022) 100142: 1-27. DOI: 10.1016/j.array.2022.100142.

Van Staden, C. 2022. Doeltreffendheid van gesamentlike ervaringsleertake tydens opleiding van dosente in afstandhoëronderwys. *Litnet Akademies* 19(3): 796-833. DOI: 10.56273/1995-5928/2022/j19n3d5.

Van Staden, C. 2022. Telegram, Signal of WhatsApp? Keuse van 'n geskikte toep om mobiele leeromgewings vir Suid-Afrikaanse hoëronderwyskontekste te skep. *Litnet Akademies* 19(02): 307-345. DOI: 10.56273/1995-5928/2022/j19n2d2.

Conference Contributions

Conference Papers/Posters

Bergh, L. & Stott, T.R. 2022. *Red-letter reading days, eye movements, green eggs and ham*. Paper delivered at the 1st Biennial International Symposium Multimodal Texts in Schools, Koper, Slovenia and online. 15-16 December 2022.

Kau, F.M. & Kogeda, O.P. 2022. *Subscription fraud prevention in telecommunication using multimodal biometric system*. Paper delivered at the 14th EAI International Conference on e-Infrastructure and

e-Services for developing countries (EAI AFRICOMM 2022), Zanzibar, Tanzania. 5-7 December 2022.

Simelane, P.T. & Kogeda, O.P. 2022. A cloud-based drones' model for detection and tracking of stationary and motion-based snakes in farms in marginalised rural areas: A preliminary study. Paper delivered at the 14th EAI International Conference on e-Infrastructure and e-Services for developing countries (EAI AFRICOMM 2022, Zanzibar, Tanzania. 5-7 December 2022.

Conference Proceedings

Aliyu, E.O. & Kotzé, J.E. 2022. Stacked language models for an optimised next-word generation. In *Proceedings of the IST Africa 2022 Conference*. Virtual. 16-20 May 2022. P. Cunningham, M. Cunningham (Eds). International Information Management Corporation (IIMC). pp. 1-12.

Atsa'am, D.D. & Wario, R. 2022. Clustering of the West African starchy roots and tubers using nutritive value. In: *Proceedings of the 2022 International Conference on Intelligent and Innovative Computing Applications*. Balaclava, Mauritius. 8-9 December 2022. S. Pudaruth & P. Owolawi (Eds). Society of Information Technologists and Engineers Ltd. (SITE). pp. 231-237.

Beelders, T.R. 2022. Eye-tracking analysis of source code reading on a line-by-line basis. In: *Proceedings of the 10th International Workshop on Eye Movements in Programming (EMIP)*. Online. 18 May 2022. N. Al Madi, T. Busjahn & B. Shariff (Eds). IEEE/ACM. pp. 1-7.

Bezuidenhout, R. & Nel, W. 2022. Transient random number seeds in permissionless blockchain systems. In: *Proceedings of the 17th International Conference on Design Science Research in Information Systems and Technology (DESRIST) 2022*. St. Petersburg, Florida, United States of America. 1-3 June 2022. Lecture Notes in Computer Science. G. Goos & J. Hartmanis (Eds). Springer. pp. 85-96.

Botha, B.S. & De Wet, L. 2022. A pilot study for measuring the usability and user experience of immersive virtual reality navigation methods. In: *Proceedings of the 2022 International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)*. Male, Maldives. 16-18 November 2022. A.S. Adam & M. Gooroochurn (Eds). IEEE. pp. 1-6.

Botha, B. & De Wet, L. 2022. Using design science research to create a virtual environment for Nursing students. In: *The 8th African Conference on Information Systems and Technology (ACIST) 2022 Proceedings*. Blantyre, Malawi. 25-26 August 2022. B. Kankuzi & W. Chigora (Eds). Digital Commons. pp. 1-11.

Gadebe, M.L., Ojo, S.O. & Kogeda, O.P. 2022. A split-then-join lightweight hybrid majority vote classifier. In: *Soft Computing and its Engineering Applications. icSoftComp 2021*. Virtual. 10-11 December 2021. Communications in Computer and Information Science. K.K. Patel, G. Doctor, A. Patel & P. Lingras (Eds). Springer, Cham. pp. 167-180.

Khomokhoana, P.J. & Nel, L. 2022. Mapping the problem-solving strategies of novice programmers to Polya's framework: SWOT analysis as a bottleneck identification tool. In: *50th Annual Conference of the Southern African Computer Lecturers' Association (SACLA) 2021*. Johannesburg, South Africa. 16 July 2021. W.S. Leung, M. Coetzee, D. Coulter & D. Cotternell (Eds). Springer. pp. 132-148.

Mase, B. & Nel, L. 2022. Common code writing errors made by novice programmers: Implications for the teaching of introductory programming. In: *50th Annual Conference of the Southern African Computer Lecturers' Association (SACLA) 2021*. Johannesburg, South Africa. 16 July 2021. W.S. Leung, M. Coetzee, D. Coulter & D. Cotternell (Eds). Springer. pp. 102-117.

Nel W., De Wet, L. & Schall, R. 2022. The value of brain-computer interface measurements when using ambiguous search queries. In: *Proceedings of the 2022 Future of Information and Communications Conference (FICC)*. San Francisco, United States of America and online. 3-4 March 2022. Lecture Notes in Networks and Systems. K. Arai (Ed). Springer. pp. 722-740.

Sediela, M.S., Gadebe, L.M. & Kogeda, O.P. 2022. Impact of radio map size on indoor localisation accuracy. In: *22nd International Conference on Computational Science and its Applications (ICCSA)*. Malaga, Spain and online. 4-7 July 2022. Lecture Notes in Computer Science. O. Gervasi, B. Murgante, E. Hendrix, D. Taniar & B. Apduhan (Eds). Springer, Cham. pp. 529-543.

Oriola, O. & Kotzé, J.E. 2022. Exploring neural embeddings and transformers for isolation of offensive and hate speech in South African social

media. In: *22nd International Conference on Computational Science and its Applications (ICCSA)*. Malaga, Spain and online. 4-7 July 2022. Lecture Notes in Computer Science. O. Gervasi, B. Murgante, E. Hendrix, D. Taniar & B. Apduhan (Eds). Springer, Cham. pp. 649-661.

Wario, R.D. 2022. Investigating use and impact of social media on student academic performance: a case of a university in South Africa. In: *16th Multi Conference on Computer Science and Information Systems (MCCSIS)*. Lisbon, Portugal. 19-22 July 2022. P. Kommers & M. Macedo (Eds). International Association for Development of the Information Society (IADIS). pp. 268-273.

STAFF (2022)

Head of Department:
Prof JE Kotzé

BLOEMFONTEIN CAMPUS:

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

QWAQWA CAMPUS:

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

SOUTH CAMPUS:

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



DEPARTMENT OF
ENGINEERING SCIENCES
 FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Louis Lagrange
 Department of Engineering Sciences

Faculty of Natural and Agricultural Sciences
 University of the Free State
 PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 3780 / 401 7165
E: lagrangelf@ufs.ac.za
W: www.ufs.ac.za/natagri/faculty-of-natural-and-agricultural-sciences-home/unlisted-pages/ensci-engineering-sciences/about-ensci

OVERVIEW OF 2022

Engineering Sciences (EnSci) expanded substantially on circular economy- and energy efficiency-related research in 2022. It also culminated in a total of 28 publications during the year.

Both staff and students have settled into a routine of more Face-2-Face (F2F) teaching, but keeping the inherent advantages of the hybrid methodology to become part of effective training.

EnSci welcomed a fourth staff member, Sandile Dladla, and is now fully capacitated for the first time.

EnSci obtained endorsement from the Engineering Council of South Africa (ECSA) to start a full new engineering programme, BEng (Agricultural and Biosystems Engineering). We are progressing well with the Department of Higher Education and Training (DHET) and Council of Higher Education (CHE) to complete the requirements to start the new programme in 2025.

ACHIEVEMENTS

Staff Achievements

Louis Lagrange participated in the UFS Thought Leader webinar series on the Energy crises in South Africa.

In 2022, both Dr Abdolhossein Naghizadeh and Dr Jacques Maritz were promoted from Lecturer to Senior Lecturer.

Dr Maritz also fulfilled an advisory role (technical and management) for the successful establishment of the UFS Interdisciplinary Centre for Digital Futures. He also led the successful implementation and commissioning of the UFS smart grid and design process of the UFS microgrid for the Qwaqwa Campus, and successfully integrated it into the Grid Related Research Group (GRRG) and UFS High-performance Computing (HPC) cloud infrastructure for further research. The GRRG, in conjunction with the UFS HPC, was awarded the hosting rights for the prestigious National Institute for Theoretical and Computational Sciences (NITHeCS) summer school in 2023.

Dr Maritz was a valuable member of the Local Organising Committee of the 5th National Global Change Conference (GCC5), to be held on the Bloemfontein Campus from 30 January to 2 February 2023.

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

TEACHING AND LEARNING

Students successfully returned to F2F and blended learning and teaching and benefitted from the training of lecturers to be more skilled facilitators on blended learning methodologies.

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



EnSci students, Elandri Crafford and Edeling Rune, participating in the annual Bridge-Building competition



Prinita Mudali and Dr Abdolhossein Naghizadeh loading bridges during the annual Bridge-Building competition



Gwarubana Lutho and Jona Wandile, winners of the 2022 Bridge-Building competition, with Dr Naghizadeh

Four final-year students (Gwarubana Lutho, Nkosi Sinesipho, Teise Noxolo and Tsietsi Paballo) designed and built a box cart and competed in the Annual Red Bull Box Cart Race in Cape Town in November 2022. The EnSci team completed the entire race and only rolled their box cart after it passed the final chequered flag and, being a well-designed box cart, there were no injuries!



EnSci students participating in the Red Bull Box Cart Race – from the left, Teise Noxolo, Gwarubana Lutho (the driver), Nkosi Sinesipho and Tsietsi Paballo

RESEARCH AND INNOVATION

Engineering Sciences opened a new laboratory for circular economy-related research projects in cement and concrete. The research focuses on advanced concrete technology, specifically on green concrete and eco-friendly cementitious systems. The laboratory facility has also been used by several outside companies for tests and research purposes.

The merSETA-funded concept Centre of Data and Digital Engineering (CDDE) is anchored in the field of digital resource management and crystallises as a smart grid initiative that forms the core of the concept CDDE.



Green concrete testing laboratory

In 2022, the UFS GRRG went through a Vision 130 re-alignment process with emphasis on growing our own forest (research infrastructure, people and aligning with the UFS digitalisation plan) and achieving maximal societal impact. This is being achieved through, *inter alia*:

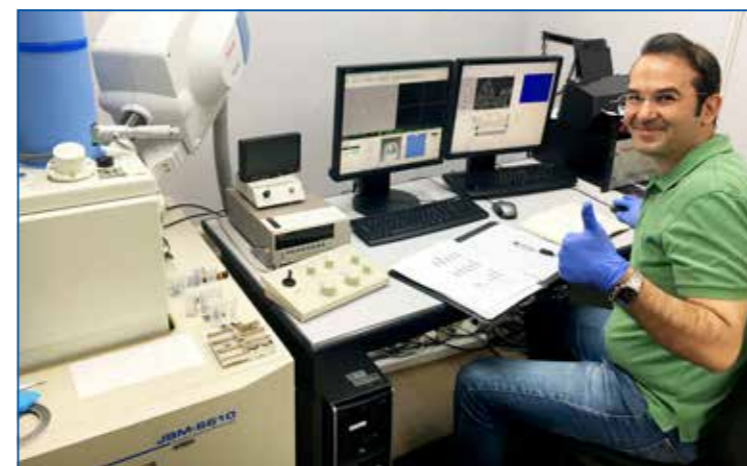
- UFS Smart Grid, conceptualised in 2019 and commissioned in 2020 logs 4-15 GB/week of raw data and transients on millisecond scale with microsecond time stamping.
- UFS Qwaqwa microgrid, conceptualised in 2021 and started on 15 December 2022. It will feed several international research groups and with data which is logged on millisecond scale with microsecond time stamping and is synchronised with the UFS smart grid.
- The UFS Digital backbone is a private cloud stacked on the UFS HPC system and will enable seamless movement of data generated by the research infrastructure. The UFS Digital backbone will enable ML/AI community to feed directly from real time data streams generated by UFS smart grid and microgrid.
- The UFS Synchro phasor network consisting of 26 Phasor Measurement Units (PMUs) with microsecond time stamping, power flow and protection against harmful transients.

GRRG staff members without PhDs are on track for obtaining their degrees by end of 2025. GRRG students are exposed to international collaborations, open data and high-performance research groups. The GRRG is positioned to provide a platform to

support academic programmes with meaningful pathways for UFS graduates in the digital paradigm. By 2024 the GRRG will increase the influx of promising young postdoctoral fellows and affiliates due to its interdisciplinary nature.

EnSci concluded its research and development on the Green Manufacturing Index (GMI) and phase 1 of the High-performance Engineering Materials (HPEM), funded by merSETA. Work has commenced on Phase 2 of the High-performance Engineering Materials research and a third phase is envisioned.

Dr Abdolhossein Naghizadeh was a member of the research team for 3D printing additive technologies for sustainable human settlements in South Africa, conducted by the University of Johannesburg (UJ) and the Department of Science and Innovation (DSI). He was author and co-author of twelve journal articles in 2022.



Dr Abdolhossein Naghizadeh

ENGAGED SCHOLARSHIP

Lagrange continued to serve as a member of a number of national and international boards, including the National Board of the South African

Institute for Agricultural Engineers (SAIAE), and the chairman of the Free State branch of the SAIAE, the National Board for training of the South African Energy Efficiency Confederation (SAEEC). He also served as the member representing Africa on the International Board for the Certified Lighting Efficiency Professional (CLEP) and Certified Business Energy Professional (BEP) training for the Association of Energy Engineers (AEE).



Louis Lagrange

Lagrange's expertise was also drawn upon as co-author and examiner of the updated 2022 CLEP training course material for the AEE. He was also co-author of four chapters of the 2022 Energy Audit Practitioner course for the South African National Energy Development Initiative (SANEDI) and three chapters of the 2022 Energy Audit Technician (EAT) course – both for the Institute of Energy Professionals Africa (IEPA).

Dr Jacques Maritz attended the Engaged Scholarship Professional Development Programme which supports the development of a Community of Practice for Engaged Scholarship (CoPES). Dr Maritz was part of the engaged Scholarship Professional Development Programme from 2022.

The UFS GRRG synchronised with the UFS Engaged Scholarship vision for the next few years, specifically integrating their outcomes in the GRRG research strategy. In terms of this strategy, the GRRG will assist in building and growing CoPES, by providing leadership for engaged scholarship in their own departments/schools/units, as well as in cross-and transdisciplinary initiatives. The GRRG also aims to contribute to pressing energy societal issues by utilising research infrastructure embedded in local paradigms (e.g. load shedding), as well as to build sustainable relationships with local communities and industry by hosting mini symposia, work sessions and fulfilling advisory roles.

The GRRG shared recent innovations and results with Centlec and negotiated the exemption of the UFS Bloemfontein Campus from loadshedding in 2022.

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 Universities of Yaoundé (Cameroon) and Erzurum Technical University (Turkey), to formulate an eco-friendly construction material called “green concrete”. The project aims to reduce the impact of cement and cement production on the environment.

Dr Naghizadeh collaborates on a research project on 3D printing additive technologies for sustainable human settlements in South Africa. The project is led by the UJ, DSI and other local and international partners from the industry.

In 2022, Dr Jacques Maritz established a researcher/student exchange agreement between the GRRG and the Norwegian University of Life Sciences. This collaboration was strengthened in a paper submitted on the stochastic nature of the South African power grid, co-authored by Dr Leonardo Gorjão and Dr Maritz.

Ongoing collaboration between GRRG and KU Leuven was strengthened through a paper outlining the influence of the microclimate on hydrogen-from-air scheme.

An international academic collaboration was also established with the Department of Electrical Engineering of Technical and Vocational University (TVU), Iran. The collaboration will focus on Green Concrete Research.

The international research and development collaboration was reconfirmed with Schweitzer Engineering Labs (SEL) in the United States of America - Grid protection department.

POSTGRADUATE STUDENTS

Members of the EnSci academic staff were involved in the co-supervision of a number of students in 2022.

Dr Maritz co-supervised an MSc student shared between Engineering Sciences and the Department of Computer Science and Informatics. The student, whose dissertation was in the field of smart grid protocols, graduated in 2022. Dr Maritz is also co-supervising a PhD student (also shared between Engineering Sciences and the Department of Computer Science and Informatics), who will graduate in 2023. The study is in the field of blockchain.

Dr Naghizadeh co-supervised three MEng students from UJ, who graduated in November 2022 and a further three UJ MEng students who are still completing their studies.

Dr Abolarin is co-supervising an Honours student in Mechanical Engineering at the University of Pretoria. The student's research is on extended surfaces.



Dr Jacques Maritz

STAFF MATTERS

Dr Abdolhossein Naghizadeh and Dr Jacques Maritz were both promoted to the position of Senior Lecturer in 2022.

EnSci welcomed Sandile Dladla as a Lecturer in the Department in 2022.



RESEARCH OUTPUTS

Research Articles

Aneke F.I. & Naghizadeh A. 2022. Conversion of auxiliary wastes for production of masonry bricks: towards conservation of natural clay. *International Journal of Applied Science and Engineering* 19(2): 2021154: DOI: 10.6703/IJASE.202206_19(2).008.

Aneke F.I. & Naghizadeh A. 2022. Utilization of Plastic Waste Material in Masonry Bricks Production Towards Strength, Durability and Environmental Sustainability: Strength, Durability and Environmental Sustainability. *Journal of Sustainable Architecture and Civil Engineering* 1(30): 121-141. DOI: 10.5755/j01.sace.30.1.29495.

Aneke F.I. & Naghizadeh A. 2022. Valorization of Plastic Waste for Masonry Bricks Production: A Novel Construction Material for Sustainability. *Journal of The Institution of Engineers (India): Series A (Online)*. DOI: 10.1007/s40030-022-00649-x

Bezuidenhout, R., Nel, W. & Maritz, J.M. 2022. Defining Decentralisation in Permissionless Blockchain Systems. *The African Journal of Information and Communication*, 2022(29):1-24.

Bezuidenhout, R., Nel, W. & Maritz, J.M. 2022. Embedding Tamper-Resistant, Publicly Verifiable Random Number Seeds in Permissionless Blockchain Systems. *IEEE Access* 10: 39912-39925. DOI: 10.1109/ACCESS.2022.3165616.

Ekolu S., Solomon F. & Naghizadeh A. 2022. Abandoned mine tailings and coal ash industrial wastes for sustainable production of geopolymer brick masonry: South African Case Study. *Key Engineering Materials* 916: 130-135. DOI: 10.4028/p-v13b28.

Ewim, D.R.E., Okwu, M.O., Onyiriuka, E.J., Abiodun, A.S., Abolarin, S.M. & Kaood, A. 2022. A quick review of the applications of artificial neural networks (ANN) in the modelling of thermal systems, *Engineering and Applied Science Research* 49(3): 444-458. DOI: 10.144456/easr.2022.45.

Fadodun, O.G., Ewim, D.R.E. & Abolarin, S.M. 2022. Investigation of turbulent entropy production rate with SWCNT/H₂O nanofluid flowing in various inwardly corrugated pipes. *Heat Transfer* 51(8): 7862-7889. DOI: 10.1002/htj.22671.

Fetuga, I.A., Olakoyejo, O.T., Abolarin, S.M., Gbegudu, J.K., Onwuegbesi, A. & Adelaja, A.O. 2022. Numerical Analysis of Thermal Performance of Waste heat Recovery Shell and tube Heat Exchangers on Counter-Flow with Different Tube Configurations. *Alexandria Engineering Journal* 64: 859-875. DOI: 10.1016/j.aej.2022.09.017.

Kaze R.C., Naghizadeh A., Tchadjie L., Adesina A., Djobo J.N.Y., Nemaleu D.J.G., Kamseu E., Melo U.C. & Tayeh B.A. 2022. Lateritic soils based geopolymer materials: A review. *Construction and Building Materials* 344(15): 128157. DOI: 10.1016/j.conbuildmat.2022.128157.

Lubbe, F., Maritz, J.M., Bosserez, T., Rongé, J. & Martens, J. A. 2022. A multiperspective analysis of microclimate dynamics for air-based solar hydrogen production. *Heliyon* 8(7): e09883. DOI: 10.1016/j.heliyon.2022.e09883.

Naghizadeh A. & Ekolu S.O. 2022. Activator-related effects of sodium hydroxide storage solution in standard testing of fly ash geopolymer mortars for alkali - silica reaction. *Materials and Structures*. 55(22): 1-16. DOI: 10.1617/s11527-021-01875-8.

Naghizadeh A., Ekolu S. & Solomon F. 2022. Challenges and problems of geopolymer brick masonry: A Review. *Key Engineering Materials* 916:136-144. DOI:10.4028/p-68r15a.

Ohemeng E.A., Ekolu S.O., Quainoo H. & Naghizadeh A. 2022. Economical and eco-friendly masonry mortar containing waste concrete powder as a supplementary cementitious material. *Case Studies in Construction Materials* 17: e01527. DOI: 10.1016/j.cscm.2022.e01527.

Olakoyejo, O.T., Adelaja, A.O., Abolarin, S.M., Adewumi, O.O., Oyekeye, M.O., Oluwo, A.A., Oluwatusin, O., Mweigye, A. 2022. Numerical Forced Convection Heat Transfer, Fluid Flow and Entropy Generation of Al₂O₃-Water Nanofluid in Elliptical Channels. *Nigerian Journal of Technology Development* 19(4): 361-372. DOI: 10.4314/njtd.v19i4.9.

Sinngu F., Ekolu S.O., Naghizadeh A. & Quainoo H.A. 2022. Experimental study and classification of natural zeolite pozzolan for cement in South Africa. *Journal of the South African Institution of Civil Engineering* 64(4): 2-15. DOI: 10.17159/2309-8775/2022/v64n4a1

Conference Contributions

Conference Papers

Abolarin, S.M., Shitta, M.B., Aninyem, M.C., Lagrange L. & Olufemi, O.O. 2022. *Influence of Efficiency Advancement on Solar PV Module Choice and Energy Yield: A Case of a Residential Building in Lagos Nigeria*. Paper delivered at the ASME Power Conference, Pittsburgh, USA. 18-19 July 2022.

Adelaja, A.O., George, O.A., Ogbemhe, J., Abolarin, S.M. & Olakoyejo O.T. 2022. *Prediction of Pressure Gradiante during Condensation in Inclined Heat Exchanger using Machine Learning Techniques*. Paper delivered at the 14th International Conference on Applied Energy (ICAE2022), Bochum, Germany and Virtual. 8-11 August 2022.

Noah, O.O., Adelaja, A.O. & Abolarin, S.M. 2022. *Developing Basic Unit Cell (BUC) Model for Natural Convection heat Transfer Characteristics In Packed Beds of Proposed Coated Particle Nuclear Fuel Design*. Paper delivered at the 14th International Conference on Applied Energy (ICAE2022), Bochum, Germany and Virtual. 8-11 August 2022.

Omosehin, O.S., Adelaja, A.O., Olakoyejo, O.T., Oluwatusin, O.O., Oyekeye, O.M. & Abolarin, S.M. 2022. *Numerical Study of the Thermal-Hydraulic Performance of Water-Based Al₂O₃-Cu Hybrid Nanofluids in a Double Layer Microchannel Heat Sink*. Paper delivered at the 14th International Conference on Applied Energy (ICAE2022), Bochum, Germany and Virtual. 8-11 August 2022.

Conference Proceedings

Abolarin, S.M., Shitta, M.B., Emmanuel, M.A., Nwosu, B.P., Aninyem M.C. & Lagrange, L. 2022. An impact of solar PV specifications on module peak power and number of modules: A case study of a five-bedroom residential duplex. *IOP Conference Series: Earth and Environmental Science*. In: *IOP Conference Series: Earth and Environmental Science, Volume 983, The Sixth International Conference on Energy Engineering and Environmental Protection (EEEP2021)*. Sanya, China (Online), 16-18 November 2021. pp: 1-8. DOI: 10.1088/1755-1315/983/1/012056.

Bezuidenhout, R., Nel, W. & Maritz, J.M. 2022. Transient Random Number Seeds in Permissionless Blockchain Systems. In: *The Transdisciplinary Reach of Design Science Research. Proceedings of the*

17th International Conference on Design Science Research in Information Systems and Technology DESRIST 2022. Lecture Notes in Computer Science, Vol 13229. St Petersburg, USA, 1-3 June 2022. A. Drechsler, A. Gerber & A. Hevner (Eds). pp: 85-96. https://doi.org/10.1007/978-3-031-06516-3_7.

Ekolu S., Tchadjie L. & Naghizadeh A. 2022. Alkali-silica reaction resistance versus susceptibility of geopolymer binders. In: *Proceedings of Concrete Solutions 2022 – 8th International Conference on Concrete Repair, Durability & Technology MATEC Web of Conferences* Vol. 361. DOI: 10.1051/mateconf/202236106003.

Kawalu N., Naghizadeh A. & Mahachi J. 2022. The effect of glass waste as an aggregate on the compressive strength and durability of fly ash-based geopolymer mortar. In: *Proceedings of Concrete Solutions 2022 – 8th International Conference on Concrete Repair, Durability & Technology MATEC Web of Conferences* Vol. 361. DOI:10.1051/mateconf/202236105007.

Naghizadeh A. & Ekolu S. 2022. Effect of different mixture parameters on the setting time of fly ash/rice husk ash-based geopolymer mortar. In: *Proceedings of Concrete Solutions 2022 – 8th International Conference on Concrete Repair, Durability & Technology MATEC Web of Conferences* Vol. 361. DOI:10.1051/mateconf/202236105001.

STAFF (2022)

Head of Department:
LF Lagrange

Senior Lecturers:	LF Lagrange, Dr J Maritz and Dr A Naghizadeh
Lecturers:	Dr SM Abolarin and S Dladla
Affiliated Lecturers:	CJB Bezuidenhout, EP Boje, JA Calitz, SJ de Wet, GH Ehlers, JJ Haefele and JC Potgieter
Affiliated Junior Lecturers:	GD le Roux, IP Scott, S Nel and G Ehlers
Research Engineer:	SJ Erasmus (Contract)
Senior Assistant Officers:	C du Toit and ZV Mngomezulu
Senior Technician:	HJD Lubbe



DEPARTMENT OF GENETICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

Prof Paul Grobler

Department of Genetics

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 3844

E: groblerjp@ufs.ac.za

W: www.ufs.ac.za/genetics

OVERVIEW OF 2022

The year 2022 marked 200 years since the birth of Gregor Mendel, regarded as the founder of the discipline of Genetics. This was a significant commemoration

in the field of Genetics and the event was thus celebrated with a special event, attended by the University community as well as external stakeholders. The keynote speaker was Prof Frank Zachos, from the Natural History Museum in Vienna, Austria, with several members of staff also presenting.

2022 also marked 15 years since the establishment of the Department of Genetics as an independent department at the UFS.

The Department hosted two other international visitors in 2022 – Prof Gordon Luikart, from the University of Montana (in July) and Prof Ahmed-Abdel-Azeem, from the Suez Canal University (in August).

Research in the Department of Genetics was conducted in the fields of Behavioural Genetics, Conservation- and Population Genetics, Human

Genetics, Systematics, Plant Molecular Genetics and Genomics, Forensic Genetics, Forensic Science and Wastewater Monitoring. A total of 37 papers were produced in 2022, an increase compared to 32 in 2021 and 26 in 2020. Two valuable pieces of equipment were received through the University Large Equipment programme.

The 2022 academic year was a productive period for the Department of Genetics in terms of completed postgraduate studies. A total of 10 MSc and two PhD degrees were awarded to students from the Department, as well as a third PhD to a staff member. This is the highest number of senior degrees awarded in a year since the Department was founded.

Three new members of staff joined the Genetics team during 2022. The Department now has a total of 18 permanent members of staff, while four affiliated researchers (national and international) bring valuable additional expertise in research and student training. Several staff members received recognition for their expertise through continued service on editorial boards, examiner duties for other institutions and engagement with stakeholders. There is also collaboration with a significant number of national and international collaborators.

ACHIEVEMENTS

Staff Achievements

Dr Marieka Gryzenhout was awarded special membership of the Arab Society for Fungal Conservation.

Dr Karen Ehlers and Dr Marieka Gryzenhout were selected for the Industry Engagement Mentoring Programme of the UFS, during which staff members are assisted to develop business plans applied to their speciality areas, that may lead to commercialisation.

Dr Tinus Viljoen, Lecturer in Forensic Sciences, obtained his PhD in Chemistry at the UFS. He is currently focusing on forensic chemistry, ballistics and single-crystal x-ray crystallography.

Student Achievements

Lt Col Anton Lucassen, from the South African Police Service (SAPS) was the first student to obtain a PhD in Forensic Genetics, since the introduction of this qualification at the UFS in 2010.

Dr Anton Lucasson, with his supervisor, Dr Karen Ehlers (left) and co-supervisor, Prof Paul Grobler (right)



TEACHING AND LEARNING

The number of modules presented at undergraduate and Honours levels remained unchanged from the immediate past, with 14 modules presented at undergraduate level and 18 modules at Honours level. The number of students in undergraduate modules decreased slightly across the board, with the size of Honours classes being stable or slightly lower. Despite a nominal decrease in numbers, the Introduction to Genetics module (BLGY1623) still had 345 first-year students enrolled, and the number of students who applied for Forensic Sciences increased to over 2 000 applications. Pass rates in undergraduate modules are mostly stable or slightly up, compared to previous years.

New third-year modules were registered for the Genetics programme to reflect the split between theory and practical work; these will be implemented from 2023. A new Lecturer, Dr Morné du Plessis, was appointed specifically to present these new practical

Attending the special event to commemorate Gregor Mendel, from the left, Prof Paul Grobler, Prof Corli Witthuhn, Prof Frank Zachos, Dr Gerda Marx, Dr Engela van Staden and Prof Danie Vermeulen





Dr Morné du Plessis

sessions and will bring new expertise in genomics.

A new edition of the textbook for GENE3744 was introduced by Prof Grobler to reflect recent developments in Genomics, that complement existing content in Population Genetics based on traditional methods.

There were a number of improvements in the undergraduate and Honours training in Forensic Science. Five new microscopes with cameras were received to be used in Forensic Science practical sessions led by Dr Sonja Brink. In FORS2616, the study material was updated by Tshepiso Motolo and tutorials were replaced with practical sessions. Two new wet practical sessions were also designed and implemented for FORS3724 by Dr Viljoen. For the first time, students in FORS3734 did a decomposition



Dr Karen Ehlers

study with a carcass, under supervision of Motolo. Dr Karen Ehlers upgraded the content of the FORS2626 module, and for FORG6804, she included guest speakers from the industry to present to the Honours students. These speakers included crime scene investigators from the SAPS Victim

Identification Centre, a forensic pathologist, a special investigator from the DNA Board, a psychologist from the UFS and a prosecutor from the National Prosecuting Authority (NPA). To test their ability to identify evidence of value and proper evidence collection skills, the second- and third-year forensic students were involved in mock crime scenes.

RESEARCH AND INNOVATION

Research in the Department of Genetics is conducted under seven broad themes, namely Behavioural Genetics, Human Genetics, Conservation- and Population Genetics, Biosystematics, Plant Molecular Genetics and Genomics, Forensic Genetics, Forensic Science and Wastewater Monitoring.

Behavioural Genetics

Current projects in this group, led by Zurika Murray, include studies on (i) genetic variation in the Vit D synthesis and transport pathway in South African individuals with MS and NMO; (ii) complex phenotypes in juvenile delinquent males, conducted in collaboration with the Jimmie Roos Special School; and (iii) aspects of Psilocybin containing mushrooms and their therapeutic application for mental health related ailments.

Human Genetics

The focus of Dr Gerda Marx, Sue-Rica Schneider and Dr Renate Rebello in Human Genetics is based on understanding human diseases. This includes not only their distribution, causes and progression, but also their most effective treatment regimes. Consequently, the training and research in the Department of Genetics has a clinical flavour. Research projects include (i) aspects of HIV host genetics; (ii) zebrafish as a model organism to study endocrine diseases; (iii) the metabolism of pharmaceuticals in zebrafish used to enhance sports performance (in collaboration with the South African Doping Control Laboratory); (iv) the pharmacogenetics of Zebrafish; (v) diabetes; (vi) psychiatric disease; and (vii) Pre-eclampsia.

Conservation Genetics

In the research group of Conservation Genetics, Prof Paul Grobler and Dr Morné du Plessis aim to conserve patterns and processes of genetic diversity in natural populations of animals. The main projects conducted in 2022 were (i) the genetic effects of isolation and fragmentation on game populations, focused on gemsbok and red hartebeest populations on game reserves in the Northern Cape; (ii) the genetic status of freshwater mussel populations from South Africa and Botswana, and marine mussels off the South African coast; (iii) the use of zebrafish to model population genetic processes,

with the emphasis on the ability of bottlenecked populations to handle environmental stressors; (iv) the genetic management of small and isolated rhino populations; and (v) various projects in collaboration with the National Zoological Garden (NZG) / South African National Biodiversity Institute (SANBI), focused on lions and migratory birds.



Magellan mussels (ribbed mussels in centre) studied by Prof Paul Grobler, intermingled with smooth mussels in the Hermanus area

Prof Grobler and Peter Mills (PhD student) attended the annual symposium of the Southern African Wildlife Management Association (SAWMA), held at Bonamanzi Private Nature Reserve, KwaZulu-Natal, from 4 to 9 September.

Prof Paul Grobler (second from left) and Peter Mills (on the right) at the SAWMA symposium, with Prof Brian Reilly and Dr Beanétri Janecke



Biosystematics

This group, led by Dr Marieka Gryzenhout, studies the biodiversity and systematics of macrofungi from South Africa, often in collaboration with citizen scientists. Other projects were focused on (i) psychedelic mushrooms; (ii) antifungal resistance in *Aspergillus*; (iii) Pecan Tree Health; and (iv) possible industrial applications using fungi.



Psilocybe cubensis Photo: Jon MacGillivray

Plant Molecular Biology

Dr Frank Maleka and his students are currently doing research on the molecular genetics of flower pigmentation in the *Clivia* species. This work is based on (i) the development of SSR markers for the identification and differentiation of *Clivia* accessions and cultivars in South Africa; and (ii) the identification of morphogenesis genes in *Clivia* species having pendulous and non-pendulous flowers.

In addition, Dr Maleka collaborates with Dr Gesine Coetzer, of the UFS Department of Soil, Crop and Climate Sciences, on the genetic characterisation of the South African cactus pear (*Opuntia ficus-indica*) germplasm, using molecular tools.

Clivia of different colours



Forensic Genetics

Dr Karen Ehlers and Letecia Wessels specialise in Forensic Genetics. Research activities in this group include the investigation into the genetic diversity of 27 Y-STR loci in different population groups in South Africa and Zimbabwe. The research into human touch DNA is still ongoing with several Honours research projects focusing on this field. As part of the completed PhD of Dr Anton Lucassen, an allele frequency database for criminal cases in South Africa was established. The project also contributed new statistical approaches to interpret Low-Template DNA mixtures and a protocol for the implementation of the probabilistic genotyping. These contributions will assist in reducing the backlog in the analysis of DNA cases at the SAPS. The Forensic Genetics and Forensic Entomology working group under Forensic Genetics identified several research projects of value during 2022. The Department of Genetics also allocated dedicated laboratory space and equipment for the Forensic Entomology laboratory where insects can be reared for research purposes. The research focuses on improving the accuracy of Post Mortem Interval estimations (PMI).

A newly emerged fly (*Chrysomya marginalis*) at the Departmental Forensic Entomology training site

Forensic Sciences

This research group is comprised of Dr Sonja Brink, Dr Tinus Viljoen and Tshepiso Motolo. Their research projects include (i) Forensic entomology rearing experiments under natural conditions; (ii) the use of biometrics in forensics; and (iii) projects on mites as forensic indicator species, pathology vs entomology, insect succession and the use of beetles to determine the PMI; and (iv) the effect of chemical concealment on a carrion ecosystem. The group has

a close collaboration with the South African Doping Control Laboratory (SADoCoL), who present a sports doping module for Honours students and also host some MSc students in Forensic Science.

Wastewater Monitoring

Prof Grobler, Dr Marx and Dr Maleka are involved in a project on the surveillance of wastewater for SARS-CoV-2 gene copies and variants, which is funded by the South African Medical Research Council (SAMRC). During 2022, the SAMRC contributed consumables as well as equipment (a Biosafety Cabinet and a -80 Freezer), and funding for a postdoctoral fellowship. Anneli Pietersen is doing the surveillance study towards her MSc degree.



Dr Mohammed Elmakki, Postdoctoral Fellow, collecting a sample at a wastewater facility

ENGAGED SCHOLARSHIP

Dr Karen Ehlers continued to serve on the National DNA Board. In this capacity, she had the opportunity to visit four regional Forensic Laboratories in South Africa as a member of the National Forensic Oversight and Ethics Board.

Prof Renate Rebello was invited as a panel member for a Professorial Committee at the University of KwaZulu-Natal, as well as appointed as a faculty representative on the Language Committee of the Senate.

Prof Paul Grobler served on the editorial boards of two accredited journals – *Mammalian Biology (Springer)* and *African Journal of Aquatic Sciences (Francis & Taylor)*. Together with Prof Francois Deacon, from the Department of Animal Science, Prof Grobler presented their work on rhino conservation at a meeting of the Free State Hunters Association on 25 May.

Dr Gerda Marx acted as external examiner for three MSc dissertations and a PhD thesis from other institutions. Prof Grobler examined one PhD for the University of Pretoria.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Gordon Luikart, from the University of Montana, spent time in the Department in July. He visited a research field site with Prof Grobler and presented a guest lecture in the Department. As part of his visit, students and staff could participate in online training in bioinformatics and R programming with experts from the University of Montana.

Prof Ahmed Abdel-Azeem, from the Suez Canal University in Egypt, visited the Department in August to discuss collaboration with Dr Marieka Gryzenhout on fungal biodiversity, conservation and industrial applications. During his visit, Prof Abdel-Azeem

presented a guest lecture in the Department.



Prof Ahmed Abdel-Azeem, Suez Canal University, presenting a guest lecture to the Department of Genetics

Dr Gryzenhout also works with the SANBI Invasion Biology Directive.

Prof Paul Grobler collaborated with Prof Antoinette Kotze from the NZG/SANBI on projects related to mammal and avian conservation, as well as with Prof Brian Reilly, from the Department of Nature Conservation at Tshwane University of Technology, on projects in Conservation Biology. Internationally, Prof Grobler works with Prof Frank Zachos (Natural History Museum, Vienna) on mammalian genetics, and with Prof Jess Jones (Department of Fish and Wildlife Conservation, Virginia Tech University, USA) on genetic connectivity in marine and freshwater mussels.

Zurika Murray, from the Behavioural Genetics group, collaborates closely with Stevan Burger from the Jimmie Roos Special School, on research related to the behavioural psychobiology of male juvenile delinquents. She also works with Prof Anandan Moodley (University of KwaZulu Natal) on the Vitamin D biosynthetic pathway genes in patients

with Multiple Sclerosis and Neuromyelitis Optica, and with Hershel Meyerowitz (North-West University) on the genetic aspects of stress management and resilience in nuclear families following the COVID-19 outbreak.

Dr Karen Ehlers maintains close links with various stakeholders in the SAPS. Collaboration with the Forensic community also continued, with the Forensic students visiting the Free State mortuary in Bloemfontein and a visit by the Mangaung Fire Chief, Braam van Zyl, who presented lectures on fire and arson cases.



Students' visit to the Free State mortuary

Chris van der Walt and JC Botha, participating in a practical exercise to extinguish a fire



POSTGRADUATE STUDENTS

The total number of postgraduate students enrolled in 2022 in the Department of Genetics for the various disciplines were

■ HONOURS (Total: 36)

Genetics:	18
Forensic Genetics:	8
Forensic Sciences:	10

■ MSC (Total: 35)

Genetics:	23
Behavioural Genetics:	3
Forensic Genetics:	5
Forensic Sciences:	1
Forensic interdisciplinary:	2
Genetics Interdisciplinary:	1

■ PHD (Total: 14)

Genetics:	7
Forensic Genetics:	3
Forensic Entomology:	1
Conservation Biology:	3

Eleven candidates graduated with the MSc in 2022:

- In Behavioural Genetics: San-Mari Burger
- In Forensic Genetics: Marli de Bruyn, Edward Nqokha, Mosipho Charmaine Sithole, David Nicholas Swanepoel, and Lucinda van der Westhuysen.
- In Genetics: Elmarie Blom, Anke Louw, Elisma Marx and Dominique Strauss.

The PhD was conferred on two candidates in 2022:

Du Toit, Zeldi (Genetics)

Thesis: Linking geographic origin and mitogenomes of the ground pangolin in southern Africa

Supervisor: Prof JP Grobler

Co-supervisor: Prof A Kotze

Lucassen, Anton (Forensic Genetics)

Thesis: Allele frequencies and DNA mixtures in the human forensic environment in South Africa

Supervisor: Dr K Ehlers

Co-supervisor: Prof JP Grobler

POSTDOCTORAL RESEARCH FELLOWS

The Department hosted three Postdoctoral Fellows funded by the UFS Directorate Research Development in 2022. Dr Soumya Ghosh (from India) and Dr Sarah Abdalla (from Sudan) work with Dr Marieka Gryzenhout on fungal research, while Dr Zanyung Zhao (from China) works with Prof Grobler in the field of Conservation Genetics.

A fourth Postdoctoral Fellow, Dr Mohammed Elmakki (from Sudan), was appointed for the wastewater research programme, in a position funded by the SAMRC. He is jointly supervised by Prof Grobler, Dr Marx and Dr Maleka.



Postdocs hosted by the Department of Genetics in 2022, standing, Dr Mohammed Elmakki and Dr Zanyung Zhao, and seated, Dr Sarah Abdalla and Dr Soumya Ghosh

STAFF MATTERS

Dr Morné du Plessis was appointed as a Lecturer in Genetics, replacing Hesmari Bindeman. He brings valuable experience and expertise in Genomics to the Department.

Tshepiso Motolo was appointed as a Lecturer, specialising in Forensic Science, replacing Zeenat



Newly appointed Lecturer in Forensic Science, Tshepiso Motolo

Raffie. Tshepiso Motolo is a forensic entomologist doing research on mites, nematodes, springtails and other invertebrates to determine the forensic significance of these organisms.

Alistair Naidoo started work as a Technician in the Department.

The Department also hosted five interns during 2022. This was

extremely beneficial, with the interns assisting with research activities and some aspects of postgraduate training. One intern assisted with monitoring the 80% class attendance rule by attending classes with a laptop and barcode scanner.

RESEARCH OUTPUTS

Research Articles

Abdelsalam, I.M., Ghosh, S., AlKafaas, S.S., Bedair, H., Malloum, A., ElKafas, S.S. & Saad-Allah, K.M. 2022. Nanotechnology as a tool for abiotic stress mitigation in horticultural crops. *Biologia* 78: 163-178. DOI: 10.1007/s11756-022-01251-z.

Ahmad, N., Vunduk, J., Klaus, A., Dahlan, N.Y., Ghosh, S., Muhammad-Sukki, F., Dufossé, L., Bani, N.A. & Wan-Mohtar, W.A.A.Q.I. 2022. Roles of medicinal mushrooms as natural food dyes and dye-sensitised solar cells (DSSC): Synergy of zero hunger and affordable energy for sustainable development. *Sustainability* 14: 13894. DOI: 10.3390/su142113894.

Ahmadi, S., Ghosh, S., Malloum, A., Bornman, C., Osagie, C., Mohammadi, L. & Igwegbe, C.A. 2022. Modeling the liquid-phase adsorption of cephalixin onto coated iron nanoparticles using response surface and molecular modeling. *Adsorption Science & Technology* Article ID 7619063. DOI: 10.1155/2022/7619063.

Akpomie, O.O., Ejechi, B.O., Banach, A.M., Adewuyi, I., Ayobola, E.D., Akpomie, K.G., Ghosh, S. & Ahmadi, S. 2022. Biogenic amine production from processed

animal and plant protein-based foods contaminated with *Escherichia coli* and *Enterococcus faecalis*. *Journal of Food Science Technology* 59(12): 4880-4888. DOI: 10.1007/s13197-022-05576-0.

Alkafaas, S.S., Abdallah, A.M., Ghosh, S., Loutfy, S.A., Elkafas, S.S., Abdel Fattah, N.F. & Hessien, M. 2023. Insight into the role of clathrin-mediated endocytosis inhibitors in SARS-CoV-2 infection. *Reviews in Medical Virology* 33(1): e2403. DOI: 10.1002/rmv.2403.

Al-Sharify, N.T., Hussein, H.A., Ahmed, S.M., Al-Sharify, T.A., Al-Sharify, Z.T., Onyeaka, H., Abdulrazaq, Z., Miri, N.T. & Ghosh, S. 2022. Polymer resin modelling for chemical and biomedical purposes. *Egyptian Journal of Chemistry* 65(10): 523-529.

Bedair, H., Rady, H.A., Hussien, A.M., Pandey, M., Apollon, W., Alkafaas, S.S. & Ghosh, S. 2022. Pesticide detection in vegetable crops using enzyme inhibition methods: A comprehensive review. *Food Analytical Methods* 15(7): 1979-2000. DOI: 10.1007/s12161-022-02254-x.

Benettayeb, A., Ghosh, S., Usman, M., Seihoub, F.Z., Soho, I., Chia, C.H. & Sillanpää, M. 2022. Some well-known alginate and chitosan modifications used in adsorption: A review. *Water* 14: 1353. DOI: 10.3390/w14091353.

Blom, E., Coetzer, W.G., Schneider, S.R. & Grobler, J.P. 2022. The phylogenetic position of zebrafish (*Danio rerio*) from South African pet shops. *Molecular Biology Reporter* 49(8): 7327-7336. DOI: 10.1007/s11033-022-07522-x.

Doan, K., Niedziałkowska, M., Stefaniak, K., Sykut, M., Jędrzejewska, B., Ratajczak-Skrzatek, U., Piotrowska, N., Ridush, B., Zachos, F.E., et al. 2022. Phylogenetics and phylogeography of red deer mtDNA lineages during the last 50 000 years in Eurasia. *Zoological Journal of the Linnean Society* 194(2): 431-456. DOI: 10.1093/zoolinnean/zlab025.

Dooley, K.B., Madisha, T.M., Strümpher, S. & Ehlers, K. 2022. Forensic genetic value of 27 Y-STR loci (Y-Filer® Plus) in the South African population. *Science & Justice* 62(3): 358-364. DOI: 10.1016/j.scijus.2022.03.009.

Falyouna, O., Maamoun, I., Ghosh, S., Malloum, A., Othmani, A., Eljamal, O., Amen, T.W.M., Oroke, A., Bornman, C., Ahmadi, S., Dehghani, M.H., Mahvi, A.H., Nasser, S., Tyagi, I., Suhas & Koduru, J.R.

2022. Sustainable technologies for the removal of chloramphenicol from pharmaceutical industries effluent: A critical review. *Journal of Molecular Liquids* 368 – Part B: 120726. DOI: 10.1016/j.molliq.2022.120726.

Farahani, R.K., Meskini, M., Langeroudi, A.G., Gharibzadeh, S., Ghosh, S. & Farahani, A.H.K. 2022. Evaluation of the different methods to detect Salmonella in poultry feces samples. *Archives of Microbiology* 204(5): 269. DOI: 10.1007/s00203-022-02840-x.

Gagnon, C.M., Svardal, H., Jasinska, A.J., Cramer, J.D., Freimer, N.B., Grobler, J.P., Turner, T.R. & Schmitt, C.A. 2022. Evidence of selection in the uncoupling protein 1 gene region suggests local adaptation to solar irradiance in savannah monkeys (*Chlorocebus* spp.). *Proceedings of the Royal Society B* 289: 20221254. DOI: 10.1098/rspb.2022.1254.

Ghosh, S., Al-Sharify, Z.T., Maleka, M.F., Onyeaka, H., Maleke, M., Maolloum, A., Godoy, L., Meskini, M., Rami, M.R., Ahmadi, S., Al-Najjar, S.Z., Al-Sharify, N.T., Ahmed, S.M. & Dehghani, M.H. 2022. Propolis efficacy on SARS-COV viruses: A review on antimicrobial activities and molecular simulations. *Environmental Science and Pollution Research* 29(39): 58628-58647. DOI: 10.1007/s11356-022-21652-6.

Ghosh, S., Alkafaas, S.S., Bornman, C., Apollon, W., Hussien, A.M., Badawy, A.E., Amer, M.H., Kamel, M.B., Mekawy, E.A. & Bedair, H. 2022. The application of rapid test paper technology for pesticide detection in horticulture crops: A comprehensive review. *Beni-Suef University Journal of Basic and Applied Science* 11(73): Article number 73. DOI: 10.1186/s43088-022-00248-6.

Ghosh, S., Malloum, A., Bornman, C., Othmani, A., Osagie, C., Esfahani, Z.K., Khanday, W.A., Ahmadi, S. & Dehghani, M.H. 2022. Novel green adsorbents for removal of aniline from industrial effluents: A review. *Journal of Molecular Liquids* 345: 118167. DOI: 10.1016/j.molliq.2021.118167.

Harfouch, R.M., Darwish, M., Beesh, M., Ibrahim, N., Dayoub, H., Zein, R., Ghosh, S. & Ahmadi, S. (2022). Formulation and preparation of a novel toothpaste using the essential oil of *Salvia officinalis*. *International Journal of Biomed Research* 2(7): 1-5. DOI: 10.31579/IJBR-2021/069.

Jacobs, R., Coetzer, W.G. & Grobler, J.P. 2022. A

phylogeographic assessment of the greater kudu (*Tragelaphus strepsiceros*) across South Africa. *Conservation Genetics* 23: 919-933. DOI: 10.1007/s10592-022-01464-4.

Khalifa, E., Mohesien, M.T., Mossa, M.I., Piekutowska, M., Alsuhaibani, A.M., Abdel-Wahab, B.A., Sotohy, A.S., Ghosh, S., Helmy, Y.A., Hussein, M. & Abdel-Azeem, A.M. 2022. Diversity of toxigenic fungi in livestock and poultry feedstuffs. *International Journal of Environmental Research and Public Health* 19: 7250. DOI: 10.3390/ijerph19127250.

Khalil, M.G., Ali, A.A., Hassanin, S.O., Al-Najjar, A.H., Ghosh, S. & Mahmoud, M.O. 2022. Comparative study on the effect of EGCG and wheat grass together with mental and physical activities against induction of Alzheimer's disease in both isolated and socialized rats. *Phytomedicine Plus* 2(1): 100146. DOI: 10.1016/j.phyplu.2021.100146.

Kinge, T.R., Ghosh, S., Cason, E.D. & Gryzenhout, M. 2022. Characterization of the endophytic mycobiome in cowpea (*Vigna unguiculata*) from a single location using Illumina sequencing. *Agriculture* 12: 333. DOI: 10.3390/agriculture12030333.

Kumar, P., Mathpal, M.C., Ghosh, S., Inwati, G.K., Maze, J.R., Duvenhage, M-M., Roos, W.D. & Swart, H.C. 2022. Plasmonic Au nanoparticles embedded in glass: Study of TOF-SIMS, XPS and its enhanced antimicrobial activities. *Journal of Alloys and Compounds* 909: 164789. DOI: 10.1016/j.jallcom.2022.164789.

Mackiewicz, P., Matosiuk, M., Świsłocka, M., Zachos, F.E., Hajji, G.M., Saveljev, A.P., Seryodkin, I.V., Farahvash, T., Rezaei, H.R., Torshizi, R.V., Mattioli, S. & Ratkiewicz, M. 2022. Phylogeny and evolution of the genus *Cervus* (Cervidae, Mammalia) as revealed by complete mitochondrial genomes. *Scientific Reports* 12: 16381. DOI: 10.1038/s41598-022-20763-x.

Magliolo, M., Naude, V.N., Van der Merwe, V.C., Prost, S., Orozco-terWengel, P., Burger, P.A., Kotze, A., Grobler, J.P. & Dalton, D.L. 2023. Simulated genetic efficacy of metapopulation management and conservation value of captive reintroductions in a rapidly declining felid. *Animal Conservation*. DOI: 10.1111/acv.12821.

Nxumalo, K.S., Grobler, J.P., Ehlers, K., Nesengani, L.T. & Mapholi, N.O. 2022. The genetic assessment of South African nguni sheep breeds using the ovine 50K chip. *Agriculture* 12: 663. DOI: 10.3390/

agriculture12050663.

Osagie, C., Daniel, C.E., Igwegbe, C.A., Ghosh, S. & Ahmadi, S. 2022. Informative statistical analysis on COVID pandemic and population as a whole. *Annals of Urology Practice and Research* 1(1): 1001.

Pambuka, G.T., Kinge, T.R., Ghosh, S., Cason, E.D., Nyaga, M.M. & Gryzenhout, M. 2022. Plant and soil core mycobiomes in a two-year sorghum-legume intercropping system of underutilized crops in South Africa. *Microorganisms* 10: 2079. DOI: 10.3390/microorganisms10102079.

Prost, S., Machado, A.P., Zumbroich, J., Preier, L., Mahtani-Williams, S., Meissner, R., Guschanski, K., Brealey, J.C., Fernandes, C.R., Vercammen, P., Hunter, L.T.B., Abramov, A.V., Plasil, M., Horin, P., Godsall-Bottriell, L., Bottriell, P., Dalton, D.L., Kotze, A. & Burger, P.A. 2022. Genomic analyses show extremely perilous conservation status of African and Asiatic cheetahs (*Acinonyx jubatus*). *Molecular Ecology* 31(16): 4208-4223. DOI: 10.1111/mec.16577.

Strauss, D., Ghosh, S., Murray, Z. & Gryzenhout, M. 2022. An overview on the taxonomy, phylogenetics and ecology of the psychedelic genera *Psilocybe*, *Panaeolus*, *Pluteus* and *Gymnopilus*. *Frontiers in Forests and Global Change* 5: 813998. DOI: 10.3389/ffgc.2022.813998.

Strauss, D., Ghosh, S., Murray, Z. & Gryzenhout, M. 2022. Psilocybin containing mushrooms: A rapidly developing biotechnology industry in the psychiatry, biomedical and nutraceutical fields. *3 Biotech* 12(12): 339. DOI: 10.1007/s13205-022-03355-4.

Supramani, S., Rejab, N.A., Ilham, Z., Wan-Mohtar, W.A.A.I. & Ghosh, S. 2022. Basal stem rot of oil palm incited by *Ganoderma* species: A review. *European Journal of Plant Pathology* 164: 1-20. DOI: 10.1007/s10658-022-02546-2.

Tedersoo, L., Mikryukov, V., Zizka, A., Bahram, M., Hagh-Doust, N., Anslan, S., Prylutskiy, O., Delgado-Baquerizo, M., Maestre, F.T., Pärn, J., Öpik, M., Moora, M., Zobel, M., Espenberg, M., Mander, Ü., Khalid, A.N., Corrales, A., Agan, A., Vasco-Palacios, A.M., Saitta, A., Rinaldi, A.C., Verbeken, A., Sulistyo BP, Tamgnoue B, Furneaux B, Ritter CD, Nyamukondiwa C, Sharp C, Marín C, Gohar D, Klavina D, Sharmah D, Dai DQ, Nouhra E, Biersma EM, Rähn E, Cameron EK, De Crop E, Otsing E, Davydov EA, Albornoz FE, Brearley FQ, Buegger F, Zahn G, Bonito G, Hiiesalu I, Barrio IC, Heilmann-Clausen J, Ankuda J, Kupagme

JY, Maciá-Vicente JG, Fovo JD, Geml J, Alatalo JM, Alvarez-Manjarrez J, Põldmaa K, Runnel K, Adamson K, Bråthen KA, Pritsch K, Tchan KI, Armolaitis K, Hyde KD, Newsham KK, Panksep K, Lateef AA, Tiirmann L, Hansson L, Lamit LJ, Saba M, Tuomi M, Gryzenhout M, Bauters M, Piepenbring M, Wijayawardene N, Yorou NS, Kurina O, Mortimer PE, Meidl P, Kohout P, Nilsson RH, Puusepp R, Drenkhan R, Garibay-Orijel R, Godoy R, Alkahtani S, Rahimlou S, Dudov SV, Pölme S, Ghosh S, Mundra S, Ahmed T, Netherway T, Henkel TW, Roslin T, Nteziriyayo V, Fedosov VE, Onipchenko VG, Yasanthika, W.A.E., Lim, Y.W., Soudzilovskaia, N.A., Antonelli, A., Kõljalg, U. & Abarenkov, K. 2022. Global patterns in endemicity and vulnerability of soil fungi. *Global Change Biology* 28(22): 6696-6710. DOI: 10.1111/gcb.16398.

Udensi, U.O., Emeagi, I.L., Daniel, V.E., Tentishe, T.L., Ghosh, S. & Achilonu, C.C. 2022. Insight to the genetic diversity of pigeon pea *Cajanus cajan* (L.) Millsp. and cowpea *Vigna unguiculata* (L.) Walp. germplasm cultivated in Nigeria based on *rbcl* gene region. *Genetic Resources and Crop Evolution* 69: 2231-2248. DOI: 10.1007/s10722-022-01373-y.

Zachos, F.E. 2022. Kostas Kampourakis & Tobias Uller (eds.), *Philosophy of Science for Biologists*, Cambridge: Cambridge University Press, 2020. *History and Philosophy of the Life Sciences* 44: 44. DOI: 10.1007/s40656-022-00526-7.

Books/Chapters in Books

Conix, S., Garnett, S.T., Zachos, F.E. & Christidis, L. 2022. Taxonomic order, disorder, and governance. In: *Species problems and beyond: Contemporary issues in philosophy and practice*. J.S. Wilkins, F.E. Zachos, & I. Pavlinov (Eds). (1st Ed.). CRC Press, Boca Raton. 14 pages.

Wilkins, J.S., Zachos, F.E. & Pavlinov, I. 2022. *Species problems and beyond: Contemporary issues in philosophy and practice*. CRC Press, Boca Raton.

Zachos, F.E. 2022. Critique of Taxonomic Reason(ing): Nature's Joints in Light of an 'Honest' Species Concept and Kurt Hübner's Historistic Philosophy of Science. In: *Species problems and beyond: Contemporary issues in philosophy and practice*. J.S. Wilkins, F.E. Zachos, & I. Pavlinov (Eds). (1st Ed.). CRC Press, Boca Raton. 26 pages.

Conference Contributions

Conference Papers/Posters

Al-Sharify, T.A., Alshrefy, Z.A., Hussein, H.A., Al-Sharify, Z.T., Onyeaka, H., Al-Sharify, M.T. & Ghosh, S. 2022. *IoT and e-learning with the impact of COVID 19 pandemic lockdown on the undergraduate university student blood pressure levels*. Paper delivered at the Proceedings of the Selected Papers of the Workshop on Emerging Technology Trends on the Smart Industry and the Internet of Things (TTSIIT 2022), Kyiv, Ukraine. 19 January 2022.

Gafforov, Y., Teshaboeva S., Kholmuradova, T., Makhkamov, T., Abduboyeva, N., Abdurazakov, A., Normakhmatov, N., Rapior, S. & Ghosh, S. 2022. *Biodiversity of fungi and fungus like organism on Solanum species in Uzbekistan*. Paper delivered at the 3rd International Eurasian Mycology Congress (EMC'22), Van, Türkiye. 7-9 September 2022.

Mills, P.J., Reilly, B.K. & Grobler, J.P. 2022. *Can biodiversity persist under current conservation regimes In Africa?* Paper delivered at the annual symposium of the Southern African Wildlife Management Association, held at Bonamanzi Private Nature Reserve, South Africa. 4-9 September 2022.

Conference Proceedings

Al-Sharify, Z.T., Al Jaaf, H.J.M., Naser, Z.A.R., Alshrefy, Z.A.I., Al-Sharify, N.T., Al-Sharify, T.A., Ghosh, S., Onyeaka, H. & Miri, T. 2022. Validating sustainable water resources and fluid flow by studying phosphorus concentration of Tigris river water in Baghdad. In: *4th International Conference on Materials Engineering & Science, AIP Conference Proceedings*. 2660, 020127. AIP Publishing. <https://doi.org/10.1063/5.0109481>.

STAFF (2022)

Head of Department:
Prof JP Grobler

Professor:	Prof JP Grobler
Associate Professor:	Prof R Rebello
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, Z Murray, Z Raffie, Dr T Viljoen and L Wessels
Affiliated Professors:	Prof FE Zachos (National History Museum, Austria) Prof A Kote(NZG-SANBI) and Prof BK Reilly (Tshwane University of Technology)
Affiliated Lecturer:	Lt Col A Lucassen (SAPS)
Senior Professional Officer:	M Mangana
Financial Officer:	B Henn
Technician:	A Naidoo
Lab Manager:	B Radise
Reception:	B Segole

DEPARTMENT OF
GEOGRAPHY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Prof Samuel Adelabu

Department of Geography

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 9927

E: AdelabuSA@ufs.ac.za

W: www.ufs.ac.za/geography

QWAQWA CAMPUS

Dr Melissa Hansen

Department of Geography

Faculty of Natural Sciences

University of the Free State

Private Bag X13 | Phuthaditjhaba

9866 South Africa

T: +27 58 718 5473

E: HansenMM@ufs.ac.za

W: www.ufs.ac.za/geography

OVERVIEW OF 2022

The Department of Geography strives to maintain high academic quality, but also to provide a curriculum that is current and responsive to the needs of the students. The Department offers a variety of programmes to undergraduates and various staff expertise to postgraduate students. The Department is spread over two UFS campuses, namely the Bloemfontein Campus and the Qwaqwa Campus.

The Department had a fruitful 2022, with one staff member obtaining a C2 National Research Foundation (NRF)-rating, a substantial increase in publications,

two new appointments, one promotion, multiple collaborations and a good presence on public forums. With the easing of COVID-19 restrictions, the Department was able to enjoy the full return of fieldwork, workshops, conferences and excursions.

ACHIEVEMENTS

Staff Achievements

Dr Jay le Roux received a C2 NRF-rating. This brings the total number of NRF-rated scientists in the Geography Department to four (excluding research fellows).

Dr Sifiso Xulu was selected to be part of the second cohort of the Future Professoriate Programme at the UFS.

Tobeka Mehlomakhulu was appointed as an adjudicator for the Master's Bronze Medal award from the *South African Geographical Journal*.

Dr Adriaan van der Walt was invited to be a plenary speaker at the 8th South Asia Heat Health Information Network Master Class, with a talk titled 'Heat Stress Mitigation and Adaptation Perspectives in South Africa'. The presentation took place online on 20 May 2022. He was also nominated for the Outstanding Review Award in 2021 for the *South African Journal of Science* (SAJS) and selected as an Associate Editor Mentee of the *South African Journal of Science Mentor Programme* for the period 2022-2023.

Dr Abraham Matamanda was appointed as the Editor of the *Town Planning Journal*, published by the UFS. His appointment to this editorial position was effective from 1 September 2022. Dr Matamanda also co-edited a special issue on 'Feeding the Growing Cities of sub-Saharan Africa', in *Frontiers in Sustainable Food System*. Additionally, he was appointed as an executive member of the South African Research Chair Initiative (SARChI) Chair in City Regions, chaired by Prof Ivan Turok. Dr Matamanda was also selected to be part of the second cohort of the Future Professoriate Programme at the UFS. In July 2022, he was invited by the Department of Architecture and Real Estate at the University of Zimbabwe to facilitate a writing workshop with postgraduate students reading for their Master's and Doctoral degrees.

Student Achievements

Zandile Mncube, a PhD candidate in the Department on the Qwaqwa Campus, won second prize for her presentation at the Qwaqwa Campus Research Conference, held from 29 to 30 September 2022.

Master's student Ayabonga Gangathele received the 'Best Student Presentation' at the National Wetland Indaba that took place at the Golden Gate Highlands National Park from 24 to 27 October 2022.



Madikizela of the Water Research Commission hands the 'Best Student Presentation' prize to Gangathele

TEACHING AND LEARNING

Dr Abraham Matamanda and Prof Verna Nel (Department of Urban and Regional Planning) held a number of writing workshops with postgraduate students from the Geography and Urban and Regional Planning departments during the year.

Tobeka Mehlomakhulu conducted an excursion to Thaba 'Nchu rural areas for Honours and third-year

students to expose them to the rural setting. This enhanced their learning on issues affecting rural development. She also led an excursion around Bloemfontein for first-year students, to enhance their learning on urban systems.

RESEARCH AND INNOVATION

Dr Abraham Matamanda was awarded an NRF grant, for which he is the global principal investigator (PI) of a team researching COVID-19 and its impacts on young people from monetary poor households (<https://panexyouth.com>). In this project, Dr Matamanda is collaborating with researchers from University College London in the UK, and Sao Paulo University, Brazil.

Dr Jay le Roux was the project leader of a Water Research Commission (WRC)-funded project titled 'A South African national input database to run the SWAT model in a GIS'. The aim was to establish a national input database to run the SWAT model in a GIS that is made available as an open-source

baseline, to standardise SWAT modelling efforts in South Africa. In collaboration with Texas A&M University and the Agricultural Research Council (ARC), the study provides geo-spatial input datasets in 'cloud storage' required as input by SWAT. This project is also part of the WRC-funded Water Research Observatory that will serve as a cloud-based big data platform for water-related data and information in South Africa. The purpose of the platform is to create models for big data analytics, such as machine learning, and the building of application programming interfaces to enable data visualisation and data-driven decision-making at various levels. The PI of that project is Prof Michael van der Laan, from the ARC, and includes researchers from three other universities – University of Florida, University of Pretoria and the University of KwaZulu-Natal. The platform website interface can be viewed at www.waterresearchobservatory.org.

Dr Liezel Rudolph went on an expedition to Gough Island in the south Atlantic Ocean. The objectives of her fieldwork were to undertake a geomorphological survey of the island and explore the suitability of geochronological dating techniques on the island's substrate.



Dr Liezel Rudolph on Gough Island

Earlier in the year, Marike Stander assisted on a research expedition to Marion Island, also in the south Atlantic Ocean. One of the research objectives was to explore the viability of using geochemical tracers in the substrate on Marion Island, which is the focus of Stander's doctoral research. Both of these research expeditions are Sub-Antarctic Landscape Climate Interactions-National Research Foundation (SALCi-NRF) funded projects, which aim to better understand the landscape evolution of some sub-Antarctic Islands and their response to long-term climate change. The research is co-led by Prof Werner Nel (University of Fort Hare) and Prof David Hedding (UNISA), and is undertaken in collaboration with the British Antarctic Survey. The expedition was supported by the South African National Department of Forestry, Fisheries and Environment, the NRF and The Royal Society for the Protection of Birds.

Dr Adriaan van der Walt received funding from the NRF South African and Japan Joint Collaboration for the proposed collaborative project titled, 'Analysis of climate influences on medical conditions and diseases'. He is also a member of a consortium of collaborators and researchers who received funding from the NRF Earth Systems Science Research Programme (ESSRP) for a proposed project titled 'Application of knowledge for the management of Extreme Climate Events (APECX)'. Dr Van der Walt will collaborate on two of six working groups -

WG2 (Agriculture): Assessment of intensification of extreme dry or wet events for improved prediction of crop production and losses and impact in three climate zones, and WP4 (Health): Predictability extreme incidence [outbreaks] of selected infectious disease air quality incidents and heatwave impacts for early warning of risk exceedance and the long-term trends. These packages are on-going.



Dr Adriaan van der Walt

Team members of the WRC-funded Water Research Observatory, from the left, Prof Michael van der Laan (ARC), Dr Jay le Roux (UFS), Cindy Viviers (University of Pretoria) and Simphiwe Maseko (University of Pretoria)



ENGAGED SCHOLARSHIP

Prof Samuel Adelabu was invited as a guest lecturer for WSC 912: Remote Sensing, Radar and Satellite Applications in Climate Science, at the Federal University of Technology, Akure, Nigeria, in April 2022. He was also a guest editor for the special issue on 'Remote Sensing Applications in Agriculture, Earth and Environmental Sciences' of the *Applied Sciences*

journal for 2022 to 2023, as well as lead editor for the book *Remote Sensing of African Mountains – Geospatial Tools towards Sustainability*, published by Springer Nature, in 2022.

A number of people associated with the Department of Geography were involved in the organisation of and participated in 1st Southern African Mountain Conference (SAMC22), held from 14 to 17 March 2022 at the Champagne Sports Resort. Dr Ralph Clark (ARU and affiliated to the Department) was Chair of the Local Organising Committee and Prof Adelabu was co-chair of the Scientific Committee and member of the Local Organising Committee, while Ntebohiseng Sekhele chaired a session on 'Communities and Livelihoods (Tourism)'. A number of students and staff presented at the conference.

Prof Geoffrey Mukwada and Dr Melissa Hansen

were invited participants to a workshop held at the Champagne Sports Resort from 11 to 14 December 2022, titled 'Maloti-Drakensberg: Safeguarding and Preservation of the Dragon Heritage'. The Workshop brought together participants from the Batlokoa and Bakoena Royal House, civil society, academia, government and local community to discuss the sustainable development of the Maloti-Drakensberg, under the themes of weather, water resources, ecology/environment, land use and human life.

Dr Adriaan van der Walt served on the Scientific Committee of the 1st Health Geography Symposium, held in an online format on 15 December 2022.

Dr Sifiso Xulu chaired a session on Environmental Issues and Challenges in Sub-Saharan Africa at the UGI-IGU Paris 2022 Centennial Congress (18 to 22 July 2022).

The Geography Department was very active in presenting their research on public forums. Dr Liezel Rudolph's research appeared in four articles in public media, shedding light on how the landscape can give us a better understanding of climate change:

- *UFS News*. 'Landscape change studies bring better understanding of climate change', 3 November 2022, by Leonie Bolleurs. Available at: <https://www.ufs.ac.za/templates/news-archive/campus-news/2022/november/landscape-change-studies-bring-better-understanding-of-climate-change>.
- *EOS 103*. 'Geospatial database for the Prince Edward Islands', 9 November 2022, by Munyaradzi Makoni. Available at: <https://doi.org/10.1029/2022E0220526>.
- *The Citizen*. 'Study of sub-Antarctic islands sheds more light on climate change', 18 November 2022, by Sipho Mabena. Available at: <https://www.citizen.co.za/news/study-sub-antarctic-islands-sheds-light-climate-change/>.
- *News24 BloemNuus*. 'Landscape change studies bring better understanding of climate change', 28 November 2022. Available at: <https://www.news24.com/news24/community-newspaper/bloemnuus/landscape-change-studies-bring-better-understanding-of-climate-change-20221128-2>.

Dr Adriaan van der Walt participated the following engagements on public forums:

- A television interview on *Kyknet Verslag* on 14 April 2022, on 'Flooding in KwaZulu Natal'.
- An article in *Sunday Times* on 17 April 2022, titled 'We are reaping the whirlwind'.
- A television interview on *Fokus* – 'Oorstromings in KwaZulu-Natal' – on 4 May 2022.
- An article on *Netwerk24* on 21 July 2022, on 'Hittegolwe hou ook 'n waarskuwing vir suider Afrika in'.

An article on Dr Melissa Hansen's research was published in *Ke Eo Taba*, the Qwaqwa Campus newsletter, in August 2022, titled 'Translocal Learning Research Reveals' by Nonsindiso Qwabe. Available at: https://www.ufs.ac.za/docs/default-source/publications/p1_ke-eo-tabo-magazine.pdf?sfvrsn=d24b4820_9.

Marike Stander also featured in public article on *UFS News* titled, 'Journey of a lifetime: Marike Stander joins research expedition to Marion Island', by Leonie Bolleurs, 05 August 2022. Available at: https://www.ufs.ac.za/templates/news-archive-item/campus-news/2022/august/journey-of-a-lifetime-marike-stander-joins-research-expedition-to-marion-island?fbclid=IwAR3PCLFmN6Z461_7N-iiI91aro2vn3uIMjTV91XrC5DFXJzoEARHjB-9m1l.



Marike Stander on Marion Island

Some members of the Department of Geography at SAMC2022. Back, from the left, Marike Stander, Dr Bonginkosi Vilakazi, Dr Jay le Roux and Dr Melissa Hansen; Middle, from the left, Dr Katlego Mashiane, Dr Adriaan van der Walt, Prof Samuel Adelabu, Nkadimo Motlohi and Dr Efosa Adagbasa; front, from the left, Sipiwe Ngwenya, Dr Hardlife Zinhiva and Solomon Zondo



NATIONAL AND INTERNATIONAL COLLABORATION

Prof Samuel Adelabu spent just over a month on invitation as a scholar to the Department of Land, Air and Water Resources at the University of California,



Prof Samuel Adelabu (fourth from left) with research members from the Department of Land, Air and Water Resources at the University of California, after his presentation to the department

(UCD) Campus. He was hosted by Prof Yufang Jin, the leader of the remote sensing group at that university. During his visit he presented to various groups, including the Hydrological Science Group and Remote Sensing Group.

Prof Geoffrey Mukwada continued to serve as the coordinator of the Mountain-to-Mountain Programme between Appalachian State University and UFS. As part of this, meteorological stations are being set up in the Maloti-Drakensberg Mountains to monitor the climate of the highly fragile environment using a Wireless Sensor Network (WSN). As part of the programme, during 2022, Prof Mukwada completed three Automatic Weather Stations. These stations are the highest in southern Africa and their establishment is opening a new frontier of mountain climate change research.



Prof Jesse Lutabingwa (left), Associate Vice-Chancellor of Appalachian State University and co-director of the Mountain to Mountain Research Project, and Prof Geoffrey Mukwada (right), coordinator of the Programme, checking the Weather Station set up at Witsieshoek

Prof Mukwada also continued to render his services as the coordinator for the University Staff Doctoral Programme, a collaboration between UFS and University of Venda in South Africa, and three universities in the USA, namely Appalachian State

University, Colorado State University and University of Montana.

Dr Abraham Matamanda is co-investigator with Prof Thulisile Mphambukeli on a project funded by the National Institute for the Humanities and Social Sciences (NIHSS), exploring the political economy of agricultural land policies in China and South Africa. He is also working on a project on urban agriculture in southern Africa, together with Postdoctoral Fellow, Dr Joe Bhanye, and Dr Joseph Musara and Extraordinary Professor Daniel Tevera from the University of the Western Cape.

Dr Liezel Rudolph leads a UFS interdisciplinary project titled 'Digital Landscapes', which brings together other researchers from the UFS Departments of Geography (Dr Jay le Roux) and Geology (Dr Martin Clark), and, in the Faculty of the Humanities, the Departments of Linguistics and Language Practice (Dr Marlie van Rooyen and Prof Kobus Marais for Translation Studies) and Art History and Visual Studies (Dr Martin Rossouw for Visual Media). The project aims to document significant South African geosites by developing digital records with the aid of drone videography and immersive 3-D photospheres. After a first successful digitisation expedition to the Barberton Makhonjwa Geotrail in February 2022, the Kgaswane Mountain Reserve offered the team the opportunity in November 2022 to similarly document the rare drainage system of the Waterkloofspruit Peatland, which will



Fieldwork excursion to the Kgaswane Wetlands (from the left) Dr Marlie van Rooyen, Dr Liezel Rudolph, Prof Kobus Marais, Dr Jay le Roux, Dr Martin Rossouw and Dr Martin Clark

include a multilingual descriptive narrative for both pedagogical and public use.

Dr Melissa Hansen hosted a Global Field Exercise in Qwaqwa in August 2022, with Prof Shogo Kudo, from Akita International University, and Kanako

Matsuyama, from the International Christian University and the Japan International Cooperation Agency (JICA) and Ogata Sadako, from Research Institute for Peace and Development. This was the latest iteration in a project on Trans-local Learning that has been ongoing since 2017. The main purpose of



Fanafikile Lephaka, Dr Melissa Hansen, Kanako Matsuyama, Prof Shogo Kudo and Dr Ralph Clark during the Global Field Exercise in Qwaqwa

trans-local learning is to create an iterative learning space to obtain new ideas and perspectives that would help practitioners, researchers and residents realise alternative interpretations regarding their communities. A series of Global Field Exercises have been held in Qwaqwa and Gojome in Akita, Japan, on the relationship between young return-migrants and sustainable development.

Dr Hansen also visited the National University of Lesotho with a delegation led by Prof Francis Petersen, Vice-Chancellor of the UFS, on 8 September 2022. She presented her work on the political ecology of the Maloti-Drakensberg Transfrontier Conservation Area. She also participated in the first Post-Lucid symposium at Lund University in Sweden (online), held from 27 to 28 October 2022, during which she delivered a paper titled 'Producing Space: Human-Mountain Relationships in the Maloti-Drakensberg Transfrontier Conservation Area'. LUCID (Lund

University Centre for the Integration of Social and Natural Dimensions of Sustainability) is the Formas-funded research programme, under which Dr Hansen completed her PhD.

POSTGRADUATE STUDENTS

The Department of Geography offers a variety of postgraduate programmes on the two campuses. In 2022, the Department hosted 20 Honours students, 24 Master's students and 29 PhD candidates, enrolled in the various programmes offered.

During the April and December graduations 15 honours degrees were awarded, and the following Master's degrees were conferred:

- Bosman, BL: MSc in Geography (with distinction)
- Mncube, Z: MSc in Environmental Geography
- Morake, L: MSc in Geography
- Mukwevho, R: MSc in Geography

POSTDOCTORAL RESEARCH FELLOWS

Prof Samuel Adelabu supervised two Postdoctoral Fellows, namely Dr Adeyemi Olusola (2020-2022) and Dr Simbarashe Jombo (2021-2022), whose terms ended in December 2022.

Dr Abraham Matamanda is hosting Dr Joe Bhanye for his Postdoctoral Fellowship, focusing on urban land governance in southern Africa.

Dr Sarah Roffe was a Postdoctoral Fellow, hosted by Dr Adriaan van der Walt. Their research is focused on developing an understanding of the atmospheric circulation mechanisms driving hot and cold extreme temperature events and their spatiotemporal patterns across southern Africa from 1979 to 2021.

Prof Geoffrey Mukwada hosted Dr Efosa Adagbasa and Dr Hardlife Zinhiva. The former is researching the impacts of climate change on plant species distribution in the Golden Gate Highlands National

Park, while the latter is dealing with the relationship between climate change and indigenous knowledge systems.

STAFF MATTERS

Dr Sifiso Xulu from Qwaqwa Campus was promoted to Senior Lecturer and Dr Abraham Matamanda, from Bloemfontein Campus, was also promoted to Senior Lecturer, effective from 1 January 2023.

Katlego Mashiane was appointed as Professional Officer on the Bloemfontein Campus, and Solomon Zondo was appointed as Lecturer on the Qwaqwa Campus.

Dr Mbali Pewa and Dr Mischka Dunn left the Department to take up other positions.

RESEARCH OUTPUTS

Research Articles

Adagbasa, E.G., Adelabu, S.A. & Okello, T.W. 2022. Application of deep learning with stratified K-fold for vegetation species discrimination in a protected mountainous region using Sentinel-2 image. *Geocarto International* 37(1): 42-162.

Adagbasa, E.G. & Mukwada, G. 2022. Mapping vegetation species succession in a mountainous grassland ecosystem using Landsat, ASTER MI, and Sentinel-2 data. *PloS One* 17(1): p.e0256672.

Adams, L.D., Martin G.D., Downs, C., Clark, V.R., Thabethe, V., Raji, I. & Steenhuisen, S. 2022. Seed dispersal by frugivores and germination of the invasive alien shrub *Pyracantha angustifolia* (Franch.) C.K. Schneid. in Free State Province, South Africa. *Biological Invasions* 24: 2809-2819.

Adeyeye, D., Olusola, A.O., Orimoloye, I.R., Singh, S. & Adelabu, S.A. 2022. Carbon footprint assessment and mitigation scenarios: a benchmark model for GHG indicator in a Nigerian University. *Environment, Development and Sustainability* (Online): 1-22.

Boardman, J. 2022. Footpath erosion: assessment, extent and impacts with especial reference to the UK. *Geography* 107(2):60-69.

Boardman, J. 2022. Sunken lanes in southern England: A review. *Proceedings of the Geologists' Association* 133: 481-490. DOI: 10.1016/j.pgeola.2022.06.001.

Clark, V.R., Burrows, J., Turpin, B., Balkwill, K., Lötter, M. & Siebert, S. 2022. The Limpopo-Mpumalanga-Eswatini Escarpment-extra-ordinary endemic plant richness and extinction risk in a summer rainfall Montane region of Southern Africa. *Frontiers in Ecology and Evolution* 10: 765854-1 - 765854-18.

Charzynski, P., Urbanska, M., Capra, G., Ganga, A., Holmes, P.J., et al. 2022. A global perspective on soil science education at third educational level; knowledge, practice, skills and challenges. *Geoderma* 425: 116053-1 - 116053-16.

Daemane, M.E., Ramoelo, A., Adelabu, S.A., Bezuidenhout, H. & Brown, L. 2022. Plant community assemblages and environmental drivers in the mountainous grassland ecosystem of South Africa. *Phytocoenologia* 51(3): 263-274.

Denoon-Stevens, S.P., Andres, L., Jones, P., Melgaco, L., Massey, R.T. & Nel, V.J. 2022. Theory versus practice in planning education: The view from South Africa. *Planning Practice and Research* 37(4): 509-525.

Fashae, O., Fatayo, O. & Olusola, A.O. 2022. Riparian health conditions of headwater streams in Southwestern Nigeria. *International Journal of River Basin Management* 2022: 1-12.

Fashae, O., Obateru, R., Olusola, A.O. & Dragovich, D. 2022. Factors controlling gully morphology on the quartzite ridges of Ibadan, Nigeria. *CATENA* 216: 106127-1 - 106127-15.

Favis-Mortlock, D., Boardman, J., Foster, I. & Sheppard, M. 2022. Comparison of observed and DEM-driven field-to-river routing of flow from eroding fields in an arable lowland catchment. *CATENA* 208. DOI: 10.1016/j.catena.2021.105737.

Filho W.L., Ternova L., Fayyaz, M.M., Abubakar, I.R., Kovaleva, M., Donkor, F.K., Anuga, S.W., Matamanda, A.R., Djekic I., Umar I.A., Olooto, F.M., Meirelles, M., Nagy, G.J., May, J., May, M., Ebuoma, E. & Begum H. 2022. An analysis of climate change and health hazards: results from an international study. *International Journal of Climate Change Strategies and Management* 14(4) DOI: 10.1108/IJCCSM-08-2021-0090.

Fitchett, J.M. & Van der Walt, A.J. 2022. Research

in Africa to tackle the climate change crises *QUEST Science for South Africa* 18(1).

Foster, I., Boardman, J., Evans, J., Copeland-Phillips, R., Vadher, A., Wright, S., Collins, A. & Manning, C. 2022. Anthropogenic sediment traps and network dislocation in a lowland UK river. *Earth Surface Processes and Landforms* 47: 143-158.

Gomes-da-Silva, J., Filardi, F.L.R., Barbosa, M.R.V., Baumgratz, J.F.A., Vidal Junior, J.D.D., et al. 2022. Brazilian Flora 2020: Leveraging the power of a collaborative scientific network. *Taxon* 71(1): 178-198.

Haider, S., Lembrechts, J., ..., Clark, V.R., ... Gwate, O., et al. 2022. Think globally, measure locally: The MIREN standardized protocol for monitoring plant species distributions along elevation gradients. *Ecology and Evolution* 12(2): e2:1-e2:16.

Jombo, S.S., Adam, E., Byrne, M. & Newete, S. 2022. Assessing the intraurban differences in vegetation coverage and surface climate in a heterogeneous area. *Transactions of the Royal Society of South Africa* 77(1): 1-10.

Jombo, S.S., Adam, E. & Tesfamichael, S. 2022. Classification of urban tree species using LiDAR data and WorldView-2 satellite imagery in a heterogeneous environment. *Geocarto International* 37(25): 9943-9966. DOI: 10.1080/10106049.2022.2028904.

Kofler, C., Mair, V., Comiti, F., Zebisch, M., Schneiderbauer, S. & Steger, S. 2022. Towards a sediment transfer capacity index of rock glaciers: Examples from two catchments in South Tyrol, (Eastern Italian Alps). *CATENA* 216: 106329-1 - 106329-14. DOI: 10.1016/j.catena.2022.106329.

Kruger, E. & Pohlo, R. 2022. Analysis of biodiversity impacts in mining environmental impact assessments before and after 2013 from Mpumalanga province, South Africa. *Environmental Monitoring & Assessment* 194, 521. DOI: 10.1007/s10661-022-10190-w

Lefulebe, B. E., Van der Walt, A.J. & Xulu, S. 2022. Fine-scale classification of urban land use and land cover with machine learning strategies in the City of Cape Town, South Africa. *Sustainability* 14: 9139. DOI: 10.3390/su14159139.

Lemanski, C. & Massey, R.T. 2022. Is the grid people or product? Relational infrastructure networks in Cape Town's energy-housing nexus. *Urban Geography* 2022: 1-25.

Le Roux, J.J., Morake L., Anderson R.L., Van der Waal, B. & Hedding, D.W. 2022. Intra-gully mapping of the largest documented gully network in South Africa using UAV photogrammetry: Implications for restoration strategies. *Progress in Physical Geography* 46(5): 772-789. DOI: 10.1177/03091333221101057.

Magadzire, T., Hoell, A., Nakalembe, C. & Tongwane, M.I. 2022. Editorial: Recent advances in agrometeorological analysis techniques for crop monitoring in support of food security early warning. *Frontiers in Climate* 4: 950447-1 - 950447-3.

Mapuru, M.J., Olusola, A.O. & Adelabu, S.A. 2022. From fossil-dependent energy to a clean, non-polluting energy: wind farms in Maluti-A-Phofung municipality, South Africa. *Development Southern Africa* 39(6): 973-989.

Mararakanye, N., Le Roux, J.J. & Franke, A.C. 2022. Long-term water quality assessments under changing land use in a large semi-arid catchment in South Africa. *Science of the Total Environment* 818: 151670. DOI: 10.1016/j.scitotenv.2021.151670.

Matamanda, A.R. 2022. Gatekeeper politics and urban planning research in the contested space of an emerging settlement: reflection on experiences in Hopley farm settlement, Harare. *International Journal of Social Research Methodology* (Online). DOI: 10.1080/13645579.2022.2097393.

Matamanda, A.R. 2022. Genesis of Hopley Farm Informal settlement in independent Harare, Zimbabwe. *African Geographical Review* (Online). DOI: 10.1080/19376812.2022.2117216.

Matamanda, A.R., Dunn, M. & Nel, V. 2022. Broken bridges over troubled waters: COVID-19 and the urban poor residing in Dinaweng informal settlement, Bloemfontein, South Africa. *South African Geographical Journal* 104(3): 309-327. DOI: 10.1080/03736245.2022.2028669.

Matamanda, A.R., Mafuku, S.H. & Bhanye, J.I. 2022. The potential of Chinhoyi as a fast-growing secondary city in addressing urban challenges in Zimbabwe. *Journal of Asian and African Studies* (Online). DOI: 10.1177/00219096221137660.

Matamanda, A.R., Mandebvu-Chaora, C. & Rammile, S. 2022. The interplay of urban agriculture and spatial (in)justice in Harare, Zimbabwe. *Land Use Policy*. 105: 106029. DOI: 10.1016/j.landusepol.2022.106029.

Matamanda, A.R. & Mphambukeli, T.N. 2022. Urban (in) security in an emerging human settlement: Perspectives from Hopley Farm Settlement, Harare, Zimbabwe. *Frontiers in Sustainable Cities* 4: 933869. DOI: 10.3389/frsc.2022.933869.

Matamanda, A.R., Mphambukeli, T.N. & Chirisa, I. 2022. Exploring water-gender-health nexus in human settlements: The burden on women and the girl-child. *Cities & Health*. DOI: 10.1080/23748834.2022.2136557.

Matamanda, A.R., Nel, V., Leboto-Khetsi, L. & Dunn, M. 2022. Risk communication in an informal settlement during COVID-19: case of Dinaweng, Bloemfontein South Africa. *Urban Governance* 2(2): 296-304. DOI: 10.1016/j.ug.2022.10.002.

Mishra, H., Pandey, B., Mukwada, G., De Los Rios, P., Nigam, N. & Sahu, N. 2022. Trapped within nature: climatic variability and its impact on traditional livelihood of Gaddi transhumance of Indian Himalayas. *Local Environment* (Online): 2162025:1 - 2162025:17.

Mncube, Z., Adelabu, S.A. & Adagbasa, E.G. 2022. Is eThekweni metropolitan municipality (EMM) experiencing light pollution?: A remote sensing analysis of nighttime data of EMM, South Africa. *Spatial Information Research* (Online): 1-13.

Mncube, Z. & Xulu, S. 2022. Progress of nighttime light applications within the google earth engine cloud platform. *Geocarto International* (Online): 1-22.

Msimanga, L. & Mukwada, G. 2022. Themes in climate change and variability within the context of rural livelihoods. A systematic literature review. *Research in Globalization* 5: 100101:1 - 100101:11.

Musosa, L., Shekede, M.D., Gwitira, I., Chirisa, I., Tevera, D. & Matamanda, A.R. 2022. Auditing the spatial and temporal changes in urban cropland in Harare Metropolitan Province, Zimbabwe. *African Geographical Review* (Online). DOI: 10.1080/19376812.2022.2128834.

Nyama, V. & Mukwada, G. 2022. Factors affecting citizen participation in local development planning in Murewa district, Zimbabwe. *Journal of Asian and African Studies* (Online): e:1-e:17.

Nyama, V. & Mukwada, G. 2022. Role of citizen participation in local development planning in Murewa district. *South African Geographical Journal* (Online): 2129765:1 - 2129765:17.

Obateru, R., Fashae, O., Osakunih, O. & Olusola, A.O. 2022. Hydraulic geometry influences some water quality parameters in a tropical headwater basin in southwestern Nigeria. *Acta Geophysica* 2022: 1-10.

Ogunjo, S. & Olusola, A.O. 2022. Signature of teleconnection patterns in river discharge within the Niger Basin. *Meteorology and Atmospheric Physics* 138: 38-1 - 38-15.

Ogunjo, S. & Olusola, A.O., Fuwape, I. & Durowoju, O. 2022. Temporal variation in deterministic chaos: the influence of Kainji dam on downstream stations along lower Niger River. *Arabian Journal of Geosciences* 15: 237-1-237-11.

Olusola, A.O., Olusola, B., Onafeso, O., Ajiola, F. & Adelabu, S.A. 2022. Early geography of the coronavirus disease outbreak in Nigeria. *Geo Journal* 87: 73-747.

Ogunjo, S., Olusola, A.O. & Orimoloye, I. 2022. Association between weather parameters and SARS-Co V-2 confirmed cases in two South African cities. *GeoHealth* 6 (e2021GH000520): 1-16.

Olusola, A.O., Onafeso, O., Fashae, O. & Adelabu, S.A. 2022. River sensing: the inclusion of red band in predicting reach-scale types using machine learning algorithms. *Hydrological Sciences Journal* 67(11): 1740-1754.

Onaolapo, T.F., Okello, T.W., Adelabu, S.A. & Adagbasa, E.G. 2022. Change in the urban landscape of the Drakensberg Mountain region, South Africa: A case study of Phuthaditjhaba. *Mountain Research and Development* 42(3): R63-R74.

Orimoloye, I.R., Belle, J.A., Orimoloye, Y.M., Olusola, A.O. & Ololade, O.O. 2022. Drought: a common environmental disaster. *Atmosphere* 13(1): 111.

Peerbhay, K., Adelabu, S.A., Lottering, R. & Singh, L. 2022. Mapping carbon content in a mountainous grassland using SPOT 5 multispectral imagery and semi-automated machine learning ensemble methods. *Scientific African* 17: e01344-1-e01344-9.

Pretorius, A., Kruger E. & Bezuidenhout, S. 2022. Google trends and water conservation awareness: the Internet's contribution in South Africa. *South African Geographical Journal* 104(1): 53-69.

Pulley, S., Zhang, Y., Copeland-Phillips, R., Vadher, A., Foster, I., Boardman, J. & Collins, A. 2022. A reconnaissance survey of channel bank particulate phosphorus concentrations, controls and estimated

contributions to riverine loads across England. *Hydrological Processes* 36: e4785-1 - e4785-12.

Ranjan, O., Rani, U., Anand, S., Pandey, B., Mukwada, G., De Los Rios, P., Akyuz, D. & Chaudhary, A. 2022. Spatial-temporal analysis of physio-climatic changes in Tawang-Chu River Basin, Eastern Himalaya in India. *International Journal of Ecology and Environmental Sciences* 49: 217-230.

Rudolph, E.M., Hedding, D.W., De Bruyn, P.J.N. & Nel, W. 2022. An open access geospatial database for the sub-Antarctic Prince Edward Islands. *South African Journal of Science* 118(9/10): Art. #12302. DOI: 10.17159/sajs.2022/12302.

Rudolph, E.M., Hedding, D.W. & Nel, W. 2022. A spatial model of Marion Island's palaeo-ice extent. *Antarctic Science* (Online): 1-9. DOI: 10.1017/S0954102022000293.

Shikwambana, L., Kganyago, M. & Xulu, S. 2022. Analysis of wildfires and associated emissions during the recent strong ENSO phases in Southern Africa using multi-source remotely-derived products. *Geocarto International* 37(27): 16654-16670.

Sibanda, W., Hansen, M.M. & Mukwada, G. 2022. Rethinking woman experiences in water and sanitation projects in Tongogara refugee camp, Zimbabwe. *International Journal of Social Science Research and Review* 5(6): 320-333.

Sibanda, W., Hansen, M.M. & Mukwada, G. 2022. The appropriation of African indigenous knowledge system in WASH activities by women at Tongogara Refugee Camp, Zimbabwe. *Cogent Social Sciences* 8(1): 2108229-1 - 2108229-17.

Sibanda, W., Mukwada, G. & Hansen, M.M. 2022. Disaster (Un)preparedness under cyclone Idai: Revisiting women activities in water and sanitation at tongogara refugee camp, Zimbabwe. *Cogent Social Sciences* 8: 2137964-1 - 2137964-19.

Tongwane, M.I., Ramotubei, T. & Moeletsi, M. 2022. Influence of climate on conflicts and migrations in Southern Africa in the 19th and early 20th centuries. *Climate* 10: 119-1 - 119-16.

Van der Walt, A.J. & Fitchett J. 2022. Extreme Temperature Events (ETEs) in South Africa: A review. *South African Geographical Journal* 104(1): 70-88. DOI: 10.1080/03736245.2021.1907219.

Wyss, R., Luthe, T., Pedoth, L., Schneiderbauer,

S., Adler, C., Apple, M., Acosta, E. E., Fitzpatrick, H., Haider, J., Ikizer, G., Imperiale, A.J., Karanci, N., Posch, E., Saidmamatov, O., & Thaler, T. 2022. Mountain Resilience: A Systematic Literature Review and Paths to the Future. *Mountain Research and Development* 42(2): A23-A36. DOI: 10.1659/MRD-JOURNAL-D-21-00044.1

Zhanda, K., Garutsa, N., Dzvimbo, M.A. & Mawonde, A. 2022. Women in the informal sector amid COVID-19: implications for household peace and economic stability in urban Zimbabwe. *Cities and Health* 6(1): 37-50.

Books/Chapters in Books

Adagbasa, E.G., Adelabu, S.A. & Okello, T. 2022. Ecological vulnerability assessment to Grassland fires in a protected mountainous area using Remote Sensing and GIS. In: *Remote sensing of African mountains. Geospatial tools toward sustainability*. First edition. S. Adelabu, A. Ramoelo, A. Olusola & E. Adagbasa (Eds). Cham: Springer. pp 67-81.

Boardman, J., Poesen, J. & Evans, M. 2022. Slopes: soil erosion. In: *The History of the Study of Landforms or the Development of Geomorphology. Volume 5: Geomorphology in the Second Half of the Twentieth Century*. T. Burt, A. Goudie & H. Viles (Eds). Geological Society of London. pp. 241-255.

Dzvimbo, M.A., Matamanda, A.R., Mawonde, A. & Magijani, F. 2022. Exploring climate change impacts on smallholder farmers in Mhondoro-Ngezi District, Zimbabwe. In: *Handbook of climate change across the food supply chain*. W.L. Filho, I. Djekic, S. Smetana & M. Kovaleva (Eds). Cham: Springer Nature. pp 381-402.

Karakadzai T., Matamanda A.R. & Chirisa I. 2022. Rainwater harvesting for water security in informal settlements: techniques, practices, and options. In: *The Palgrave Encyclopedia of Urban and Regional Futures*. L.W. Filho, A.M. Azul, F. Doni & A.L. Salvia (Eds). Cham: Palgrave Macmillan. pp. 1371-1381

Matamanda, A.R. 2022. Are we there yet? Prospects and barriers to implementing smart city initiatives in Harare, Zimbabwe. In: *Sustainable and smart spatial planning in Africa: Case studies and solutions*. C. Chavunduka (Eds). New York: CRC Press.

Matamanda, A.R., Chirisa, I., Rammile, S. & Marais, M. 2022. *Housing and Technology: A special focus on Zimbabwe*. Cham: Springer Nature.

Matamanda, A.R., Kohima, J.M., Nel, V. & Chirisa, I. 2022. Climate change adaptation and planning education in southern Africa. In: *Planning cities in Africa*. G.A. Gebregiorgis, S. Greiving, A.H. Namangaya & W. Kombe (Eds). Cham: Springer Nature. pp. 103-117.

Matamanda, A.R., Nel, V., Chanza, N., Leboto-Khetsi, L., Mangara, F. & Paradza, P. 2022. The political economy of COVID-19 pandemic: lessons learned from the responses of local government in sub-Saharan Africa. In: *Local Government and the COVID-19 pandemic*. C. Nunes Silva (Eds) Cham: Springer Nature. pp 103-128.

Matamanda A.R., Nel, V., Dunn, M., Mgwele, A., Rammile, S., Leboto-Khetsi, L., Kohima, J.M. & Ngo, P.B. 2022. Sustainable development goals and urban health challenges in informal settlements of Mangaung Municipality, South Africa. In: *Handbook of Sustainability Science in the Future: Policies, Technologies and Education by 2050*. W.L. Filho, A.M. Azul, F. Doni & A.L. Salvia (Eds). Cham: Springer Nature.

Mofokeng, D.O., Olusola, A.O. & Adelabu, S.A. 2022. Development of lightning hazard map for fire danger assessment over mountainous protected area using Geospatial technology. In: *Remote sensing of African mountains: Geospatial tools toward sustainability*. First edition S. Adelabu, A. Ramoelo, A. Olusola & E. Adagbasa (Eds). Cham: Springer. pp 131-156.

Mukwada, G. 2022. Current crisis and future woes: The case of climate change in the Drakensberg Mountains region of Southern Africa and its socio-economic impacts on the region. In; *Mountain Landscapes in Transition*. U. Schickhoff, R.B. Singh & S. Mal (Eds). Cham: Springer. pp. 449-467.

Mukwada, G. & Mutana, S. 2022. 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*. First edition. A. Membretti S. Taylor & J. Delves (Eds). Cham: Springer. pp. 75-89.

Mutana, S. & Mukwada, G. 2022. SDGs as indicators of holistic small town tourism development. A case for Phuthaditjhaba South Africa. First Edition. In: *Sustainable futures in Southern Africa's mountains: Multiple perspectives on an emerging city*. A. Membretti, S. Taylor & J. Delves (Eds). Cham: Springer. pp. 141-152.

Ogunjo, S., Olusola, A.O. & Olusegun, C. 2022. Bivariate copula modelling of precipitation and river discharge within the Niger basin. In: *Soil-Water, agriculture, and climate change: Exploring linkages*. S.K. Dubey, P.K. Jha, P.K. Gupta, A. Nanda & V Gupta (Eds). pp 93-106.

Olusola, A.O. & Adelabu, S.A. 2022. Implications of rainfall variabilities in light of climate change on crop production in the Sudan-Sahelian Belt of Nigeria. In: *Water-Energy-Nexus in the ecological transition*. V. Naddeo, K. Choo & M. Ksibi (Eds). pp 103-106.

Olusola, A.O. & Adelabu, S.A. 2022. Satellite sensors, machine learning, and river channel unit types: A review. In: *Water resource modeling and computational technologies*. First Edition. M. Zakwan, A. Wahid, M. Niazkar & U. Chatterjee (Eds). Amsterdam: Elsevier. pp. 117-132.

Olusola, A.O. & Ayodele-Olajire, D. 2022. A review of climate change trends and scenarios (2011-2021). First edition. In: *Water resource modeling and computational technologies*. M. Zakwan, A. Wahid, M. Niazkar & U. Chatterjee (Eds). Amsterdam: Elsevier. pp. 545-560.

Olusola, A.O., Onafeso, O., Fashae, O. & Adelabu, S.A. 2022. Geomorphological analyses of third-order basins in Southwestern Nigeria. First Edition. In: *Drainage basin dynamics: An introduction to Morphology, Landscape and Modelling*. P.K. Shit, B. Bera. A. Islam, S. Ghosh & G. Bhunia (Eds). Cham: Springer Nature. pp. 455-475.

Onalapo, T.F., Okello, T. & Adelabu, S.A. 2022. Evaluating settlement development change, pre, and post-1994 in the Drakensberg Mountains of Afromontane region, South Africa. In *Remote sensing of African mountains: Geospatial tools toward sustainability*. First edition. S. Adelabu, A. Ramoelo, A. Olusola & E. Adagbasa (Eds). Cham: Springer. pp. 171-192.

Olusola, A.O., Oluwatola, A., Akpoterai, L., Ogunjo, S., Olusegun, C. & Adelabu, S.A. 2022. Flood assessment along lower Niger river using Google Earth Engine. In: *Soil-Water, agriculture, and climate change: Exploring linkages*. S.K. Dubey, P.K. Jha, P.K. Gupta, A. Nanda & V Gupta (Eds). pp 329-343.

Sekhele, N.M. & Voua Otomo, P. 2022. 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: Multiple perspectives on an emerging city. First edition. A. Membretti, S. Taylor & J. Delves (Eds). Cham: Springer. pp. 91-104.

Semela, M., Olusola, AO, Adelabu, SA & Ramoelo, A. 2022. Montane grasslands: Biomass estimations using remote sensing techniques in Africa. In: *Remote sensing of African mountains Geospatial tools toward sustainability*. First edition. S. Adelabu, A. Ramoelo, A. Olusola & E. Adagbasa (Eds). Cham: Springer. pp 1-18.

Conference Contributions

Conference Papers/Posters

Adagbasa, G.E. & Mukwada, G. 2022. *Modelling the environmental and human factors influencing the spatial distribution of Acacia mearnsii in a protected mountainous grassland ecosystem using Landsat and Sentinel II images*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Adelabu, S. 2022. *Earth observation in the Afromontane: Opportunities and challenges*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Buthelezi, N. & Matamanda, A.R. & Nel, V. 2022. *Climate change adaptation policies in Southern Africa and Inequality disparity in urban informal settlements*. Paper delivered at the Development Days Conference: Urban infrastructure as key to achieving SDG 11: conditions, experiences and perspectives from the Global South, Helsinki, Finland. 17-18 February 2022.

Buthelezi, N. & Matamanda, A.R. & Nel, V. 2022. *Climate change disaster risk reduction and management systems in low income areas: A case study of Buffalo City, South Africa*. Paper delivered at the International Geographical Union Commission on Geography of Governance (IGU CGoG) webinar 'Local Governance and Climate Emergency'. Online webinar. 8 November 2022.

Buthelezi, N. & Matamanda, A.R. & Nel, V. 2022. *Climate Change disaster risk reduction and management systems in vulnerable urban communities of South Africa*. Paper delivered at the International

Geographical Union Commission on Geography of Governance (IGU CGoG): Local Governance in a time of global emergencies Conference, Mexico City, Mexico. 29–31 August 2022.

Clark, V.R., Burrows, J.E., Turpin, B.C., Balkwill, K., Siebert, S.J. & Lötter, M. 2022. *The Limpopo-Mpumalanga-Eswatini Escarpment – extraordinary endemic plant richness and extinction risk in a summer rainfall montane region of southern Africa*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Clark, V.R. & Timberlake, J. 2022. *First quantification of plant endemics in the Manica Highlands (Zimbabwe-Mozambique), and necessary replacement of the Chimanimani-Nyanga Centre of Floristic Endemism with the Manica Highlands Centre*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Dlamini, N., Mukwada, G. & Schroeder, K. 2022. *The spatial context of alcohol consumption among students in a rural South African college*. Postgraduate student Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Dlamini, S., Le Roux, A. & Hansen, M. 2022. *Assessing cooperation between involved stakeholders to improve water condition of the upper Tugela River, South Africa*. Postgraduate Student Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Gangathele, A.M., Grundling, A.T., Grundling, P.L. & Le Roux, J.P. 2022. *Gully erosion impact on selected peat properties: a case study of Waterkloof Spruit peatland in Kgaswane Mountain Reserve*. Paper delivered at National Wetland Indaba, Golden Gate Highlands National Park. 24–27 October 2022.

Hansen, M. 2022. *Producing space: Human-mountain relationships in the maloti-Drakensberg Transfrontier Conservation and Development Area*. Paper delivered at the Post-LUCID Symposium, Lund University, Lund, Sweden. 27–28 October 2022.

Hansen, M. 2022. *The production of space in the*

Maloti-Drakensberg Transfrontier Conservation and Development Area. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Hugo, M., Bhanye, J.I., Bingle, R. & Matamanda, R.A. 2022. *ChemCity Eco-Industrial Park: opportunities, challenges and lessons for future sustainable industrial infrastructure development in South Africa*. Paper delivered at the African Infrastructural Futures: Urban research debates & priorities. African Center for Cities, University of Cape Town, Cape Town. 21–23 November 2022.

Kruger, J.A., Van der Walt, A.J. & Roffe, S.J. 2022. *Heatwave trend analysis across the Northern Cape, South Africa: 1980–2020*. Paper delivered at the Biennial Conference of the Society of South African Geographers (SSAG), University of Pretoria, South Africa. 15–16 September 2022.

Le Roux, J.J., Mararakanye, N., Mudaly, L., Weepener, H. & Van der Laan, M. 2022. *Development of a South African national input database to run the SWAT model in a GIS*. Paper delivered at the Kirkham Conference, Kruger National Park, Skukuza Rest Camp. 28 August–2 September 2022.

Le Roux, J.J., Morake, L., Anderson, R.L., Van der Waal, B. & Hedding, D. 2022. *How large can gullies be? A case study at Tsolo Mountain, Eastern Cape*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Molise, S.D. & Matamanda, A.R. 2022. *Factors affecting the use and value of Traditional Ecological Knowledge in Conservation and Management of Savanna Ecosystem among the rural communities of Capricorn District Municipality, Limpopo, South Africa*. Paper delivered at the 28th International Sustainable Development Research Society Conference, Stockholm, Sweden (Virtual Presentation). 15–17 June 2022.

Molise, S.D. & Matamanda, A.R. 2022. *Is there a place for traditional ecological knowledge in South Africa's legislation?* Paper delivered at the Navigating Complex Pluriversal Relations: Indigeneity, Natural Resources Governance and Intercontinental Relations in the 21st century. University of Pretoria, South Africa. 4–7 July 2022.

Msimanga, L. & Mukwada, G. 2022. *Dynamics of rural mountain livelihoods under a changing climate: The case of the Eastern Free State region of South Africa*. Postgraduate Student Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Mukwevho, R., Van der Walt A.J. & Deacon, F. 2022. *Exploring the home ranges and movement patterns of giraffes (Giraffa Camelopardalis) under current climate change conditions by using extreme warm temperature events as an indicator*. Paper delivered at the 57th Annual Congress of the Grassland Society of Southern Africa. Aldam Holiday Resort and Conference Centre, Ventersburg, South Africa. 25–29 July 2022.

Mukwevho, R., Van der Walt, A.J. & Deacon, F. 2022. *Impact of climate change on wind (speed/direction) and its effect on the travel directions of giraffes (Giraffa Camelopardalis)*. Paper delivered at the 57th Annual Congress of the Grassland Society of Southern Africa. Aldam Holiday Resort and Conference Centre, Ventersburg, South Africa. 25–29 July 2022.

Mutana, S., Mukwada, G. & Gango, T. 2022. *Local community perceptions on mountain tourism and development in Vumba, Manica Highlands of Zimbabwe*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Ngo, P.B., Matamanda, A.R., Nel, V., Owolabi, S. & Ayantokun, A.S. 2022. *Is segregation a thing of the past or is it here to stay: analysing the decolonisation process through the spatial transformation of the post-colonial city of Bloemfontein, South Africa*. Paper delivered at the Society of South African Geographers Biennial Conference, University of Pretoria, Pretoria, South Africa. 12–14 September 2022.

Ngwenya, S.J. & Mukwada, G. 2022. *Mountain ecosystem governance and climate change: Adaptation in a local municipality in South Africa: The case of Maluti-a-Phofung Municipality*. Postgraduate Student Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

O'Leary, G., O'Leary, K., Mota, M.M. & Clark, V.R. 2022. *Communities as beneficiaries of mountain tourism: A case study of Witsieshoek Mountain*

Lodge (Transfrontier Parks Destinations and the Batlokoa Community. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Olusola, A., Boothroyd, R. & Adelabu, S.A. 2022. *Geomorphic characterization of the Lower Niger River using Google Earth Engine*. Paper delivered at the EGU General Assembly 2022, Vienna, Austria. 23–27 May 2022.

Rammile, S.N. & Matamanda, A.R. 2022. *A place called home: understanding toponyms*. Paper delivered at the 58th ISOCARP world planning congress 'From wealthy to healthy cities', Brussels, Belgium. 3–6 October 2022.

Rossouw, M.P., Rudolph, E M., & Clark, M.D. 2022. *Cameras, phones, and drones to convey stones: on digital geosite visualisation as intermedia translation*. Paper delivered at the Transfers and Transversals Conference, Bloemfontein, South Africa. 1–2 December 2022.

Rudolph, E.M. 2022. *A Geographer's take on Africa, Art and Antarctica*. Paper delivered at the Antarctica, Africa and the Arts. Agulhas National Park, South Africa. 23–25 May 2022.

Rudolph, E.M., Clark, M., Buschke, F., Le Roux, J. & Rossouw, M. 2022. *Drones and immersive visualisation technologies make geosites more accessible for research and education: examples from South Africa's Mpumalanga province*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Rudolph, E.M., Hedding, D. W., De Bruyn, P.J.N. & Nel, W. 2022. *A geospatial database for the sub-Antarctic Prince Edward Islands*. E-Poster presented at the SCAR Open Science Conference, Goa, India. 1–5 August 2022.

Sekhele, N. 2022. *Conservation conflicts and climate change nexus of Afromontane rural communities: A literature review*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14–17 March 2022.

Sekhele, N. 2022. *Classification of land cover changes of natural resources harvested by communities surrounding the Golden Gate Highlands National Park*. Paper delivered at the Society of South African

Geographers (SSAG) Student Conference, University of Pretoria, South Africa. 16 September 2022.

Shezi, N. & Mukwada, G. 2022. *The climate change-urban planning nexus in a mountain environment: The case of the Eastern Free State region of South Africa*. Postgraduate Student Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Stander, M.H., Le Roux, J.J., Abd Elbasit, M.A.M. & Liu, G. 2022. *Using geochemical tracers to differentiate between soil types in a research catchment*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Van der Walt, A.J., Kruger, J.A. & Roffe, S. 2022. *Exploring trends of warm extreme temperature events in Maloti-Drakensberg montane region: 1980-2020*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Van der Walt, A.J., Kruger, J.A. & Roffe, S. 2022. *Exploring trends of warm extreme temperature events in Maloti-Drakensberg montane region: 1980-2020*. Paper delivered at the Biennial Conference of the Society of South African Geographers (SSAG), University of Pretoria, South Africa. 15-16 September 2022.

Van der Walt, A.J., Steyn, C. & Fitchett, F. 2022. *An analysis of Extreme Temperature Events (ETEs) in Namibia*. Paper delivered at the African Biometeorology Colloquium. Online. 8 June 2022.

Van Rooyen, M., Marais, K. & Rudolph, E. M. 2022. *Translating digital landscapes: process, complexity and multimodality in translations for virtual geography field trips*. Paper delivered at the Transfers and Transversals Conference. Bloemfontein, South Africa. 1-2 December 2022.

Van Tol, J., Schneiderbauer, S., Delves., Hilpod, A., Szarzynski, J., Niedrist, G. & Clark, V.R. 2022. *Establishing a long-term socioecological research platform in the Maloti-Drakensberg: The need, focus and lessons from the international community*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Vilakazi, B.S. & Mukwada, G. 2022. *Evaluating*

greenhouse gases emission and land degradation on different gradient paradigms of mountain areas in Bergville. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Xulu, S. 2022. *Unsupervised classification of drought effects on plan*. Paper delivered at the International Geographic Union (IGU) Paris Centennial Congress, Paris, France. 18-22 July 2022.

Zinhiva, H., Mukwada, G. & Mutanda, G.W. 2022. *Assessing the urgency for climate action in buttressing community conservation work in southern Afromontane forests*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Zinhiva, H. & Mukwada, G. 2022. *Juxtaposing ecosystem- and community-based approaches for climate change adaptation in the ecotourism sector in the eastern highlands of Zimbabwe*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Zondo, S.A. & Mukwada, G. 2022. *Resilience of transhumance in the wake of climate change: The case of the Maloti-Drakensberg region of South Africa*. Paper delivered at the 1st South African Mountain Conference (SAMC2022), Champagne Sports Resort, Maloti-Drakensberg, South Africa. 14-17 March 2022.

Conference Proceedings

Adelabu, S.A., Mncube, Z. & Adagbasa E.G. 2022. *Utilising VIIRS DNB nighttime light data together with LANDSAT daytime data to assess changes in light pollution in Ethekezi Metropolitan municipality (EMM)*. In: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Nice, France, 6-11 June 2022. S. Zlatanova, G. Sithole & J. Barton (Eds). Copernicus Publications. pp. 463-470.

Jombo, S.S. & Adelabu, S.A. 2022. *A bibliometric review and analysis of MODIS land surface temperature data application in Africa*. In: *IGARSS 2022-2022 IEEE International Geoscience and Remote Sensing Symposium*. Kuala Lumpur, Malaysia. 17-22 July 2022. Curran Associates. pp.

2410-2413.

Jombo, S.S. & Adelabu, S.A. 2022. *Spatiotemporal variations of land surface temperature and vegetation coverage in Free State Province, South Africa*. In: *IGARSS 2022-2022 IEEE International Geoscience and Remote Sensing Symposium*. Kuala Lumpur, Malaysia. 17-22 July 2022. Curran Associates. pp. 2414-2417.

Sibiya, M., Nkosi, S. & Xulu, S. 2022. *Optimised detection of Anredera Cordifolia (Madeira Vine) using as Mask-RCNN and Anredera Cordifolia's prominent features as object classes*. In: *3rd International Conference on Next Generation Computing Applications (IEEE NextComp)*, Flic-en-Flac, Mauritius, 06-08 October 2022. Curran Associates. pp. 1-6.

Research Reports

Le Roux, J.J., Mararakanye, N., Mudaly, L., Weepener, H.L., & Van der Laan, M. 2022. *Development of a South African national input database to run the SWAT model in a GIS*. Report delivered to the Water Research Commission (WRC).



STAFF (2022)

Head of Department:
Prof SA Adelabu

BLOEMFONTEIN CAMPUS:

Associate Professor:	Prof SA Adelabu
Senior Lecturers:	Dr JJ le Roux and Dr AJ van der Walt
Lecturers:	Dr M Dunn, E Kruger, Dr A Matamanda, T Mehlomakhulu, Dr EM Rudolph and MH Stander
Senior Officer:	N van Dyk (Professional Services)
Officers (Professional Services):	S Brits and K Mashiane
Research Fellows:	Prof J Boardman, Prof K Chatiza, Prof Holmes, Dr R Massey and Prof A Ramoelo

QWAQWA CAMPUS:

Subject Head:	Dr MM Hansen
Professor:	Prof G Mukwada
Lecturers:	Dr MM Hansen, Dr P Mahasa, Dr M Pewa, N Sekhele, Dr S Xulu and S Zondo
Senior Assistant Officer:	M Lebeko
Affiliated Associate Professor:	Prof VR Clark
Research Fellows:	Prof S Kudo, Dr S Schneiderbauer and Dr M Tongwane

DEPARTMENT OF
GEOLOGY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



C O N T A C T D E T A I L S

Prof Bisrat Yibas

Department of Geology

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 3080

E: YibasBabsoB@ufs.ac.za

W: www.ufs.ac.za/geology

OVERVIEW OF 2022

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 six undergraduate, three Honours and four MSc programmes (Geology, Geochemistry, Environmental Geology and Mineral Resource Management [MRM]), as well as PhD by research. The Department offers 19 undergraduate modules, 10 Honours and 12 structured MSc (MRM) modules.

In 2022, the Department enrolled a total of 157 students (116 undergraduate (for BSc), 17 for BSc Honours, 50 for MSc (37 in Mineral Resource Management (MRM), 16 in Geology, Geochemistry and Environmental Geology), and 7 for PhD. A total of 50 students completed their studies (29 BSc, 17 BSc Honours, 3 MSc [MRM] and 1 PhD).

The appointment of Prof John Carranza (Economic Geology) was a significant highlight in the academic staff development strategy of the Department.

With financial assistance from the Faculty of Natural and Agricultural Sciences, the Department acquired

a JEOL JXA-iSP100 Electron Probe Microanalyser (EMPA), the first of its kind to be installed in South Africa. The instrument was installed and commissioned in October and staff underwent initial training on the use of the instrument in November. A second round of training will take place in February 2023. The EMPA is a significant addition to the laboratory of the Department of Geology to enable generation of high-quality mineral chemistry data and enhance the quality and quantity of research outputs and postgraduate research.

The Department also acquired a new stereomicroscope to support research to measure, document, and package small apatite and zircon crystals (~0.2 mm long) into tiny platinum and niobium tubes for helium isotope analysis with the financial assistance of the Faculty. Dr Robert Muir, a Sedimentologist, is the main investigator who will be using the microscope.



The newly acquired and commissioned EOL JXA-iSP100 Electron Probe Microanalyser (EPMA)

The new stereomicroscope acquired in 2022



ACHIEVEMENTS

Staff Achievements

Prof John Carranza won the 2022 William Christian Krumbein Award which was granted by the International Association for Mathematical Geosciences (IAMG) for his 'Outstanding Contributions to Mathematical Geosciences'. The Award was made at the 2022 Annual Meeting of the IAMG, held in Nancy, France.



Prof John Carranza delivering his keynote lecture at IAMG

Prof Carranza was invited to deliver a keynote presentation at the Symposium of the Japan Society of Geoinformatics on 2 December 2022 (online) on the topic 'Spatial Patterns of Mineralization Across Geographic Scales: Their Exploration Significance'.

Dr Robert Muir was invited to present at the TEDx event in Johannesburg. The talk, 'Priceless gifts from an everlasting mountain range', can be viewed at https://www.youtube.com/watch?v=_VDr-a9VaBU.



Second-year students setting up and compiling grid maps at Austin's Post



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 2022 best student prize winners were Lehlohonolo K Matsie (first-year), Madzanga Matsheka (second-year) and Mthokozisi Ndlovu (third-year). The Geology Department would like to thank Philip Fouche, Wiley Publishers, the Professional Provident Society Insurance Company Ltd (PPS) and Kumba Resources Ltd. who are our loyal and generous sponsors of the yearly best student prizes.

In 2022, our students hosted a showcase booth for the Merensky Group for Airborne Geological Image Classification (MAGIC) Lab and made a presentation on drones, big data, and GIS, during International GIS Day (on 16 November) hosted by the UFS for the Department of Education (Government) in the UFS's Equitas foyer and auditorium.

TEACHING AND LEARNING

The Department offers six undergraduate programmes for the BSc, majoring in Geology, Environmental Geology, Geochemistry, Geology and Geography, 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.

In line with the UFS Teaching and Learning guidelines and the Faculty of Natural and Agricultural Sciences' principles to manage the academic project in 2022, the Department of Geology implemented full-scale face-to-face (F2F) teaching and learning, following the lifting of the restrictions due to COVID-19. Field excursions were also conducted as they had been in a pre-COVID-19 days.



Third-year economic geology students visiting the open cast iron mine at the Kolemela-Kumba iron mining operations



Igneous geology students visiting the Big Hole in Kimberley



Robert Trumbull of the German Research Centre for Geosciences (GFZ), Prof Lew Ashwal (University of the Witwatersrand) and Prof Susan Webb (University of the Witwatersrand).

Prof John Carranza was involved in two important EU-funded projects – Exploration Information System (EIS) and SEMACRET, a project on the sustainable exploration for orthomagmatic (critical) raw materials in the EU for charting the road to the green energy transition. He also conducts two NRF-funded projects. The first on 'Minute Mineral Maps: Ciphers to Hidden Prospects in Frontier Regions' and the other on 'Spatial Analysis of Geothermal Resource Occurrence Controls and Prospectivity'.

2022 was a year of measurable growth for Dr Martin Clark as an academic, as well as the leader of the newly established MAGIC lab, funded by the Hans Merensky Group. Collectively his research group had three members graduate, one with an MSc, and two with Honours' degrees, and in the fourth quarter of 2022, approval was granted for incoming Postdocs to join the group in 2023.



PhD student, Samkalo Radebe, hard at work in the MAGIC Lab

RESEARCH AND INNOVATION

Prof Frederick Roelofse continued with his research as a member of the coordinating team of the International Continental Scientific Drilling Programme (ICDP) funded the (Bushveld drilling project) (BVDP), conducted in collaboration with Dr

The MAGIC Lab acquired a significant orthophotographic and multispectral drone system, a Wingtra Gen II, with which is planned to have central applications across various natural science projects. The drone is capable of 400 ha2 of coverage, generating imagery at 1-3 cm/pix absolute image resolutions. Two camera payloads were also acquired, viz. a Micasense Rededge-P multispectral camera and a Sony RX1R-II orthophotographic

camera. Their applications with multispectral equipment are geared towards growing cost-effective spectral mapping in preparation for new stages of growth in subsequent years.



The newest acquisition of the MAGIC group – a Wingtra Gen II fixed-wing drone

The interdisciplinarity of the MAGIC Lab's research in establishing new projects across our university's faculties, in affiliation with UFS Interdisciplinary Centre for Digital Futures, aims to promote novel and impactful modes of study across various disciplines. In 2022, several conference and paper contributions can attest to MAGIC's growth within these interdisciplinary initiatives.

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). As part of this funding scheme, Prof Roelofse successfully delivered two CIMERA-funded MSc students, Thapelo Motaung and Mafete Malatji, and continued with the supervision of CIMERA-funded PhD student, Justine Magson.

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'. In September 2022, she was selected to participate in the ICDP training course on Continental Scientific Drilling, held at the Geocenter KTB in Windischeschenbach (Germany). In November 2022, she gave a talk on the 'Constraints on the Nd-isotopic composition and nature of the last major influx of magma into the Bushveld Complex'.

Dr Robert Muir works on several projects – such as landscape evolution of the southern Cape of South Africa, Neotectonics of southern Africa, Mid-Permian ecosystems of the main Karoo Basin, Quaternary fossil termitaria of the Western Cape, Erosion mechanisms and rates on Table Mountain and Environmental change across the Jurassic-Cretaceous boundary in South Africa.



Dr Robert Muir

Jarlen Keet completed her doctoral research on deciphering the lateral and vertical variation of strontium, neodymium and sulphur isotopes of the Flatreef, to understand the implications for its formation and its correlation to the Merensky Reef in the remainder of the Bushveld Complex. She submitted her PhD thesis at the end of 2022. The thesis contains three publications two of which are published, and one was under review.

Ernest Matome Moitsi continued working on the mineralogical characterisation and metallurgical responses of the mineralised Footwall to the Brakspruit Facies of the Merensky Reef at Sibanye-Stillwater Karee Pt Mine, in the Bushveld Complex as well as a process mineralogical assessment of various UG2-ore types from Hossy, Rowland and Saffy Shafts of the Sibanye-Stillwater Marikana Operations.

Megan Welman-Purchase submitted her PhD thesis on the stability of Prussian blue and Turnbull's blue with implications for Witwatersrand sulfidic Au-tailings environment, and on the behaviour of cyanide in Au-mine tailings. Her research includes a chemical experiment study to distinguish

Prussian from Turnbull's blue, forming the basis for bioremediation research.

ENGAGED SCHOLARSHIP

Prof Frederick Roelofse continued to serve as chair of the Palaeoproterozoic Task Group of the South African Committee for Stratigraphy (SACS) and as regional member of council of the GSSA. Prof Roelofse is also a South African representative on the International Mineralogical Association (IMA) Commission for Gem Materials, and he also continued to serve on the National ICDP Committee. He is also a member of the



Prof Freddie Roelofse

Editorial Board of *Die Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie*.

Prof John Carranza is the current President of the Association of Applied Geochemists (formerly Association of Exploration Geochemists) for which he served as Vice President (2020–2021), Councillor (2009–2010, 2011–2012), Fellow (from 2009), and member (1991–2008). 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.

Dr Robert Muir serves on the Volunteer Committee on public outreach for the Palaeontological Society of South Africa (PSSA), initiated and run the UFS wing of the DST-NRF Genus (CoE-Palaeoscience) Accelerator programme.

Dr Martin Clark continued his role in the newly established Interdisciplinary Centre for Digital Futures (ICDF) in the UFS as convenor of the Digital Backbone working group and continued in his position on the ICT committee of the Natural

and Agricultural Science Faculty, and driver of the Department of Geology's digitalisation plan. He also continued in his role as a guest editor for a special issue of the MDPI journal, Minerals, titled 'Geochronology, Crystallography and Phase Transition in Shocked Minerals'.

Dr Clark made a presentation on building and sustaining mutually beneficial partnerships for engaged scholarship with diverse communities during the UFS's Engaged Scholarship Seminar and he also gave a talk on open problems in Geology '4IR transdisciplinarity in the Geosciences', during the Interdisciplinary Centre for Digital Futures (ICDF) Symposium, hosted in the Centenary Complex.

Ernest Moitsi continued to serve as the co-opted committee member of the Mineralogical Association of South Africa (MINSa).

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, and the increasing levels of collaboration. The feedback the Department received from mining companies on the quality of our graduates was very encouraging. As a result, student bursaries, 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 the 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 2022.

Dr Robert Muir is involved in a research project titled 'Environmental change across the Jurassic-Cretaceous boundary in South Africa', funded by DST-NRF Centre of Excellence in Palaeoscience (Genus) in collaboration with University of Cape Town, Berkeley Geochronology Centre and University of Johannesburg.

Dr Martin Clark continued his international collaboration based from the University of Johannesburg under the leadership of Prof Dirk van Reenen, studying the evolution of the Limpopo Complex.



Dr Martin Clark and Prof Dirk van Reenen (UJ) investigating the rocks of the Limpopo Complex

The staff of the Geology Department continue maintaining active collaboration and expanding their collaborative spheres with researchers from the following institutions:

- Albany Museum
- Australian Nuclear Science and technology Organisation (ANSTO)
- Agencia Estatal Consejo Superior de Investigaciones Cientificas (Spain) – collaboration in EU-funded EIS project
- Albany Museum
- Associacao para a Investigacao e Desenvolvimento de Ciencias (Portugal) – collaboration in EU-funded SEMACRET project
- Berkeley Geochronology Centre
- BEAK Consultants GmbH (Germany) – collaboration in EU-funded EIS project

- Bureau de Recherches Geologiques et Minieres (BRGM) – collaboration in EU-funded EIS project
- Central University of Technology
- CIMERA, South Africa
- Council for Geoscience
- Czech Geological Survey – collaboration in EU-funded SEMACRET project
- Deutsche Lithium GmbH (Germany) – collaboration in EU-funded EIS project
- Eduardo Mondlane University (Mozambique) – collaboration in NRF-funded project Spatial Analysis of Geothermal Resource Occurrence Controls and Prospectivity
- Freidrich-Alexander University, Germany
- Geological Survey of Finland – collaboration in EU-funded EIS project
- Geological Survey of Sweden – collaboration in EU-funded EIS project
- German Research Centre for Geosciences – GFZ Potsdam, Germany
- Gispo Ltd (Finland) – collaboration in EU-funded EIS project
- James Cook University, Townsville, Australia
- Keliber Technology Oy (Finland) – collaboration in EU-funded EIS project
- Korzinski Institution, Chernogolovka, Russia
- Louisiana State University, USA
- Luleå University of Technology (Sweden) – collaboration in EU-funded EIS project
- Museum of Natural History, Sweden
- McGregor Museum
- Natural History Museum, London, UK
- Oulu University (Finland) – collaboration in EU-funded SEMACRET project
- Polish Academy of Sciences, Poland
- Polish Geological Institute – collaboration in EU-funded SEMACRET project
- Rhodes University

- Sibanye-Stillwater Company
- SHRIMP Centre of the Chinese Academy of Geological Sciences, Beijing, China
- University of Cape Town
- University of Colorado
- University of Idaho
- University of Johannesburg
- University of Pretoria
- University of the Witwatersrand
- Université de Lille, France
- University of Exeter, UK
- University of Leoben, Austria
- Universität Hamburg, Germany
- University of Tsukuba, Ibaraki, Japan
- University of Vienna, Austria
- Natural History Museum in London
- Natural History Museum Vienna, Austria
- University of Gothenburg, Sweden
- University of Oslo, Norway
- University of Turku (Finland) – collaboration in EU-funded EIS project
- University of Zambia – collaboration in NRF-funded project Spatial Analysis of Geothermal Resource Occurrence Controls and Prospectivity
- 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 2022, the Department enrolled 74 postgraduate students – 17 Honours, 50 MSc and 7 PhD candidates.



Mineralogy Honours students at Gold 1 Tailings Dam

The Department's Honours programmes offer specialisation degrees in Geology, Geochemistry and Environmental Geology. As part of the programme, the Honours students participated in various field trips and excursions, including to the Gold 1 Tailings Dam, the Anglo Laboratory, and the Mintek Laboratory in Johannesburg.

A total of 47 students completed their studies (29 BSc, 17 BSc Honours, three MSc (MRM) and one PhD). The three MSc (MRM) graduates were Anthony Daniel Davis, Charlotte Maenge Kali, and Alet van Deventer.

POSTDOCTORAL RESEARCH FELLOWS

Dr Emmylou Kotze was hosted as a Postdoctoral Research Fellow under the supervision of Prof Roelofse, working in the Bushveld Research Group.



Staff of the Department of Geology 2022

Front, from the left, Dr R Muir, Prof B Yibas, M Purchase-Welman and Ruvey Zaal

Second row, from the left, EM Motsi, P Lehloenya, A Felix and JJ Keet

Third row, from the left, Prof F Roelofse, J Magson, C van der Vyver and D Radikgomo

Back, from the left, Dr H Minnaar, JW Nel, R Makhadi, and Dr R Hansen

(Absent: Prof John Carranza, Dr Martin Clark and Thendo Mapholi)

STAFF MATTERS

The Department welcomed Prof John Carranza as a Professor of Economic Geology in January 2022.

RESEARCH OUTPUTS

Research Articles

Busakwe, N.S., Carranza, E.J.M., Chagi, O. & Hoyer, L. 2022. Micro-fractures in the Ngubevu Gold and Base Metal Mines (Natal Thrust Front, Tugela Terrane, South Africa): Are they consistent with macro-

scale deformation, and what do they tell us? *South African Journal of Geology* 125: 79–98. DOI: 10.25131/sajg.125.0008.

Cheweshe, T.T., Welman-Purchase, M. & Deysel, L-M. 2022. Extraction of Tungsten from Wolframite Sample Using Ammonium Phosphate Salt as Flux. *JOM* 74(49): 283–292. DOI: 10.1007/s11837-021-05021-1.

Cheweshe, T.T., Welman-Purchase, M. & Deysel, L-M. 2022. Fusion of chromite Ore using Sodium phosphate salt as flux and the effects of sodium ions in wet chemical analysis. *Journal of Metallurgy* 73: 1344–1352. DOI: 10.1007/S11837-021-04632-y.

Colarossi, D., Fewlass, H., Stahlschmidt, M.C., Presnyakova, D., Matembo, J., Hein, M., Talamo, S. & Archer, W. 2022. A targeted drilling and dating campaign to identify Stone Age archaeological sites before excavation in west coast southern Africa. *Quaternary Geochronology* 71: 101314. DOI: 10.1016/j.quageo.2022.101314.

Esmailoghli, S., Tabatabaei, S.H. & Carranza, E.J.M. 2022. 3DU-TA: A new multifractal model involving surface topography for separation of geochemical anomalies. *Journal of Geochemical Exploration* 24: 107061. DOI: 10.1016/j.gexplo.2022.107061.

Gauert C. & Zeh, A. 2022. Downdip Development of the Ni-Cu-PGE-Bearing Mafic to Ultramafic Uitkomst Complex, Mpumalanga Province, South Africa. *Minerals* 12(1): 22. DOI: 10.3390/min12010022.

Geranian, H. & Carranza, E.J.M. 2022. Mapping of regional-scale multi-element geochemical anomalies using hierarchical clustering algorithms. *Natural Resources Research* 31: 1841–1865.

Hohl, S.V., Rodler, A.S., Viehmann, S., Huang, X, Xu, J., Gaucher, C., Germs, G.J.B., Hegenberger, W., Goderis, S., Wei, H. & Frei, R. 2022. C, Sr, Nd isotope chemostratigraphy and zircon provenance of the Witvlei Group (Namibia): Neoproterozoic glaciations and seawater evolution. *Precambrian Research* 372. DOI: 10.1016/j.precamres.2022.106600.

Huber, M.S., Kovaleva, E., Clark, MD, Riller, U. & Fourie, FD. 2022. Evidence from the Vredefort Granophyre Dikes points to crustal relaxation following basin-size impact cratering. *Icarus* 374: 114812. DOI: 10.1016/j.icarus.2021.114812.

Jemmali, N., Rddad, L. Sońnicka, M., Rahali, E., Souissi, F. & Carranza, E.J.M. 2022. Genesis of Zn-Pb-(Ba-Sr) mineralization in the Jebel El Akhouat deposit near the Ech Chehid salt diapir, Northern Tunisia. *Mineralogy and Petrology* 116: 71–91. DOI: 10.1007/s00710-021-00767-7.

Kotzé, E., Roelofse, F., Grobler, D., Gauert, C. & Purchase, M. 2022. Geological setting and concentration of scandium in the Flatreef and eastern limb chromitites of the Bushveld Complex. *JSAIMM* 122(9): 517–526. DOI: 10.17159/2411-9717/1987/2022.

Kotzé, E., Schuth, E.S., Goldmann, S. & Holtz, F. 2022. The influence of humic substances on the weathering of PGE in chromitite of the Bushveld Complex: An experimental simulation of the weathering

environment. *South African Journal of Geology* 125(3–4): 291–306. DOI: 10.25131/sajg.125.0020.

Liu, Y. & Carranza, E.J.M. 2022. Uncertainty analysis of geochemical anomaly by combining sequential indicator co-simulation and singularity analysis. *Natural Resources Research* 31: 1889–1908. DOI: 10.1007/s11053-021-10001-y

Liu, Y., Carranza, E.J.M. & Xia, Q. 2022. Developments in Quantitative Assessment and Modeling of Mineral Resource Potential: An Overview. *Natural Resources Research* 31(4): 1825–1842. DOI: 10.1007/s11053-022-10075-2.

Nwaila, G.T., Zhang, S.E., Bourdeau J.E., Ghorbani, Y. & Carranza E.J.M. 2022. Artificial intelligence-based anomaly detection of the Assen iron deposit in South Africa using remote sensing data from the Landsat-8 Operational Land Imager. *Artificial Intelligence in Geosciences* 3: 71–85. DOI: 10.1016/j.aiig.2022.10.001.

Parsa, M., Carranza, E.J.M. & Ahmadi, B. 2022. Deep GMDH neural networks for predictive mapping of mineral prospectivity in terrains hosting few but large mineral deposits. *Natural Resources Research* 31: 37–50. DOI: 10.1007/s11053-021-09984-5.

Prevec, R., Nel, A., Day, M.O., Muir, R.A., Matiwane, A., Kirkaldy, A.P., Moyo, S., Staniczek, A., Carigliano, B., Maseko, Z., Kom, N., Rubidge, B.S., Garroute, R., Holland, A. & Barber-James, H.M. 2022. New South African Lagerstätte reveals middle Permian Gondwanan lakeshore ecosystem in exquisite detail. *Communications Biology* 5(1): 1154. DOI: 10.1038/s42003-022-04132-y.

McPherron, S.M., Archer, W., Otarola-Castillo, E.R., Torquato M.G. & Keevil, T.L. 2022. Machine learning, bootstrapping, null models, and why we are still not 100% sure which bone surface modifications were made by crocodiles. *Journal of Human Evolution* 164: 103071. DOI: 10.1016/j.jhevol.2021.103071.

Shevyrev, S. & Carranza, E.J.M. 2022. Application of maximum entropy for mineral prospectivity mapping in heavily vegetated areas of Greater Kurile Chain with Landsat 8 data. *Ore Geology Reviews* 142: 104758. DOI: 10.1016/j.oregeorev.2022.104758.

Soltani-Mohammadi, S., Abbaszadeh, M., Hezarkhani, A. & Carranza, E.J.M. 2022. Uncertainty analysis of thermodynamic variables of fluid inclusions: a deposit-scale spatial exploratory data modeling through fuzzy kriging. *Natural Resources*

Research 31: 51-65. DOI: 10.1007/s11053-021-09969-4.

Song, Y., Yang, L., Carranza, E.J.M., Bagas, L., Gao, Y., Sun, B. & Wang, P. 2022. Contrasting Anomaly Patterns of Magmatic-Hydrothermal Polymetallic and Orogenic Gold Deposits and their Suitable Exploration Methods: A Case Study from the Qinling Orogen. *Natural Resources Research* 31(3): 1083-1102. DOI: 10.1007/s11053-022-10031-0.

Wang, H., Zou, R., Carranza, E.J.M. & Madani, N. 2022. Modelling spatial uncertainty of geochemical anomalies using fractal and sequential indicator simulation methods. *Geochemistry: Exploration, Environment, Analysis* 22(4). DOI: 10.1144/geochem2022-029.

Wipki, M., Röhlings, H.G., Gauert, C. & Wellmer, F.W. 2022). Hans Merensky (1871-1952) – An exceptional geologist, miner, prospector, future-oriented scientist, conservationist and patron. *Zeitschrift der Deutschen Gesellschaft für Geowissenschaften / Journal of the German Society for Geosciences* 173(2): 375-394. DOI: 10.1127/zdgg/2022/0317.

Xie, S., Huang, N., Deng, J. Wu, S., Zhan, M., Carranza, E.J.M., Zhang, Y. & Meng, F. 2022. Quantitative prediction of prospectivity for Pb-Zn deposits in Guangxi (China) by back-propagation neural network and fuzzy weights-of-evidence modelling. *Geochemistry: Exploration, Environment, Analysis* 22 (2). DOI: 10.1144/geochem2021-085.

Yang, F., Kong, M., Xie, S., Nie, L., Song, Y., Wang, C., Han, W., Carranza, E.J.M., Wang, Q. & Guo, Z. 2022. The Relationship between Particle Size and Element Distribution in Stream Sediments from the Dongyuan W-Mo Deposit, Eastern China. *Minerals* 12(4): 431. DOI: 10.3390/min12040431.

Yang, Y., Liu, J., Carranza, E.J.M., Ding, S., Fan, X., Wang, G., Zhang, L., Yao, S., Zhao, J., Shengdong Li, S., Da, R., Yang, Z. & Jia, C. 2022. Geological and geochemical constraints on the genesis of the Xiqianluzi Pb-Zn polymetallic deposit in Beishan, Gansu Province, NW China. *Geological Journal* 57:3623-3647. DOI: 10.1002/gj.4491.

Yang, F., Xie, S., Hao, Z., Carranza, E.J.M., Song, Y., Liu, Q., Xu, R., Nie, L., Han, W., Chengwen Wang, C. & Wang, Q. 2022. Geochemical Quantitative Assessment of Mineral Resource Potential in the Da Hinggan Mountains in Inner Mongolia, China. *Minerals* 12(4): 434. DOI: 10.3390/min12040434.

Zhang, S., Carranza, E.J.M., Xiao, K., Yang, F., Chen, Z., Li, N., Wei, H. & Xiang, J. 2022. Mineral prospectivity mapping based on Isolation Forest and Random Forest: Implication for the existence of spatial signature for mineralization in outliers. *Natural Resources Research* 31: 1981-1999. DOI: 10.1007/s11053-021-09872-y.

Zhang, Z., Wang, G., Carranza, E.J.M., Fan, J., Liu, X., Zhang, X., Dong, Y., Chang, X.P. & Sha, D. 2022. An Integrated Framework for Data-Driven Mineral Prospectivity Mapping Using Bagging-Based Positive-Unlabeled Learning and Bayesian Cost-Sensitive Logistic Regression. *Natural Resources Research* 31(6): 3041-3060. DOI: /10.1007/s11053-022-10120-0.

Zhang, Z., Wang, G., Carranza, E.J.M., Yang, S., Zhao, K., Yang, W. & Sha, D. 2022. Three-dimensional pseudo-lithologic modeling via adaptive feature weighted k-means algorithm from multi-source geophysical datasets, Qingchengzi Pb-Zn-Ag-Au District, China. *Natural Resources Research* 31: 2163-2179. DOI: 10.1007/s11053-021-09927-0.

Zhou, W.D., Xie, S.Y., Bao, Z.Y., Carranza, E.J.M., Wang, Y. & Tang, M. 2022. Modeling of the correlation between mineral size and shale pore structure at meso- and macroscales. *Mathematical Geosciences* 54: 131-150. DOI: 10.1007/s11004-021-09954-w.

Zuo, L., Wang, G., Carranza, E.J.M., Zhai, D., Pang, Z., Cao, K., Mou, N. & Huang, L. 2022. Short-Wavelength Infrared Spectral Analysis and 3D Vector Modeling for Deep Exploration in the Weilasituo Magmatic-Hydrothermal Li-Sn polymetallic Deposit, Inner Mongolia, NE China. *Natural Resources Research* 31(6): 3121-3153. DOI: 10.1007/s11053-022-10111-1.

Conference Contributions

Conference Papers/Posters

Abrahams, M., Muir, R.A., Genise, G.F. & Almond, J. 2022. *Building a Home: Morphological Description of Clustered Middle Pleistocene Termitaria, Calitzdorp, South Africa.* Paper delivered at the Palaentological Society of South Africa Conference 2022, Clarens, South Africa. 12-15 September 2022.

Abrahams, M., Muir, R.A., Genise, J. & Almond, J. 2022. *A new termite nest ichnofossil, Middle Pleistocene, South Africa.* Paper delivered at the International Palaeontological Congress, Khon Kaen,

Thailand. 7-11 November 2022.

Archer, W., Presnyakova D. A., Aldeias, V., Gur-Arie, S., Colarossi, D., Hutten, L., Lauer, T., Porraz, G. & Shaw, M. 2022. *Late Acheulean occupations of Montagu Cave and the pattern of Middle Pleistocene behavioral change in western Cape southern Africa.* Paper delivered at the 12th annual meeting of the European Society for the Study of Human Evolution, Tübingen, Germany. 22-24 September 2022.

Muir, R.A., Abrahams, M. & Hadebe, G. 2022. *Geomorphology, Sedimentology and Preliminary Radioisotopic Age of Middle Pleistocene Termitaria near Calitzdorp, South Africa.* Paper delivered at the Palaentological Society of South Africa Conference 2022, Clarens, South Africa. 12-15 September 2022.

Rossouw, M., Rudolph, E.M. & Clark, M.D. 2022. *Cameras, phones, and drones to convey stones: on digital geosite visualisation as intermedia translation.* Paper delivered at the Transfers and Transversals Conference. Bloemfontein, South Africa. 1-2 December 2022.

Rudolph, E.M., Clark, M.D., Buschke, F., Le Roux, J. & Rossouw, M. 2022. *Drones and immersive visualization technologies make geosites more accessible for research and education: Examples from South Africa's Mpumalanga Province.* Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Drakensburg, South Africa. 14-17 March 2022.

Conference Proceedings

.Netshitungulwana, K.R.T, Gauert, C., Vermeulen, D., Yibas, B., Mateo Shai, M. & Lusunzi, R. 2022. *Geochemical Characterisation of the Witbank Coalfield Geological Strata and Assessment of Potential Metal Impact on the Receiving Environment.* In: IMWA 2022 – “Reconnect”. Christchurch, New Zealand, 6-10 November 2022. J. Pope, Ch. Wolkersdorfer, R. Rait, D. Trumm, H. Christenson & K. Wolkersdorfer (Eds). pp. 329-335.



STAFF (2022)

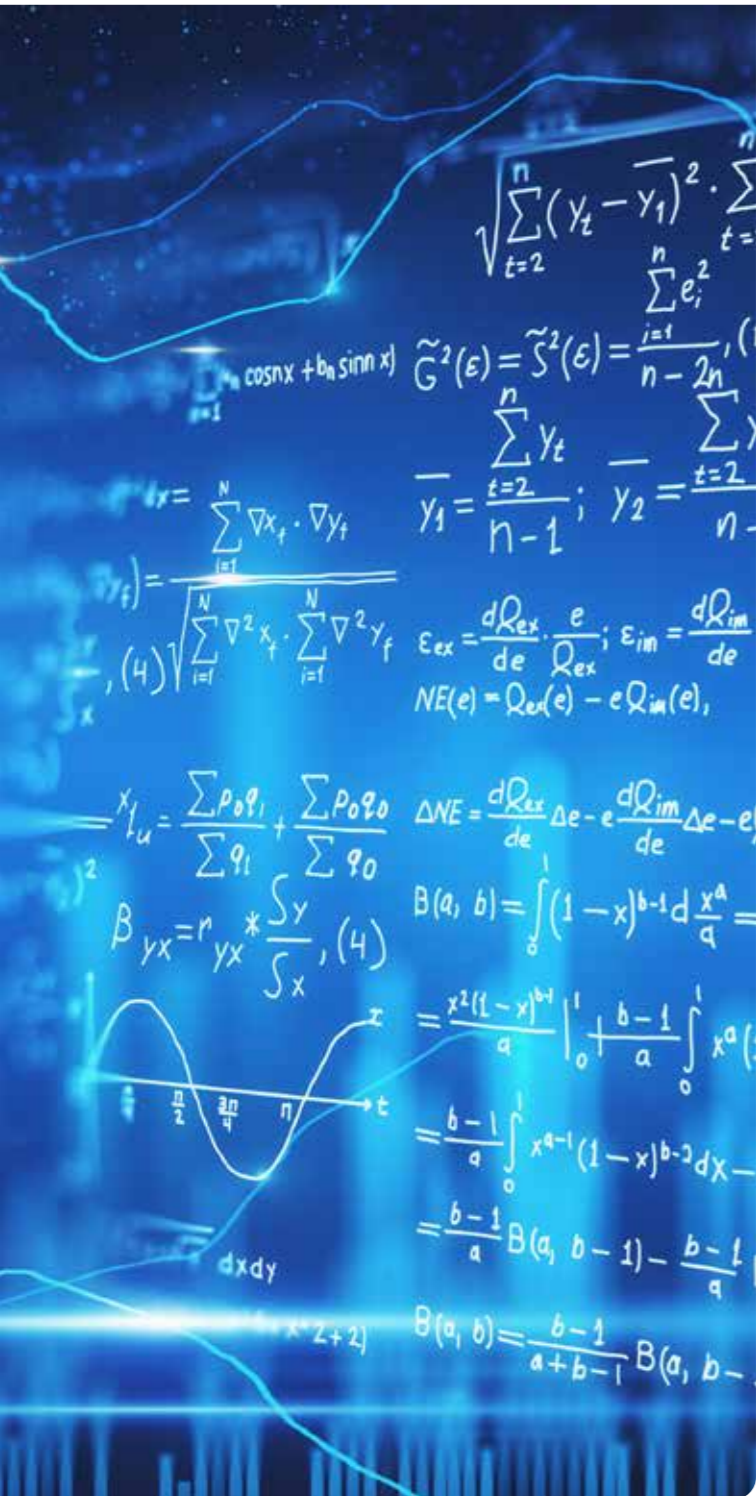
Head of Department:
Prof B Yibas

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 R Hansen, Dr H Minnaar and Dr R Muir
Lecturers:	Dr M Clark, M Dimmick-Touw (Contract), JJ Keet, J Magson, R Makhadi and ME Moitsi
Junior Lecturers:	T Mapholi and J Nel
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:	J Magson 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 M Sadeghi, Dr MJ van der Merwe and Prof WA van der Westhuizen
Senior Assistant Officers:	A Felix, C van der Vyver and R Zaal
Technical Officers:	P Lehloeny, M Purchase and D Radikgomo

DEPARTMENT OF

MATHEMATICAL STATISTICS AND ACTUARIAL SCIENCE

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Frans Koning

Department Mathematical Statistics and Actuarial Science

Faculty of Natural and Agricultural Sciences

University of the Free State
PO Box 339 | Bloemfontein 9300 | South Africa

- T: +27 51 401 3417
- E: koningf@ufs.ac.za
- E: <https://www.ufs.ac.za/msas>

OVERVIEW OF 2022

The Department of Mathematical Statistics and Actuarial Science had a good year in 2022, during which we returned to F2F lecturing. Staff members attended conferences as usual, and Honours students attended the regular annual actuarial careers fair at the University of Pretoria (UP). We lost two staff members: Charl Pretorius moved to North-West University (NWU) and Linda Van der Merwe went on early retirement. We have appointed one person as a replacement (awaiting visa) and will make another appointment in 2023. Both publications and earnings from lecturing look positive. The departmental component of postgraduate students is rising, and we plan to increase the intake in 2023. Jan Blomerus took over from Michael von Maltitz as programme director and is doing an exceptional job. The Department also underwent a five-yearly review, which will assist in further improving our Department.

ACHIEVEMENTS

Staff Achievements

Two staff members, Sandile Shongwe and Liza da Silva, completed their PhDs in 2022, and will submit their theses in early 2023. Louwtjie Voges completed his Master's *cum laude*, under the supervision of Prof Abrie van der Merwe (who is currently aged 82 and still as sharp ever).

At the UFS Learning and Teaching Awards, Dr Michael von Maltitz won the award for the 'Best Innovation in Curriculum Development Conference Paper', and first place in the category 'Innovating my Curriculum through Assessment'. Dr Sean van der Merwe achieved second place in the category 'Innovating my Curriculum through the use of Technology and/or Online Tools'.



Dr Sean van der Merwe receiving his award from Dr Engela van Staden (Vice-Rector: Academic) at the UFS Learning and Teaching Awards

NATIONAL AND INTERNATIONAL COLLABORATION

In 2020, Prof Maxim Finkelstein, our A-rated researcher, was appointed as a Visiting Professor at the Strathclyde University in Glasgow, UK. This

collaboration continues to benefit both universities. In the future, we plan to extend collaboration of our Department with the Department of Management Sciences at Strathclyde University.

Our collaboration with KU Leuven has also been long-standing, and continues with visits from Prof Jan Beirlant, world-renowned for his work in extreme value theory.

OTHER ACTIVITIES

Several statistical staff members attended the 63rd Annual Conference of the South African Statistical Association (SASA 2022), held in George from 28 November to 2 December.

The Statistical Consultation Unit (SCU) in the Department provides statistical consultation services to UFS researchers – staff and postgraduate students. The SCU makes a contribution throughout the research process, from the planning of the research project, through the analysis of research data, to the publication of the findings. On request,



Members of staff at SASA 2022
Back, from the left, Prof Jan Beirlant, Dr Mandla Diko, Prof Robert Schall, Dr Sean van der Merwe, Prof Delson Chikobvu and Sandile Shongwe
Front, from the left, Zani Ludick, Dr Trudie Strauss and Prof Andréhette Verster

the Unit also offers short lectures on statistical concepts and research methodology to staff and postgraduate students or contributes statistical expertise to UFS projects in other ways.

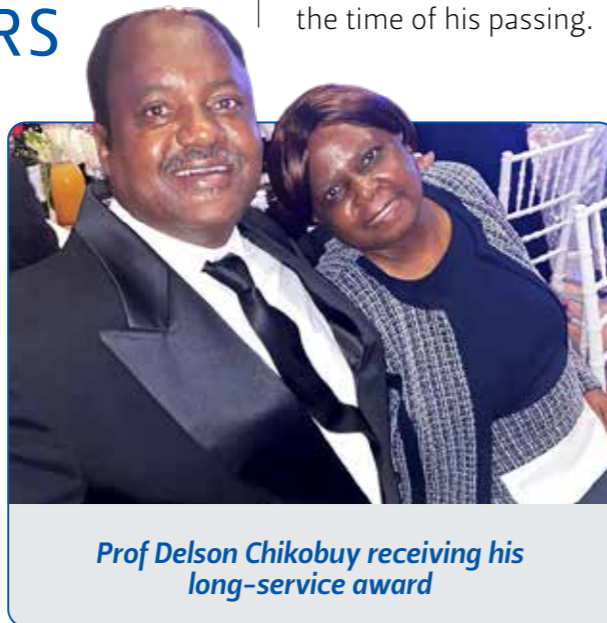
From the start of 2022, we implemented an online project application and tracking system. Applications to the Unit are made via an online form, which is automatically processed and responded to. This streamlines the initial stages of every project and creates transparency within the Unit regarding the inflow and assignment of projects. A live tracking system is then used to monitor the progress and completion of projects, so that workload is clear at all times. In 2022, the SCU handled a total of 69 projects.

STAFF MATTERS

Dr Delson Chikobvu was promoted to Associate Professor.

Professor Fabio Correa, from Rhodes University, has been appointed but he still awaits a visa and will commence his appointment in 2023.

Dr Linda van der Merwe went on early retirement at the middle of the year.



Prof Delson Chikobvu receiving his long-service award

The staff of the Department at the start of 2022, is reflected in the organogram below:

Prof Delson Chikobvu received a long-service award of 25 years in October 2022, and William Baranya who served as support staff in the Department, received a 40-year service award.

Dr Martin van Zyl sadly passed away early in the year. Although he had retired two years previously due to ill health, he was still active as a research fellow at the time of his passing.

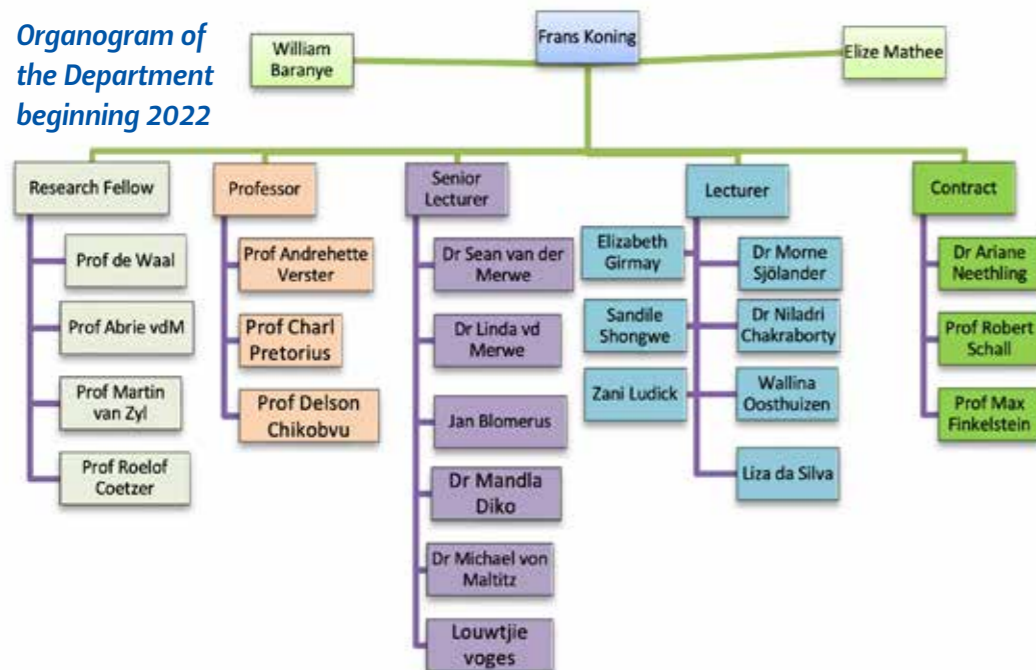


Dr Martin van Zyl



'Tannie' Ella Hayes

Organogram of the Department beginning 2022



'Tannie' Ella Hayes, who had previously been the secretary in the Department for many years, also sadly passed away.

With regard to family matters, Zani Ludick got engaged to Lance Phillip, and Louwtjie Voges got married.

RESEARCH OUTPUTS

Research Articles

Abbasi, S.A., Yeganeh, A. & Shongwe, S.C. 2022. Monitoring non-parametric profiles using adaptive EWMA control chart. *Scientific Reports* 12: 14336. Online. DOI: 10.1038/s41598-022-18381-8.

Adeoti, O.A., Malela-Majika, J-C., Shongwe, S.C. & Aslam, M. 2022. A homogeneously weighted moving average control chart for Conway-Maxwell Poisson distribution. *Journal of Applied Statistics* 49(12): 3090-3119. DOI: 10.1080/02664763.2021.1937582.

Beirlant, J., Maribe, G., Naveau, P. & Verster, A. 2022. Bias reduced peaks over threshold tail estimation. *REVSTAT-Statistical Journal* 20(3): 277-304. DOI: 10.57805/revstat.v20i3.372.

Cha, J.H. & Finkelstein, M. 2022. A new warranty policy for heterogeneous items subject to monotone degradation processes. *Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability* 236(1): 55-65. DOI: 10.1177/1748006X211028712.

Cha, J.H. & Finkelstein, M. 2022. Acceptance reliability sampling plan for items with two failure modes. *Statistics* 56(6): 1345-1363. DOI: 10.1080/02331888.2022.2154354.

Cha, J.H. & Finkelstein, M. 2022. On some general survival models with delayed failures. *Communications in Statistics - Theory and methods* 51(22): 7911-7928. DOI: 10.1080/03610926.2021.1884261.

Cha, J.H., Finkelstein, M. & Levitin, G. 2022. Age-replacement policy for items described by stochastic degradation with dependent increments. *IMA Journal of Management Mathematics* 33(2): 273-287. DOI: 10.1093/imaman/dpab014.

Cha, J.H., Finkelstein, M. & Levitin, G. 2022. Replacement policy for heterogeneous items subject to Gamma degradation processes. *Methodology and computing in applied probability* 24: 1323-1340. DOI: 10.1007/s11009-021-09859-5.

Chideme, C. & Chikobvu, D. 2022. A Markov chain approach to the pattern of blood donation status at a blood service centre in Zimbabwe. *The Open Public Health Journal* 15: 1-13. DOI: 10.2174/18749445-v15-e221014-2022-49

Chikobvu, D & Chideme, C. 2022. A Markov jump process approach to modeling blood donor status: Donor retention and attrition rates at a blood service center in Zimbabwe. *Health Science Reports* (5)6: 867. Online. DOI: 10.1002/hsr2.867.

Chipumuro, M. & Chikobvu, D. 2022. Modelling tourist arrivals in South Africa to assess the impact of the COVID-19 pandemic on the tourism sector. *African Journal of Hospitality, Tourism and Leisure* 11(4): 1381-1394. DOI: 10.46222/ajhtl.19770720.297.

Fabris-Rotelli, I., Von Maltitz, M.J., Smit, A., Das, S., Roberts, D., Maribe, G., Maposa, D. & Correa, F.M. 2022. Development of an early career academic supervisor in Statistics - A discussion toward a guiding rubric. *Orion* 38(1): 29-51. DOI: 10.5784/38-1-716.

Finkelstein, M. & Cha, J.H. 2022. On degradation-based remaining lifetime. *Probability in the Engineering and Informational Sciences*: 36 (3): 812-823. DOI:10.1017/S0269964821000097.

Finkelstein, M. & Cha, J.H. 2022. Reducing degradation and age of items in imperfect repair modelling. *Test* 31: 1058-1081. DOI: 10.1007/s11749-022-00813-2.

Finkelstein, M., Cha, J.H. & Chakraborty, N. 2022. Balancing load and performance for different failure models. *Applied Stochastic Models in Business and Industry*: 38(2): 323-333. DOI:10.1002/asmb.2662.

Finkelstein, M., Cha, J.H. & Langston, A. 2022. Optimal preventive switching of components in degrading systems. *Reliability Engineering & System Safety*: 219: 1-11. DOI: 10.1016/j.res.2021.108266.

Gbadegesin, J., Marais, L., Von Maltitz, M.J., Cloete, J., Lenka, M., Rani, K., Campbell, M., Stuart, D-S., Venter, A., Koetaan, Q., Pretorius, W. 2022. Student housing satisfaction at a South African University. *Journal of Student Affairs Research and Practice* 59(5): 559-579. Online. DOI: 10.1080/19496591.2022.2032111.

Ghosh, S., Bhuyan, P. & Finkelstein, M. 2022. On a bivariate copula for modeling negative dependence: application to New York air quality data. *Statistical Methods & Applications* 31: 1329-1353. DOI: 10.1007/s10260-022-00636-3.

Goyal, D., Finkelstein, M. & Hazra, N.K. 2022. On history-dependent mixed shock models. *Probability in the Engineering and Informational Sciences* 36(4) 1080-1097. DOI: 10.1017/s0269964821000255.

Goyal, D., Hazra, N.K. & Finkelstein, M. 2022. On the time-dependent Delta-Shock model governed by the generalized Pólya process. *Methodology and Computing in Applied Probability* 24: 1627-1650. DOI:10.1007/s11009-021-09880-8.

Goyal, D., Hazra, N.K. & Finkelstein, M. 2022. On the general -shock model. *Test* 31: 994-1029. doi.org/10.1007/s11749-022-00810-5.

Goyal, D., Hazra, N.K. & Finkelstein, M. 2022. On properties of the phase-type mixed poisson process and its applications to reliability shock modelling. *Methodology and Computing in Applied Probability* 24: 2933-2960. DOI: 10.1007/s11009-022-09961-2.

Hazra, N.K., Finkelstein, M. & Cha, J.H. 2022. On a hazard (failure) rate process with delays after shocks. *Statistics & Probability Letters* 181: 109276. Online. DOI: 10.1016/j.spl.2021.109276.

Iqbal, A., Mahmood, T., Nazir, H.Z. & Chakraborty, N. 2022. On the improved generalized linear model-based monitoring methods for Poisson distributed processes. *Concurrency computation practice and experience* 34(11): e6889. Online. DOI:10.1002/cpe.6889.

Jakata, O. & Chikobvu, D. 2022. Extreme value modelling of the monthly South African industrial index (J520) returns. *Statistics, optimization and information computing* 10(2): 638-655. DOI: 10.19139/soic-2310-5070-906.

Jakata, O. & Chikobvu, D. 2022. Extreme value modelling of the South African Industrial Index (J50) returns using the generalized extreme value distribution. *International Journal of Applied Management Science* 14(4): 299-315. DOI: 10.1504/IJAMS.2022.10051999.

Lee, H., Cha, J.H. & Finkelstein, M. 2022. A preventive replacement policy for a system subject to bivariate generalized polya failure process. *Mathematics* 10(11): 1-18. DOI: 10.3390/math10111833.

Levitin, G., Finkelstein, M. & Xiang, Y. 2022. Optimal preventive replacement for cold standby systems with elements exposed to shocks during operation and task transfers. *IEEE transactions on systems, man, and cybernetics: systems* 52(3): 1787-1794. DOI: :10.1109/TSMC.2020.3034493.

Makoni, T., Chikobvu, D. & Sigauke, C. 2022. Combined hierarchical tourist arrival forecast for

great Zimbabwe national monuments. *African Journal of Hospitality, Tourism and Leisure* 11(6): 2092-2012. DOI: 10.46222/ajhtl.19770720.2102.

Malela-Majika, J-C., Shongwe, S., Castagliola, P. & Mutambayi, R.M. 2022. A novel single composite Shewhart-EWMA control chart for monitoring the process mean. *Quality and Reliability Engineering International* 38(4): 1760-1789. DOI:10.1002/qre.3045.

Matizirofa, L. & Chikobvu, D. 2022. A descriptive model for predictors of stroke in South Africa using the least absolute shrinkage and selection operator (LASSO) logistic regression. *International Journal on Disability and Human Development*: 21(4): 403-412.

Matizirofa, L. & Chikobvu, D. 2022. Analysis of modifiable and non-modifiable predictors of stroke in South Africa using Bayesian quantile regression model. *International Journal on Disability and Human Development* 21(4): 391-401.

Ndlovu, T. & Chikobvu, D. 2022. Comparing riskiness of exchange rate volatility using the value at risk and expected shortfall methods. *Investment management and financial innovations*: 19(2): 360-371. DOI: 10.21511/imfi.19(2).2022.31

Pavolo, D. & Chikobvu, D. 2022. Estimating rubber covered conveyor belting cure times using multiple simultaneous optimizations ensemble. *Operational Research in Engineering Sciences Theory and Applications* 5: 90-106. doi.org/10.31181/oresta180222016p.

Pavolo, D. & Chikobvu, D. 2022. Jackknifing the model averaging: investigating the improvements to fitness to data and prediction accuracy of two-input under-fitted and just-fitted response models. *International Journal of Operational Research* 45(1): 86-106. DOI: 10.1504/IJOR.2020.10030928.

Pavolo, D. & Chikobvu, D. 2022. Using criterion-based model averaging in two-input multiple response surface methodology problems. *International Journal of Operational Research* 44(1): 80-101. DOI: 10.1504/IJOR.2022.123030.

Retief, C.A., Retief, H.J. & Van der Merwe, S. 2022. Evaluating the neutrophil-to-lymphocyte ratio as an indicator for early referral of patients with COVID-19 pneumonia to a high-care facility. *South African Medical Journal* 112(10): 795-799. DOI: 10.7196/SAMJ.2022.v112i10.16590.

Shojaee, O., Asadi, M. & Finkelstein, M. 2022. Stochastic properties of generalized finite a-mixtures. *Probability in the Engineering and Informational Sciences* 36(4): 1055-1079. DOI: 10.1017/s0269964821000243.

Van der Walt, M.S., Daffue, W., Goedhals, J., Van der Merwe, S. & Deacon, F. 2022. A preliminary study on the siphon mechanism in Giraffe (*Giraffa Camelopardalis*). *Animals (Bael)* 12(23): 3348. Online: DOI: 10.3390/ani12233348.

Van der Merwe, A.J., Von Maltitz, M.J., Meyer, J.H. & Groenewald, P.C.N. 2022. A simulation study to compare reference and other priors in the case of a standard univariate student t-distribution. *South African Statistical Journal* 56(2): 91-120. DOI: 10.37920/sasj.2022.56.2.2.

Verster, A. & Kwaramba, N. 2022. A different way of choosing a threshold in a bivariate extreme value study. *Statistics, Optimization and Information Computing* 10(2): 505-518. DOI: 10.19139/soic-2310-5070-1318.

Verster, A. & Kwaramba, N. 2022. Estimating the dependence parameter in bivariate extreme value statistics through a Bayesian approach. *Orion* 38(2): 107-121. DOI: 10.5784/38-2-771.

STAFF (2022)

Head of Department:
FF Koning

- Professor:** Prof C Pretorius
- Associate Professors:** Prof D Chikobvu and Prof A Verster
- Senior Lecturers:** J Blomerus, FF Koning, Dr M Diko, Dr L van der Merwe, Dr S van der Merwe, L Voges and Dr M von Maltitz
- Lecturers:** Dr N Chakraborty, L da Silva, E Girmay, Z Ludick, W Oosthuizen, S Shongwe and Dr M Sjölander
- Research Fellows:** Prof R Coetzer, Prof DJ de Waal, Prof A Ring, Prof R Schall, Prof A van der Merwe and Prof M van Zyl
- Programme Director:** J Blomerus
- Secretary:** ME Mathee
- Messenger:** W Baranye
- Contract appointments:** Prof J Beirlant, Prof M Finkelstein and Dr A Neethling



DEPARTMENT OF

MATHEMATICS AND APPLIED MATHEMATICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Dr Christiaan Venter

Department of Mathematics and Applied Mathematics

Faculty of Natural and Agricultural Sciences

University of the Free State
PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2320

E: VenterC@ufs.ac.za

W: www.ufs.ac.za/mam

QWAQWA CAMPUS

Dr Ur Koumba

Department of Mathematics and Applied Mathematics

Faculty of Natural Sciences

University of the Free State
Private Bag X13 | Phuthaditjhaba 9866
South Africa

T: +27 58 718 5303

E: KoumbaUA@ufs.ac.za

W: www.ufs.ac.za/mam

OVERVIEW OF 2022

The Department of Mathematics and Applied Mathematics strives to create research, learning and teaching environments that allow staff and students to flourish. In that light, 2022 was a good year, even though improvement is certainly always possible.

The year started off quite positively with new appointments in January and February. In January we were joined by Dr Christian Budde and in February by Dr Yibeltal Terefe, both at Senior Lecturer level. They both quickly found their feet and have already made a positive impact in terms of research, teaching and learning. Protests, on particularly the Qwaqwa Campus, initially placed a damper on the academic project, but innovative measures and staff determination saved the day yet again. In February the first departmental research seminar was held, followed by seminars in April, September and October. In June a full day was spent on staff research talks, involving all staff from both campuses. Interspersed we held more research talks – for example Prof Tomas Vetrik’s inaugural lecture in May and Prof Jeandrew Brink’s online contribution to a webinar on the black hole at the centre of our galaxy, in June

The Department underwent a five-yearly external review in October. In line with the Department’s endeavour to aim for continuous improvement, the review report was welcomed. The review panel’s findings were generally very positive and from their recommendations, an improvement plan was created. The year ended positively with successful examinations, conference attendance and fruitful research visits.

ACHIEVEMENTS

Staff Achievements

During the April 2022 graduation ceremony, Elize Swartz, a part-time lecturer in the Department, was not only awarded her MSc in Mathematics, but also received the Dean’s Medal for the top achievement as Master’s student in the Faculty of Natural and Agricultural Sciences.

During the 9th Heidelberg Laureate Forum (HLF), held from 18 to 23 September, Dr Christian Budde was given the special opportunity to present a poster. The HLF is a special forum where only 100 young researchers are selected to join in a few days of lectures, panel discussions and networking with ‘the Laureates’, i.e.

Fields Medal winners, Abel Prize winners and Turing award winners.



Dr Christian Budde at the 2022 Heidelberg Laureate Forum

Student Achievements

Elandri Crafford 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 2021. These prizes were officially awarded at the Faculty Prize Giving Ceremony in April 2022.



Elize Swartz, the 2022 Dean’s Medal winner for MSc studies

TEACHING AND LEARNING

On the Bloemfontein Campus, classes started off well in February, with fewer disruptions than in 2021. Unfortunately, the same was not true on the Qwaqwa Campus during the first semester, with some of the most destructive protests ever experienced there. The closing of the Qwaqwa Campus for a substantial period in the first semester placed a great deal of pressure on staff to again make and successfully implement new plans for covering the curriculum adequately and fairly. Fortunately, the second semester proceeded quite smoothly with almost no disruption.

Twenty-three (23) undergraduate and 11 Honours modules were successfully offered during the year. Despite a pressured environment with high expectations requiring increasing adaptability and creativity, staff managed to perform commendably.

RESEARCH AND INNOVATION

2022 saw a reasonable output in terms of publications. More importantly for the longer-term, 2022 saw the surfacing of a new energy for research.

The Department hosted four seminars and also a first-ever Research Day in which all research staff participated. This event also served to bring together the staff from the Bloemfontein and Qwaqwa campuses. A concerted effort will be made in 2023 to continue with frequent seminar talks and to devise mechanisms to encourage research, including collaboration and applications for funding.

At the Departmental Research Day, held on the 20 June on the Bloemfontein Campus, all staff members had the opportunity to make a 25-minute presentation on their current research. As part of their presentations, each also had to identify possible projects they could use to host Honours research essays. The Research Day will become an annual event and hopefully a highlight on the Department's calendar.

From 1 October, Dr Danie van Wyk joined the Department as a Research Fellow. He is also Visiting Assistant Professor of Mathematics at Amherst College in Massachusetts, USA. It is anticipated that Dr Van Wyk will make a valuable contribution to the research output of the Department and also assist with collaboration and networking, specifically with other Algebraists.

ENGAGED SCHOLARSHIP

Prof Johan Meyer was involved in the setting and moderation of Olympiad papers for the national Maths Olympiads and also organised the UFS students' participation in the annual South African Tertiary Maths Olympiad (SATMO).

Dr Renier Jansen and Dr Christiaan Venter were again very involved with Nautilus Mathematics, which holds quarterly Maths Olympiad workshops and competitions for learners from Grade 4 to Grade 12 from all over the Free State.

Some staff members, such as Prof Tomas Vetrík, Prof Johan Meyer, Dr Edgard Ngounda and Dr Christian Budde, served as reviewers for journals. Prof Vetrík was appointed as an editor of the *Iranian Journal of Mathematical Chemistry*.

Dr Ngounda, Dr Budde and Prof Vetrík also assisted in organising special sessions at the 65th Congress of the South African Mathematical Society (SAMS).

On 29 March 2022, Dr Christian Budde presented a talk at the African Institute of Mathematical Science (AIMS) in Muizenberg, South Africa. The title of his talk was 'One-parameter semigroups – An operator theoretical approach to evolution equations'.

On 3 June 2022, Prof Jeandrew Brink formed part of an online public webinar, 'The first image of the Black Hole at our Galactic Centre, making a presentation titled 'Theory: Black Hole Shadow – Constraints on GR?' This online event was jointly hosted by the African Astronomical Society (AfAS) and the Department of Science and Innovation (DSI).

From 1 to 11 November 2022, Prof Tomas Vetrík was a guest lecturer at the Centre International De Mathématiques Pures et Appliquées (CIMPA) School on Recent Advances in Combinatorics and its Applications. It was hosted at the COMSATS University Islamabad, in Lahore, Pakistan. The course presented by Prof Vetrík was titled 'Cayley graphs and the degree-diameter problem'.

From 3 to 5 December 2022, Dr Renier Jansen participated in the Topology for Tomorrow workshop at AIMS, in Muizenberg.

NATIONAL AND INTERNATIONAL COLLABORATION

Prof Johan Meyer published a paper with collaborators from the Department of Mathematics at Manipal Institute of Technology, Manipal Academy of Higher Education, in India. He also collaborated and published a paper with a former colleague, Dr Ben-Eben de Klerk, now working in the private sector.

Prof Tomas Vetrík continued with various international collaborators in 2022 – with researchers from India, Saudi Arabia, South Korea, Ethiopia, United Arab Emirates and Qatar.

Dr Christian Budde collaborated internationally with researchers from Germany and the Netherlands and nationally with researchers from the North-

West University in Potchefstroom and from University Stellenbosch University.



Dr Yibeltal Terefe

Dr Yibeltal Terefe collaborated nationally with researchers from the University of Pretoria and the University of the Witwatersrand. Internationally he published with researchers from Cameroon and Botswana.



Sello Mbambo, from the Qwaqwa Campus, presenting a seminar talk on 28 October titled 'Properties of Bishop-Phelps Cone in a Banach Space'

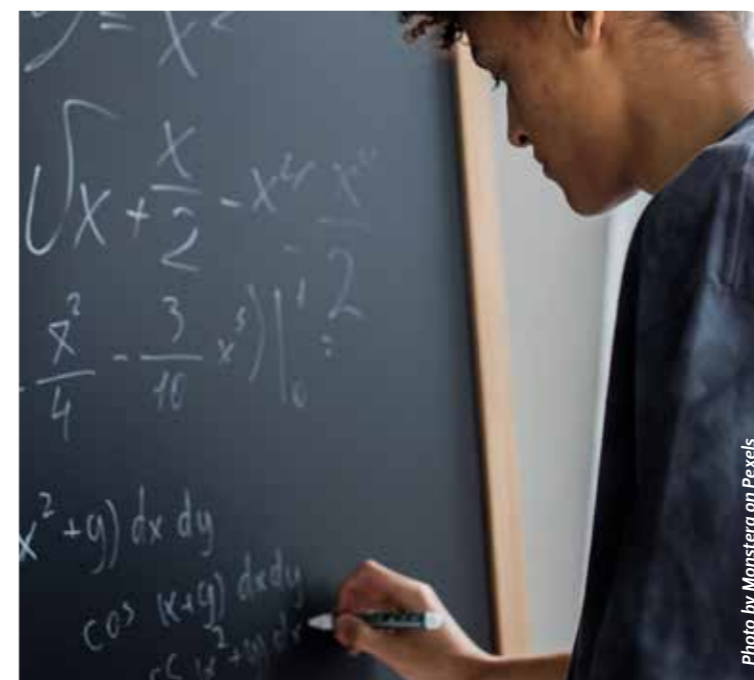
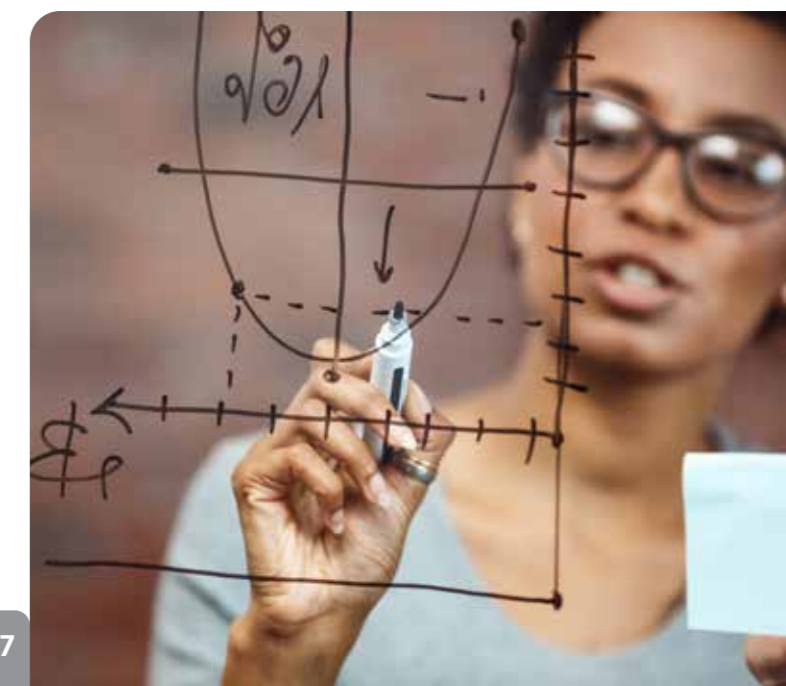
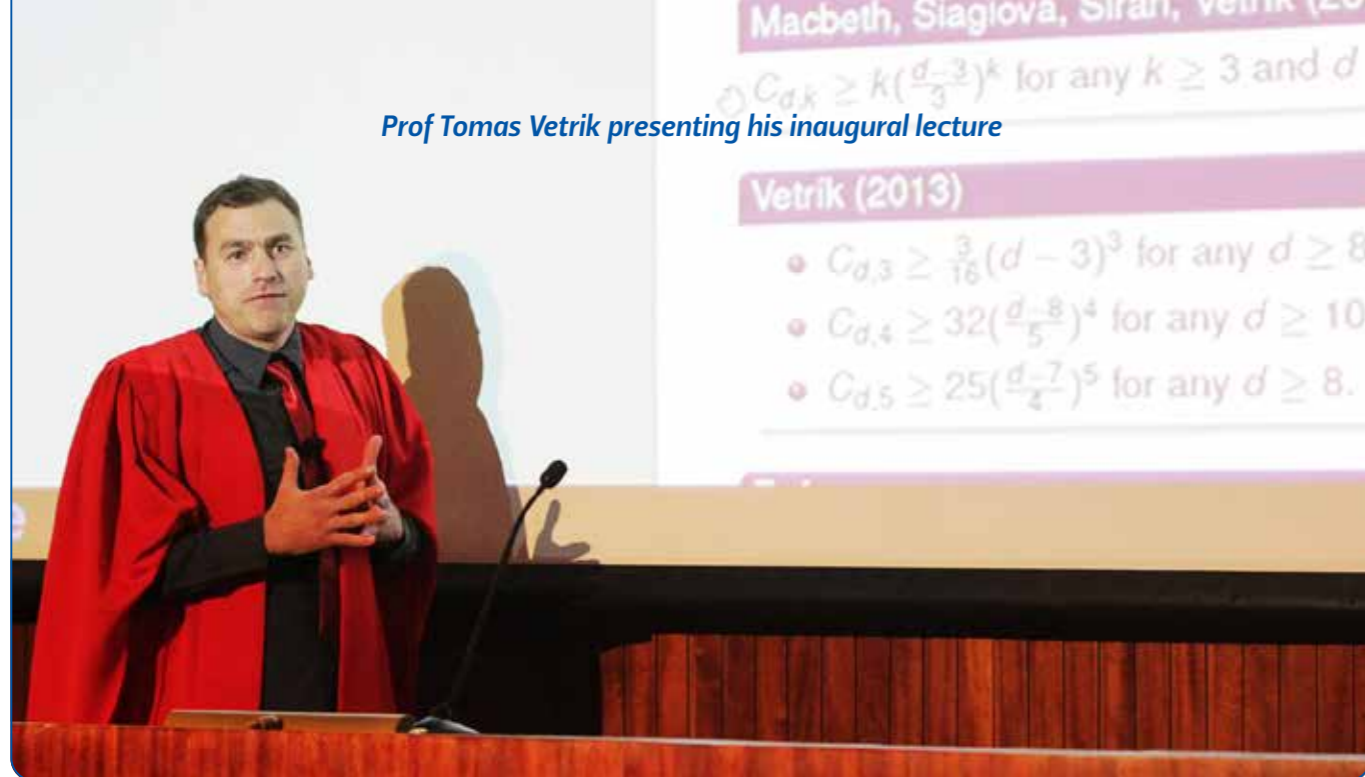


Photo by Monstera on Pexels





Prof Tomas Vetrík presenting his inaugural lecture

OTHER ACTIVITIES

On 19 May, Prof Tomas Vetrík delivered his inaugural lecture as full Professor on the topic of 'Extremal Graph Theory'.

On 15 June, Dr Christiaan Venter represented the Department at the annual Flash Facts competition of the Faculty of Natural and Agricultural Sciences, with a talk titled 'Compactness of Star Polygons'.

POSTGRADUATE STUDENTS

In 2022, five students were enrolled for BSc Honours in Mathematics and Applied Mathematics, of whom two obtained the qualification. One new student registered for a Master's degree in Mathematics, while one student continued with a Master's degree in Mathematics. One student continued with PhD studies and submitted for examination in November.



Prof Johan Mayer

STAFF MATTERS

In January we were joined by Dr Christian Budde and in February by Dr Yibeltal Terefe, both at Senior Lecturer level.

After 16 years in the Department, Marinda Venter retired as Officer in June 2022. Timothy Jansen started as the new Officer in July.

From 1 July, Dr Edgard Ngounda started as the new Programme Director, taking over from Dr Christiaan Venter, who had served in this position for seven and a half years.

During the second semester, Sello Mbambo was granted doctoral study leave for six months to work closely with his supervisor in Pretoria. Mbambo's University Capacity Development Programme (UCDP) grant funded a replacement staff member, Tlotlo Phawe, who successfully handled his classes on the Qwaqwa Campus.

Dr Elizabeth Maritz completed her two-year participation in the Emerging Scholars Accelerator Programme (ESAP) and described the experience as insightful and a positive influence on her career path.

Prof Johan Meyer received a long service award for 35 years uninterrupted service at the UFS.

RESEARCH OUTPUTS

Research Articles

Alfuraidan, M.R., Das, K.C., Vetrík, T. & Balachandran, S. 2022. General Randić index of unicyclic graphs with given diameter. *Discrete Applied Mathematics* 306: 7-16. DOI: 10.1016/j.dam.2021.09.016.

Budde, C.J. & Kreulich, J. 2022. Application of abstract semigroup theory to the asymptotic behavior of CO-semigroups. *Complex Anal. Oper. Theory* 16:105. DOI: doi.org/10.1007/s11785-022-01285-w.

Budde, C.J., Labuschagne, L. & Steyn, C. 2022. Almost everywhere convergence for noncommutative spaces. *Banach J. Math. Anal.* 16:56. DOI: doi.org/10.1007/s43037-022-00209-2.

Budde, C.J. & Wegner, S-A. 2022. A Lumer-Phillips type generation theorem for bi-continuous semigroups. *Z. Anal. Anwend.* 41(1-2): 65-80. DOI: 10.4171/ZAA/1695.

Chapwanya, M., Lubuma, J., Terefe, Y.A. & Tsanou, B. 2022. Analysis of War and Conflict Effect on the Transmission Dynamics of the Tenth Ebola Outbreak in the Democratic Republic of Congo. *Bull Math Biol.* 84(12):136. DOI: 10.1007/s11538-022-01094-4.

De Klerk, B-E. & Meyer, J.H. 2022. Functional graphs of abelian group endomorphisms. *Discrete Mathematics* 345(2): 112691, ISSN 0012-365X, DOI: 10.1016/j.disc.2021.112691.

Feyissa, Y.K., Imran, M., Vetrík, T. & Hunde, N. 2022. On the general eccentric distance sum of graphs and trees. *Iranian Journal of Mathematical Chemistry* 13(4): 239-252. DOI: 10.22052/IJMC.2022.246189.1617.

Feyissa, Y.K. & Vetrík, T. 2022. Bounds on the general eccentric distance sum of graphs. *Discrete Mathematics Letters* 10: 99-106. DOI: 10.47443/dml.2022.070.

Imran, M. & Vetrík, T. 2022. On the partition dimension of infinite graphs. *Mathematical Reports* 24: 433-442.

Sahoo, T., Meyer, J.H., Panackal, H., Srinivas, K.B. & Prasad, K.S. 2022. Partial Order in Matrix Nearings. *Bull. Iran. Math. Soc.* 48: 3195-3209. DOI: 10.1007/s41980-022-00689-w.

Swartz, E. & Vetrík, T. 2022. Survey on the general Randić index: extremal results and bounds. *Rocky*

Mountain Journal of Mathematics 52(4): 1177-1203. DOI: 10.1216/rmj.2022.52.1177.

Terefe, Y.A., Kassa, S.M. & Njagarah, J.B.H. 2022. Impact of the WHO Integrated Stewardship Policy on the Control of Methicillin-Resistant *Staphylococcus aureus* and Third-Generation Cephalosporin-Resistant *Escherichia coli*: Using a Mathematical Modeling Approach. *Bull Math Biol.* 84(9): 97. DOI: 10.1007/s11538-022-01051-1.

Van der Merwe, A.J., Von Maltitz, M.J., Meyer, J.H. & Groenewald, P.C.N. 2022. A simulation study to compare reference and other priors in the case of a standard univariate Student t-distribution. *South African Statistical Journal* 56(2): 91-120. DOI: 10.37920/sasj.2022.56.2.2.

Venter, C., Haddad, C.R. & Codron, D. 2022. A novel approach to determine the surface area of buckspoor spider webs and other irregular-shaped two-dimensional objects. *MethodsX* 9: 101904, ISSN 2215-0161. DOI: 10.1016/j.mex.2022.101904.

Vetrík, T. 2022. General Randić index of unicyclic graphs with given girth and diameter. *Asian-European Journal of Mathematics* 15(9): 2250165. DOI: 10.1142/S1793557122501650.

Vetrík, T. 2022. General sum-connectivity index of unicyclic graphs with given diameter and girth. *Discrete Mathematics, Algorithms and Applications* 14(4): 2150140. DOI: 10.1142/S1793830921501408.

Vetrík, T. & Balachandran, S. 2022. General Randić index of unicyclic graphs with given number of pendant vertices. *Discrete Mathematics Letters* 8: 83-88. DOI: 10.47443/dml.2021.0124.

Vetrík, T. & Balachandran, S. 2022. Zeroth-order general Randić index of trees. *Boletim da Sociedade Paranaense de Matemática* 40: 1-9. DOI: 10.5269/bspm.45062.

Vetrík, T., Jaradat, M.M.M. & Bataineh, M.S. 2022. A note on the Ramsey number for small graphs. *Journal of Discrete Mathematical Sciences and Cryptography* 25(2): 463-470. DOI: 10.1080/09720529.2020.1726080.

Vetrík, T., Masre, M. & Balachandran, S. 2022. Zeroth-order general Randić index of trees with given distance k-domination number. *Electronic Journal of Graph Theory and Applications* 10(1): 247-257. DOI: 10.5614/ejgta.2022.10.1.17.

Conference Contributions

Conference Papers/Posters

Budde, C.J. 2022. *A Lumer-Phillips type generation theorem for bi-continuous semigroups*. Paper delivered at International Conference: One-Parameter Semigroups of Operators 2022, National Research University Higher School of Economics, Moscow, Russia (Virtual). 14-18 February 2022.

Budde, C.J. 2022. *A Lumer-Phillips type generation theorem for bi-continuous semigroups*. Paper delivered at the 65th South African Mathematical Society (SAMS) Congress, Stellenbosch, South Africa. 6-8 December 2022.

Budde, C.J. 2022. *A Lumer-Phillips type generation theorem for bi-continuous semigroups*. Paper delivered as part of the Oberseminar Analysis, Dresden University of Technology, Germany (Virtual). 14 December 2022.

Budde, C.J. 2022. *A monotone convergence theorem for strong Feller semigroups*. Paper delivered at the Functional Analysis and Operator Theory South Africa (FAOTSA) workshop, Berg-en-Dal Rest Camp, Kruger National Park, South Africa. 30 September-3 October 2022.

Budde, C.J. 2022. *Intermediate and Extrapolated Spaces for Bi-continuous Operator Semigroups*. Poster presented at the 9th Heidelberg Laureate Forum (HLF), Heidelberg, Germany. 18-23 September 2022.

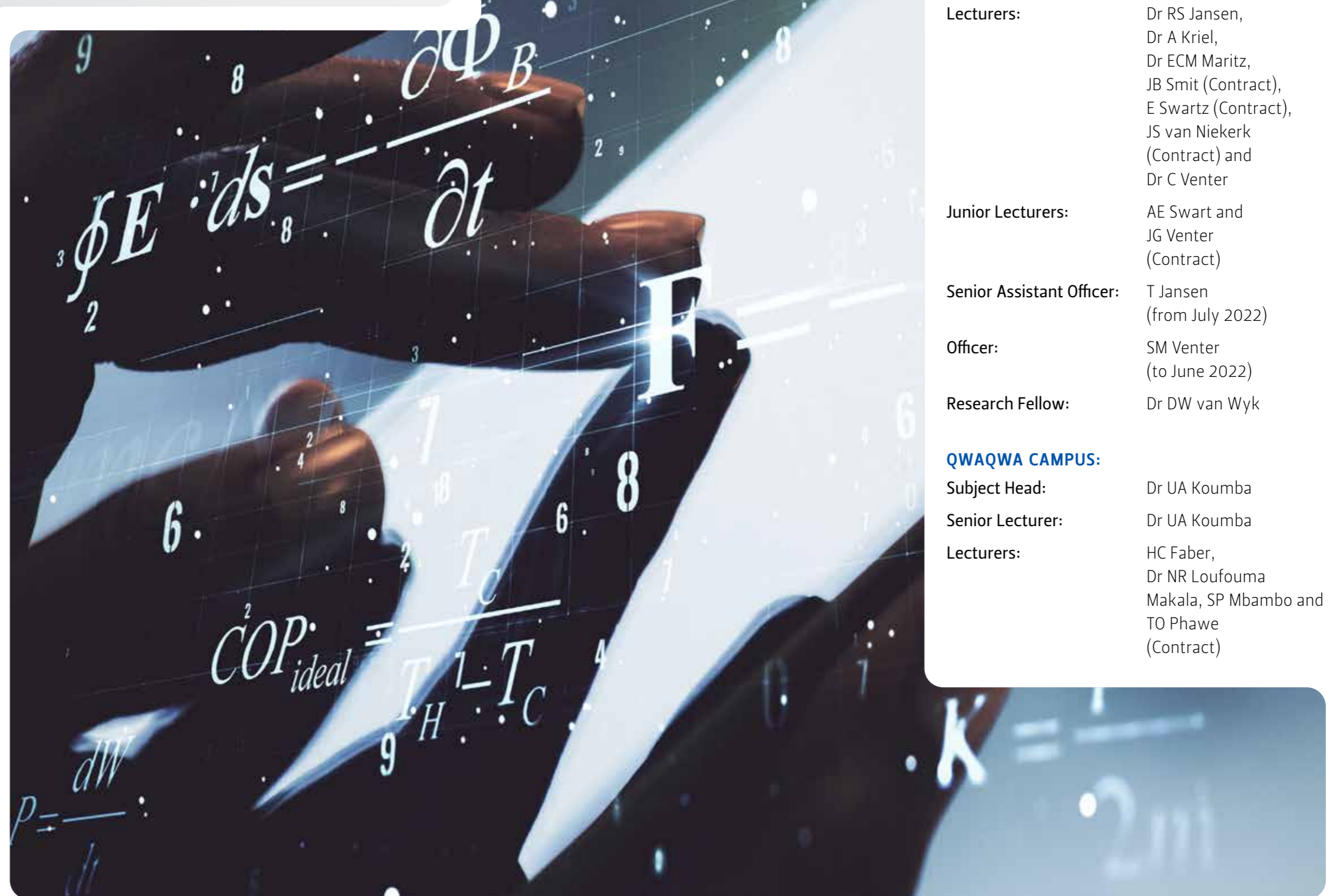
Maritz, E.C.M. 2022. *Grid resilience under failure cascades*. Paper delivered at the University of the Free State Smart Grid Engineering and ICDF Symposium, Bloemfontein, South Africa. 22 July 2022.

Mbambo, S.P. 2022. *Characterization of a Reflexive Banach space using Bishop - Phelps cones*. Paper delivered at the International Conference on Topology, Algebra and Category Theory (TACT2022), UNISA, Pretoria, South Africa. 19-22 September 2022.

Mbambo, S.P. 2022. *Properties of Bishop - Phelps cone in a Banach space*. Paper delivered at the Annual Southern Africa Mathematical Sciences Association (SAMSA) Conference, Eduardo Mondlane University, Maputo, Mozambique. 22-25 November 2022.

Terefe, Y.A. 2022. *Impact of the WHO Integrated Stewardship Policy on the Control of Methicillin-Resistant Staphylococcus aureus: Using a Mathematical Modeling Approach*. Paper delivered at the MALS (Modelling and Analysis in Life Sciences) workshop, Dinokeng Game Reserve, Hammanskraal, South Africa. 20-23 November 2022.

Vetrik, T. 2022. *General indices of graphs*. Paper delivered at the International Conference on Graph Theory and Information Security V, Bandung, Indonesia (Virtual). 22-25 May 2022.



STAFF (2022)

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, JB Smit (Contract), E Swartz (Contract), JS van Niekerk (Contract) and Dr C Venter
Junior Lecturers:	AE Swart and JG Venter (Contract)
Senior Assistant Officer:	T Jansen (from July 2022)
Officer:	SM Venter (to June 2022)
Research Fellow:	Dr DW van Wyk

QWAQWA CAMPUS:

Subject Head:	Dr UA Koumba
Senior Lecturer:	Dr UA Koumba
Lecturers:	HC Faber, Dr NR Loufouma Makala, SP Mbambo and TO Phawe (Contract)

DEPARTMENT OF

MICROBIOLOGY AND BIOCHEMISTRY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Prof Jacobus Albertyn

Department of Microbiology and Biochemistry

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2396

E: albertynj@ufs.ac.za

W: www.ufs.ac.za/mb

OVERVIEW OF 2022

The Department of Microbiology and Biochemistry is a dynamic department that contributes to teaching and learning as well as research and engaged scholarship in the two subject areas, as indicated in the departmental name. The Department currently employs sixteen dedicated, full-time permanent academic staff members, most with NRF-rating. One lecturer is part of the nGAP programme and another lecturer is funded through the SARChi Chair of Prof Carlien Pohl-Albertyn. The Department's research focuses on three principal areas – (i) the production of safe and novel food products, (ii) biocatalysis, bioremediation and bioprospecting and (iii) the improvement of human and animal health. This work is conducted in well-equipped laboratories and often in collaboration with other academic institutions and industry partners. This led to the graduation of 38 postgraduate students in 2022, with 25 BSc Honours degrees, 9 MSc degrees and 4 PhD degrees being conferred at the two graduation ceremonies.

ACHIEVEMENTS

Staff Achievements

Prof Carlien Pohl-Albertyn formed part of an expert panel that reported on the South African Government's response to combat the COVID-19 pandemic. The First Edition COVID-19 Country Report was published in June 2022. She was also appointed as part of the Experts Group to develop the Second Edition COVID-19 Country Report on the implementation of measures to manage, respond and combat the negative impacts of the COVID-19 pandemic in South Africa.

Prof Pohl-Albertyn received NRF-funding through the National Equipment Programme for a new, state-of-the-art confocal laser scanning microscope that was installed at the Centre for Microscopy during 2022. In addition, she was invited to present two keynote addresses during the week of 5 to 9 December 2022 – one at the South African Microscopy Society Conference in Johannesburg and one at the 2nd African Microbiome Workshop and Symposium in Stellenbosch.

Dr Julio Castillo was invited to deliver the keynote address on 'Omics for Bioprospection and Drug discovery' at the Science Forum organised by the University of Trujillo, Peru, held on 28 and 29 March 2022. Dr Castillo was also the Keynote Speaker at the Science Forum South Africa, delivering a talk on 'Biomining: new perspectives'. The Forum was organised by ACE Sudáfrica and the Embassy of Spain in South Africa on 1 December 2022.

The Biocatalysis group at the UFS (led by Prof Martie Smit and Prof Dirk Opperman) was awarded a CSIR/DSI/TIA grant to be one of the three academic nodes (together with the University of the Witwatersrand and Rhodes University) of the newly established Industrial Biocatalysis Hub (IBH). The IBH will also host two academic partners from previously disadvantaged universities and two to three industrial partners.

Prof Garry Osthoff authored a book titled *Post office murals of South Africa*, which was launched on 15 September 2022. The book is a photographic collection of ceramic tile artworks that were applied as decoration to government buildings, specifically post offices, in the 1930s.

Prof Trudi O'Neill delivered her inaugural lecture, 'Rotavirus: New strategies to outsmart an old foe' on 1 September 2022 on the Bloemfontein Campus.



Prof Trudi O'Neill delivering her inaugural lecture

Student Achievements

Clarissa van Heerden received the Inqaba Biotechnical Industries Prize for the best Honours student in Microbiology, Maphori Maliehe received the JP van der Walt Prize for the best MSc dissertation in yeast science (with distinction), Samantha McCarlie received the ICA International Chemicals Prize for the best MSc dissertation in Microbiology/Microbial Biotechnology and Michail Krüger received the Inqaba Biochemical Industries Prize for the best MSc dissertation in Biochemistry.

Two Masters' students from the Applied and Environmental Microbiology Group (AEMG), Jameel Alom and Aoate Tsimatsima, were awarded Alliance 4 Universities (A4U) bursaries to stay for five months at the University Autonomous of Barcelona, Spain, during the second semester of 2022.

Dr Alba Gomez, a Postdoctoral researcher and member of the AEMG, recently received the first prize for the best young researcher and PhD thesis, awarded by ACE-South Africa and the foundation Ramón Areces Foundation.

Michail Krüger, a PhD student from the Biocatalysis



Clarissa van Heerden, Maphori Maliehe, Samantha McCarlie and Michail Krüger receiving their awards



group, received the David Blow bursary to attend the Diamond-CCP4 Data Collection and Structure Solution Workshop 2022 at Diamond Light Source in the UK. Jasmin Aschenbrenner, also a PhD student from the same group, received an International Union of Biochemistry and Molecular Biology (IUBMB) travel fellowship to attend the 22nd International Conference on Cytochrome P450s (ICCP450) in Washington DC.

RESEARCH AND INNOVATION

The research undertaken within the Department can be clustered into three main themes: (1) safe and novel food products and processes, (ii) biocatalysis, bioremediation and bioprospecting and (iii) improvement of human and animal health.

Safe and novel food products and processes

In 2022, Prof Celia Hugo and her research group continued their research on psychrotolerant bacteria in food, with an emphasis on the genus *Chryseobacterium/Kaistella*. Four novel *Kaistella* species are in the process of being described. The group also investigated 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 and protective cultures showed promising results. The research by Prof Hugo, under contract by MilkSA, resulted in the Dairy Standards Agency adopting the methods suggested by Prof Hugo in the report on age gelation in UHT milk and the development of methods for the detection of psychrotolerant bacteria and their enzymes.

The research on the milk composition of African non-dairy animals by Prof Garry Osthoff continues to add surprises to the knowledge of milk composition. Progress was made in the study of the metabolites in milk, and inter-species differences were noted. As was experienced with the fats and proteins of milk, the elephant delivered the most interesting data. It was previously shown that the carbohydrate fraction of this milk is unique. The latest data confirm this uniqueness as well as the changes over lactation.



Photo by kt rb on Unsplash

In cooperation with Prof Maryna de Wit (Department of Sustainable Food Systems and Development), the research on *Opuntia* (prickly pear plants) mucilage polysaccharides of the cladodes and fruit peels was directed into the field of functional properties of hydrocolloids. This involves rheological tests regarding viscosity, gel formation, and the tensile strength of dried cast gels. It was shown that the mucilage might improve the physical properties of composite hydrocolloid carbohydrates such as pectin and alginates. A PhD thesis and several publications are forthcoming.



Photo by Arin Turkey on Pexels

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 desalination 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 titled 'Biogeochemical Processes in a Subsurface Hypersaline Environment near the Abiotic Fringe Zone', Dr Castillo, Dr Alba Gomez, and Prof Maggy Lau (Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences) are investigating 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 MOAB mine, will be used to confirm this biogeochemical pathway.

Dr Julio Castillo, Aoate Tsimatsima and PhD candidate, Andisiwe Matu, collaborated with Prof Miquel Senar from the High-Performance Computing Department 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, for the first time, the microbial composition of the endophytic microorganisms (i.e. fungi and bacteria) that inhabit African potatoes. In addition, Tsimatsima, Dr Castillo



Tsimatsima harvesting wild African potato in the Wepener district of the Free State

and Prof Senar are creating a new pipeline to improve the binning step for fungi genomes obtained from metagenomes.

The project '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 initiative of the European Union's Horizon Europe programme. Dr Castillo is the principle investigator of the study on 'The effect of Quorum Sensing on bioleaching and selective biorecovery processes of cobalt and rare earth elements from mining tailings' within the overall project.

The tailing sampling from Phalaborwa Industrial Complex was completed in November and the metagenomics analysis (i.e. targeted metagenomics and shotgun metagenomics) will be carried out in the tailings during 2023. The first objective is to determine the synergistic and antagonistic interaction in the microbial communities (i.e. fungi and bacteria) and their association with rare earth, using metagenomics and bioinformatics analysis in order to design a proper consortium. Once the consortium is designed, the bioleaching of rare earth elements will be assessed, using synthetic autoinducers (best-studied autoinducers are acyl homoserine lactone (AHL) molecules) to promote the release of those elements from the tailings.

The **Biocatalysis Group**, of Prof Dirk Opperman and Prof Martie Smit has, for more than ten years, focused 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 explores the structure-function relationship of these biocatalysts through structure determination using protein X-ray crystallography. This allows the study of their natural evolution, as well as inform 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.

For a month in October/November, Dr Gabriela Schröder, a Postdoctoral researcher in the Group, and PhD student, Michail Krüger, visited the Biocatalysis research group of Prof Jennifer Littlechild, at the University of Exeter (UK), for a research exchange within the ThermoK project. The scope of the ThermoK project centres on the

thermophilic breakdown of keratin-laden biomass waste and has several international partners within the EU ERA-NET framework. Michail Krüger also had the opportunity to attend the Diamond-CCP4 Data Collection and Structure Solution Workshop 2022 at Diamond Light Source (UK). This opportunity to attend the workshop was made possible by the David Blow bursary.

Jasmin Aschenbrenner attended the 22nd International Conference on Cytochrome P450s (ICCP450), held from 17 to 21 July in Washington DC (USA), where she presented her doctoral research on the structure determination of a fungal CYP and its engineering to alter the regioselectivity of this enzyme. The registration fee and parts of the travel costs were funded through the IUBMB Travel Fellowship.

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. The study was expanded to include various animal strains, including bovine and porcine from both Mozambique and South Africa.

Two approaches for rotavirus vaccine development are also under investigation, namely a replication-deficient rotavirus vaccine through the production of rotavirus proteins in yeast, 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). As part of the DFG-funded project, an explorative study on the incidence of bovine rotavirus was initiated in conjunction with three farms in the Western Cape and one in the Free State.

In a quest for a possible broad-spectrum antiviral, the role of lipids during rotavirus replication is also being investigated. Two members of the Molecular Virology group, PhD student Wico Sander and Postdoctoral Fellow Bonang Mochochoko, attended

the 14th International dsRNA virus Symposium in Banff, Canada, from 10 to 14 October 2022. This is the foremost conference for researchers working on viruses containing a double-stranded RNA genome.



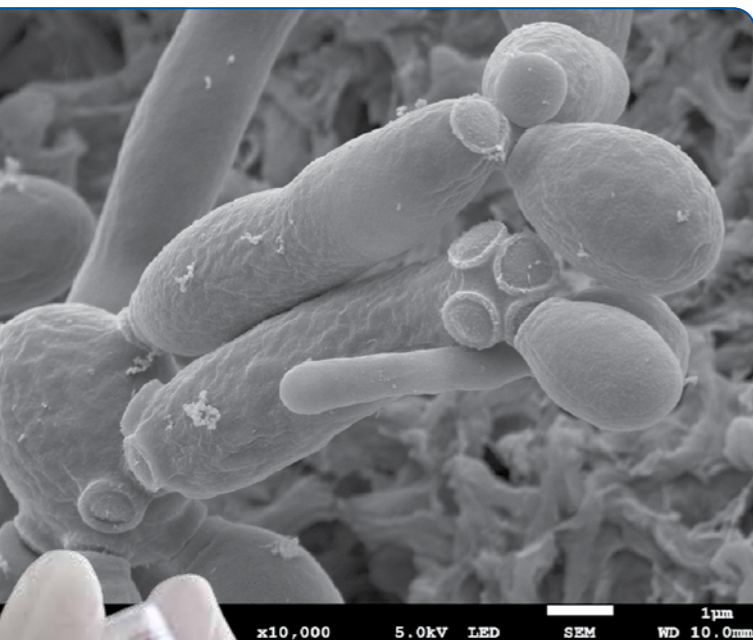
Dr Carmien Tolmie

Dr Carmien Tolmie leads the **Structure-Based Drug Discovery** group, which uses structural biology methods to develop novel therapies to treat infectious disease. 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, from the pathogens *Candida albicans* and *Aspergillus flavus*. A second project on antiviral drug-discovery is based on the reverse transcriptase-polymerase from hepatitis B virus as a target. 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 researchers of the Xchem team at the Diamond Light Source synchrotron, UK. To date, X-ray crystallographic fragment screening has not been used in the development of antifungal compounds.

The work of the **Clinical Biochemistry Group**, led by Dr Frans O'Neill, focuses on metabolism of selected sterols in various fauna and production of reproductive hormones. The former forms part of an interdisciplinary project in which a holistic approach to understand rhinoceros biology and its interaction with the environment is investigated, while the latter has a specific focus on equine chorionic gonadotropin (eCG) – an important hormone used in animal breeding. The work done on the recombinant production of eCG was presented at the 25th Conference of the European Society for Domestic Animal Reproduction (ESDAR) in Thessaloniki, Greece, at the end of September 2022.

Four academic staff members work together within the **Pathogenic Yeast Research Group** – Prof Carlien Pohl-Albertyn (who holds the Research Chair in Pathogenic Yeasts under the NRF South African Research Chair Initiative [SARChI]), Prof Koos Albertyn, Prof Olihile Sebolai and Dr Onele Gcilitshana. The Group focuses on molecular mechanisms of virulence and the role of bioactive lipids 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*. One of the highlights of the work published in 2022 by this Group was the possible interaction between *Cryptococcus neoformans* as SARS-CoV-2. In 2022, five MSc students (three with distinction) and one PhD student completed their research in the Group and obtained their degrees.



Electron micrograph of the pathogenic yeast, *Candida albicans*, taken by Henco Steyn, an MSc student in the group

The **Veterinary Biotechnology Research Group** of Prof Rob Bragg and Dr Charlotte Boucher (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 which contain a wide range of resistance genes, not only to disinfectants, but also 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 down-regulated. 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.

During 2022, work continued and expanded on the efficacy of novel antimicrobial privacy curtains for use in hospitals. A proudly South African antimicrobial curtain has been developed and various projects to test the efficacy of these new curtains, have been undertaken. Work on the control of hospital acquired infections using improved biosecurity, was started in 2022.

ENGAGED SCHOLARSHIP

As part of the Biodiversity Biobanks SA initiative hosted by the South African National Biodiversity Institute (SANBI), Prof Carlien Pohl-Albertyn was able to secure funding of more than R 1 million to upgrade the infrastructure and equipment in the yeast culture collection in 2022. Through this funding the Department was also able to appoint a new curator to standardise the processes and upgrade the digital database of the culture collection.



Prof Trudi O'Neill (fourth from left in the first row), together with Wico Sander (fifth from left), Nikita Barron (between Prof O'Neill and Sander), Ayanda Thusi, (third from right, second row) and Bonang Mochochoko, (second from right, second row next to Thusi), attended the first annual meeting of AfRota2 in Maputo

NATIONAL AND INTERNATIONAL COLLABORATION

The Veterinary Biotechnology Group continued their collaborative projects with Dr Asgar, of Saife VetMed in India, on various potential commercial products. 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.

Prof Dirk Opperman continued his ongoing collaborative projects with Prof Frank Hollmann and Dr Caroline Paul from Delft University of Technology (Netherlands). The groups bring together different expertise in the field of Biocatalysis, including protein structure determination, directed evolution and process development, and are currently focusing on the application of biocatalysts in Green Chemistry. Prof Opperman, together with research groups from Norway (University of Bergen and NORCE), the United Kingdom (Exeter University), France (CEA) and Kenya (University of Nairobi), continued

their collaborative project 'ThermoK', an ERA-NET co-fund on Food Systems and Climate (FOSC), to develop biotechnological routes to upcycle waste products and promote a circular economy.

Dr Carmien Tolmie continued a collaboration with Prof Frank von Delft, from the University of Oxford, and the XChem group at the Diamond Light Source, on structure-based drug discovery for novel antifungal drugs.

Prof Trudi O'Neill continued to collaborate with Dr Martin Blasco from the Centre for Biotechnology of the Argentinean National Institute of Industrial Technology (INTI) in Buenos Aires, Argentina, and colleague, Prof Koos Albertyn, on rotavirus protein expression in yeast. She also continued her long-standing collaboration with Dr Nilsa de Deus from the National Institute of Health, Maputo, Mozambique, on rotavirus diversity in Mozambique. Prof O'Neill also collaborated with Prof Martin Nyaga from the UFS Next Generation Sequencing (NGS) Unit and Dr Celeste Donato, from the Enteric Diseases Group (Murdoch Children's Research Institute, Melbourne, Australia), on this topic.

Second phase funding of the German Research Foundation (DFG)-funded project titled, 'Antigens and reassortant strains for rotaviruses circulating in Africa (AfRota)', commenced on 1 February 2022. The project includes researchers in Germany (Prof Reimar Johne and Dr Alexander Falkenhagen, Federal Institute of Risk Assessment), Mozambique (Dr de Deus) and South Africa (Prof Albie van Dijk, North-West University). The project utilises the rotavirus reverse genetics system and aims to generate chimeric viruses that can be used in next-generation rotavirus vaccine development. The first annual meeting of AfRota2 was held from 14 to 16 September 2022 in Maputo, Mozambique and included student participation from the consortium members.

Collaboration with Prof Carlien Pohl-Albertyn on the role of bioactive lipids in infection was also continued. Prof Pohl-Albertyn and Prof O'Neill also collaborated with Dr Ulrich Desselberger, from the University of Cambridge, United Kingdom, on a Frontiers in Physiology research topic entitled 'Significance of cellular lipids for viral replication and pathogenesis.'

The Applied and Environmental Microbiology group of Dr Julio Castillo continued their collaboration with the University of Limpopo (Dr Kgabo Moganedi - Department of Biochemistry, Microbiology, and Biotechnology), on the project titled 'Developing a bacterial consortium for improving the quality of mining-contaminated water'.

The Group has established a collaboration with the University of Cadiz (Prof Alfonso Corzo) on a project which involves the bioprecipitation of metallic copper from acid mine drainage in the Iberian Pyrite Belt. The AEMG will be responsible for the bioinformatics analysis. The 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 Ritsumeikan University (Prof Hiroshi Ogasawara) on the project, 'Drillhole investigations of earthquake physics and deep life in fault zones in South African mines'.

In addition, the AEMG still collaborates 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.



From left to right 1: Dr Julio Castillo, 2: Dr Alba Gomez, 3: Prof Hiroshi Ogasawara (Ritsumeikan University (Japan)), 4: Bennie Liebenberg (Moab Mine), and students from the Ritsumeikan University

Dr Julio Castillo, together with Dr Alba Gomez-Arias and Prof Walter Purcell (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 titled 'Mine tailings reprocessing, revalorisation and risk reduction through sequential innovations in metal recovery, geopolymerization, ceramics and sealing processes'. The project is funded by the ERA-MIN3 program supported by European Commission's Horizon 2020. Two PhD and two Master's students are expected to graduate from this project.

Dr Frans O'Neill continued his collaboration with Prof David Marais (UCT) on phytosterols in selected South African fauna and Dr Dee Blackhurst (UCT) on reactive oxygen species in rotavirus-infected cells. The ongoing interdisciplinary collaborative effort, centred on rhinoceros, includes researchers from several departments within the UFS Faculty of Natural and Agricultural Sciences, as well as the Faculty of Health Sciences. Dr O'Neill is also part of an interdisciplinary project with Dr Angelique Lewies of the Department of Cardiothoracic Surgery, which is looking at developing a cardiac organoid model

for drug screening and disease modelling. He is also collaborating with Dr Fanie Steyn, of AniPharm (Pty) Ltd, on the production of equine chorionic gonadotropin, and with Dr Martin Blasco of the INTI Centre for Biotechnology (Argentina), on receptor-based assays.

Prof Carlien Pohl-Albertyn visited the School of Physical Sciences at the University of Kent, as part of her appointment as visiting academic and continued with the established collaboration with Prof Jennifer Hiscock regarding the development of novel antibiofilm compounds.

POSTGRADUATE STUDENTS

In 2022, 20 students enrolled with the Department for BSc Honours, 30 students were registered for Master's and 17 students were registered for Doctoral degrees.

At the graduation ceremonies held in April and December 2022, six students graduated with the BSc Honours (Biochemistry) and a further 19 with the BSc Honours (Microbiology).

At Master's level, Michail Willie Kruger graduated with the MSc (Biochemistry) – with distinction. The following students received their MSc (Microbiology):

- Adedoja, Toluwase Deborah
- Badenhorst, Moira
- Maliehe, Maphori (with distinction)
- McCarlie, Samantha Jayne (with distinction)
- Mendes dos Ramos, Séergio
- Ntoi, Mathope Anna (with distinction)
- Porotloane, Faith Boitumelo (with distinction)
- Van Wyk, Aurelia Genevieve

The PhD was conferred on the following candidates:

PhD – Microbial Biotechnology

MOLOANTOA, Karabelo Macmillan

Thesis: Optimisation of a passive denitrification system by a novel bacterial consortium enriched from mining wastewaters

Supervisor: Dr E Cason

Co-Supervisors: Dr J Castillo-Hernandez & Prof A Valverde

PhD – Microbiology

COETSEE, Elke

Thesis: Investigation into the presence of HP2-like and mu-like prophages within the genomes of the most prevalent serovars of *Avibacterium paragallinarum* in South Africa

Supervisor: Prof RR Bragg

Co-supervisor: Dr CE Boucher

MASEME, Mpeyake Jacob

Thesis: Biocatalytic production of δ -dodecalactone

Supervisor: Prof MS Smit

Co-supervisor: Prof DJ Opperman

MOKOENA, Nthabiseng Zelda

Thesis: The influence of polyunsaturated fatty acids on *Candida albicans* and *Pseudomonas aeruginosa* infections of *Caenorhabditis elegans*

Supervisor: Prof CH Pohl-Albertyn

Co-supervisor: Prof J Albertyn



POSTDOCTORAL FELLOWS

Dr Gabriela Schröder (South Africa), joined the Biocatalysis group after completing her PhD as a Fulbright Fellow in the USA.

Dr Obinna Ezeokoli (Nigeria) and Dr Maryam Bello-Akinosho joined the Pathogenic Yeast Research Group.

STAFF MATTERS

Prof Koos Albertyn acted as Head of Department during the last four months of 2021, during which Prof Martie Smit took long-leave. Prof Smit stepped down

as Head of Department at the end of 2021 and Prof Albertyn was subsequently appointed as new Head of Department for the period 2022 to 2026.



Prof Dirk Opperman

Dr Adepemi Odundejí was appointed as curator of the yeast culture collection in February 2022.

Prof Dirk Opperman was promoted to full Professor.

RESEARCH OUTPUTS

Research Articles

Akinmoladun, O.F., Fon, F.N., Mpendulo, C.T., Hugo, A., Falowo, A.B. & Nantapo, C.T.W. 2022. Fatty acid profile, oxidative stability of lipids and sensory attributes of water restricted Xhosa goat meat supplemented with vitamin C. *Animal Production Science* 62: 6-77.

Belter, B., McCarlie, S.J., Boucher-Van Jaarsveld, C.E. & Bragg, R.R. 2022. Investigation into the

metabolism of quaternary ammonium compound disinfectants by bacteria. *Microbial Drug Resistance* 28: 841-848.

Bolaniran, T., Jamiu, A.T., Garuba, T., Wudil, A.M., Adeola, H.A. & Sabiu, S. 2022. An appraisal of the metabolites, pharmacological and biotechnological significance of edible mushrooms. *Transactions of the Royal Society of South Africa* 76(3): 257-272.

Desselberger, U., Pohl, C.H. & O'Neill, H.G. 2022. Editorial: Significance of cellular lipids for viral replication and pathogenesis. *Frontiers in Physiology* 13: 906205.

Gómez-Arias, A., Yesares, L., Díaz, J., Caraballo, M.A., Maleke, M., Sáez, R., Van Heerden, E., Vermeulen, D., Nieto, J.M. & Castillo, J. 2022. Mine waste from carbonatite deposits as potential rare earth resource: Insight into the Phalaborwa (Palabora) Complex. *Journal of Geochemical Exploration* 232: 106884.

Guillén, M.T., Delgado, J., Gómez-Arias, A., Nieto, J.M. & Castillo, J. 2022. Bioaccessibility and human exposure to metals in urban soils (Huelva, SW Spain): evaluation by in vitro gastric extraction. *Environmental Geochemistry and Health* 44: 1501-1519.

Hlahla, J.M., Mafa, M.S., Van der Merwe, R., Alexander, O., Duvenhage, M.-M., Kemp, G. & Moloi, M.J. 2022. The photosynthetic efficiency and carbohydrates responses of six edamame (*Glycine max.* L. Merrill) cultivars under drought stress. *Plants* 11: 394.

Hugo, A., Van Wyngaard, B.E., Strydom, P.E., De Witt, F.H., Pohl, C.H. & Kanengoni, A.T. 2022. The effect of dietary *Echium* oil supplementation on the fatty acid profile, omega-3 fatty acid content and subcutaneous fat quality of pork. *Livestock Science* 257: 104833.

Jacobs, C.L., Do Aido-Machado, R., Tolmie, C., Smit, M.S. & Opperman, D.J. 2022. CYP153A71 from *Alcanivorax dieselolei*: Oxidation beyond monoterminal hydroxylation of n-alkanes. *Catalysts* 12: 1213.

Karolyte, R., Warr, O., Van Heerden, E., Flude, S., De Lange, F., Webb, S., Ballentine, C.J. & Sherwood Lollar, B. 2022. The role of porosity in H₂/He production ratios in fracture fluids from the Witwatersrand Basin, South Africa. *Chemical Geology* 595: 120788.

Li, L., Wei, S., Sherwood Lollar, B., Wing, B., Bui, T.H., Ono, S., Lau Vetter, M.C.Y., Onstott, T.C., Kieft, T.L., Borgonie, G., Linage-Alvarez, L., Kuloyo, O. & Van Heerden, E.

2022. In situ oxidation of sulfide minerals supports widespread sulfate reducing bacteria in the deep subsurface of the Witwatersrand Basin (South Africa): Insights from multiple sulfur and oxygen isotopes. *Earth and Planetary Science Letters* 577: 117247.

Mafa, M.S., Rufetu, E., Alexander, O., Kemp, G. & Mohase, L. 2022. Cell-wall structural carbohydrates reinforcements are part of the defence mechanisms of wheat against Russian wheat aphid (*Diuraphis noxia*) infestation. *Plant Physiology and Biochemistry* 179: 168-178.

Mjokane, N., Maliehe, M., Folorunso, O.S., Ogundeji, A.O., Gcilitshana, O.M.N., Albertyn, J., Pohl, C.H. & Sebolai, O.M. 2022. Cryptococcal protease(s) and the activation of SARS-CoV-2 spike (S) protein. *Cells* 11: 437.

Moloantoa, K.M., Khetscha, Z.P., Van Heerden, E., Castillo, J.C. & Cason, E.D. 2022 Nitrate water contamination from industrial activities and complete denitrification as a remediation option. *Water* 14: 799.

Mwanza, E.P., Hugo, A., Charimba, G. & Hugo, C.J. 2022. Pathogenic potential and control of *Chryseobacterium* species from clinical, fish, food and environmental sources. *Microorganisms* 10: 895.

Odenyi, O.A., Olawuyi, O.J., Ogunsanya, O. & Unuofun, J.O. 2022. Occurrence of common core structure and genotype-specific signatures among the *Vibrio* of environmentally diverse vended crabs and shrimps from selected Lagos seafood markets, Nigeria. *Biodiversitas* 23: 3081-3090.

Olckers, S.-L., Osthoff, G., Guzman, G.C., Wentzel, B., Van Biljon, A. & Labuschagne, M. 2022. Drought and heat stress effects on gluten protein composition and its relation to bread-making quality in wheat. *Journal of Cereal Science* 108: 103562.

Otunola, B., Aghoghovwia, M., Thwala M, Gómez-Arias A, Jordaan R., Castillo J. & Ololade O. 2022. Influence of clay mineral amendments characteristics on heavy metals uptake in Vetiver grass (*Chrysopogon zizanioides* L. Roberty) and Indian mustard (*Brassica juncea* L. Czern). *Sustainability* 14:5856.

Pohl, C.H. 2022. Competition for iron during polymicrobial infections may increase antifungal drug susceptibility – How will it impact treatment options? *Infection and Immunity* 90: 1-3.

Pohl, C.H. 2022. Recent advances and opportunities in the study of *Candida albicans* polymicrobial biofilms.

Frontiers in Cellular and Infection Microbiology 12: 836379. DOI: 10.3389/fcimb.2022.836379.

Sander, W.J., Fourie, C., Sabiu, S., O'Neill, F.H., Pohl, C.H. & O'Neill, H.G. 2022. Reactive oxygen species as potential antiviral targets. *Reviews in Medical Virology* 32: e2240.

Sander, W.J., Kemp, G., Hugo, A., Pohl, C.H. & O'Neill, H.G. 2022. Rotavirus-mediated prostaglandin E₂ production in MA104 cells promotes virus attachment and internalisation, resulting in an increased viral load. *Frontiers in Physiology* 13: 805565.

Staats, G.J., Mc Carlie, S.J., Boucher-Van Jaarsveld, C.E. & Bragg, R.R. 2022. Susceptibility tests and predictions of transporter profile in *Serratia* Species. *Microorganisms* 10: 2257.

Van Rooyen, B., De Wit, M. & Osthoff, G. 2022. Functionality of native mucilage from cactus pears as a potential functional food ingredient at industrial scale. *Acta Horticulturae* 1343: 481-488

Van Rooyen, B., De Wit, M. & Osthoff, G. 2022. Gelling potential of native cactus pear mucilage. *Acta Horticulturae* 1343:489-495.

Chapters in Books

Mc Carlie, S., Staats, G., Belter, B., Van der Walt, B. & Bragg, R. 2022. Molecular tools for the study of resistance to disinfectants. In: *The Global Antimicrobial Resistance Epidemic - Innovative Approaches and Cutting-Edge Solutions*. G. Tellez-Isaias (Ed). London: IntechOpen. ISBN: 978-1-80356-043-4. Chapter 5.

Motlhalamme, T.Y., Zhou, N., Gamero, A., Mehlomakulu, N.N., Jolly, N., Pohl-Albertyn, C.H. & Setati, M.W. 2022. Origin and evolution of yeasts. In: *Yeast: From Nature to Bioprocesses*. Eds. S.L.A. Junior, H. Treichel, T.O. Basso & B.U. Stambuk (Eds). Singapur: Bentham Science Publishers Ltd. ISBN: 978-981-5051-07-0. pp. 1-26.

Osthoff, G. 2022. Milk: Elephant milk. In: *Encyclopedia of Dairy Science*, 3rd Edition. Eds. P.L.H. McSweeney & J.P. McNamara (Eds). Elsevier. ISBN: 9780128187661. pp.530-542

Osthoff, G. 2022. Milk: Milks of non-dairy mammals. In: *Encyclopedia of Dairy Science*, 3rd Edition. P.L.H. McSweeney & J.P. McNamara (Eds). Elsevier. ISBN: 9780128187661. pp.647-663.

Conference Contributions

Conference Papers/Posters

Aschenbrenner, J.C., Ebrecht, A.C., Tolmie, C., Smit, M.S. & Opperman, D.J. 2022. *The first structure of a fungal hydroxylase from the CYP505 family and engineering of its regioselectivity by comparison with CYP102A1.* Poster delivered at the 22nd International Conference on Cytochrome P450, Washington DC, USA. 17–21 July 2022.

Boneschans, M., Opperman D.J. & O'Neill, F.H. 2022. *The purification of equine chorionic gonadotropin (eCG) from serum.* Poster delivered at the 28th South African Society for Biochemistry and Molecular Biology Virtual Conference. 23–26 January 2022.

Fourie, C., Ogunyinka, M.I., Legisa, D.M., Blasco, M., Albertyn, J. & O'Neill, H.G. 2022. *Production of secreted VP6 by *Arxula adenivorans* as subunit vaccine candidate.* Paper delivered at the 28th South African Society for Biochemistry and Molecular Biology Virtual Conference. 23–26 January 2022.

Lekena, N., Opperman D., O'Neill H. & O'Neill, F. 2022. *Recombinant production of equine chorionic gonadotropin.* Paper delivered at the 25th Annual European Society for Domestic Animal Production Conference, Thessaloniki, Greece. 28 September–2 October 2022.

Lekena, N. Opperman, D.J., O'Neill, H.G. & O'Neill, F.H. 2022. *Effect of promoter usage on recombinant eCG expression levels in stably-transfected CHO-K1 cells.* Paper delivered at the 28th South African Society for Biochemistry and Molecular Biology Virtual Conference. 23–26 January 2022.

Maliehe, M., Lahiri, S., Folorunso, O.S., Ogundeji, A.O., Pohl, C.H. & Sebolai, O.M. 2022. *Amoebal pressure helps *Cryptococcus neoformans* to maintain virulence.* Paper delivered at the 9th Conference of the Federation of Infectious Diseases Societies of Southern Africa, Durban, South Africa. 3–5 November 2022.

Mjokane, N., Maliehe, M., Folorunso, O.S., Ogundeji, A.O., Gcilitshana, O.M.N., Albertyn, J., Pohl, C.H. & Sebolai, O.M. 2022. *Activation of SARS-CoV-2 Spike protein by a fungal protease(s).* Paper delivered at the 9th Conference of the Federation of Infectious Diseases Societies of Southern Africa, Durban, South Africa. 3–5 November

Mjokane, N., Ogundeji, A.O., Folorunso, O.S., Pohl, C.H., Albertyn, J. & Sebolai, O.M. 2022. *Chemo-sensitising properties of aspirin alter the macrophage phenotype orientation.* Paper delivered at the 9th Conference of the Federation of Infectious Diseases Societies of Southern Africa, Durban, South Africa. 3–5 November 2022.

Mochochoko, B.M., Pohl, C.H. & O'Neill, H.G. 2022. *Enteric viruses and the gut mycobiome: Rotavirus *Candida albicans* interactions.* Poster presented at the 14th International dsRNA Virus Symposium, Banff, Canada. 10–14 October 2022.

Pohl, C.H. 2022. *Here is looking at you, Yeast.* Keynote address delivered at the 57th Congress of the Microscopy Society of South Africa, Johannesburg, South Africa. 5–8 December 2022.

Pohl, C.H. 2022. *Don't forget the fungi.* Keynote address delivered at the 2nd African Microbiome Institute Symposium, Stellenbosch, South Africa. 7–9 December 2022.

Sander, W.J., Pohl, C.H. & O'Neill, H.G. 2022. *Expression of rotavirus viroplasm-like proteins, NSP2 and NSP5, in HEK293 cells and subsequent effect on PGE₂ production.* Poster presented at the 14th International dsRNA Virus Symposium, Banff, Canada. 10–14 October 2022.

Smit, M.S., Opperman, D.J. & Aschenbrenner, J.C. 2022. *A unique subfamily of self-sufficient in-chain hydroxylating cytochrome P450 monooxygenases from the Aspergillaceae.* Poster presented at the International Union of Microbiological Societies (IUMS) Virtual Congress. 20–22 July 2022.

Thusi, A.X., Mendes dos Ramos, S., Albertyn, J. & O'Neill, H.G. 2022. *Production of bacterially expressed truncated dVP4-NSP4p fused protein as a subunit vaccine candidate.* Poster presented at the 28th South African Society for Biochemistry and Molecular Biology Virtual Conference. 23–26 January 2022.

Tolmie, C., Do Aido Machado, R., Ferroni, F.M., Smit, M.S. & Opperman, D.J. 2022. *Natural variation in the 'control loop' of BVMOAFL210 and its influence on regioselectivity and sulfoxidation.* Paper delivered at the 28th South African Society for Biochemistry and Molecular Biology Virtual Conference. 23–26 January 2022.

STAFF (2022)

**Head of Department:
Prof J Albertyn**

Professors:	Prof J Albertyn, Prof R Bragg, Prof C Hugo, Prof G Osthoff, Prof T O'Neill, Prof D Opperman, Prof C Pohl-Albertyn, Prof M Smit and Prof B Viljoen
Associate Professor:	Prof O Sebolai
Affiliate Associate Professors:	Prof AS Bareetseng and Prof A Valverde Portal
Senior Lecturer:	Dr F O'Neill

Lecturers:	Dr O Gcilitshana, P Letebele, L Steyn and Dr C Tolmie
Senior Researchers:	Dr J Castillo-Hernandez and Dr G Kemp
Research Fellow:	Dr C Boucher
Programme Director:	Dr F O'Neill
Senior Officer - Professional Services:	S Marais
Officers - Professional Services:	Y Makaum, Dr A Ogundeji and C van Rooyen
Senior Assistant Officer - Storeman:	E van den Heever M Mogopodi
Technical Help:	K Mashuga, L Mazwi, P Mereko and J Mvula

Academic staff of the Department Microbiology and Biochemistry
Front, from the left: P Letebele, Dr F O'Neill, Prof R Bragg, Dr G Kemp and Prof C Hugo;
Middle, from the left, Dr O Gcilitshana, Prof T O'Neill, Dr C Tolmie, Prof M Smit, Prof D Opperman and Prof J Albertyn (Head of Department); Back, from the left: Prof O Sebolai, Dr J Castillo-Hernandez, Prof C Pohl-Albertyn, L Steyn, Prof G Osthoff and Prof B Viljoen



DEPARTMENT OF
PHYSICS

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Prof Koos Terblans
Department of Physics

Faculty of Natural and Agricultural Sciences
University of the Free State
PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2321
E: terblansjj@ufs.ac.za
W: www.ufs.ac.za/physics

QWAQWA CAMPUS

Dr Kamohelo Tshabalala
Department of Physics

Faculty of Natural and Agricultural Sciences
University of the Free State
Private Bag X13 | Phuthaditjhaba 9866
South Africa

T: +27 58 718 5302
E: tshabalalakg@ufs.ac.za
W: www.ufs.ac.za/physics

OVERVIEW OF 2022

2022 has been an exciting year for the Department of Physics. With the decline of the pandemic and the return to 'normal', we once again thrived. 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.

coating method', published in *Materials Research Bulletin* and prepared under supervision of Prof Kroon and Prof Swart.



Boitumelo Tladi

ACHIEVEMENTS

Staff Achievements

Prof Hendrik Swart, holder of the SARCHI Chair on Solid State Luminescent and Advanced Materials, received the prestigious Havenga Prize for Physical Sciences. The Havenga Prize has been awarded annually by the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (SAAWK), for the past 77 years for original research in the natural sciences or a technical field. Candidates are specifically judged on research publications and evidence of their promotion of Afrikaans.



Prof Hendrik Swart, winner of the 2022 Havenga Prize for Physical Sciences

PLOS Biology published a list of global leading scientists compiled by Stanford University. Eighteen of those scientists were from the UFS, of whom three are from the Department of Physics - which comprises 2% of the world's top scientists. The scientists affiliated to the Department of Physics included in the list, were Prof Hendrik Swart (SARCHI Research Chair in Solid State Luminescent and Advanced Materials), Prof Jorma Hölsä (Applied Physics) and Prof Ted Kroon (Applied Physics).

Prof Brian van Soelen won the Faculty's Flash Facts competition in the staff category, held on 15 and 16 June 2022.

Student Achievements

Boitumelo Tladi received the prize for the best MSc publication in Condensed Matter Physics / Material Science at the Conference of the South African Institute of Physics for her publication 'Graphene oxide and its films produced using a nebuliser spray

RESEARCH AND INNOVATION

Lengau Solar Car Project

The project coordinator, Dr Hendrik van Heerden, along with staff and students from the Department of Physics as well as various other UFS departments and divisions, including Electronics and Instrumentation, Engineering Sciences and Geography, registered to compete,

design and build a solar car and subsequently participated in their very first Sasol Solar Challenge in 2022.

The Sasol Solar Challenge is a biennial competition which was started in 2008. The team competed with seven other teams from both local and international institutions or groups. The event was held on the public roads of South Africa, with the teams sharing the roads with regular traffic. The route included not only straight and flat roads, but also winding and steep mountain climbs. The aim was to test not only the technology and innovation of the cars and teams, but also the perseverance of the participants over an eight-day period.

Lengau Solar Car





The UFS Solar Challenge team: Denver de Koker, Gert Ehlers, Pieter Lotz, Johane Odendaal, Albert Dreyer, Adriaan van der Walt, Louis Lagrange, Monica van der Walt, Pat van Heerden, Lucas Erasmus, Edward Lee, Mark Jackson, Antonie Fourie, Prof Koos Terblans, Sogo Abolarin, Daniel Wium and Schalk Nel

The participating teams departed from Carnival City in Brakpan on 9 September and arrived at the finish line at the V&A Waterfront in Cape Town on Friday 16 September. Team UFS completed the event in seventh place overall, covering 530.2 km.

The main aim of this first participation by the team was to acquire skills and knowledge about the event and to test various ideas and technological setups and designs. This project was not only a scientific and engineering exercise, but also a strong marketing opportunity.

Astrophysics Research

The Astrophysics Research Group at the UFS is one of the leading academic institutions in astronomical research. The focus of the research group is, *inter alia*, on multi-wavelength studies of high energy and very high energy sources – Galactic and Extra-Galactic. This includes the observational and theoretical study of the production of radiation across the whole electromagnetic spectrum from galactic sources, like gamma-ray binaries, cataclysmic variables and the jets from Active Galactic Nuclei (AGN), especially blazars, to understand the plethora of physical

processes in these systems. The group is part of the H.E.S.S. and Cherenkov Telescope Array (CTA) Gamma-Ray Collaborations.

In addition, the group undertakes multi-wavelength studies of transient emissions from accretion driven sources. The research involves using multiple instruments, such as the South African Large Telescope (SALT) and MeerKat, South African Astronomical Observatory (SAAO) 1.9 m. Telescope, the Boyden 1.5 m Telescope, XMM-Newton, Chandra, Swift and Fermi-LAT. Theoretical modelling is undertaken to explain observational data utilizing the UFS High Performance Cluster.

In 2022, the Astrophysics Group collaborated with the Institute of Astrophysics of Andalusia (IAA) in Spain and University College, Dublin (UCD), in Ireland, to install a robotic telescope, designated BOOTES 6 (Burst Observer and Optical Transient Exploring System), at the Boyden Observatory. The BOOTES collaboration is headed by the Institute of Astrophysics of Andalusia. BOOTES 6 is the sixth telescope in the global network. The previous five are located in Spain (BOOTES 1 and BOOTES 2), New Zealand (BOOTES 3), China

(BOOTES 4) and Mexico (BOOTES 5). BOOTES 7 will be in Chile. The telescopes in the network are intended to observe transient high energy sources in the universe, including X-ray transients and gamma ray bursts (GRBs). GRBs and transient X-ray bursts can only be detected and located by satellites in space. This information is swiftly passed on to the BOOTES research collaboration and the telescopes, which are equipped with special cameras, are swiftly focused on to the source of the transient event and then image it. All the telescopes are controlled from a single centre, in Spain. The Astrophysics Research Group has a particular focus on high energy astronomy and this research falls very much within its area of interest.

A spectrograph with a polarimeter was successfully mounted to the Boyden Observatory 1.5 m telescope that will provide scientists with visual access to both the Northern and Southern Hemispheres. The instrument will allow researchers to do simultaneous polarimetry and spectroscopy of astronomical sources. This is vital for the research they are working on. Mounting the spectrograph to the telescope and installing the polarimeter completed the upgrade of the 1.5 m. telescope. Much of the work was undertaken in collaboration with researchers from the Appalachian State University (ASU, in particular Prof Richard Gray, a world-renowned expert in stellar spectroscopy.

Assisting Prof Richard Gray with the installation of the spectrograph and the polarimeter. On the left of spectrograph, from the left: Innes Basson (Head of Electronics and Instrumentation), Mark Jackson (Electronics and Instrumentation), Prof Pieter Meintjes (Senior Professor, Department of Physics), Hélène Szegedi (Lecturer, Department of Physics) and Prof Richard Gray. On the right of the spectrograph, front, Natali Matchelt (MSc student), Izak van der Westhuizen (Lecturer, Department of Physics), Barend Crous (Electronics and Instrumentation). Middle: Wian Smit (MSc student), Joleen Barnard (MSc student). ack: Kobus Krüger (Electronics and Instrumentation), Henri Roodt (Electronics and Instrumentation) and Dr Hendrik van Heerden (Department of Physics)



Unfortunately, there were some setbacks, as the dome of the 1.5 m telescope leaked during the heavy rains experienced in 2022 and had to be re-waterproofed. During this process the spectropolarimeter was dismantled and taken to the Physics Department. It is anticipated that the telescope will be fully operational in 2023.

The group also collaborates with Prof David Buckley (SAAO) and Prof Phil Charles (Fellow of the Royal Astronomical Society).

In 2022, the Astrophysics Group hosted the High Energy Astrophysics in Southern Africa 2022 (HEASA2022) conference, in Brandfort from 28 September to 1 October. This was the ninth conference in the annual series.

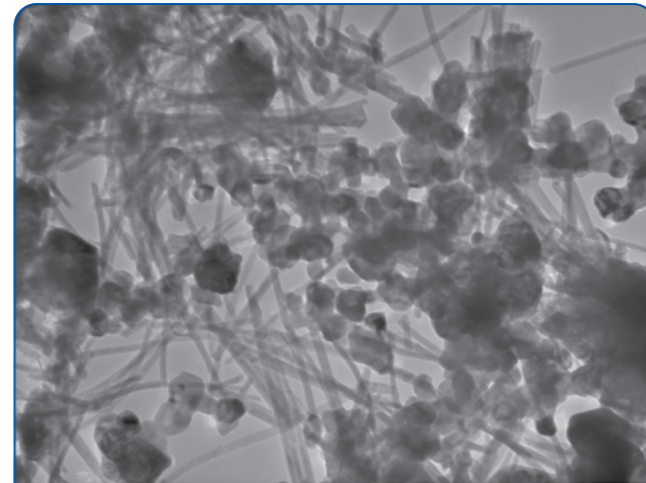
SARChI Chair in Solid State Luminescent and Advanced Materials

The SARChI Chair in Solid State Luminescent and Advanced Materials was awarded to the UFS at the end of 2012, and subsequently renewed at the end of 2017 and again at the end of 2021. The Chair is a Tier 1 Chair which are for established researchers that are recognised internationally as a leader in their field and/or have received international recognition for their research contributions. The Chair-holder is Prof Hendrik Swart.

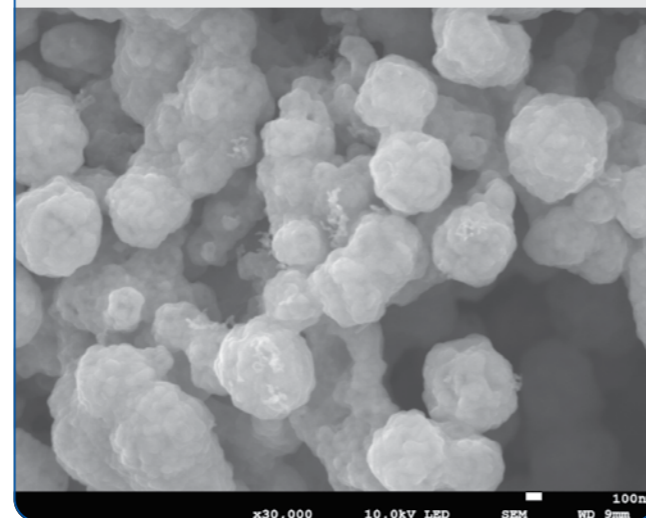
The main research fields which form part of the Chair are:

- Micro- and nanophosphors for applications in infrastructure and high-technology flat-panel displays.
- Nanotechnology for high-tech development as well as development in rural areas.
- Phosphors for use in solid-state lighting and full-colour flat-panel displays.
- Phosphors devices to enhance the efficiency of current solar cells (photovoltaic [PV] materials).
- Newly developed phosphors for temperature and gas sensing.
- Phosphors for dosimetry applications.
- Theoretical and experimental studies on the formation of nano-particles.

The team consists of 10 researchers, of whom 8 are rated. There are currently 13 Postdoctoral Fellows and about 30 MSc and PhD students hosted by the Chair. The research work was internationally presented as plenary and keynote presentations during the past few years.



Upconversion nanomaterials, also called UNMs, are gaining popularity as new-generation imaging tools due to their unique optical properties. These UNMs were fabricated by Dr Promod Kumar, from La₂O₃:Er/Yb nanocrystals



Prof Lisa Coetsee-Hugo is involved in surface characterisation and luminescent and advanced materials. Auger electron spectroscopy (AES) and X-ray photoelectron spectroscopy (XPS) are highly specialised surface analysis techniques, that can be used to analyse the outermost atomic layers (< 10 nm) of a solid material. Answering questions about the composition, structure, optical, electrical and

mechanical properties and chemical state of the outermost atomic layers is crucial in understanding many technological processes. Examples of these processes are chemical reactions (such as

oxidation, corrosion and degradation), catalysis, adhesion, thermionic emission, crystal growth, segregation and erosion.



Prof Lisa Coetsee-Hugo

Prof Coetsee-Hugo's research in the field of Si solar cells focuses on increasing the efficiency of the solar cells by minimising the effects of the spectral mismatch. Photons with low energy will

not be absorbed by the solar cells to generate electron-hole pairs. In contrast, photons with energies much higher than the band gap of the solar cell will dissipate their energy as heat, which is known as thermalisation loss. Thermalisation loss accounts for the majority of the loss due to the spectral mismatch. This loss can be reduced through using a suitable luminescent layer (known as a spectral converter) that is able to convert the high energy photons, such as ultraviolet or blue photons, into two lower energy photons through quantum cutting or the down-conversion processes. These converted low energy photons must be emitted in the infra-red (IR) regions where Si solar cells can absorb them (± 1.1 eV or 1100 nm). To find the ideal spectral converter, investigations were done on SrF₂:Eu,Pr,Yb, CaF₂:Ce,Tb, Y₂O₃:Bi³⁺, Y₂O₃:Tm³⁺ and YOF:Bi, Ho luminescent materials. Investigations included different synthesis techniques to obtain powder and thin film samples, characterisation in order to obtain the compositional, structural, morphological, chemical and luminescent properties. It also included some degradation studies. The best results obtained thus far were intense near-infrared (NIR) emission under Eu²⁺ sensitization in the SrF₂:Eu, Pr, Yb sample and IR emission enhancement for the YOF:Bi, Ho powders samples.



Photoluminescence image of YOF:Ho³⁺. Produced by Dr Nadir Saeed, a Postdoctoral Fellow supervised by Prof Coetsee-Hugo

Prof Richard Harris undertakes research on nanomaterials for health. In his research, through computational modelling, simulations and complementary experimental work, he investigates the synthetic chemistry, magnetic characterisation and biological applications of inorganic/organic – core/shell Fe₃O₄ based magnetic nanoparticles as well as metal- and metal-oxide nanoparticles. He also studies the adsorption of different chemotherapy drugs and their concentrations onto Fe₃O₄ nanoparticles (to be employed as nanocarriers) within a Molecular Dynamics framework and Monte Carlo simulated annealing scheme. Bonding modes are investigated with reference to chemisorption, physisorption, as well as hydrogen bonding in the context of bond strength (binding energy) as a function of both the drug molecule's loading as well as a change in nanoparticle size. Density functional theory (DFT) simulations are also performed to investigate the conditions for charge transfer from the temozolomide surfactant via the highest occupied molecular orbitals (HOMO), lowest unoccupied molecular orbitals (LUMO) as well as the electrostatic potentials. From this, the preferential sites for both electrophilic and nucleophilic attacks can be calculated. This is important, for example, when considering the interaction with the blood-brain barrier as this remains a major challenge in effective chemotherapy of brain metastases. Despite the variability in its barrier function within

brain tumour lesions, most drugs are still prevented from effectively entering the brain. With the computational studies, he investigates the changes the chemotherapy drugs may undergo when interacting with the nano-drug-carrier, within the context of delivering it to the target area. In addition, the detection of small molecules and the screening via SERS of various drugs to create an accurate judgement in emergent medical and forensic settings are investigated.

Dr Mart-Mari Duvenhage's research relates to material characterisation using the powerful Time of Flight Secondary Mass Spectroscopy (TOF Sims) technique. Various samples can be characterised with this technique, including powders, thin films, metals, insulating materials like glass and polymers, dried biological samples, rocks and even soil samples. It is a very sensitive technique and can detect concentrations in the part per billion (ppb) range. This makes it ideal to detect dopants in phosphors and semiconductor materials. It is also extremely surface sensitive and can give elemental information from the first few nanometres of a sample. The system is equipped with three sputter guns which allows depth profiling of any material. The Ar sputter gun can be used to make a depth profile of organic materials keeping the large organic molecules intact, making identification of these materials so much easier. Some of the research projects are (i) Dopant distribution in phosphors powders; (ii) Depth profiling of multilayer metal samples and solar cells; (iii) Detection of oxygen isotopes in micro meteorites; (iv) Identifying different lipids in fat cells; and (v) Determination of metal distribution in polymers for use in batteries.

Prof David Motaung's research focuses on semiconductor metal oxides (SMO heterostructure for gas sensing application).

Our Postdoctoral Research Fellows form an integral and very important part of the team. Their research includes, *inter alia*, Plasmonic-enhanced up-down conversion photoluminescence (Dr Emad Hasabeldaim), Synthesis and characterisation of thermographic phosphors with sub-K sensitivity (Dr Simon Ogugua), Metal halide perovskite (MHP) quantum dots and nanocrystals for luminescence and photovoltaic applications (Dr Govind Nair) and Luminescent nanomaterials derived from two-dimensional (2D) materials and their applications for energy storage and conversion (Dr Sarojini Jeeva Panchu).



Prof Richard Harris



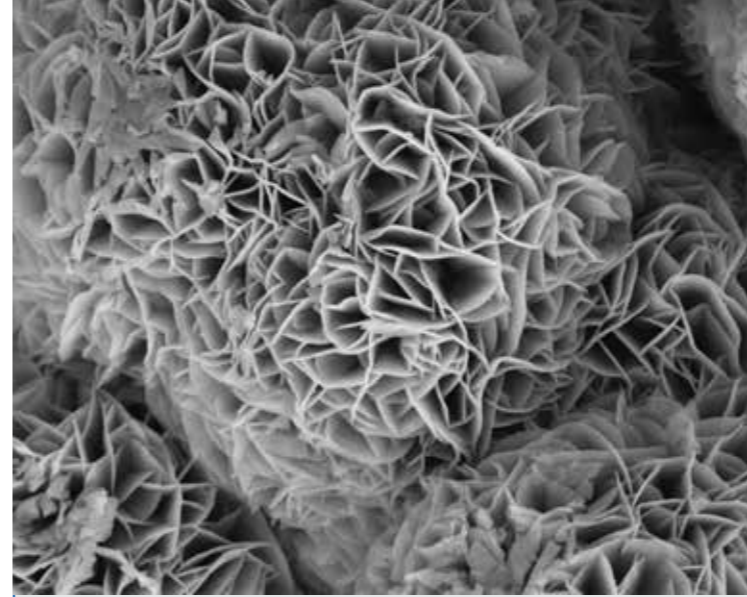
Dr Mart-Mari Duvenhage



Prof David Motaung



Various Perovskite quantum dots prepared by Dr Govind Nair



This SEM image illustrates magnifications of a nickel doped MoS₂ (Ni-MoS₂) microsphere, based on the work of Dr Panchu

Collaborators include Prof Paul Holloway (University of Florida) and Prof Kenneth Hillie (CSIT).

ENGAGED SCHOLARSHIP

The Two Observatories Project at the UFS involves the Boyden Observatory (approximately 28 km from Bloemfontein) and the old Lamont-Hussey Observatory on Naval Hill in the centre of Bloemfontein, which now houses the Naval Hill Planetarium. The UFS is responsible for both observatories, which are used in synergy to educate and inform citizens about the natural sciences. The observatories are also important for the display and communication of South African astronomical heritage.

Boyden is ideal for small conferences, workshops and public evenings, often including lectures by UFS staff and attracting a loyal and knowledgeable following. In addition to offering planetarium shows, including full dome films, the Naval Hill Planetarium is a good venue for public lectures and concerts. The site also offers a large hall that is ideal for educational and corporate events and larger functions and is primarily used for environmental education. Collectively all these facilities operate under the banner of the Free State Centre for Earth and Space.

The digital planetarium system has been in constant use

since it was first installed in 2013 and upgrades to the latest computer and projector technologies were long overdue. Over a number of years, the UFS had raised funds for the upgrade. Approximately 80% of the funding was provided by the UFS Faculty of Natural and Agricultural Sciences and the UFS ICT Services, while the remaining funds came from donors, in particular the Hermann Ohlthaver Trust, First Technology and RAUBEX. The upgrade took place in May and June 2022, during which high-end laser projectors and new computers were installed, overseen by two planetarium technology experts from Germany. Some UFS staff and students assisted and derived benefits from collaborating with the German experts for the installation. The upgraded system results in a far superior image on the planetarium dome. The laser delete as well as the that the projectors will not need regular replacement lamps and will use far less electricity.



During the installation of the new computer and projector equipment at the Naval Hill Planetarium, from the left, Dieter Schwab and Alex Reither (both from Sky-Skan, Germany), Prof Matie Hoffman (UFS Department of Physics), Barry Crous (UFS Instrumentation Division) and Pat van Heerden (UFS Department of Physics)

The two observatories are important to the UFS on many levels – both observatories allow the UFS to connect with the scientific community, schools as well as the public, and both are unique venues often used for UFS events and to host high-profile guests. On 22 March 2022, the UFS hosted an event for a delegation from the US Consulate and the Appalachian State University. It was an opportunity to share the

American astronomical heritage that the UFS has curated over many years at Boyden Observatory.



From the left, Vincent Spera (US Consulate), Prof Francis Petersen (UFS Vice-Chancellor), Dr Khotso Mokhele (former UFS Chancellor), Helene Szegedi (UFS Department of Physics), Prof Jesse Lutabingwa (Appalachian State University), Prof Pieter Meintjes (UFS Department of Physics) and Dr Cornelius Hagenmeier (UFS International Office)

Regular events included numerous public star gazing evenings at Boyden Observatory, as well as hosting visiting scientists – such as Jim Adams, former NASA engineer, who presented lectures to UFS students and spoke to the public at the planetarium.

Physics first-year students visited the planetarium and Boyden Observatory on 13 October 2022 as a social excursion for all Physics students in the first-year modules.

The CLNS3702 Community Service Module

This module is a special UFS module to address scarce skills in teaching science and mathematics at schools, through special workshops. The module is an elective for UFS science students in their third year and involves teaching natural science subjects to underprivileged and dysfunctional schools. The students are taught pedagogy, community service and cultural competence.

Women in Physics in South Africa

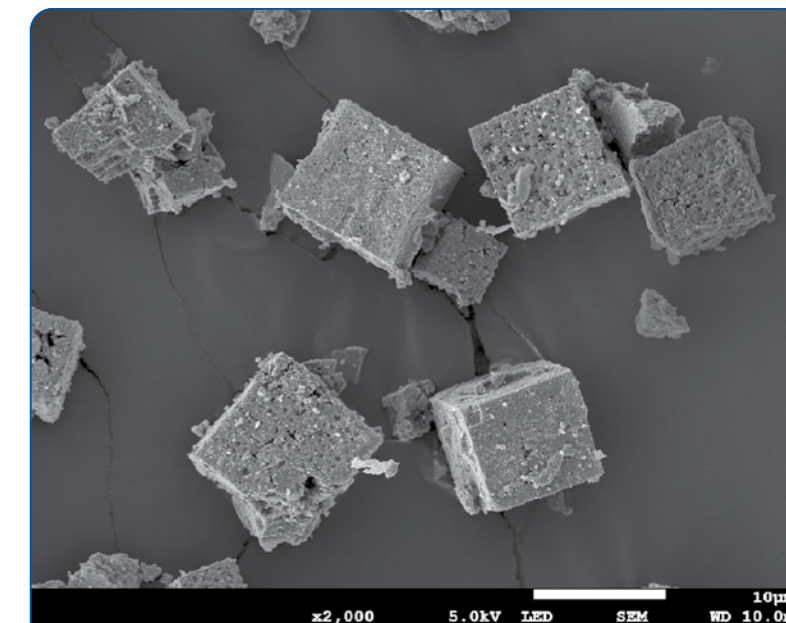
A lunch for the Women in Physics in South Africa (WiPiSA) was hosted by the Department of Physics on 17 August 2023. The WiPiSA forum was formed under

the South African Institute of Physics (SAIP) as a means of addressing the under-representation of women in physics. The event was attended by 42 women. Hélène Szegedi welcomed everyone and introduced the three invited speakers, Dr Keamogetswe Ramonaheng (UFS Department of Medical Physics), Dr Zamaswazi Tshabalala (Postdoctoral Fellow in the UFS Department of Physics) and Dr Jessymol Thomas (South African Astronomical Observatory). Each speaker shared her journey on becoming a physicist, which included her motivation to study physics, her challenges and triumphs and a brief overview of her research and achievements. The speakers also gave valuable and practical advice on tackling research obstacles, growing within the Department and building networks and collaborations with other universities and research facilities. A tour of the physics and microscopy research facilities was conducted by Dr Mart-Mari Duvenhage (Department of Physics), Nonkululeko Phili (Centre for Microscopy) and Hanlie Grobler (Centre for Microscopy).



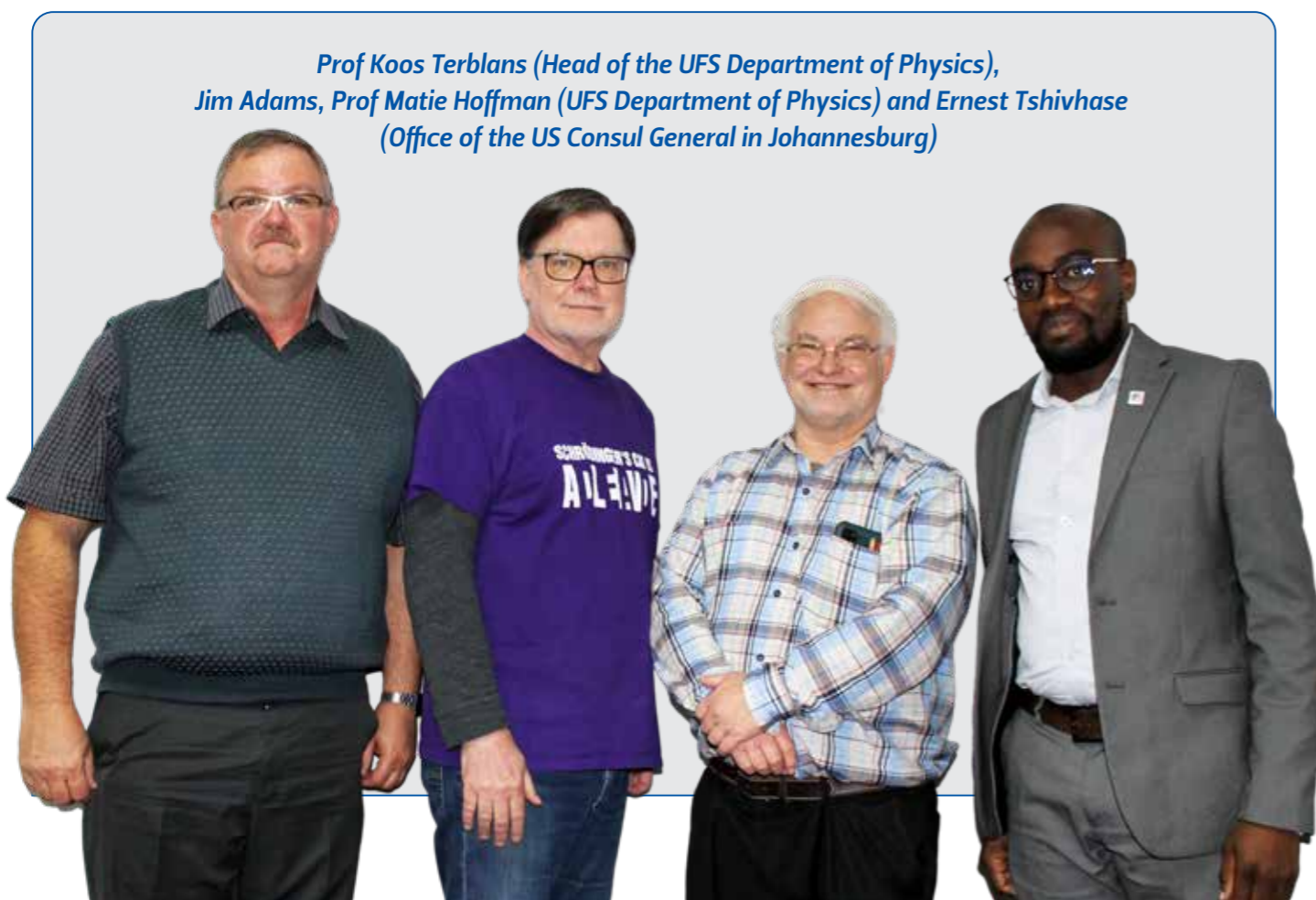
From the left, Dr Mart-Mari Duvenhage, Hélène Szegedi, Dr Jessymol Thomas, Dr Hanlie du Raan, Karen Cronje, Dr Keamogetswe Ramonaheng and Dr Zamaswazi Tshabalala

Sciences' Flash Facts competition. The elimination round was presented in the form of a mini conference, held on 10 June 2022, which brought about excitement and fun for the competitors. Winners selected to proceed to the final round were TM Abdalkreem (PhD in Solid State Physics), W Smit (MSc in Astrophysics), M van der Walt (MSc in Solid State Physics) and IP van der Westhuizen (PhD in Astrophysics). In addition, one postdoctoral fellow (Dr GB Nair) and two staff members (E Lee and Prof B van Soelen) were selected to move on to the final round, held on 15 and 16 June.



Research by MSc student, Katlego Morulane – (SEM) image of the synthesized In₂O₃ incorporated with Co₃O₄ heterostructures formed a cubic shape with voids and cracks on the surface

A strontium hexaborate (SrB₆O₁₀) sample incorporated in glass to act as solar concentrators – from the research of Lucas Erasmus, a PhD student under the supervision of Prof Swart



Prof Koos Terblans (Head of the UFS Department of Physics), Jim Adams, Prof Matie Hoffman (UFS Department of Physics) and Ernest Tshivhase (Office of the US Consul General in Johannesburg)

POSTGRADUATE STUDENTS

This year, the Department encouraged the students to compete in the Faculty of Natural and Agricultural

During 2022 the Department delivered five MSc and three PhD graduates.

On the Bloemfontein Campus, RA Phokojoe, M Mokoena, HT Ramolahloane and J Barnard graduated with an MSc degree, as did LA Miya on the Qwaqwa Campus.

The following candidates were conferred with the PhD:

Lian, Song You

Thesis: Grain boundary diffusion and surface segregation under stress: theoretical, experimental and molecular dynamics investigation

Supervisors: Prof JJ Terblans, Prof HC Swart and Prof JY Wang

Nqayi, Sibusiso

Thesis: Modelling and simulation study of the physiochemical properties in relation to toxicity of gold nanostructures.

Supervisors: Prof RA Harris and Dr S Cronje

Nyake, Tankiso

Thesis: The study of silver nanoparticles' physiochemical properties in relation to toxicity via molecular dynamics and density functional theory modelling.

Supervisors: Prof RA Harris and Dr S Cronje

POSTDOCTORAL RESEARCH FELLOWS

In 2022, the Department of Physics hosted eleven postdoctoral research fellows – all involved in Solid-state Physics. They were:

- Dr EHH Hasabeldaim, from Sudan
- 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



Dr Govind Nair

In the final round of the Flash Facts Competition, Dr Govind Nair won first prize in the postdoctoral category.

STAFF MATTERS

Prof Robin Edward (Ted) Kroon presented his Inaugural Lecture – ‘What’s the use of a rainbow?’ – on 18 April 2022. Prof Kroon holds a C2-rating from the National Research Foundation and has published more than 150 articles and book chapters, achieving a Scopus h-index of 26.



Prof Ted Kroon

Bantloseng Mohlala was appointed as Senior Assistant Officer: Professional Services

RESEARCH OUTPUTS

Research Articles

Abdelrehman, M.H.M., Kroon, R.E., Coetsee-Hugo, E., Yousif, A., Seed Ahmed, H.A.A. & Swart, H.C. 2022. Photoluminescence, cathodoluminescence degradation and surface analysis of $Gd_2O_3:Bi^{3+}$ pulsed laser deposition thin films. *Physics B* 631: 413618. DOI: 10.1016/j.physb.2021.413618.

Abdelrehman, M.H.M., Kroon, R.E., Yousif, A., Seed Ahmed, H.A.A. & Swart, H.C. 2022. Luminescence properties of Yb^{3+} and Er^{3+} co-doped into $Gd_2O_3:Bi^{3+}$ phosphor powder. *Journal of Alloys and Compounds* 902: 163856. DOI: 10.1016/j.jallcom.2022.163856.

Abdollahi, S., Britto, R.J. et.al. 2022. Incremental Fermi large area telescope fourth source catalog. *The Astrophysical Journal Supplement Series* 260: 53. DOI: 10.3847/1538-4365/ac6751.

Abe, H., Van Soelen, B. et.al. 2022. Gamma-ray observations of MAXI J1820+070 during the 2018 outburst. *Monthly Notices of the Royal Astronomical Society* 517: 4736-4751. DOI: 10.1093/mnras/stac2686.

Aharonian, F., Van Soelen, B. et al. 2022. A deep spectromorphological study of the γ -ray emission surrounding the young massive stellar cluster Westerlund 1. *Astronomy & Astrophysics* 666: A124. DOI: 10.1051/0004-6361/202244323.

Aharonian, F., Van Soelen, B. et.al. 2022. Time-resolved hadronic particle acceleration in the recurrent nova RS Ophiuchi. *Science* 376: 77-80. DOI: 10.1126/science.abn0567.

Alebachew, N., Murthy, H.C.A., Abdissa, B., Demissie, T.B., Von Eschwege, K.G., Langner, E.H.G. & Coetsee-Hugo, L. 2022. Synthesis and characterization of $CuO@S$ -doped $g-C_3N_4$ based nanocomposites for binder-free sensor applications. *RSC Advances* 12: 29959-29974. DOI: 10.1039/d2ra04752g.

Ayoub, I., Kumar, V., Abolhassani, R., Sehgal, R., Sharma, V., Shegal, R., Swart, H.C. & Mishra, Y.K. 2022. Advances in ZnO: Manipulation of defects for enhancing their technological potentials. *Nanotechnology Reviews* 11: 575-619. DOI: 10.1515/ntrev-2022-0035.

Bele, A., Mhlongo, M.R., Koao, L.F., Motaung, T.E., Malevu, T.D., Hlatshwayo, T.T. Mpelane, S., Mlambo, M. & Motloug, S.V. 2022. Effects of varying Sm^{3+}

concentration on the structure, morphology and photoluminescence properties of the $BaAl_2O_4/CaAl_2O_4/CaAl_6O_{13}/Ca_3Al_2O_6:x\% Sm^{3+}$ ($0 \leq x \leq 1.9$) mixed phases using citrate sol-gel method. *Heliyon* 8: e12573. DOI: 10.1016/j.heliyon.2022.e12573.

Bharuth-Ram, K., Doyle, T.B., Adoons, V. & Ronning, C. 2022. Absence of ferromagnetic behaviour in Mn implanted ZnO. *Hyperfine Interactions* 243: 25. DOI: 10.1007/s10751-022-01809-y.

Brennan, S.J., Meintjes, P.J., Van Soelen, B. & et.al. 2022. Photometric and spectroscopic evolution of the interacting transient AT 2016jbu(Gaia16cfr). *Monthly Notices of the Royal Astronomical Society* 513: 5642-5665. DOI: 10.1093/mnras/stac1243.

Brennan, S.J., Meintjes, P.J., Van Soelen, B. et.al. 2022. Progenitor, environment, and modelling of the interacting transient AT 2016jbu (Gaia16cfr). *Monthly Notices of the Royal Astronomical Society* 513: 5666-5685. DOI: 10.1093/mnras/stac1228.

Buckley, D.A.H., Britto, R.J., Chandra, S., Krushinsky, V., Bottcher, M., Razzaque S., Lipunov, V., Stallin, C.S., Gorbovskoy, E., Tiurina, N., Vlasenko, D. & Kniazev, A. 2022. A multiwavelength study of the flat-spectrum radio quasar NVSS J141922-083830 covering four flaring episodes. *Monthly notices of the Royal Astronomical Society* 517: 5791-5804. DOI: 10.1093/mnras/stac2181.

Choudhary, S., Sharma, K., Bhatti, M.S., Sharma, V. & Kumar, V. 2022. DOE-based synthesis of gellan gum-acrylic acid-based biodegradable hydrogels: screening of significant process variables and *in situ* filed studies. *RCS Advances* 12: 4780-4794. DOI: 10.1039/d1ra08786j.

Harris, R.A. 2022. Simulation study on the physicochemical properties of Fe_3O_4 nanoparticles as drug delivery vehicles for dopamine replacement therapy of Parkinson's disease. *Materials Today Communications* 31: 1039829. DOI: 10.1016/j.mtcomm.2022.103829.

Harris, R.A. 2022. The PEGylated and non-PEGylated interaction of the anticancer drug 5-fluorouacil with paramagnetic Fe_3O_4 nanoparticles as drug carrier. *Journal of Molecular Liquids* 360: 119515. DOI: 10.1016/j.molliq.2022.119515.

Hasabeldaim, E.H.H., Swart, H.C. & Kroon, R.E. 2022. Plasmonic induced 5D_3 - 5D_4 cross-relaxation of Tb^{3+} in CaF_2 thin films. *Journal of Luminescence* 249: 119041. DOI: 10.1016/j.jlumin.2022.119041.

- Haunsbhavi, K., Alagarasan, D., Shivaramu, N.J., Mahesh, H.M., Murahari, P. & Angadi, B.** 2022. Nanostructured NiO thin film for ammonia sensing at elevated temperatures. *Journal of Electronic Materials* 51: 6356-6368. DOI: 10.1007/s11664-022-09859-2.
- Hlahla, J.M., Mafa, M.S., Van der Merwe, R., Alexander, O., Duvenhage, M., Kemp, G. & Moloi, M.J.** 2022. The photosynthetic efficiency and carbohydrates responses of six edamame (*Glycine max*. L. Merrill) cultivars under drought stress. *Plants* 11: 394. DOI: 10.3390/plants11030394.
- Jaffer, B.M., Swart, H.C., Seed Ahmed, H.A.A., Yousif, A. & Kroon R.E.** 2022. Comparative study of luminescence of Bi doped LaOC1 and LaOBr phosphor powders. *Journal of Luminescence* 250: 119050. DOI: 10.1016/j.jlumine.2022.119050.
- Janbandhu, K.S., Pawade, V.B., Dhoble, S.J. & Swart, H.C.** 2022. Synthesis and upconversion properties of $\text{KAlF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ phosphor for bioimaging application. *Infrared Physics and Technology* 126: 104328. DOI: 10.1016/j.infrared.2022.104328.
- Khajuria, P., Manhas, M., Bedyal, A.K., Vij, A., Swart, H.C. & Kumar, V.** 2022. Structural and luminescence characterization of thermally stable orange-red emitting $\text{LiSrP}_2\text{O}_9:\text{Sm}^{3+}$ phosphor to fill the amber gap in WLEDs. *Displays* 75: 102302. DOI: 10.1016/j.displa.2022.102302.
- Khambule, S.P., Motloung, S.V., Motaung, T.E., Koao, L.F., Kroon, R.E. & Malimabe, M.A.** 2022. Tuneable blue to orange phosphor from Sm^{3+} doped ZnAl_2O_4 nanomaterials. *Results in Optics* 9: 100280. DOI: 10.1016/j.rio.2022.100280.
- Khumalo, N., Mohomane, S., Motloung, S.V., Koao, L., Malevu, D.T. & Motaung, T.E.** 2022. Effect of $\text{H}_2\text{SO}_4/\text{HClO}_4$ mixture on properties of sugarcane bagasse cellulose crystals. *Wood Research* 67(6): 929-940. DOI: 10.37763/wr.1336-4561/67.6.929943.
- Krishnan, R., Kroon, R.E. & Swart, H.C.** 2022. Charge transfer characteristics and luminescence properties of Eu^{3+} activated Ba_2YMoO_6 and $\text{BaY}_2(\text{MoO}_4)_4$ phosphors. *Materials Research Bulletin* 145: 111554. DOI: 10.1016/j.materresbull.2021.111554.
- Krishnan, R., Shibu, S.N., Poelman, D., Badyal, A.K., Kunti, A.K., Swart, H.C. & Menon, S.G.** 2022. Recent advances in microwave synthesis for photoluminescence and photocatalysis. *Materials Today Communications* 32: 103890. DOI: 10.1016/j.tcomm.2022.103890.
- Kumar, P., Mathpal, M.C., Gosh, S., Inwati, G.K., Maze, J.R., Duvenhage, M.M., Roos, W.D. & Swart, H.C.** 2022. Plasmonic Au nanoparticles embedded in glass: Study of TOF-SIMS, XPS and its enhanced antimicrobial activities. *Journal of Alloys and Compounds* 909: 164789. DOI: 10.1016/j.jallcom.2022.164789.
- Kumar, V., Tiwari, S.P., Etefa, H.F., Jule, L.T., Ntwaeaborwa, O.M. & Swart, H.C.** 2022. Energy transfer mechanism in Eu^{3+} doped tin oxide nanophosphors for red solid state lighting. *Journal of Luminescence* 250: 119085. DOI: 10.1016/j.jlumine.2022.119085.
- Lian, S., Fourie, A., Wang, J., Swart, H.C. & Terblans, J.J.** 2022. Effects of sputtering induced artifacts on the determination of diffusion coefficient: Application to Ni/Cu system. *Vacuum* 202: 111206. DOI: 10.1016/j.vacuum.2022.111206.
- Lian, S., Wang, J., Swart, H.C. & Terblans, J.J.** 2022. Molecular dynamics simulation and thermodynamics calculation on surface segregation in Ni-Cu nano-films under stress. *Physica Scripta* 97: 105702. DOI: 10.1088/1402-4896/ac8b43.
- Lian, S., Wang, K., Yan, Y., Zhou, M., Wang, J., Swart, H.C., Xu, C. & Terblans, J.J.** 2022. Water vapor permeation in amorphous/polycrystalline inorganic layers on polyethylene terephthalate substrates. *Thin Solid Films* 763: 139584. DOI: 10.1016/j.tsf.2022.139584.
- Lian, S., Yang, H., Kovac, J., Terblans, J.J., Wang, J., Swart, H.C. & Xu, C.** 2022. Quantification of Ag/Ni Auger electron spectroscopy depth profiles upon preferential sputtering with non-stationary roughness. *Thin Solid Films* 750: 139202. DOI: 10.1016/j.tsf.2022.139202.
- Maake, P.J., Mokoena, T.P., Bolokang, A.S., Hintsho-Mbita, N., Tshilongo, J., Cummings, F.R., Swart, H.C., Iwuoha, E.I. & Motaung, D.E.** 2022. Fabrication of AgCu/TiO₂ nanoparticle-based sensors for selective detection of xylene vapor. *Materials Advances* 3: 7302-7318. DOI: 10.1039/d2ma00587e.
- Mabelane, T.S., Koao, L.F., Motloung, S.V., Motaung, T.E., Kroon, R.E. & Mhlongo, M.R.** 2022. Effect of annealing period on the structure, morphology, and optical properties of $\text{CaAl}_2\text{O}_4:0.1\% \text{Sm}^{3+}$ prepared by citrate-sol-gel method. *Journal of Molecular Structure* 1260: 132751. DOI: 10.1016/j.molstruc.2022.132751.
- Mabuea, B.P., Swart, H.C. & Erasmus, E.** 2022. Photocatalytic decomposition of an Azo dye using transition-metal-doped tungsten and molybdenum carbides. *ACS Omega* 7: 23401-23411. DOI: 10.1021/acsomega.2c01727.
- Malimabe, M.A., Motloung, S.V., Motaung, T.E., Swart, H.C., Dejene, F.B. & Koao, L.F.** 2022. Influence of ZnO: $\text{Ce}^{3+}/\text{Eu}^{3+}$ doped and co-doped nanopowders on the properties of poly (ϵ -caprolactone) nanocomposites. *Journal of Luminescence* 251: 119134. DOI: 10.1016/j.jlumine.2022.119134.
- Mamabolo, M.S., Tshabalala, Z.P., Swart, H.C., Mphaahuli, G.E., Hillie, T.K. & Motaung, D.E.** 2022. Low temperature tunability on CO selectivity, low detection limit based on SnO₂-hollowspheres induced by various bases. *Surfaces and Interfaces* 31: 101954. DOI: 10.1016/j.surfin.2022.101954.
- Manabeng, M., Mwankemwa, B.S., Ocaya, R.O., Motaung, T.E. & Malevu, T.D.** 2022. A review of the impact of zinc oxide nanostructure morphology on perovskite solar cell performance. *Processes* 10: 1803. DOI: 10.3390/pr10091803.
- Miya, L.A., Motloung, S.V., Motaung, T.E., Swart, H.C., Hile, D.D. & Koao, L.F.** 2022. Study of the structural, morphological and optical properties of ZnSe doped with Yb^{3+} . *Materials Today Communications* 33: 104677. DOI: 10.1016/j.mtcomm.2022.104677.
- Mocwana, M.L., Mokoena, P.P., Mbule, P.S., Beas, I.N., Kabongo, G.L. Ogugua, S.N. & Tshabalala, T.E.** 2022. Photocatalytic degradation of methylene blue and ortho-toluidine blue: Activity of lanthanum composites La_xMO_y (M: Fe, Co, Ni). *Catalysts* 12:1313. DOI: 10.3390/catal12111313.
- Moherane, L., Alexander, O.T., Schutte-Smith, M., Kroon, R.E., Mokolokolo, P.P., Biswas, S., Prince, S., Visser, H.G. & Manicum, A.E.** 2022. Polypyridyl coordinated rhenium (I) tricarbonyl complexes as model devices for cancer diagnosis and treatment. *Polyhedron* 228: 116178. DOI: 10.1016/j.poly.2022.116178.
- Mohomane, S.M., Motloung, S.V., Koao, L.F. & Motaung, T.E.** 2022. Effects of acid hydrolysis on the extraction of cellulose nanocrystals (CNCs): A review. *Cellulose Chemistry and Technology* 56(7-8): 691-703. DOI:10.35812/CelluloseChemTechnol.2022.56.61.
- Moji, R.G., Motloung, S.V., Motaung, T.E. & Koao, L.F.** 2022. Characterization of the incorporated SiO₂ co-doped with Sr²⁺ and Tb³⁺ phosphors into PLA polymer matrix. *Journal of Molecular Structure* 1263: 133176. DOI: 10.1016/j.molstruc.2022.133176.
- Mokoena, T.P., Swart, H.C., Hillie, K.T., Tshabalala, Z.P. Jozela, M., Tshilongo, J. & Motaung, D.E.** 2022. Enhancing propanol gas sensing performance of p-type NiO gas sensor induced by exceptionally large surface area and crystallinity. *Applied Surface Science* 571: 151121. DOI: 10.1016/j.apsusc.2021.151121.
- Morebodi, K.B., Reddy, L., Balakrishna, A., Erasmus, L.J.B., Swart, H.C. & Masiteng, P.L.** 2022. Investigation of photoluminescence properties and energy transfer in Sm^{3+} and Eu^{3+} co-doped $\text{Na}_2\text{Ca}(\text{SO}_4)_2$ nanophosphors prepared by combustion technique. *Solid State Science* 134: 107059. DOI: 10.1016/j.solidstatesciences.2022.107059.
- Motaung, D.E., Tshabalala, Z.P., Makgwane, P.R., Mahmoud, F.A., Oosthuizen, D.N., Cummings, F.R., Leshabane, N., Hintsho-Mbita, N., Li, X., Ray, S.S. & Swart, H.C.** 2022. Multi-functioning of CeO₂-SnO₂ heterostructure as room temperature ferromagnetism and chemiresistive sensors. *Journal of Alloys and Compounds* 906: 164317. DOI: 10.1016/j.jallcom.2022.164317.
- Motaung, T.E., Motloung, S.V., Koao, L.F., Malevu, T.D. & Liganiso, E.C.** 2022. A thermic effect on degradation kinetics of sugar cane bagasse polypropylene composites. *Journal of Composites Science* 6: 123. DOI: 10.3390/jcs6050123.
- Nair, G.B., Tamboli, S., Kroon, R.E., Dhoble, S.J. & Swart, H.C.** 2022. Facile room-temperature colloidal synthesis of CsPbBr₃ perovskite nanocrystals by the Emulsion-based ligand-assisted reprecipitation approach: Tuning the color-emission by the demulsification process. *Journal of Alloys and Compounds* 928: 167249. DOI: 10.1016/j.jallcom.2022.167249.
- Nemufulwi, M.I., Swart, H.C. & Mhlongo, G.H.** 2022. Highly selective acetone detection displayed by a surface engineered fiber-like ZnFe₂O₄ based-sensor following heat-treatment ramping rate variation. *Materials Letters* 330: 133214. DOI: 10.1016/j.matlet.2022.133214.
- Ngake, T., Nqayi, S., Gulumian, M., Cronje, S. & Harris, R.A.** 2022. Recent developments in computational and experimental studies of physicochemical properties of Au and Ag nanostructures on cellular uptake and nanostructure toxicity. *BBA - General Subjects* 1866: 130170. DOI: 10.1016/j.

bbagen.2022.130170.

Nkosi, S.S., Mkwae, P.S., Ogundipe, S.A., Leshabane, N., Revaprasadu, N. & Kroon, R.E. 2022. Abnormal p-type to n-type switching nitric oxide gas sensing: Ni(OH)₂ nanoplatelets on amorphous NiO seed layers. *Vacuum* 200: 111032. DOI: 10.1016/j.vacuum.2022.111032.

Nqayi, S., Gulumian, M., Cronje, S. & Harris, R.A. 2022. Computational study of the effect of size and surface functionalization on Au nanoparticles on their stability to study biological descriptors. *Journal of Molecular Modeling* 28: 376. DOI: 10.1007/s00894-022-05367.6.

Panchu, S.E. Sekar, S., Rajaram, V., Kolanthai, E., Panchu, S.J., Swart, H.C. & Kalkura, S.N. 2022. Enriching trace level adsorption affinity of As³⁺ ion using hydrothermally synthesized iron-doped hydroxyapatite nanorods. *Journal of Inorganic and Organometallic Polymers and Materials* 32: 47-62. DOI: 10.1007/s10904-021-02103-0.

Ocaya, R.O., Al-Sehemi, A.G., Dere, A., Al-Ghamdi, A.A. & Yakuphanoglu, F. 2022. Electrical, photoconductive, and photovoltaic characteristics of a Bi₂Se₃ 3D topological insulator based metal-insulator-semiconductor diode. *Sensors and Actuators: A. Physical* 341: 113575. DOI: 10.1016/j.sna.2022.113575.

Ocaya, R.O., Erol, I., Al-Sehemi, A.G., Dere, A., Al-Ghamdi, A.A. & Yakuphanoglu, F. 2022. ZnO-doped PFAMA: a novel transparent conducting polymer for fast photodiodes. *Journal of Materials Science* 33: 24803-24818. DOI: 10.1007/s10854-022-09192-8.

Pandey, R. Thapa, P., Kumar, V., Zhu, Y., Wang, N., Bystrzejewski, M. & Tiwari, S.K. 2022. Updates in phase change materials for thermoelectric devices: Status and challenges. *Materialia* 21: 101357. DOI: 10.1016/j.mtla.2022.101357.

Prakash, J., De Oliveira, P.R., Swart, H.C., Remyantseva, M., Packirisamy, M., Janegitz, B.C. & Li, X. 2022. Nanomaterial-based surface-enhanced Raman scattering spectroscopy for sensing and diagnostics of gas molecules in environment and healthcare. *Sensors & Diagnostics* 1: 1143-1164. DOI: 10.1039/d2sd00133k.

Prakash, J., Krishna, S.B.N., Kumar, P., Kumar, V., Ghosh, K.S., Swart, H.C., Bellucci, S. & Cho, J. 2022. Recent advances on metal oxide based nano-photocatalysts as potential antibacterial and

antiviral agents. *Catalysts* 12: 1047. DOI: 10.3390/catal12091047.

Saeed, N.A.M., Coetsee, E. & Swart, H.C. 2022. Infrared emission enhancement through holmium(3+) co-doped yttrium oxyfluoride doped with bismuth(3+) phosphor. *Optical Materials* 131: 112655. DOI: 10.1016/j.optmat.2022.112655.

Satpute, N.S., Mehare, C.M., Tiwari, A., Swart, H.C. & Dhoble, S.J. 2022. Synthesis and luminescence characterization of downconversion and downshifting phosphor for efficiency enhancement of solar cells: Perspectives and challenges. *ACS Applied Electronic Materials* 4: 3354-3391. DOI: 10.1021/acsaelm.2c00595.

Schutte, H.M., Britto, R.J., Bottcher, M., Van Soelen, B., Marais, J.P., Kaur, A., Falcone, A.D., Buckley, D.A.H., Rajoelimanana, A.F. & Cooper J. 2022. Modeling the spectral energy distributions and spectropolarimetry of blazars – applications to 4C+01.02 in 2016-2017. *The Astrophysical Journal* 925:139. DOI: 10.3847/1538-4357/ac3cb5.

Sefage, A.P., Mamo, M.A., Masiteng, P.L., Balakrishna, A., Coetsee, E., Swart, H.C. & Reddy, L. 2022. The concentration effect of Ce³⁺ ions on the photoluminescence properties of the host sensitized NaMPO₄-Ce³⁺ (M=Mg and Ca) phosphors via solid-state reaction method. *Physics B* 647: 414383. DOI: 10.1016/j.physb.2022.414383.

Singh, K.K., Dhar, V.K. & Meintjes, P.J. 2022. Artificial neural networks for cosmic gamma-ray propagation in the universe. *New Astronomy* 91: 101701. DOI: 10.1016/j.newast.2021.101701.

Singh, R., Bedyal, A.K., Manhas, M., Swart, H.C. & Kumar, V. 2022. Charge compensated CaSr₂(PO₄)₂:Sm³⁺, Li⁺/Na⁺/K⁺ phosphor: Luminescence and thermometric studies. *Journal of Alloys and Compounds* 901: 163793. DOI: 10.1016/j.jallcom.2022.163793.

Singh, R., Manhas, M., Bedyal, A.K., Durani, F., Swart, H.C. & Kumar, V. 2022. Thermometric and luminescence studies of Eu³⁺ activated CaSr₂(PO₄)₂ phosphor for non-contact thermometry and solid state lighting applications. *Materials Chemistry and Physics* 219: 126735. DOI: 10.1016/j.matchemphys.2022.126735.

Sridhar, G., Deepak, H.N., Samvit, G.M., Lewis, P.M., Choudhari, K.S., Kroon, R.E., Swart, H.C. & Kulkarni, S.D. 2022. Cr-doped ZnGa₂O₄: Simple synthesis

of intense red-NIR emitting nanoparticles with enhanced quantum efficiency. *Optical Materials* 123: 111919. DOI: 10.1016/j.optmat.2021.111919.

Sukul, P.P., Kumar, K. & Swart, H.C. 2022. Erbium energy bridging upconversion mechanism studies on BAKL:Er³⁺/Yb³⁺ glass-ceramics and simultaneous enhancement of color purity of the green luminescence. *Dalton Transactions* 51: 2827-2839. DOI: 10.1039/d1dt03918k.

Sukul, P.P. & Swart, H.C. 2022. Crystal phase modified blue upconversion on Tm³⁺/Yb³⁺:BCZT ceramic phosphor benefits multifunctionality in white-light applications. *Dalton Transactions* 51: 11515. DOI: 10.1039/d2dt01962k.

Szegedi, H., Charles, P.A., Meintjes, P.J. & Odendaal, A. 2022. Transient behaviour of three SU Uma-type dwarf novae: AR pic, QW ser, and V521 peg. *Monthly Notices of the Royal Astronomical Society* 513: 4682-4695. DOI: 10.1093/mnras/stac1161.

Thwala, M.M., Afantitis, A., Papadiamantis, A.G., Tsoumanis, A., Melagraki, G., Dlamini, L.N., Ouma, C.N.M., Ramasami, P., Harris, R., Puzynm T., Sanabria, N., Lynch, I. & Gulumian, M. 2022. Using the Isalos platform to develop a (Q)SAR model that predicts metal oxide toxicity utilizing facet-based electronic, image analysis-based, and periodic table derived properties as descriptors. *Structural Chemistry* 33: 527-538. DOI: 10.1007/s11224-021-01869-w.

Tiwari, S.K., Pandey, R., Wang, N., Kumar, V., Sunday, O.J., Bystrzejewski, M., Zhu, Y. & Mishra, Y.K. 2022. Progress in diamonds and diamondoids nanosystems for emerging technologies. *Advance Science* 9: 105770. 2105770. DOI: 10.1002/advs.202105770.

Tladi, B.C., Swart, H.C., Erasmus, R.M. & Kroon, R.E. 2022. Graphene oxide and its films produces using a nebulizer spray coating method. *Materials Research Bulletin* 151: 111806. DOI: 10.1016/j.materresbull.2022.111806.

Ungula, J., Kiprotich, S., Swart, H.C. & Dejene, F.B. 2022. Investigation on the material properties of ZnO nanorods deposited on Fa-doped ZnO seeded glass substrate: Effects of CBD precursor concentration. *Surface and Interface Analysis* 54: 1023-1031. DOI: 10.1002/sia7127.

Van Soelen, B., Mc Keague, S., Malyshev, D., Chernyakova, M., Komin, N., Matchett, N. & Monageng, I. 2022. Improved binary solution for the gamma-ray binary 1FGL J1018.6-5856. *Monthly*

Notices of the Royal Astrophysical Society 515: 1078-1085. DOI: 10.1093/mnras/stac1754.

Yagoub, M.Y.A., Swart, H.C. & Coetsee, E. 2022. The morphology and downshifting luminescence of [CaY]F₂ crystals doped with Ce³⁺/Eu^{3+/2+}/Na⁺. *Ceramics International* 48: 23657-23665. DOI: 10.1016/j.ceramint.2022.05.014.

Yagoub, M.Y.A., Swart, H.C. & Coetsee, E. 2022. The role of Li⁺ interstitial ions in up-conversion intensity of CaF₂:Yb³⁺, Tb³⁺ phosphors. *Materials Research Bulletin* 156: 111986. DOI: 10.1016/j.materresbull.2022.111986.

Yan, Y., Lian, S., Klinger, L., Rabkin, E., Wang, J. & Xu, C. 2022. Thermodynamics and kinetics of surface/interface segregation in the stressed ultrathin alloy film on inert substrate. *Applied Surface Science* 562: 150050. DOI: 10.1016/j.apsusc.2021.150050.

Yan, Y., Zhong, F., Lian, S., Wang, Z., Wang, J. & Xu, C. 2022. Understanding the kinetics of Fe subsurface dissolution and surface segregation upon annealing Fe on Pd(111) in vacuum/oxygen environment. *Applied Physics A* 128: 127. DOI: 10.1007/s00339-022-05269-7.

Yang, Z., Liu, G., Zhao, Y., Zhou, Y., Qiao, J., Molokeyev, M.S., Swart, H.C. & Xia, Z. 2022. Competitive site occupation toward improved quantum efficiency of SrLaScO₄:Eu red phosphors for warm white LEDs. *Advanced Optical Materials* 10: 2102373. DOI: 10.1002/adom.202102373.

Books/Chapters in Books

Ayoub, I., Mushtaq, U., Hussain, N., Rubab, S., Sehgal, R., Swart, H.C. & Kumar, V. 2022. Rare-earth-activated phosphors for LED applications. In: *Rare-earth-activated phosphors*. V. Dubey, N. Dubey, M.M. Domanska, M. Jayasimhadri & S.J. Dhoble (Eds). Netherlands: Elsevier. pp. 205-240.

Chopra, V., Kadam, A.R., Swart, H.C. & Dhoble, S.J. 2022. Introduction to luminescence and radiation dosimetry techniques. In: *Radiation Dosimetry Phosphors*. S.J. Dhoble, V. Chopra, V.Nayar, G. Kitis, D. Poelman & H.C. Swart (Eds). United States: Woodhead Publishing. pp. 1-26.

Hile, D.D., Swart, H.C., Motloun, S.V. & Koao, L.F. 2022. Zinc selenide semiconductor: synthesis, properties and applications. In: *Nanoscale compound semiconductors and their optoelectronics*

applications. V.B. Pawade, S.J. Dhoble & H.C. Swart (Eds). United States: Woodhead Publishing. pp. 67-84.

Hussain, N., Ayoub, I., Mushtaq, U., Sehgal, R., Rubab, S., Sehgal, R., Swart, H.C. & Kumar, V. 2022. Introduction to phosphors and luminescence. In: *Rare-earth-activated phosphors*. V. Dubey, N. Dubey, M.M. Domanska, M. Jayasimhadri & S.J. Dhoble (Eds). Netherlands: Elsevier. pp. 3-41.

Inwati, G.K., Kumar, P. & Swart, H.C. 2022. Multifunctional properties of hybrid semiconducting nanomaterials and their applications. In: *Nanoscale compound semiconductors and their optoelectronics applications*. V.B. Pawade, S.J. Dhoble & H.C. Swart (Eds). United States: Woodhead Publishing. pp.315-350.

Kroon, R.E. 2022. Metal nanoparticle enhanced upconversion of lanthanide ions. In: *Luminescent Nanomaterials*. O.M. Ntwaeaborwa (Ed). Singapore: Jenny Stanford Publishing. pp. 179-212.

Kumar, P., Inwati, G.K., Mathpal, M.C., Maze, J. & Swart, H.C. 2022. Recent advances on ferrites nanomaterial's as photocatalyst for environment. In: *Advances in Nanostructured Materials*. B.P. Swain (Ed). Singapore: Springer Nature. pp. 381-413.

Kumar, P., Mathpal, M.C., Inwati, G.K., Swart, H.C. & Roos, W.D. 2022. Graphene oxide based semiconducting nanomaterial's composites for environmental applications. In: *Nanoscale compound semiconductors and their optoelectronics applications*. V.B. Pawade, S.J. Dhoble & H.C. Swart (Eds). United States: Woodhead Publishing. pp. 407-432.

Makgwane, P.R., Hlekelele, L., Motaung, D.E., Mavuso, M.A., Mphahlele-Makgwane, M.M. & Mokoena, T.P. 2022. Recent advancement in the development of metal oxide heterostructures for environmental remediation. In: *Metal Oxide-Based Heterostructures: Fabrication and Applications*. N. Kumar & B.M. Soucase (Eds). Netherlands: Elsevier. pp. 193-246.

Makgwane, P.R. & Motaung, D.E. 2022. Nanoscale phenomena in metal oxide heterostructures. In: *Metal Oxide-Based Heterostructures: Fabrication and Applications*. N. Kumar & B.M. Soucase (Eds). Netherlands: Elsevier. pp. 77-105.

Meena, M.L., Som, S., Lu, C., Badgoti, R.S., Dutta, S., Singh, R.K., Lin, S.D. & Swart, H.C. 2022. Metal

oxides based materials for display devices. In: *Metal Oxide-Based Heterostructures: Fabrication and Applications*. N. Kumar & B.M. Soucase (Eds). Netherlands: Elsevier. pp. 297-330.

Mofokeng, S.J., Mokoena, T.P., Mhlongo, M.R. & Motaung, D.E. 2022. Metal oxide heterostructure-based light-emitting diodes. In: *Metal Oxide-Based Heterostructures: Fabrication and Applications*. N. Kumar & B.M. Soucase (Eds). Netherlands: Elsevier. pp. 331-358.

Mokoena, T.P., Mofokeng, S.J. & Motaung, D.E. 2022. Nanosensors for smartphone sensing method. In: *Nanotechnology-based smart remote sensing networks for disaster prevention*. A. Denizli, M.S. Alencar, T.A. Nguyen & D.E. Motaung (Eds). Netherlands: Elsevier. pp. 123-135.

Mokoena, T.P., Oosthuizen, D.N., Makgwane, P.R., Mofokeng, S., Mphahlele-Makgwane, M.M., Swart, H.C. & Motaung, D.E. 2022. Interface effects in metal oxide heterostructures. In: *Metal Oxide-Based Heterostructures: Fabrication and Applications*. N. Kumar & B.M. Soucase (Eds). Netherlands: Elsevier. pp. 43-75.

Mokoena, T.P., Tshabalala, Z.P., Hillie, K.T., Swart, H.C. & Motaung, D.E. 2022. Nanobiosensors for soil microbial detection. In: *Nanosensors for smart agriculture*. A Denizli, T.A. Nguyen, S. Rajendran, F Yasin & A.K. Nadda (Eds). Netherlands: Elsevier. pp. 355-365.

Motaung, D.E. & Makgwane, P.R. 2022. Heterojunction metal oxide-based thin-film transistors for sensing. In: *Metal Oxide-Based Heterostructures: Fabrication and Applications*. N. Kumar & B.M. Soucase (Eds). Netherlands: Elsevier. pp. 391-415.

Nair, G.B., Tamboli, S., Dhoble, S.J. & Swart, H.C. 2022. Exploration of commercially available phosphors for thermoluminescence dosimetry. In: *Radiation Dosimetry Phosphors*. S.J. Dhoble, V. Chopra, V.Nayar, G. Kitis, D. Poelman & H.C. Swart (Eds). United States: Woodhead Publishing. pp. 71-97.

Ogugua, S.N., Kroon, R.E. & Swart, H.C. 2022. Tunable luminescence from Dy³⁺ and Pr³⁺ doped mixed rare-earth oxyorthosilicate phosphors. In: *Luminescent Nanomaterials*. O.M. Ntwaeaborwa (Ed). Singapore: Jenny Stanford Publishing. pp. 449-479.

Oosthuizen, D.N. 2022. Introduction to compound semiconductor nanocrystals and their applications.

In: *Nanoscale compound semiconductors and their optoelectronics applications*. V.B. Pawade, S.J. Dhoble & H.C. Swart (Eds). United States: Woodhead Publishing. pp. 1-46.

Pawade, V.B., Dhoble, S.J., & Swart, H.C. 2022. Graphene-based semiconductor nanocrystals for optoelectronics devices. In: *Nanoscale compound semiconductors and their optoelectronics applications*. V.B. Pawade, S.J. Dhoble & H.C. Swart (Eds). United States: Woodhead Publishing. pp.383-406.

Shivaramu, N.J., Lakshminarasappa, B.N., Coetsee, E. & Swart, H.C. 2022. Thermoluminescent materials for high-energy dosimetry. In: *Radiation Dosimetry Phosphors*. S.J. Dhoble, V. Chopra, V.Nayar, G. Kitis, D. Poelman & H.C. Swart (Eds). United States: Woodhead Publishing. pp. 211-350.

Theka, T.J. & Motaung, D.E. 2022. Smart and autonomous (self-powered) nanosensor networks. In: *Nanotechnology-based smart remote sensing networks for disaster prevention*. A. Denizli, M.S. Alencar, T.A. Nguyen & D.E. Motaung (Editors). Netherlands: Elsevier. pp.105-121.

Tshabalala, A.P., Mokoena, T.P. & Motaung, D.E. 2022. Current commercial nanosensors and devices/products used in agriculture. In: *Nanosensors for smart agriculture*. A Denizli, T.A. Nguyen, S. Rajendran, F Yasin & A.K. Nadda (Eds). Netherlands: Elsevier. pp. 165-181.

Yagoub, M.Y.A., Swart, H.C. & Coetsee, H. 2022. Luminescent materials as spectral converters for enhancing solar cells' efficiency. In: *Luminescent Nanomaterials*. O.M. Ntwaeaborwa (Ed). Singapore: Jenny Stanford Publishing. pp. 235-258.

Yawalkar, M.M., Menon, S., Swart, H.C. & Dhoble, S.J. 2022. Fundamentals of photodynamic therapy. In: *Photophysics and Nanophysics in therapeutics*. N.M. Mahajan, A. Saini, N.A. Raut & S.J. Dhoble (Eds). Netherlands: Elsevier. pp. 51-87.

Conference Contributions

Conference Papers/Posters

Abdalkreem, T.M., Kroon, R.E. & Swart, H.C. 2022. Assessment of the size of nanoparticles by using X-ray diffraction and scanning electron microscopy. Poster presented at the 57th Annual Microscopy Society of South Africa Conference, Johannesburg,

South Africa. 5-8 December 2022.

Barnard, J., Van Soelen, B., Acharya, S., Cooper, J., Martin-Camilo, A., Vaidya, B. & Van der Westhuizen, I.P. 2022. Long-term optical spectropolarimetric behaviour of a BLL and FSRQ during low states. Paper delivered at the 9th High Energy Astrophysics in Southern Africa (HEASA2022) conference, Brandfort, South Africa. 28 September-1 October 2022.

Barnard, J., Van Soelen, B., Bottcher, M., Buckley, D.A.H., Martin-Carrilo, A, Cooper, J. & Schutte, H.M. 2022. Results from optical spectropolarimetric observations of blazars. Poster presented at the 10th International Fermi Symposium, Johannesburg, South Africa. 9-15 October 2022.

Barnard, J., Van Soelen, B., Martin-Carrilo, A, Cooper, J., Acharya, S., Bottcher, M., Britto, R.J., Buckley, D.A.H., Marais, J.P., Schutte, H.M. & Vaidya, B. 2022. Optical spectropolarimetric behaviour of a selection of blazars. Poster presented at the 7th Heidelberg International Symposium on High-Energy Gamma-ray Astronomy, Barcelona, Spain. 4-8 July 2022.

Buckley, D. 2022. Discovery of a second AR Sco-like white dwarf pulsar. Paper delivered at the 9th High Energy Astrophysics in Southern Africa (HEASA2022) conference, Brandfort, South Africa. 28 September-1 October 2022.

Charak, I., Manhas, M., Bedyal, A., Swart, H.C. & Kumar, V. 2022. Highly pure and thermally stable orange red emitting Sm³⁺ activated Sr₂B₂O₅ Phosphors for filling Amber gap. Paper delivered at the International Conference on Materials Sustainability Development (ICMSD-2022), Jammu, India. 19-20 October 2022.

Cooper, J. & Van Soelen, B. 2022. SALT spectropolarimetric pipeline comparisons. Poster presented at the 9th High Energy Astrophysics in Southern Africa (HEASA2022) conference, Brandfort, South Africa. 28 September-1 October 2022.

Cooper, J. & Van Soelen, B. 2022. SALT spectropolarimetric pipeline comparisons. Poster presented at the 10th International Fermi Symposium, Johannesburg, South Africa. 9-15 October 2022.

Erasmus, L.J.B., Smet, P.F., Poelman, D., Terblans, J.J. & Swart, H.C. 2022. Integrating a phosphor into an index-matched waveguide for solar energy application. Paper delivered at the 9th International Conference on Optical, Optoelectronic and Photonic

Materials and Applications & 14th Europhysical Conference on Defects in Insulating Materials, Ghent, Belgium. 3-8 July 2022.

Kgomo, M.B., Shingange, K., Nemifulwi, M.I., Swart, H.C. & Mhlongo, G.H. 2022. *Highly methane responsive nanosensor layer based on mesoporous nanostructured belt-like Indium Oxide*. Paper delivered at the 8th International Conference on Nanoscience and Nanotechnology in Africa (NanoAfrica 2022), Cape Town, South Africa. 26-28 October 2022.

Kgomo, M., Swart, H.C. & Mhlongo, G.H. 2022. *Highly methane responsive nanosensor layer based on mesoporous nanostructured belts-like Indium Oxide*. Paper delivered at the 66th Annual Conference of the South African Institute of Physics, Virtual, South Africa. 4-8 July 2022.

Khajuria, P., Manhas, M., Bedyal, A., Vij, A., Swart, H.C. & Kumar, V. 2022. *Orange red emitting LiSrP₃O₉:Sm³⁺ phosphor to fill amber gap in WLED applications*. Paper delivered at the International Conference on Materials Sustainability Development (ICMSD-2022), Jammu, India. 19-20 October 2022.

Kulik, D., Van Soelen, B. & Van der Westhuizen, I.P. 2022. *Modelled light curve variability due to blob injection in RMHD jet simulations*. Poster presented at the 10th International Fermi Symposium, Johannesburg, South Africa. 9-15 October 2022.

Kumar, P. & Swart, H.C. 2022. *Plasmonic nanostructures embedded in a dielectric host for SERS and optical limiting devices*. Paper delivered at the International e-Conference on Innovative Functionalities of Advanced Materials (ICIFAM-2022), Oromia Region, Ethiopia. 16-17 June 2022.

Lee, E., Harris, R.A., Terblans, J.J. & Swart, H.C. 2022. *Production of SrVO₃ through co-precipitation synthesis and annealing in reducing atmosphere*. Paper delivered at the 57th Annual Microscopy Society of South Africa Conference, Johannesburg, South Africa. 5-8 December 2022.

Madzime, S.T., Meintjes, P.J. & Van Heerden, H.J. 2022. *A search for gamma-ray emission from a sample of highly magnetized white dwarfs using Fermi-LAT*. Poster presented at the 9th High Energy Astrophysics in Southern Africa (HEASA2022) conference, Brandfort, South Africa. 28 September-1 October 2022.

Madzime, S.T., Meintjes, P.J. & Van Heerden, H.J.

2022. *A search for gamma-ray emission from AE Aquarii a highly magnetized white dwarf using Fermi-LAT*. Poster presented at the 10th International Fermi Symposium, Johannesburg, South Africa. 9-15 October 2022.

Matchett, N., Van Soelen, B. & Gray, R.O. 2022. *Analysing the orbital solutions of the gamma-ray binary HESS J0632+057 with the new radial velocity measurement from SALT*. Paper delivered the 10th International Fermi Symposium, Johannesburg, South Africa. 9-15 October 2022.

Matchett, N., Van Soelen, B. & Gray, R.O. 2022. *Constraining the orbital solution of the gamma-ray binary HESS J0632+057 with radial velocity measurements and non-thermal emission modelling*. Paper delivered at the 9th High Energy Astrophysics in Southern Africa (HEASA2022) conference, Brandfort, South Africa. 28 September-1 October 2022.

Matchett, N., Van Soelen, B. & Gray, R.O. 2022. *New radial velocity measurements for orbital parameter analysis of the gamma-ray binary HESS J0632+057*. Poster presented at the 7th Heidelberg International Symposium on High-Energy Gamma-ray Astronomy, Barcelona, Spain. 4-8 July 2022.

Nemifulwi, M.I., Swart, H.C. & Mhlongo, G.H. 2022. *Enhanced sensing properties of ZnO/ZnFe₂O₄ heterostructures induced by oxygen vacancies*. Paper delivered at the 8th International Conference on Nanoscience and Nanotechnology in Africa (NanoAfrica 2022), Cape Town, South Africa. 26-28 October 2022.

Nemifulwi, M.I., Swart, H.C. & Mhlongo, G.H. 2022. *Preparation and characterization of porous ZnFe₂O₄ hollow fibers with enhanced sensing response and selective detection of acetone*. Paper delivered at the 66th Annual Conference of the South African Institute of Physics, Virtual, South Africa. 4-8 July 2022.

Ngake, T., Cronje, S. & Harris, R.A. 2022. *Effects of Silver nanoparticles' physicochemical properties on their toxicity*. Paper delivered at the Department of Science and Innovation (DSI) Workshop, Johannesburg, South Africa. 12 October 2022.

Nqayi S., Cronje, S. & Harris, R.A. 2022. *Study of physicochemical properties of Au nanostructures in cell internalization and toxicity*. Paper delivered at the Department of Science and Innovation (DSI)

Workshop, Johannesburg, South Africa. 12 October 2022.

Ocaya, R.O. 2022. *A group theory approach in the analysis of temperature symmetry in semiconducting junction devices*. Paper delivered at the 11th International Conference on Mathematical Modeling in Physical Sciences, Athens, Greece. 5-8 September 2022.

Reddy, L., Swart, H.C., Balakrishna, A. & Ntwaeaborwa, O.M. 2022. *Structural and photoluminescent properties of Y₂O₃, Y₂O₃-AG: Eu³⁺ (where AG = PO₄²⁻, SO₄²⁻, BO₃³⁻) nanophosphors for white-LED applications*. Paper delivered at the 66th Annual Conference of the South African Institute of Physics, Virtual, South Africa. 4-8 July 2022.

Shivaramu, N.J., Coetsee, E., Holsa, J. & Swart, H.C. 2022. *Green persistent luminescence in Tb-doped barium aluminate phosphors*. Paper delivered at the 12th International Symposium on Phosphor Materials. Lanzhou, China. 30 July-3 August 2022.

Singh, R., Manhas, M., Bedyal, A., Durani, F., Swart, H.C. & Kumar, V. 2022. *Temperature sensing performance of CaSr₂(PO₄)₂:Eu³⁺ orthophosphate phosphor by using fluorescence intensity ratio approach*. Paper delivered at the International Conference on Materials Sustainability Development (ICMSD-2022), Jammu, India. 19-20 October 2022.

Smit, W. 2022. *sCMOS sensor for high energy event follow ups*. Poster presented at the 9th High Energy Astrophysics in Southern Africa conference (HEASA2022), Brandfort, South Africa. 28 September-1 October 2022.

Swart, H.C. 2022. *Applications of AES, XPS and TOF SIMS to phosphor materials*. Paper delivered at the 9th International Conference on Optical, Optoelectronic and Photonic Materials and Applications & 14th Europhysical Conference on Defects in Insulating Materials, Ghent, Belgium. 3-8 July 2022.

Swart, H.C. 2022. *Luminescent materials for solid state lighting and solar cell applications*. Paper delivered at the International e-Conference on Innovative Functionalities of Advanced Materials (ICIFAM-2022), Oromia Region, Ethiopia. 16-17 June 2022.

Swart, H.C. 2022. *Structure and surface properties*. Paper delivered at the 6th South African Nanoscience and Nanotechnology Summer School, Cape Town, South Africa. 23-25 October 2022.

Van der Westhuizen, I.P. 2022. *Modelling the synchrotron self-absorption from RMHD simulations of relativistic jets using PLUTO Lagrangian particle module*. Paper delivered at the Annual Conference and General Assembly of the African Astronomical Society, Virtual, South Africa. 14-18 March 2022.

Van der Westhuizen, I.P., Van Soelen, B. & Vaidya, B. 2022. *Exploring radio morphologies of AGN jets with hybrid fluid-particle simulations*. Paper delivered at the 9th High Energy Astrophysics in Southern Africa conference (HEASA2022), Brandfort, South Africa. 28 September-1 October 2022.

Van der Westhuizen, I.P., Van Soelen, B. & Vaidya, B. 2022. *Modelling the large-scale morphology of AGN jets using fluid-particle hybrid simulations*. Poster presented at the 7th Heidelberg International Symposium on High-Energy Gamma-ray Astronomy, Barcelona, Spain. 4-8 July 2022.

Van Soelen, B. 2022. *Optical observations of gamma-ray binaries*. Paper delivered at the First Pan-African Astro-Particle and Collider Physics Workshop, Virtual, South Africa. 21-23 March 2022.

Van Soelen, B. 2022. *SALT observations of gamma-ray binaries*. Paper delivered at the 66th Annual Conference of the South African Institute of Physics, Virtual, South Africa. 4-8 July 2022.

Van Soelen, B., Chemyakova, M., Malyshev, D. & Mc Keague, S. 2022. *Long term behaviour of the circumstellar disc in the gamma-ray binary system PSR B1250-63/LS 2883*. Paper delivered at the 9th High Energy Astrophysics in Southern Africa conference (HEASA2022), Brandfort, South Africa. 28 September-1 October 2022.

Van Soelen, B. & Du Plooy, D. 2022. *Gamma-gamma absorption in gamma-ray binaries*. Paper delivered at the 10th International Fermi Symposium, Johannesburg, South Africa. 9-15 October 2022.

Van Soelen, B., McKeague, S., Malyshec, D., Chernyakova, M., Komin, N., Matchett, N. & Mongeng, I. 2022. *Updated binary solution for 1FGLJ1018.6-5856 and the implications for gamma-ray production*. Paper delivered at the Annual Conference and General Assembly of the African Astronomical Society, Virtual, South Africa. 14-18 March 2022.

Yagoub, M.Y.A., Swart, H.C. & Coetsee, E. 2022. *Luminescent nanomaterials for solar cells' application*. Paper delivered at the International

e-Conference on Innovative Functionalities of Advanced Materials. Oromia, Ethiopia. 16-17 June 2022.

Yimamu, A.U., Asfaw, M., Motloung, S.J., Dejene, F.B., Terblans, J.J. & Swart, H.C. 2022. *Electrodeposition of CdTe thin film: Effect of deposition voltage from acetate precursor for solar energy application*. Paper delivered at the 1st international research conference, Material Science and Engineering for Sustainable Development, Dire Dawa University, Ethiopia, 23-24 May 2022.

Yimamu, A.U., Dejene, B.F., Terblans, J.J., Swart, H.C. & Motloung, S.J. 2022. *Electrodeposition of CdTe thin film effect of deposition temperature from acetate precursor for solar energy application*. Poster presented at the 66th Annual Conference of the South African Institute of Physics, Virtual, South Africa. 4-8 July 2022.

Yousif, A., Al Sharif, M.H.I. & Swart, H.C. 2022. *Luminescence of sol gel derived Ca(1-x-y)O:Bi_x³⁺, Tb_y³⁺ phosphor*. Paper delivered at the International e-Conference on Innovative Functionalities of Advanced Materials (ICIFAM-2022), Oromia Region, Ethiopia. 16-17 June 2022.

Conference Proceedings

Barnard, J., Van Soelen, B., Cooper, J., Britto, R.J., Marais, J.P., Van der Westhuizen, I.P., Buckley, D.A.H., Schutte, H.M., Bottcher, M., Vaidya, B., Acharya, S. & Martin-Carrillo, A. 2022. Optical spectropolarimetry monitoring of flaring blazars. In: *Proceedings of SAIP 2022, the 65th Annual Conference of the South African Institute of Physics*. Virtual, South Africa. 22-30 July 2021. A. Prinsloo (Ed). The South African Institute of Physics (SAIP). pp. 364-369.

Barnard, J., Van Soelen, B., Cooper, J., Britto, R.J., Marais, J.P., Van der Westhuizen, I.P., Buckley, D.A.H., Schutte, H.M., Bottcher, M., Vaidya, B., Acharya, S. & Martin-Carrillo, A. 2022. Optical spectropolarimetry observations of the BL Lac-type object PKS 0537-441 after a period of quiescence. In: *Proceedings of Science: High Energy Astrophysics in Southern Africa 2021*. Virtual, South Africa. 13-17 September 2021. M. Bottcher (Ed). Sissa Medialab. pp. 009(1)-009(5).

Bedyal, A.K., Kunti, A., Kumar, V. & Swart, H.C. 2022. Investigation of thermoluminescence response and trapping parameters of Gamma-ray irradiated

Zn₃(VO₄)₂ phosphors. In: *AIP Conference Proceedings 2357: National Conference on Advances in Applied Sciences and Mathematics*. Rajpura, India. 24-25 September 2020. A. Upmanyu, M. KumarKakker, P. Kumar & J. Bhatti (Eds). AIP Publishing. pp. 070001(1)-070001(5).

Cooper, J., Van Soelen, B. & Britto, R.J. 2022. Development of tools for the SALT/RSS spectropolarimetry reductions: application to the blazar 3C279. In: *Proceedings of Science: High Energy Astrophysics in Southern Africa 2021*. Virtual, South Africa. 13-17 September 2021. M. Bottcher (Ed). Sissa Medialab. pp. 056(1)-056(7).

Kaplan, Q., Meintjes, P.J. & Van Heerden, H.J. 2022. Low-power pulsed emission at the spin period of the white dwarf in AR Scorpii? In: *Proceedings of Science: High Energy Astrophysics in Southern Africa 2021*. Virtual, South Africa. 13-17 September 2021. M. Bottcher (Ed). Sissa Medialab. pp. 045(1)-045(9).

Madzime, S.T., Meintjes, P.J., Van Heerden, H.J., Singh, K.K., Buckley, D.A.H., Woudt, P.A. & Fender, R. 2022. The detection of pulsed emission at the spin-period of the white dwarf in AE Aquarii in MeerKAT and Fermi-LAT data. In: *Proceedings of Science: High Energy Astrophysics in Southern Africa 2021*. Virtual, South Africa. 13-17 September 2021. M. Bottcher (Ed). Sissa Medialab. pp. 046(1)-046(9).

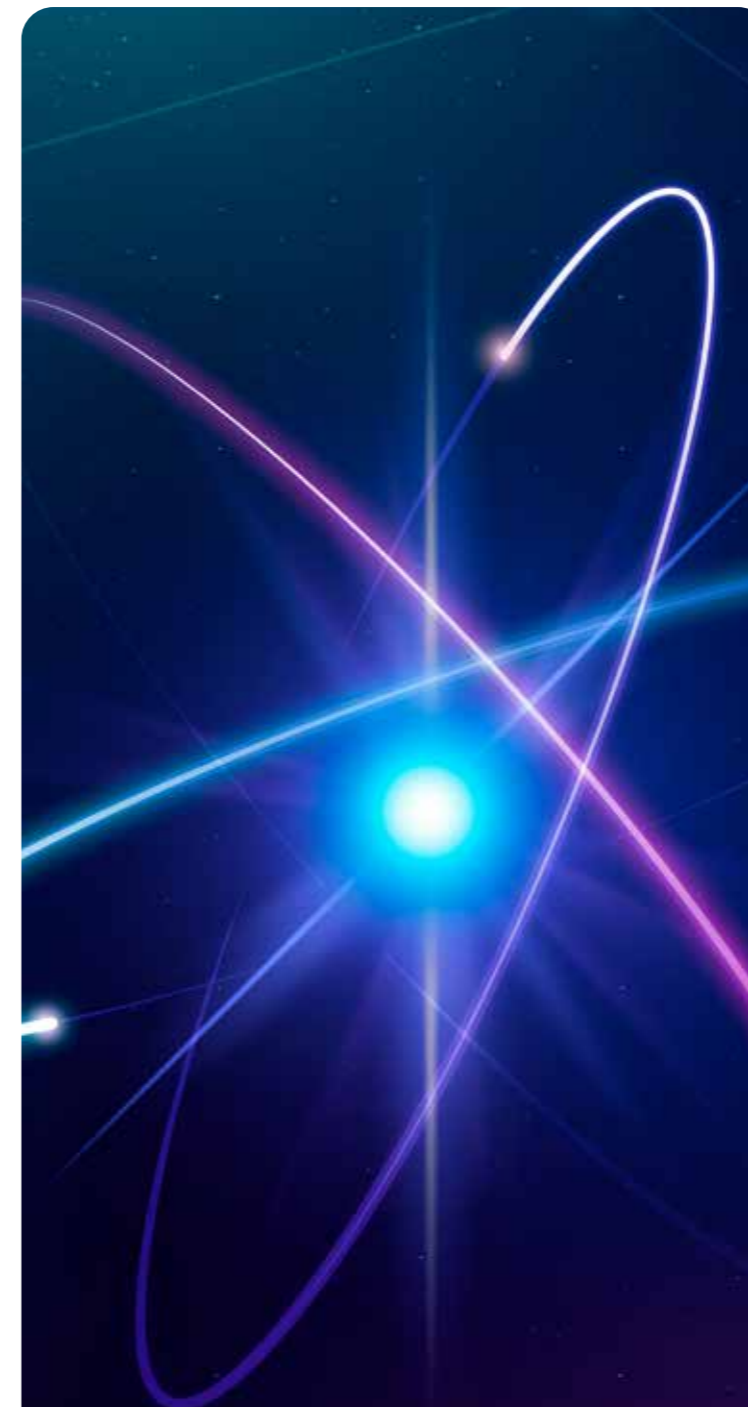
Matchett, N., Van Soelen, B. & Gray, R.O. 2022. Investigating the orbital parameters of the gamma-ray binary HESS J0632+057. In: *Proceedings of SAIP 2022, the 65th Annual Conference of the South African Institute of Physics*. Virtual, South Africa. 22-30 July 2021. A. Prinsloo (Ed). The South African Institute of Physics (SAIP). pp. 370-374.

Mokoena, M., Tshabalala, K.G., Swart, H.C., Dejene, B.F., Mhlongo, M.R. & Motloung, S.J. 2022. Preparation and characterization of erbium-activated yttrium orthovanadate-phosphate by chemical bath deposition. In: *Proceedings of SAIP 2022, the 66th Annual Conference of the South African Institute of Physics*. Gqeberha, South Africa. 4-8 July 2022. A. Prinsloo (Ed). The South African Institute of Physics (SAIP). pp. 36-42.

Van Soelen, B. & Du Plooy, D. 2022. Considering the importance of gamma-gamma absorption in gamma-ray binaries. In: *Proceedings of Science: High Energy Astrophysics in Southern Africa 2021*.

Virtual, South Africa. 13-17 September 2021. M. Bottcher (Ed). Sissa Medialab. pp. 028(1)-028(7).

Yimamu, A.U., Dejene, B.F., Terblans, J.J., Swart, H.C. & Motloung, S.J. 2022. Effects of deposition temperature on the properties of CdTe thin films prepared by electrodeposition method for solar energy applications. In: *Proceedings of SAIP 2022, the 66th Annual Conference of the South African Institute of Physics*. Gqeberha, South Africa. 4-8 July 2022. A. Prinsloo (Ed). The South African Institute of Physics (SAIP). pp. 62-67.



STAFF (2022)

**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 Coetsee-Hugo, Prof RA Harris, Prof MJH Hoffman and Prof B van Soelen

Lecturers: Dr S Cronje, H Szegedi, IP van der Westhuizen and DP van Jaarsveldt

Researcher: Dr M Duvenhage

Junior Researcher: LJB Erasmus

Affiliate Associate

Professors: Prof KT Hillie and Prof G Mhlongo

Research Associates: Prof JPK Hölsä, Dr V Kumar and Dr J Prakash

Senior Officer: Dr HJ van Heerden (Professional Services)

Officers: K Cronje, AJ Fourie (Professional Services) and B Mhlongo (Professional Services)

Assistant Officers: Y Loots and D Mangope

QWAQWA CAMPUS:

Subject Head: Dr KG Tshabalala

Associate Professor: Prof LF Koao and Prof RO Ocaya

Senior Lecturer: Dr KG Tshabalala

Lecturer: Dr SJ Motloung

Senior Assistant

Officer: V Adoons (Professional Services)

Assistant Officer: S Bogacwi

DEPARTMENT OF
PLANT SCIENCES

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Prof Liezel Herselman

Department of Plant Sciences

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2514

E: HerselmanL@ufs.ac.za

W: www.ufs.ac.za/natagri/departments-and-divisions/plant-sciences-home

QWAQWA CAMPUS

Prof Sandy-Lynn Steenhuisen

Department of Plant Sciences

Faculty of Natural and Agricultural Sciences

University of the Free State

Private Bag X13 | Phuthaditjhaba 9866

South Africa

T: +27 58 718 5330

E: SteenhuisenS@ufs.ac.za

W: www.ufs.ac.za/natagri/departments-and-divisions/plant-sciences-home

OVERVIEW OF 2022

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 (on both Bloemfontein and Qwaqwa campuses), Plant Breeding and Plant Pathology. The unity of the Department is evident from the interdisciplinary

research between the different divisions. Academic staff in the Department showed their commitment and passion for teaching and learning by attending various teaching- and learning-related courses and workshops, including the curriculum renewal programme workshop. Various successful excursions were organised for undergraduate students, providing them with the necessary practical skills and experience needed to excel in their studies, but also in future jobs. Staff published a total of 63 scientific papers in accredited journals, contributed towards four books/book chapters and delivered 70 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 five Postdoctoral Fellows and nine interns during the year. A total of 111 postgraduate students were registered in the Department, of which 19 were international students. During 2022, 18 Honours, 11 Master's and 9 Doctoral students obtained their degrees.

ACHIEVEMENTS

Staff Achievements

Prof Maryke Labuschagne was selected for the 7th Edition of Science by Women for Africa programme: Visiting Senior Research Fellowships in Spanish Centres of Excellence, for which she spent six months at the Institute for Sustainable Agriculture in Córdoba, Spain.

Prof Wijnand Swart, in his capacity as President of the Southern African Society for Plant Pathology (SASPP), chaired the Biennial General Meeting of the SASPP held at Future Africa on the University of Pretoria campus during August 2022. He delivered the Presidential Address at the Gala function at which he was also elected as a Fellow of the Society in recognition of outstanding accomplishments in Plant Pathology as well as support for and service to the SASPP society and to Plant Pathology in southern Africa.

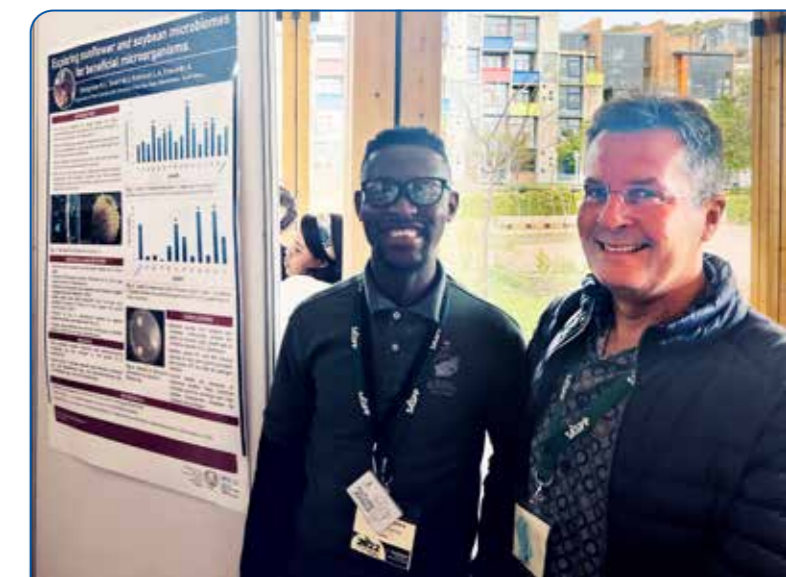
Prof Louis Scott was a guest editor for a collection of 24 articles in *Palaeoecology of Africa* volume 35 (International Yearbook of Landscape Evolution and Palaeoenvironments, CRC Press).

Dr Angeline van Biljon was again elected to serve on the Southern African Plant Breeders' Association (SAPBA) executive committee during the 14th Southern African Plant Breeding biennial conference, that was held at the Protea Hotel by Marriott in Stellenbosch, from 6 to 9 March 2022.

Student Achievements

Henry John Basson was awarded a Plant Breeding internship (field testing) for six months from Bayer, Germany. He participated in the Bayer Winter oilseed rape breeding programme, which included all major processes (trial planning, preparation and maintenance, phenotypic scoring, data collection and analysis). Henry's innovative nature and diligence led to him being recommended for a Plant Breeder's position in Hungary.

Neo Hlongwane was presented with the runner-up Student Poster Award at the SASPP conference, hosted in August by the University of Pretoria.

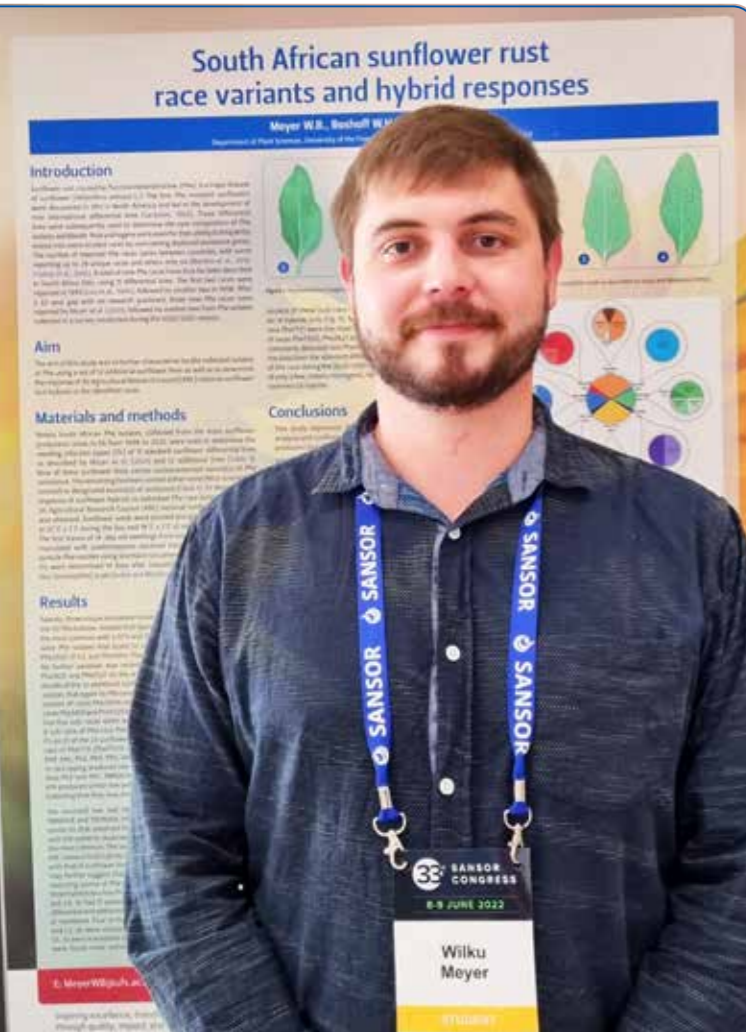


Neo Hlongwane proudly presenting his runner-up SASPP conference poster presentation to Professor Pedro Crous

Jo Cobbold, supervised by Dr Lize Joubert and Dr Lisa Rothmann, won the prize for the best Honours presentation at the 47th Annual Conference of the South African Association of Botanists (SAAB) with her talk titled 'To Bee or Not to Bee'.

Wilku Meyer was invited as one of eight student

finalists to attend the 33rd South African National Seed Organization (SANSOR) Congress held at the President Hotel in Cape Town from 7 to 9 June. Presenting on sunflower rust and hybrid responses, Wilku was announced the winner of the PhD Student Poster Competition judged “to have conveyed the results, and practical outcomes of his research, the best”.



Wilku Meyer at his winning PhD student poster during the SANSOR Congress

Six postgraduate students from the Department of Plant Sciences attended the annual Postgraduate Symposium, hosted by the Department of Botany and Plant Biotechnology of the University of Johannesburg (UJ). Three of these students won awards, namely Tumo Makheta (1st prize in the BSc Honours category), Tsietsjo Khajoane (2nd prize in the MSc category) and Alec Edwards (2nd prize in the PhD category).



Winners at the annual Postgraduate Symposium held at UJ, from the left, Alec Edwards, Tsietsjo Khajoane and Tumo Makheta

During the annual Faculty Prize Giving Function, various under- and postgraduate students received prizes. In Plant Pathology, Amy Coetzer received the second-year incentive prize, Lineo Maphobole the award for the best final-year student and Zizipho Spelman was awarded best MSc in Plant Pathology. In Botany, Carli van Niekerk received the prize for the best second-year student, Rolanka Vermeulen for the best third-year student and Goitseone Sedimo for the best Honours student. In Plant Breeding, Franco Botha received the prize for the best second-year student, Pieter du Preez for the best third-year student, Diana Mngomezulu for the best fourth-year student, Carmen Meyer for the best MSc student and Dr Prince Matova for the best PhD student.

TEACHING AND LEARNING

Dr Rothmann was awarded the Scholarship of Teaching and Learning Fellowship and will be part of the second cohort of this initiative of the Vice-Rector: Academic, Dr Engela van Staden.

From 1 to 11 February, Dr Joubert and Dr Andri van Aardt organised the third-year Botany excursion for 10 students. Dr Van Aardt and Magdil Frylinck from the Geo Potts Herbarium took the students on a four-day field trip to Hogsback in the Eastern Cape. During the excursion, the students were trained in several vegetation survey, plant identification, research and specimen collection techniques.



Third-year Botany students during the excursion to Hogsback

Prof Willem Boshoff and Dr Van Biljon presented invited lectures titled ‘Stem rust in wheat – the Southern African perspective’ and ‘Nutritional improvement through biofortification’, respectively, as part of an 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.

Dr Dimitri Veldkornet and Dr Makoena (Boke) Moloi were responsible for the Botany excursion for

second-year students at Amanzi Game Reserve near Bloemfontein. 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. Students were trained in new plant ecophysiological techniques that are used in the field, to capture and process data collected.

Dr Boke Moloi and Dr Dimitri Veldkornet (on the left of the photo) together with the second-year students who participated in the excursion at Amanzi Game Reserve



RESEARCH AND INNOVATION

SARChI Chair in Disease Resistance and Quality of Field Crops

Research highlights in the rust programme of the National Research Foundation (NRF) South African Research Chairs Initiative (SARChI) Chair in Disease Resistance and Quality in Field Crops' for the report period, include the acceptance of 11 research papers in peer-reviewed journals. Four of these papers resulted from contributions made by UFS staff to international studies in the control of cereal diseases. This includes a paper from a collaborative project with Prof Simon Krattinger's group at the King Abdullah University of Science and Technology (KAUST) and Dr Renée Prins and her team at CenGen in the prestigious journal *Nature Genetics*. This research was funded by KAUST and reported on the first genome sequence for a South African wheat cultivar (Kariega) and the successful cloning of the Yr27 stripe rust resistance gene.

A PhD thesis was submitted from the monitoring of the rust disease causing fungal (*Puccinia*) populations of important crops in South Africa. Rust on green beans in KwaZulu-Natal (KZN) was monitored, and one PhD study is underway on sunflower rust. Stripe rust outbreaks in the warmer irrigation areas were investigated. An MSc student is doing a survey and genotypic characterisation of rust species of South African grasses. In the project on genetic reconstruction of three South African cereal rust populations using herbarium specimens, for *Puccinia triticina* (*Pt*, wheat leaf rust) and *P. graminis* f. sp. *tritici* (*Pgt*, wheat stem rust), microsatellite markers were successfully used to genotype historic and recent collections.

An MSc student sequence analysis of the *avrSr35* and *avrSr50* gene sequences in the South African *Pgt* population. Another MSc student worked on part of the project titled 'Genetic and functional analysis of resistance/tolerance against strobilurin and azole fungicide application in the South African *Pgt*, *P. striiformis* f. sp. *tritici* (*Pst*, wheat stripe rust) and *Pt* populations', and completed her

dissertation. In terms of inhibition of *Pgt*, *Pst* and *Pt* urediniospore germination and growth using two purified compounds derived from smoke, point inoculation on intact leaves confirmed the inhibitory effect on *Pst*. The molecular survey of Berberis species in South Africa was continued on several barberry plants collected from all over the country. For the molecular and biochemical characterisation of the adult plant disease resistance response of two different wheat varieties against *Pgt* infection, the expression patterns of six selected genes were verified in *Pgt* inoculated adult plant resistant (APR) wheat lines W1406 and W6979 wheat. This was part of an MSc study that was submitted.

An MSc study was done on improving combined rust and Fusarium head blight (FHB) resistance in existing pre-breeding wheat lines. *Lr27/Sr31/Yr9* and *Qfhs.ifa.5A-1* were successfully incorporated and a total of 129 F1 seeds were harvested for further studies. In another postgraduate study, comparison of pre-breeding wheat lines with different levels of FHB resistance to the accumulation of Fusarium mycotoxins was done to determine the correlation between FHB resistance in wheat and the level of tricothecenes produced. Thus far, 350 isolates were identified and confirmed as *Fusarium graminearum*, the predominant causal pathogen of FHB in South Africa. The deoxynivalenol (DON) quantification results confirmed that 15 A-DON producers were more pathogenic than the 3 A-DON producers.

Fusarium head blight- (FHB) infected wheat spike



The genotypic and phenotypic validation of FHB resistance in wheat showed a positive correlation between type II resistant lines and disease incidence.

In terms of the quality of field crops, one PhD was completed on genetic improvement of zinc content in grain of normal, provitamin A and quality protein maize, and another on abiotic stress tolerance and nutritional values of newly developed quality protein maize hybrids in sub-Saharan Africa. A paper from the first study was presented in Ireland at the European Federation of Food Science and Technology (EFFOST) conference. An MSc was completed on genotype and environmental effects on maize grain yield, nutritional value and milling quality. Another MSc study is underway on the influence of low nitrogen conditions on the nutritional value of quality protein maize. A PhD study is underway on breeding for high provitamin A content in Zambian cassava germplasm. An MSc study was completed on the influence of the wheat bread making gene on the gluten quality of selected South African wheat cultivars.

A PhD project is underway on the effects of heat and drought stress on bread wheat gluten protein composition and quality, and an MSc project on resistant starch in South African wheat cultivars. A project on the effects of biotic and abiotic stress conditions on wheat gluten, using proteomics, also continues. In terms of the research on legumes, one MSc project was completed, titled 'Evaluating cowpea mutant genotypes for grain yield and nutritional value in South Africa'. Two PhD projects are underway on cowpea, one on genetic diversity in a West-African collection and the other on inheritance of quality characteristics in South African cowpea. Two sorghum PhD projects are also underway, both on sorghum yield and grain quality, one on an Ethiopian germplasm collection, and the other on South African material. Genome-wide association studies are being done on the most important yield and quality characteristics.

Botany: Plant physiology/ biochemistry and molecular biology

During 2022, Dr Arun Gokul focused on candidate microbiological biocontrol agents (identified previously) that were tested on maize. The

experiments showed no adverse effects on the growth or health of maize when the biocontrol agents (endophytic isolates) colonised plants. One of the most notable findings includes two isolates that were able to improve the growth and resilience of a commercial maize cultivar exposed to different *Fusarium* phytopathogens. Currently research is focusing on identifying the mechanisms associated with the improved health of maize under phytopathogen stress.

Dr Moloi conducts research on plant ecophysiology, investigating the effects of drought, high temperature, and a combination of the two stresses on the physiological, biochemical and morphological responses of edamame and cowpea. Another project involves the use of natural bio-stimulants, biodegradable inorganic compounds and micronutrients to mitigate the negative effects of such stresses in edamame and spinach. The research is of great importance as it brings solutions for crop production under changing climatic conditions.

Dr Lintle Mohase and her research team investigated plant defence mechanisms in wheat infested by the Russian wheat aphid (*Uromyces noxia*). She collaborates internally with a biochemist (Dr Mpho Mafa), molecular biologist (Prof Botma Visser) and plant pathologist (Prof Boshoff), 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.



Dr Boke Moloi



Dr Mpho Mafa

Dr Mafa's research team (Carbohydrates and Enzymology Laboratory [CHEM-LAB]) aims to correlate the physiological and biochemical functions of carbohydrates and carbohydrates-active enzymes (CAZymes) to comprehensively understand how they protect plants against biotic and abiotic stress in the greenhouse and

field conditions or produce value-added chemicals in the bio-refinery sector. Their interests focus on three key research niches, namely the identification, characterisation and profiling of the defensive roles of structural carbohydrates (cell wall components) and non-structural carbohydrates (soluble sugars), physicochemical and functional characterisation of CAZymes and their application, and the application of CAZymes in agro-waste processing. Dr Mafa also received an NRF-Thuthuka grant for a project on the formulation of a holocellulolytic enzyme cocktail for hydrolysis of delignified rooibos bagasse to produce value-added chemicals.

Dr Rudo Ngara continued with her two umbrella projects on drought stress in plants, and abscisic acid signalling systems and drought-stressed transcriptome analyses in sorghum. With the general project on drought stress in plants, Dr Ngara is still working closely with Dr Stephen Chivasa from Durham University, UK, mainly for metabolome and proteome analyses. For the transcriptome work, Dr Ngara and her research group work closely with Dr Dirk Swanevelder from the ARC-Biotechnology Platform.

Prof Visser, in collaboration with Prof Boshoff, studies the genetic variation within fungi that cause rust diseases of cereal crops. During 2022, microsatellite markers were used to describe the genetic structure of *Pgt* isolates causing stem rust of wheat in South Africa. This included the genetic characterisation of a new race, as well as the reconstruction of the genetic development of the pathogen in South Africa over the last 120 years, using herbarium specimens. In addition, the gene encoding the CYP51 protein that is targeted by fungicides, was sequenced to identify

possible mutational variants that could lead to fungicide insensitivity or tolerance of the pathogen against the fungicide. Similar sequence analyses of the *avrSr35* and *avrSr50* genes were completed to determine the possibility of the development of virulence within stem rust against the *Sr35* and *Sr50* genes. A biochemical analysis of the interaction between wheat and the leaf rust pathogen (*P. triticina*) was also completed in collaboration with Dr Mafa and Dr Howard Castelyn.

Botany: Plant taxonomy and molecular systematics

Dr Joubert collaborated with Pieter Bester from the South African National Biodiversity Institute (SANBI) on a field trip to the Northern Cape, during which four new *Nemesia* species were collected. Dr Mariëtte Jackson oversaw the DNA sequencing and phylogenetic analysis of the specimens and the new species are now being described and named as part of a taxonomic revision of *Nemesia*, a genus of indigenous snapdragons.

Dr Jackson is heading the Molecular Systematics Research group. The phylogenetic analysis of some genera in the Asteraceae is continuing. Dr Jackson was also involved in a Plant Pathology MSc project with Dr Rothmann, in which fungi within sorghum kernels were identified using molecular techniques and fungi are being identified in soybean cultivars. Dr Jackson is also collaborating with Dr Joubert

Pieter Bester and MSc student, Goitseone Sedimo, in the Kamiesberg during field work to study *Nemesia* (snapdragons) in the Northern Cape



on her *Nemesia* project, for which an MSc student submitted her dissertation and obtained her degree *cum laude*.

Botany: Palaeoecology and ecology

Prof Scott continued with his international collaboration with researchers from Namibia, Spain and the USA. He published on fossil pollen research of hyrax dung and owl guano providing a unique record of past environmental changes during the last 10 000 years for the Namib Desert.

Dr Van Aardt has ongoing research on pollen cores from Colbyn and the Rietvlei Dam, Gauteng region, supplied by Dr Piet-Louis Grundling and co-workers and dated by Stephan Woodborne at iThemba LABS. She also collaborates with researchers from Spain, Germany and the USA on the Palaeoecology and Open-Landscape adaptations of Pleistocene humans in South Africa (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 Soil, Crop and Climate Sciences.

In affiliation with the Afromontane Research Unit (ARU), Dr Sandy Steenhuisen and Postdoctoral Fellow, Dr Stephanie Payne, continued an international collaborative project on the effects of climate change on range-expanding plant species (RangeX) based in the Northern Drakensberg. This project, funded by the Department of Science and Innovation (DSI) through a BiodiverSA call



Fieldwork in the Drakensberg, from the left, Dr Grant Martin (Centre for Biological Control, Rhodes University, affiliate with UFS Department of Zoology and Entomology), Dr Ralph Clark (ARU), Dr Sandy-Lynn Steenhuisen (Plant Sciences), Evelin Iseli (Swiss Federal Institute of Technology [ETH] Zurich), Georg Valentin Flückiger (ETH Zurich), Dr Stephanie Payne-Smith (Plant Sciences), Prof Jake Maximillian Alexander (ETH Zurich), Dr Onalenna Gwate (Geography) and Dr Jamie Alison (Aarhus University)

(Horizon 2020), and led by South African principal investigator Prof Ralph Clark and Swiss principal investigator Dr Jake Alexander, has resulted in a new research station being built at 3 100 metres above sea level on the plateau of the Amphitheatre near Namahadi Pass. Two summer seasons of data have been collected with remote cameras on the pollinator communities and weather patterns at low and high elevations in these mountains.

Prof Toke Thomas Høye (Aarhus University) and Prof Jake Maximillian Alexander (ETH Zurich) setting up the station



Dr Steenhuisen supervises various research projects with Dr Grant Martin (Director of the Centre for Biological Control, Rhodes University and affiliate of the Department of Zoology and Entomology at UFS), Dr Kim Canavan (Postdoctoral researcher at the Centre for Biological Control, Rhodes University), and Prof Dave Richardson (Centre for Biological Control, Stellenbosch University) on the impacts and spread of invasive alien plants in the Free State and Eastern Cape grasslands. A project development intern, Thembelihle Mbele, funded by SANBI, started research on invasive pampas grass this year and has been awarded a SANBI bursary to pursue her masters on this species from 2023.

Dr Veldkornet's research focuses on the diversity and distribution of estuarine plants and snails and the impact of erosion at the Berg River Estuary. In collaboration with Prof Anusha Rajkaran (University of the Western Cape) and Dr Nasreen Peer (Stellenbosch University), an MSc student (UFS) 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. Abundance foundation species, such as *Spartina maritima*, have been significantly reduced and the only refuge for other intertidal plants and animals is in salt marsh creeks. 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.

Plant Breeding: Molecular plant breeding

Dr Ansori Maré collaborated with Prof Liezel Herselman and Prof Boshoff (Plant Pathology) to identify new rust resistance sources in wheat using molecular markers and phenotypic evaluations to evaluate mapping populations. Selected wheat cultivars/lines from two different breeding backgrounds have been identified with unknown rust resistance. The two breeding backgrounds are the International Maize and Wheat Improvement Center (CIMMYT) rust resistant nursery and Sensako cultivars. This research is funded by the NRF-



Sclerotinia on different crops (soybean, cabbage and sunflowers)



Thuthuka and South African Winter Cereal Industry Trust (SAWCIT). Further progress has been made with cross-breeding and molecular markers to enhance rust- and FHB-resistant wheat lines with a higher number of resistance genes, to ensure durable resistance in wheat. This project is funded by the Central Research Fund of the UFS.

Dr Adré Minnaar-Ontong's research focuses on breeding for resistance against fungal diseases across multiple economically important crops, including resistance breeding against *Sclerotinia sclerotiorum* diseases (sunflower and soybean), soybean sudden death syndrome (SDS) and associated phytotoxins and mycotoxins produced by FHB causal pathogens, to promote the improvement of disease control strategies.

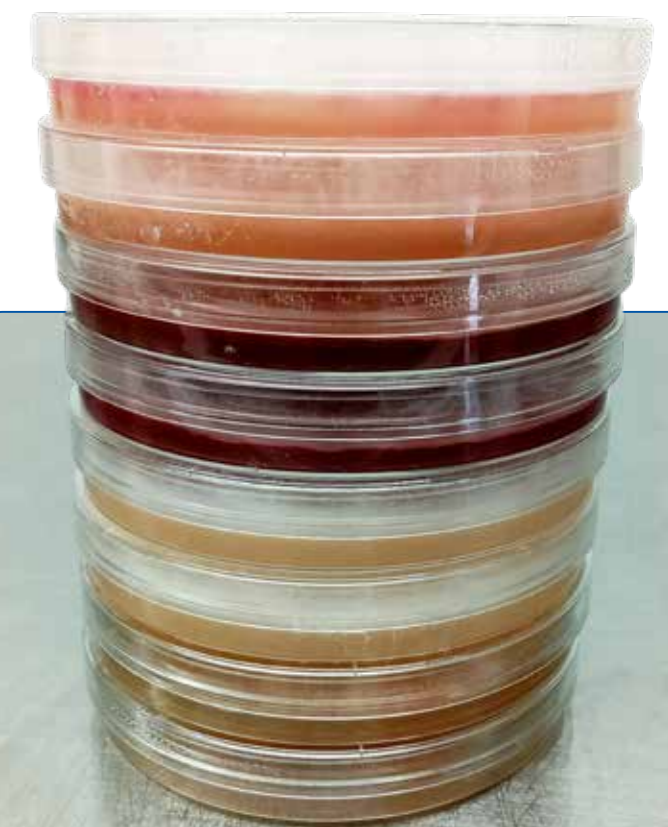
The *Sclerotinia* resistance research of Dr Minnaar-Ontong is funded by GrainSA. This research also forms part of the South African *Sclerotinia* Research Network (SASRN) founded in 2017. The research led to the sampling of more than 1 000 isolates from eight of the nine South African provinces across multiple crops from which the *Sclerotinia sclerotiorum* culture collection was established. This culture collection expands continuously as more *Sclerotinia* infections are being reported every season.

The SDS resistance research includes the evaluation of South African commercial soybean, as well as edamame germplasm for potential resistance to this destructive disease. *Fusarium virguliforme* was identified and concluded as the causal pathogen of SDS. A pre-breeding programme for SDS resistance was initiated using marker-assisted breeding approaches. The outcome of both projects will contribute significantly to soybean production of South Africa.

Evaluation of sudden death syndrome (SDS) resistance after soil inoculation



Breeding for resistance against mycotoxins associated with FHB causal species was funded by the SARChI Chair in Disease Resistance and Quality of Field Crops for 2021 and 2022. Several *Fusarium* species associated with FHB were identified, but *F. graminearum* was identified as the predominant causal species in South Africa. Mycotoxins involved pose a threat to both humans and animals. These mycotoxins also negatively impact food security, therefore resistance breeding against these secondary metabolites should be priority. Knowledge gained from analyses will assist with the development of effective control strategies, i.e. resistance breeding against FHB and the associated mycotoxins. This will assist with improving wheat production in South Africa.



FHB isolates

Plant Breeding: Conventional breeding

Dr Rouxlène van der Merwe focused on 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 undertaken in collaboration with Dr Minnaar-Ontong and Dr Maré, who assist with marker-assisted selection of progenies grown in field trials. One MSc student (Kelvin Hlatswayo) is working on this project.

Dr Van der Merwe also 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 Dr Van Biljon, who assisted with sugar analysis, Dr Arno Hugo, who assisted with fatty acid analysis, and Dr Moloï, who assisted with physiological response analyses. The project is funded by the NRF-Competitive Support for Unrated Researchers. One MSc student (Drikus Coertzen) is working on this project.

Dr Van der Merwe's research on the impact of water-limited-stress on the morphology, physiology and nutritional quality of dry bean is making progress. This project aims to characterise dry bean cultivars in terms of drought stress tolerance and nutritional quality, and is undertaken in collaboration with

Lesole Sefume evaluating his dry bean plants, which form part of his MSc project on the evaluation of drought stress on dry bean yield and nutritional value



Dr Van Biljon, who assisted with nutritional quality analysis, and Dr Moloï, who assisted with physiological response analyses. One MSc student (Lesole Sefume) is working on this project.

Plant Breeding: Wheat-quality and crop-nutritional value research

Dr Van Biljon continued with research on the influence of abiotic stress on the nutritional profile and quality of various crops, focusing on crops like wheat, maize, vegetable-type soybean, dry bean and sorghum. The nutritional screening includes the study of storage proteins through size exclusion- and reverse-phase high-performance liquid chromatography. The total starch, amylose, sugar, tryptophan, mineral content (especially iron and zinc) and bioavailability of these minerals are also determined. Dr Van Biljon also collaborates with Prof Maryna de Wit from the Department of Sustainable Food Systems and Development (UFS) to study proteins in mucilage of *Opuntia* genotypes.

Dr Ntombi Mbuma's research focused on the evaluation of cowpea genotypes for grain yield and nutritional value in collaboration with the ARC and on the genotype and environmental effects in maize in collaboration with Bayer.

Plant Pathology: Cereal rust diseases

Prof Boshoff continued with wheat cultivar and breeding line assessment for resistance to rusts. This project is funded by SAWCIT and results are published annually in the national wheat production guidelines of ARC-SG. Research to characterise isolates of the maize rust pathogen, *Puccinia sorghi*, was carried out with financial support of the Maize Trust. This is a collaborative project with Prof Visser and researchers at the Forestry and Biotechnology Institute (FABI). Researchers in this group delivered sixteen congress contributions, four popular publications, a *YouTube* broadcast and an *RSG* radio talk. Several industry-related research projects were successfully carried out during the year in close collaboration with staff at CenGen, ARC-SG, and seed companies Stark Ayres, Syngenta and Corteva Agriscience. Nine postgraduate students and one fourth-year student

conducted research on rust-related projects, of which most were interdisciplinary.



The UFS rust research group, from the left, front: Dr Cornél Bender, Lineo Maphobole and Karen Venter; middle: Tumo Makhetha, Isabella du Toit, Emily Tsotetsi, Dembe Ramovha and Dr Ansori Maré; and back: Prof Willem Boshoff, Wilku Meyer, Dr Howard Castelyn and Prof Botma Visser

Plant Pathology: Soil microbial ecology

Prof Swart's research broadly focuses on adopting a 'total systems approach' to plant health management by utilising the functional diversity of fungi and bacteria, above- and below-ground, as bio-indicators of soil and plant health. This involves understanding multi-trophic interactions that occur in agroecosystems, with particular attention to the phytobiome and in particular, the rhizosphere microbiome. In so doing, innovative crop production and protection strategies can be developed with particular emphasis on beneficial microbes that influence both plant and soil health.

Plant Pathology: Mycology

Dr Gert Marais leads the Pecan Research Group at the UFS that was established in 2017 to provide support to the pecan industry with regard to pecan diseases and their management. During the 2022 growing season, six field trips were undertaken, including to areas such as Luckhoff along the Orange River to Upington, Vaalharts, Jacobsdal, as well as various other areas in Limpopo, Mpumalanga, Gauteng, Eastern Cape, Western Cape and KZN. During these trips, famer's days were organised at which information regarding the newest findings on student projects were shared with pecan producers and interested parties. In 2022, a three-year project was negotiated with the South African Pecan Nut Producers Association (SAPPA), focussing on the cause of overall decline in pecans. Current studies also investigate 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 Paradys Experimental Farm and has now entered its third season.

Plant Pathology: Epidemiology

Dr Rothmann leads the MCLab Field Pathology and Epidemiology Research Group, which focuses on diseases associated with summer grain crops –

Dr Lisa Rothmann, Thabiso Masisi, Neo Hlongwane and Marlese Meiring during a visit to a sunflower field trial



sorghum, soybean and sunflower. In an internal collaboration with Dr Jackson (Botany), Thabiso Masisi, supported by the Sorghum Trust, initiated his PhD degree in January 2022, with the title, 'Incidence, management and producer perceptions of fungal diseases in sorghum cropping systems'. An external collaboration with Dr Lindy Rose, from Stellenbosch University, has been initiated for this study. Dr Rose has also been appointed at the co-supervisor for Masisi. Prof André Pelsler, from the UFS Department of Sociology, is a collaborator on this project and will assist in investigating socio-economic factors associated with disease management decision making.

PhD graduate, Marlese Meiring, supervised by Dr Rothmann and Prof Neal McLaren, conducted research titled 'Sclerotinia sclerotiorum disease potential and management responses in soybean and sunflower'. This study was supported by the DSI, the Oil and Protein Seeds Development Trust (OPDT), Oilseeds Advisory Committee (OAC), Sasol Agricultural Trust and Winfield United South Africa, as well as GrainSA. The project aimed to evaluate soybean and sunflower cultivars for escape resistance towards Sclerotinia sclerotiorum and will be ongoing for the 2022/2023 season, with Dr Derick van Staden (Agronomy Info Services, Mpumalanga) and Koos Strydom (producer, Free State). In November, Meiring was presented with her outstanding 2019 OPDT and OAC achievement award by Gerhard Keun (Chief Executive Officer: OPDT) and Dr Erhard Briedenhann (Chairperson: OAC) for best Master's dissertation.

In January of 2022, the project on 'Identifying and assessing soybean seedborne diseases, towards improving seed health through reducing prevalent fungal pathogens' continued with Neo Hlongwane as a registered MSc Agric student conducting the research. Continued funding has been approved for this study by the Central Research Fund of the UFS.

ENGAGED SCHOLARSHIP

Dr Minnaar-Ontong participated as reviewer for the following international accredited journals: *European Journal of Plant Pathology*, *Frontiers*,

Genetic Resources and Crop Evolution, *Molecular Biology Reports* and the *South African Journal of Botany*. Dr Minnaar-Ontong was a board member of the National Grain Research Programme (University of Pretoria) and was an Agriculture ambassador with regard to the AgriCareers roadshow presented by 'Food for Mzansi' to engage with schools on careers in agriculture, and she presented at the Youth empowerment conference in Kuruman (engagement with scholars, unemployed youth and unemployed agriculture graduates).



Dr Chrisna Steyn and MSc student, Diana Mngomezulu, during a Food for Mzansi road trip

Dr Minnaar-Ontong acted as the coordinator of the Crop Research Platform (CRP), which was established in the Faculty of Natural and Agricultural Sciences at the UFS. The CRP was established following requests from tertiary institutions, organised agriculture and industry role players. The aim of the CRP is the promotion of all crop-related research and, as coordinator, Dr Minnaar-Ontong is managing the flow of research and research outputs between the UFS and national and international role players.



The community of Groblershoop in front of the water tank sponsored by the Crop Research Platform of the UFS

Dr Andri van Aardt and her postgraduate students surveying the vegetation at Mooiwater Conservancy, from the left, Jubilant Sithole, Johanco Viljoen, Jaydon Deyers, Emma Ferreira, Linde de Jager, Joshua Giddy and Dr Van Aardt



Dr Van Aardt assisted the community of Bainsvlei in surveying the vegetation of Mooiwater Conservancy to determine plant community assemblages. She was assisted by several postgraduate students during the fieldwork for this project. She also presented a talk 'Alien Invasion @ 7 Dams' during the annual meeting of the Friends of Seven Dams.

Dr Moloi reviewed manuscripts for the *Agronomy* journal, which is a Q1 journal.

Dr Rothmann was elected and appointed as the *President Elect* of the American Phytopathology Society: African Division.

Dr Rothmann and Meiring contributed to a farmers' day in March 2022 with collaborator, Dr Derick van Staden of Agronomy Info Services. The focus was on Sclerotinia diseases with industry partners under the auspices of the SASRN, supported by GrainSA. Shorter information sessions for farmers have been conducted primarily in the Free State and Mpumalanga. The first farmer information day in Mooifontein, North West, was launched with emerging and smallholder producers. These sessions are to connect producers with the current research being conducted, and also to hear from producers what their needs from academia and industry are. The focus 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 are produced and distributed through the SA Grain magazine, *Oilseed Focus*, and the Dry Bean Producers' Organisation's *SA Drybeans Magazine*. Contributions were made by Dr Rothmann, Meiring, Naomi Kleinhans, Masisi and Hlongwane, representatives of the Plant Pathology division. Topics covered include Sclerotinia cultivar evaluations and potential interventions of diseases associated with *Sclerotinia sclerotiorum*.

Dr Joubert presented two talks to the Botanical Society of South Africa's (BotSoc) Free State Branch. The first talk, 'Interesting aspects of the relationship between indigenous flowers and their pollinators', was presented during BotSoc's annual general meeting. The second talk and practical demonstration on the family Lamiaceae, its identification and economic uses, was presented in

the Free State Botanical Garden potting shed.

Dr Joubert and Dr Van Aardt were guest speakers on two programmes of Pretoria FM's *Natuur en wetenskap* (Nature and Science programme), during which they answered listener's questions on plants and nature.

Prof Herselman was invited to present a plenary lecture at the University of Limpopo's 12th Faculty of Science and Agriculture Research Day, in September 2022. The title of her lecture was 'The omics of molecular plant breeding'.

Frylinck continued with the digitisation project of the Geo Potts Herbarium. This project will lead to the more efficient management of the collection and make the digitised specimen records available online for use by the international scientific community.

Dr Mafa acted as reviewer for the following journals: *Journal of Chemical Ecology*, *Biomass Conversion and Biorefinery*, *European Food Research and Technology*, *Genes and Plant Physiology and Biochemistry*.

Prof Labuschagne again served as Speciality Chief Editor for *Frontiers in Sustainable Food Systems* (division Crop Biology and Sustainability) and served on the editorial boards of *Cereal Chemistry* and *Journal of Cereal Science*.

Dr Steenhuisen and Dipuo Mosea joined mentees and mentors in the Mountain to Mountain Women's Mentorship Programme in June 2022 for a workshop to discuss women's mentorship in academia, hosted by Appalachian State University in Boone, North Carolina.

Dr Van der Merwe was invited to present an online lecture, titled 'A pre-breeding strategy for drought-stress tolerance in soybean', as part of the SAPBA webinar on Breeding for Climate Change that was hosted by SANSOR in collaboration with the South African Society of Crop Production (SASCP). Dr Van der Merwe was also invited to present a talk on 'Legumes in the fight against climate change', and to participate in a panel discussion on 'Responding to the climate crisis with biotechnology', as part of a seminar held by Crop Life South Africa in collaboration with the United States Department of Agriculture (USDA) Foreign Agriculture Service in August at the SA Grain Building in Pretoria.

NATIONAL AND INTERNATIONAL COLLABORATION

Members of the Department of Plant Sciences have strong local, national and international collaborations. Most of these are reported in detail in the chapter on Research and Innovation. In addition, our members have the following noteworthy collaborations.

Dr Gokul has national collaboration with Prof Marshall Keyster (Environmental Biotechnology Laboratory) and Prof Ashwil Klein (Plant Omics Laboratory) at the University of the Western Cape (running for the third year). The collaboration has resulted in the graduation of two MSc students and nine peer-reviewed articles and one book chapter in high impact factor journals.

Dr Minnaar-Ontong collaborated with Syngenta on breeding for resistance to Sclerotinia diseases in soybean, with other breeding companies from industry, and researchers from the University of Manitoba, Canada and the University of Nebraska as well as the USDA, USA.

Prof Scott submitted fossil pollen data produced over several decades in the Department to the African Pollen Database (<https://africanpollendatabase.ipsl.fr/#/home>), a data repository for reconstructing past vegetation and climate during the Quaternary period on the continent.

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 are currently supervising an MSc student on the project. She also collaborated with Prof Brigitta Tóth of the University of Debrecen, Hungary and their work produced one publication in a peer reviewed journal.

Dr Rothmann is involved in the official Memorandum of Understanding (MOU) between GrainSA and the UFS, which states that Plant Sciences was reappointed for administrating the SASRN, composed of a community of practice and a research consortium. The SASRN has continued

their website and social media activities since the launch in September 2019. This 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 also collaborates with AgriSeed/DMS Genetics in Delmas, where soybean and sunflower field trials on the experimental farm are aimed at cultivar and fungicide evaluations.

Dr Joubert and Dr Jackson collaborated with Hanlie Grobler from the Centre for Microscopy at the UFS and Prof Beverley Glover from the Department of Plant Sciences at the University of Cambridge on the project titled 'The role of flower structure in the diversification of the genus *Nemesia* (Scrophulariaceae)'. This project yielded novel insights into the developmental mechanisms that produce different spur shapes and the role of spur variation in the evolution and diversity of *Nemesia*.

Dr Mafa collaborates with Dr Samkelo Malgas (University of Pretoria's Department of Biochemistry, Genetics and Microbiology – Division of Biochemistry) and Prof Brett Pletschke (Rhodes University's Department of Biochemistry and Microbiology) on a project on carbohydrates or CAZymes application in the biorefinery sector for the production of value-added products. Dr Mafa also collaborated with Dr Orbett Alexander with regard to Fourier-Transformed infrared spectroscopy and X-ray Diffractometers machines at the UFS Department of Chemistry, and with Dr Gabré Kemp at the UFS Department of Microbiology and Biochemistry, on Liquid Chromatography-Mass Spectrometry.

Prof Labuschagne collaborated with colleagues at the University of Córdoba, and CIMMYT in Mexico, Zimbabwe and Kenya, as well as the International Institute for Tropical Agriculture in Nigeria.

Dr Steenhuisen facilitated the signing of an MOU between Rhodes University and UFS for collaborative research on invasive plant species, principally with the Centre for Biological Control and its Director, Dr Grant Martin. This MOU will provide a foundation for shared funding for project running costs and bursaries being transferred between institutions for postgraduates supervised at UFS and co-supervised by Rhodes University. The first bursary to be used in this manner is to fund Masters' candidate,

Mentees and mentors attending the Mountain to Mountain Women's Mentorship Programme at the Appalachian State University in Boone, North Carolina – back from the left, Dr Mbali Pewa (Geography), Ngitheni Nyoka (Zoology), Prof Aliza le Roux (Zoology), Dipuo Mosea (Plant Sciences) and Dr Sandy-Lynn Steenhuisen (Plant Sciences); front from the left, Lethiwe Sokhela (Research and Development Office) and Nozipho Kheswa (Zoology)



Tapiwanashe Mashamba, on the current distribution of invasive willow trees in the Grassland Biome of South Africa.

Dr Steenhuisen co-supervises Master's and Doctoral students at other national universities, namely University of Witwatersrand and University of KwaZulu-Natal.

Dr 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 biostimulants on crop biomass and yield and also to determine possible phytotoxic effects on plants. The report developed by Dr Van der Merwe will assist with the registration of the newly developed biostimulants as group 3 fertilisers with the Department of Agriculture, Forestry and Fisheries. Dr Van der Merwe continued her collaboration with Prof Qiuying Zhang from the Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, on a project focusing on breeding for resistance to pod shattering in vegetable-type soybean.

Brewis Fourie (left) and Rudi Lombaard (right) collecting soybean leaves for nutrient analyses, which forms part of Dr Rouxléne van der Merwe's collaboration with TransfOrmus



Dr Marais collaborates with SAPPA and FABI (Prof Bernard Slippers and Prof Wilhelm de Beer) to study diseases in the pecan industry in South Africa.

Prof Swart was closely involved in the negotiation and signing of a Collaboration Agreement between the University of Cape Town and the UFS relevant to the diversification of mining land for agricultural use and socio-economic development. Prof Swart has a 30-year track record involving the cultivation and health of cactus pear (*Opuntia ficus-indica*), a crop that forms an integral part of the research to be undertaken under this Collaboration Agreement.

Dr Jackson and Frylinck collaborate with Dr Madeleen Struwig (North-West University, Mahikeng Campus) on the phylogenetic analysis of genera *Commicarpus* and *Boerhavia* (Nyctaginaceae).

POSTGRADUATE STUDENTS

During 2022, 11 Honours, 57 Master's and 43 Doctoral students were enrolled for postgraduate studies in the Department of Plant Sciences.

Honours graduates

At the 2022 graduations, 15 students graduated with BSc Hons majoring in Botany (eight on the Bloemfontein Campus and seven on the Qwaqwa Campus), two students graduated with BSc Hons majoring in Plant Health Ecology, and one student graduated with BSc Hons in Agriculture majoring in Plant Breeding.

Master's graduates

Ten students graduated with an MSc in 2022:

- Grobler, H (Botany, Bloemfontein Campus – with distinction)
- Hlahla, JM (Botany, Bloemfontein Campus – with distinction)
- Liatile, PC (Botany, Bloemfontein Campus)
- Mokoena, MA (Botany, Qwaqwa Campus)
- Moloi, KT (Botany, Qwaqwa Campus – with distinction)
- Moruri, P (Botany, Qwaqwa Campus)

- Müller, M (Botany, Bloemfontein Campus)
- Ngwenya, SP (Botany, Qwaqwa Campus – with distinction)
- Sibanyoni, RN (Botany, Bloemfontein Campus)
- Sivhada, RA (Plant Breeding)

One student, HS Fosa, graduated with an MSc Agriculture specialising in Plant Pathology.

Doctoral graduates

Nine candidates from the Department of Plant Sciences graduated with a PhD in 2022:

ADEYEOLUWA, Temitayo Esther (Botany)

Thesis: An in vitro comparative study on the antioxidant, antibacterial and antidiabetic potentials of five tropical spices employed as traditional therapy

Supervisor: Prof AOT Ashafa

ENGIDA, Bitew Tilahun (Plant Breeding)

Thesis: Abiotic stress tolerance and nutritional values of newly developed quality protein maize hybrids in sub-Saharan Africa

Supervisor: Prof MT Labuschagne

KWEMOI, Daniel Bomet (Plant Breeding)

Thesis: Genetic analysis of resistance to Maize Lethal Necrosis with emphasis on strategies for improvement of host resistance

Supervisor: Prof MT Labuschagne

MATONGERA, Nakai (Plant Breeding)

Thesis: Genetic improvement of zinc content in grain of normal, provitamin A and quality protein maize

Supervisor: Prof MT Labuschagne

MEIRING, Marlese Christine (Plant Pathology)

Thesis: Sclerotinia sclerotiorum disease potential and management responses in soybean and sunflower

Supervisor: Dr L Rothmann

SENWAYO, Sphamandla (Plant Breeding)

Thesis: Genetic improvement of drought tolerant maize hybrids under a combination of biotic and abiotic stress conditions

Supervisor: Dr R van der Merwe

SIWALE, Julius (Plant Breeding)

Thesis: Phenotypic and nutritional diversity of southern African bambara groundnut germplasm

Supervisor: Prof MT Labuschagne

SWANEPOEL, Jacobus Francois (Plant Breeding)

Thesis: Developing a breeding strategy for butternut squash (*Cucurbita moschata* Duch. ex Poir) in South Africa

Supervisor: Dr R van der Merwe

VOUA OTOMO, Laetitia (Botany)

Thesis: Bioactivity, isolation and characterisation of compounds from plants used against secondary infections associated with elephantiasis in Kwazulu-Natal, South Africa

Supervisor: Dr LV Komoreng

POSTDOCTORAL RESEARCH FELLOWS

In Plant Breeding, two Postdoctoral Fellows were appointed in 2022, namely Dr Tesfaye Mekonnen (from Ethiopia) and Dr Neila Abdi (from Tunisia), both working on projects within the SARChI Chair.

Dr Stephanie Payne (South Africa), hosted by Prof Sandy Steenhuisen, co-taught BIOL6834: Advanced Biostatistics in 2022, presented at two international conferences in South Africa and Austria, leads the pollination aspects of the international RangeX project in affiliation with the ARU, supervised two Honours projects, and is co-supervising two Master's and one Doctoral candidate in the Department. She was also hosted by the ARU and Swiss collaborators for a research visit to RangeX sites in Zurich,

Switzerland, in September 2022. Dr Payne was selected and represented the Qwaqwa Department of Plant Sciences in the postdoctoral category of the Flash Fact Competition in Bloemfontein in 2022.

Dr Howard Castelyn (South Africa) was appointed as a Postdoctoral Fellow in the laboratory of Prof Visser for a final year in 2022, to continue with the bio-informatic analysis of the adult wheat-stem rust interaction. He was co-supervisor of Christiaan Botha (MSc in Botany) on the characterisation of the adult plant resistance response of wheat after stem rust infection, which was obtained with a distinction. Dr Castelyn participated in a project to unravel the role of carbohydrates and carbohydrate active enzymes towards leaf rust resistance in wheat. He also contributed significantly to the establishment of the MARPLE bio-informatic skill set that was established within the Department.

Dr Conrad Achilonu (from Nigeria) was appointed in November as Postdoctoral Fellow, working on pecan diseases in South Africa.



STAFF MATTERS

Prof Willem Boshoff received an NRF-C2 rating in 2022.

Dr Ntombi Mbuma, Lecturer at Plant Breeding, resigned in November 2022.

The following staff members received long service awards:

- Prof Anofi (Tom) Ashafa (15 years)
- Dr Cornél Bender (20 years)
- Dr Pheello Mojau (>15 years)
- Ngaka Mzizi (>15 years)
- Teboho Pitso (>15 years years)

The Department employed the following interns for a period of six-months each:

- Mamosela Mohotloane
- Mathapelo Masilo
- Patricia Masole
- Matshediso Semela
- Ntombenhle Radebe
- Phindile Msimanga
- Isabella Maseng
- Chumisa Silwana
- Matsatsi Moletsane

RESEARCH OUTPUTS

Research Articles

Abdi, N., Van Biljon, A., Steyn, C. & Labuschagne, M. 2022. Salicylic acid improves salt stress tolerance of two bread wheat cultivars. *Plants* 11: 1853. DOI: 10.3390/plants11141853.

Adams, L.D., Martin, G.D., Downs, C.T., Clark, V.R., Thabethe, V., Raji, I.A. & Steenhuisen, S. 2022. Seed dispersal by frugivores and germination of the invasive alien shrub *Pyracantha angustifolia* (Franch.) C.K. Schneid. in Free State Province, South Africa. *Biological Invasions* 24: 2809-2819. DOI: 10.1007/s10530-022-02807-5.

Aina, O., Bakare, O.O., Daniel, A.I., Gokul, A., Beukes, D.R., Fadaka, A.O., Keyster, M. & Klein, A. 2022. Seaweed-derived phenolic compounds in growth promotion and stress alleviation in plants. *Life* 12: 1548. DOI: 10.3390/life12101548.

Alves, K.D.S., Rothmann, L.A., & Del Ponte, E.M. 2022. Linking climate variables to large-scale spatial pattern and risk of citrus Huanglongbing: A hierarchical Bayesian modeling approach. *Phytopathology* 112: 189-196. DOI: 10.1094/PHYTO-05-21-0219-Fl.

Amegbor, I.K., Van Biljon, A., Shargie, N., Tarekegne, A. & Labuschagne, M.T. 2022. Does the quality protein maize trait cause hybrid yield losses? A case study in Southern Africa. *Euphytica* 218: 87. DOI: 10.1007/s10681-022-03041-9.

Amegbor, I.K., Van Biljon, A., Shargie, N., Tarekegne, A. & Labuschagne, M.T. 2022. Grain quality of hybrids from quality and non-quality protein maize inbred lines. *Journal of Cereal Science* 107: 103544. DOI: 10.1016/j.jcs.2022.103544.

Amegbor, K.I., Van Biljon, A., Shargie, N., Tarekegne, A. & Labuschagne, M.T. 2022. Heritability and associations among grain yield and quality traits in quality protein maize (QPM) and non-QPM hybrids. *Plants* 11: 713. DOI: 10.3390/plants11060713.

Amegbor, I.K., Van Biljon, A., Shargie, N., Tarekegne, A. & Labuschagne, M.T. 2022. Identifying quality protein maize inbred lines for improved maize nutritional value in southern Africa. *Foods* 11: 898. DOI: 10.3390/foods11070898.

Athiyannan, N., Abrouk, M., Boshoff, W.H.P., Cauet, S., Rodde, N., Kudrna, D., Mohammed, N., Bettgenhaeuser, J., Botha, K., Derman, S., Wing, R.A., Prins, R. & Krattinger, S.G. 2022. Long-read genome sequencing of bread wheat facilitates disease resistance gene cloning. *Nature Genetics* 54: 227-231. DOI: 10.1038/s41588-022-01022-1.

Bakare, O.O., Gokul, A., Fadaka, A.O., Wu, R., Niekerk, L., Barker, A.M., Keyster, M. & Klein, M. 2022. Plant antimicrobial peptides (PAMPs): Features, applications, production, expression, and challenges. *Molecules* 27(12): 3703. DOI: 10.3390/molecules27123703.

Bakare, O.O., Gokul, A., Jimoh, M.O., Klein, A. & Keyster, M. 2022. In silico discovery of biomarkers for the accurate and sensitive detection of *Fusarium solani*. *Frontiers in Bioinformatics* 87. DOI: 10.3389/fbinf.2022.972529.

Bakare, O.O., Gokul, A. & Keyster, M. 2022. Analytical studies of antimicrobial peptides as diagnostic biomarkers for the detection of bacterial and viral pneumonia. *Bioengineering* (Basel) 9(7): 305. DOI: 10.3390/bioengineering9070305. PMID: 35877356; PMCID: PMC9311714.

Boshoff, W.H.P., Visser, B., Bender, C.M., Wood, A.R., Rothmann, L., Wilson, K., Hamilton-Attwell, V.L. & Pretorius, Z.A. 2022. Fig rust caused by *Phakopsora nishidana* in South Africa. *Phytopathologia Mediterranea* 61(2): 283-298. DOI: 10.36253/phyto-13034.

Boshoff, W.H.P., Wood, A.R., Visser, B., Bender, C.M., Joubert, L., Richter, J., Aime, M.C. & Pretorius, Z.A. 2022. The life cycle of *Puccinia digitariae* on *Digitaria eriantha* and *Solanum* species in South Africa. *Mycologia* 114: 319-336. DOI: 10.1080/00275514.2022.2031493.

Chemonges, M., Herselman, L., Pretorius, Z.A., Marè, A. & Boshoff, W.H.P. 2022. Characterisation of stem rust resistance in the South African winter wheat cultivar PAN 3161. *Euphytica* 218: 139. DOI: 10.1007/s10681-022-03087-9.

Chevalier, M., Chase, B.M., Quick, L.J. & Scott, L. 2022. An atlas of southern African pollen types and their climatic affinities. *Palaeoecology of Africa* 35: 239-257.

Crous, P.W., Sandoval-Denis, M., Costa, M.M., Groenewald, J.Z., Van Iperen, A.L., Starink-Willemse, M., Hernández-Restrepo, M., Kandemir, H., Ulaszewski, B., De Boer, W., Abdel-Azeem, A.M., Abdollahzadeh, J., Akulov, A., Bakhshi, M., Bezerra, J.D.P., Bhunjun, C.S., Câmara, M.P.S., Chaverri, P., Vieira, W.A.S., Decock, C.A., Gaya, E., Gené, J., Guarro, J., Gramaje, D., Grube, M., Gupta, V.K., Guarnaccia, V., Hill, R., Hirooka, Y., Hyde, K.D., Jayawardena, R.S., Jeewon, R., Jurjević, Ž., Korsten, L., Lamprecht, S.C., Lombard, L., Maharachchikumbura, S.S.N., Polizzi, G., Rajeshkumar, K.C., Salgado-Salazar, C., Shang, Q.-J., Shivas, R.G., Summerbell, R.C., Sun, G.Y., Swart, W.J., Tan, Y.P., Vizzini, A., Xia, J.W., Zare, R., González, C.D., Iturriaga, T., Savary, O., Coton, M., Coton, E., Jany, J.-L., Liu, C., Zeng, Z.-Q., Zhuang, W.-Y., Yu, Z.-H. & Thines, M. 2022. *Fusarium* and allied fusarioid taxa (FUSA). 1. *Fungal Systematics and Evolution* 9: 161-200.

Dabengwa, A.N., Archibald, S., Finch, J., Scott, L., Gillson, L. & Bond, W.J. 2022. Sedimentary charcoal studies from southern Africa's grassy

biomes: a potential resource for informing the management of fires and ecosystems. *African Journal of Range & Forage Science* 2022: 1-17. DOI: 10.2989/10220119.2021.2016965.

Daniel, A.I., Fadaka, A.O., Gokul, A., Bakare, O.O., Aina, O., Fisher, S., Burt, A.F., Mavumengwana, V., Keyster, M. & Klein, A. 2022. Biofertilizer: The future of food security and food safety. *Microorganisms* 10: 1220. DOI: 10.3390/microorganisms10061220.

Ertiro, B.T., Das, B., Kosgei, T., Tesfaye, A.T., Labuschagne, M.T., Worku, M.R., Olsen, M.S., Chaikam, V. & Gowda, M. 2022. Relationship between grain yield and quality traits under optimum and low-nitrogen stressed environments in tropical maize. *Agronomy* 12: 438. DOI: 10.3390/agronomy12020438.

Fisher, S., De Villers, D., Du Plessis, M., Hattingh, K., Saulse, C., Basson, G., Barker, A., Daniel, A.I., Al-Hashimi, A., Hitzeroth, A., Makhwanyane, T., Mavumengwana, V., Gokul, A., Keyster, M. & Klein, A. 2022. Draft whole-genome sequence of *Penicillium simplicissimum* A4, a putative endophyte from *Echium plantagineum*. *Microbiology Resource Announcements* e00854.

Gerrano, A.S., Mbuma, N.W., & Mumm, R.H. 2022. Expression of nutritional traits in vegetable cowpea grown under various South African agro-ecological conditions. *Plants* 11(11): 13. DOI: 10.3390/plants11111422.

Hlahla, J.M., Mafa, M.S., Van der Merwe, R., Alexander, O., Duvenhage, M.-M., Kemp, G. & Moloi, M.K. 2022. The photosynthetic efficiency and carbohydrates responses of six edamame (*Glycine max.* L. Merrill) cultivars under drought stress. *Plants* 11(3): 394. DOI: 10.3390/plants11030394.

Kloppe, T., Boshoff, W.H.P., Pretorius, Z.A., Lesch, D., Erdemel, B., Morgounov, A., Kuhnem, P., Murphy, P. & Cowger, C. 2022. Virulence of *Blumeria graminis* f. sp. *tritici* in Brazil, South Africa, Turkey, Russia and Australia. *Frontiers in Plant Science* 13: article 954958. DOI: 10.3389/fpls.2022.954958.

Lézine, A.-M. Ivory, S., Gosling, W. & Scott, L. 2022. The African pollen database, state of the art. *Palaeoecology of Africa* 35: 5-12.

Liatile, P.C., Potgieter, G. & Moloi, M.J. 2022. 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. *Plants* 11: 3374.

Lombard, M., & Van Aardt, A.C. 2022. Taking stock of foodplants growing in the Cradle of Humankind Fossil Hominin Site, South Africa. *African Archaeological Review* 39: 59-77. DOI: 10.1007/s10437-021-09470-6.

Mafa, M.S., Rufetu, E., Alexander, O., Kemp, G. & Mohase, L. 2022. Cell-wall structural carbohydrates reinforcements are part of the defence mechanisms of wheat against Russian wheat aphid (*Diuraphis noxia*) infestation. *Plant Physiology and Biochemistry* 179: 168-178. DOI: 10.1016/j.plaphy.2022.03.018.

Marè, A., Boshoff, W.H.P. & Herselman, L. 2022. Phenotypic assessment and fungal gene expression of *Fusarium graminearum* in wheat. *Euphytica* 218: 113. DOI: 10.1007/s10681-022-03068-y.

Masole, P., Steenhuisen, S. & Martin, G.D. 2022. Current status of the invasive shrub *Berberis julianae* C.K. Schneid. (Berberidaceae) in Golden Gate Highlands National Park (Free State Province, South Africa). *South African Journal of Botany* 150: 99-105. DOI: 10.1016/j.sajb.2022.07.010.

Matova, P.M., Kamutando, C.N., Kutwayo, D., Magorokosho, C. & Labuschagne, M. 2022. Fall armyworm response of maize parental lines, experimental hybrids, and commercial cultivars in southern Africa. *Agronomy* 12: 1463. DOI: 10.3390/agronomy12061463.

Matova, P.M., Kamutando, C.N., Magorokosho, C., Mutari, B. & Labuschagne, M. 2022. Adaptability and stability analysis of commercial cultivars, experimental hybrids and lines under natural fall armyworm infestation in Zimbabwe using different stability models. *Agronomy* 12: 1724. DOI: 10.3390/agronomy12071724.

Mbuma, N.W., Gerrano, A.S., Lebaka, N. & Labuschagne, M.T. 2022. Interrelationship between grain yield components and nutritional quality traits in cowpea genotypes. *South African Journal of Botany* 150: 34-43. DOI: 10.1016/j.sajb.2022.07.006.

Mbuma, N.W., Labuschagne, M., Siwale, J. & Hugo, A. 2022. Characterization of Southern African bambara groundnut germplasm collection for nutritional value and fatty acid composition. *Journal of Food Composition and Analysis* 109: 104477. DOI: 10.1016/j.jfca.2022.104477.

McInturf, S.A., Khan, M.A., Gokul, A., Castro-Guerrero, N.A., Hoehner, R., Li, J., Margault, H., Fichman, Y., Kunz, H.H., Goggin, F.L., Keyster, M.,

Nechushtai, R., Mittler, R. & Mendoza-Cózatl, D.G. 2022. Cadmium interference with iron sensing reveals transcriptional programs sensitive and insensitive to reactive oxygen species. *Journal of Experimental Botany*. Sep 9: erab393. DOI: 10.1093/jxb/erab393.

Mekonnen, T.W., Gerrano, A.S., Mbuma, N.W. & Labuschagne, M.T. 2022. Breeding of cowpea as highly nutritious and climate resilient vegetable in sub-Saharan Africa: progress, opportunities, and challenges. *Plants* 11: 1583. DOI: 10.3390/plants11121583.

Mekonnen, T.W., Mekbib, F., Amsalu, B., Gedil, M. & Labuschagne, M. 2022. Breeding implications of nodulation performance and root structure under natural inoculation for soil fertility enhancement and sustainable cowpea production. *Frontiers in Sustainable Food Systems* 6: 1076760. DOI: 10.3389/fsufs.2022.1076760.

Mekonnen, T.W., Mekbib, F., Amsalu, B., Gedil, M. & Labuschagne, M. 2022. Genotype by environment interaction and grain yield stability of drought tolerant cowpea landraces in Ethiopia. *Euphytica* 218: 57. DOI: 10.1007/s10681-022-03011-1.

Mekonnen, T.W., Mekbib, F., Amsalu, B., Gedil, M. & Labuschagne, M. 2022. Implications of qualitative trait diversity for future cowpea improvement and genetic resource conservation. *South African Journal of Botany* 151: 763-773. DOI: 10.1016/j.sajb.2022.10.047.

Moloi, M.J. & Khoza, B.M. 2022. The effect of selenium foliar application on the physiological responses of edamame under different water treatments. *Agronomy* 12: 2400.

Mphela, W.M., Laurie, S.M., Minnaar-Ontong, A. & Bihon, W. 2022. Development and screening of *Fusarium* wilt resistant lines in sweet potato [*Ipomoea batatas* (L.) Lam]. *Euphytica* 218: 68.

Ndoro, O., Magorokosho, C., Setimela, P., Kamutando, C. & Labuschagne, M. 2022. Identification of exotic temperate maize inbreds for use in tropical breeding programs. *Euphytica* 218: 164. DOI: 10.1007/s10681-022-03119-4.

Nkomo, M., Gokul, A., Ndimba, R., Badiwe, M., Keyster, M. & Klein, A. 2022. Piperonylic acid alters growth, mineral content accumulation and ROS scavenging capacity in chia seedlings. *Annals of Botany Plants* 14(3). DOI: 10.1093/aobpla/plac025.

Olckers, S., Osthoff, G., Guzmán, C., Wentzel, B., Van Biljon, A. & Labuschagne, M. 2022. Drought and heat stress effects on gluten protein composition and its relation to bread-making quality in wheat. *Journal of Cereal Science* 108: 103562. DOI: 10.1016/j.jcs.2022.103562.

Olckers, S.-L., Osthoff, G., Ng, P.K.W., Van Biljon, A. & Labuschagne, M. 2022. The impact of low nitrogen conditions on the chemical composition and flour pasting properties of quality protein maize. *Cereal Research Communications* 50: 1117-1125. DOI: 10.1007/s42976-022-00253-6.

Park, R.F., Boshoff, W.H.P., Cabral, A.L., Chong, J., Martinelli, J.A., McMullen, M., Mitchell-Fetch, J.W., Paczos-Grzęda, E., Prats, E., Roake, J., Sowa, S., Ziems, L. & Singh, D. 2022. Breeding oat for resistance to the crown rust pathogen *Puccinia coronata* f. sp. *avenae*: achievements and prospects. *Theoretical and Applied Genetics* 135: 3709-3734. DOI: 10.1007/s00122-022-04121-z.

Rothmann, L.A. & McLaren, N.W. 2022. Prevalence of *Sclerotinia sclerotiorum* sclerotia recovered from soybean and sunflower. *Journal of Phytopathology* 170: 605-613. DOI: 10.1111/jph.13124

Sadler, R., Parker, T., Verboom, G.A., Ellis, A.G., Jackson, M., Van Zyl, J., Manning, J. & Bergh, N.G. 2022. A molecular phylogeny of *Calenduleae* (Asteraceae) supports the transfer of *Dimorphotheca polyptera* DC. to *Osteospermum* L. *South African Journal of Botany* 151: 234-245.

Scott, L. 2022. Rise of the Palaeoecology of Africa series. *Palaeoecology of Africa* 35: 1-4. DOI: 10.1201/9781003162766-1.

Scott, L., Gil-Romera, G., Marais, E. & Brook, G.A. 2022. Holocene environmental change along the central Namib Desert escarpment derived from hyrax and owl dung. *Review of Palaeobotany and Palynology* 305: 104746. DOI: 10.1016/j.revpalbo.2022.104746.

Scott, L., Sobol, M., Neuman, F.H., Gil-Romera, G., Fernández-Jalvo, Y., Bousman, C.B., Horwitz, L.K. & Van Aardt, A.C. 2022. Late Quaternary palaeoenvironments in the central semi-arid region of South Africa from pollen in cave, pan, spring, stream and dung deposits. *Quaternary International* 614: 84-97. DOI: 10.1016/j.quaint.2020.10.065.

Siwale, J., Labuschagne, M., Gerrano, A.S. & Mbuma, N.W. 2022. Phenotypic diversity and

characterization of the southern African bambara groundnut germplasm collection for grain yield and yield components. *Agronomy* 12: 1811. DOI: 10.3390/agronomy12081811.

Siwale, J., Labuschagne, M., Gerrano, A.S., Paterne, A., & Mbuma, N.W. 2022. Variation in protein content, starch components, selected minerals and their bioavailability in bambara groundnut accessions. *Journal of Food Composition and Analysis*. 115: 104991. DOI: 10.1016/j.jfca.2022.104991.

Sobol, M., Chazan, M., Scott, L. & Finkelstein, S.A. 2022. Characterizing the Meghalayan Stage in southern Africa: a multiproxy record of paleoenvironmental change at the southern margin of the Kalahari. *Quaternary International* 614: 98–110. DOI: 10.1016/j.quaint.2021.03.013.

Spelman, Z., Visser, B., Terefe, T., Pretorius, Z.A. & Boshoff, W.H.P. 2022. Pathogenicity and microsatellite characterization of *Puccinia hordei* in South Africa. *Crop Protection* 158: 106014. DOI: 10.1016/j.cropro.2022.106014.

Szabo, L.J., Olivera, P.D., Wanyera, R., Visser, B. & Jin, Y. 2022. Development of a diagnostic assay for differentiation between genetic groups in Clades I, II, III, and IV of *Puccinia graminis* f. sp. *tritici*. *Plant Disease* 106: 2211–2220. DOI: 10.1094/PDIS-10-21-2161-RE.

Tembo, E., Minnaar-Ontong, A., Menkir, A., Marais, G., Magorokosho, C. & Labuschagne, M. 2022. Inheritance of resistance to *Fusarium verticillioides* ear rot in maize inbred lines of southern, West and Central Africa origin. *Crop Science* 62: 1818–1833. DOI: 10.1002/csc2.20776.

Terefe, T.G., Visser, B., Pretorius, Z.A. & Boshoff, W.H.P. 2022. Physiologic races of *Puccinia triticina* detected on wheat in South Africa from 2017 to 2020. *European Journal of Plant Pathology* DOI: 10.1007/s10658-022-02583-x.

Tesfuhoney, W.A., Swart, W.J., Van Rensburg, L.D., Wolmarans, K., Walker, S., & Yu, H.C. 2022. Soil microbial activity as influenced by crusted runoff strip length and mulch cover under in-field rainwater harvesting (IRWH). *Physics and Chemistry of the Earth* 128: 103258.

Tóth, B., Moloi, M.J., Mousavi, S.M.N., Illés, Á., Bojtor, C., Szőke, L. & Nagy, J. 2022. The evaluation of the effects of Zn, and amino acid-containing foliar fertilizers on the physiological and biochemical responses of a Hungarian fodder corn hybrid. *Agronomy* 12: 1523.

Van Schalkwyk, H.J., Adams, T., Persoons, A., Boshoff, W.H.P., Wanyera, R., Hovmøller, M., Uauy, C., Boyd, L., Pretorius, Z.A., Prins, R. & Saunders, D.G.O. 2022. Pathogenomic analyses of *Puccinia striiformis* f. sp. *tritici* supports a close genetic relationship between South and East Africa. *Phytopathology* 71: 279–288. DOI: 10.1111/ppa.13468.

Zipfel, B., Montgomery, C., Neumann, F.H., Scott, L., Choiniere, J. & Hancox, J.P. 2022. Overlooked or unimportant? An overview of the coprolite collections at the University of the Witwatersrand, Johannesburg, South Africa. *The Museum Journal* 65.2: 1–16. DOI: 10.1111/cura.12531.

Books/Chapters in Books

Canavan, K., Canavan, S., Clark, V.R., Gwate, O., Mapaura, A., Richardson, D.M., Steenhuisen, S. & Martin, G.D. 2022. Invasive alien plants in the montane areas of South Africa: Impacts and management options. In: *Human-Nature Interactions. Exploring nature's values across landscapes*. L. Misiune, D. Depellegrin & L.E. Vigl (Eds). Switzerland: Springer Nature. pp 169–180.

Gosling, W., Lézine, A-M. & Scott, L. 2022. Quaternary vegetation – The African Pollen Database. In: *Palaeoecology of Africa. International Yearbook of Landscape Evolution and Palaeoenvironments*. Volume 35. J. Runge (Ed). CRC Press, Taylor & Francis Group. pp 417. ISSN 2372–5907.

Horwitz, L.K., Avery, M.D., Bamford, M.K., Berna, F., Brink, J.S., Ecker, M., Fernandez-Jalvo, Y., Goldberg, P., Holt, S., Lee-Thorp, J., Matmon, A., Pickering, R., Porat, N., Rossouw, L., Scott, L., Shaar, R. & Chazan, M. 2022. Wonderwerk Cave, Northern Cape Province: An Early-Middle Pleistocene Paleoenvironmental sequence for the interior of South Africa. In: *African Paleoenvironment and Human Evolution*. S.C. Reynolds & R. Bobe (Eds). Cambridge University Press. Cambridge, pp. 141–160. DOI: 10.1017/9781139696470.

Niekerk, L., Carelse, M.F., Bakare, O.O., Klein, A., Gokul, A., & Keyster, M. 2022. Application of gene mining and editing technologies for agricultural research and breeding. In: *Technologies in Plant Biotechnology and Breeding of Field Crops*. Kamaluddin, U. Kiran & M.Z. Abdin (Eds.). Singapore: Springer. pp 41–65.

Conference Contributions

Papers delivered

Achilonu, C.C., Marais, G.J., Ghosh, S. & Gryzenhout, M. 2022. First report of black spot disease and seedling wilt of pecans (*Carya illinoensis*) caused by *Alternaria alternata* in South Africa. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathology (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Adams, L.D., Clark, V.R., Thabethe, V., Raji, I.A., Martin, G., Steenhuisen, S. & Downs, C. 2022. Role of avian frugivores in germination of an invasive alien shrub *Pyracantha angustifolia* in Free State grasslands, South Africa. Paper delivered at the 15th Pan-African Ornithological Congress, Victoria Falls, Zimbabwe. 21–25 November 2022.

Adams, L.D., Clark, V.R., Thabethe, V., Raji, I.A., Martin, G., Steenhuisen, S. & Downs, C. 2022. Role of avian frugivores in germination of an invasive alien shrub *Pyracantha angustifolia* in Free State grasslands, South Africa. Paper delivered at the 28th International Ornithological Congress, hosted virtually by the University of KwaZulu-Natal. 15–19 August 2022.

Adams, L.D., Martin, G., Clark, V.R. & Steenhuisen, S. 2022. Reproductive ecology of an invasive alien plant *Pyracantha angustifolia* in the eastern Free State Grasslands. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Adams, L.D., Martin, G., Steenhuisen, S. & Downs, C. 2022. Community perceptions on fleshy-fruited invasive alien plants in the grasslands. Paper delivered at the School of Life Sciences Biodiversity Cluster UKZN (virtual). 28 September 2022.

Adams, L.D., Martin, G., Steenhuisen, S. & Downs, C. 2022. Fleshy-fruited invasive alien plants in the Grasslands. Paper delivered at the 4th South African National Biodiversity Institute (SANBI) Student Research Day (online). 12 April 2022.

Adams, L.D., Martin, G., Steenhuisen, S. & Downs, C. 2022. Fleshy-fruited invasive alien plants in grasslands: preliminary results from a systematic review. Paper delivered at the Biological Invasions Symposium, Alice, South Africa. 6–8 July 2022.

Alison, J., Steenhuisen, S., Payne, S.L. & Hoye, T. 2022. Camera surveillance uncovers novel plant-pollinator interactions in montane ecosystems. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Bender, C.M., Boshoff, W.H.P., Visser, B., Wood, A.R., Rothmann, L. & Pretorius, Z.A. 2022. Fig rust: an unexplored disease in South Africa. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Bester, S.P. & Joubert, L. 2022. In search of the true identity of *Nemesia ligulata*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University. 17–20 January 2022.

Bijzet, Z., Booyse, M. & Labuschagne, M. 2022. Selecting for trait stability in a citrus breeding programme. Paper delivered at the XIV International Citrus Conference, Turkey. 6–11 November 2022.

Bilal, H., Boshoff, W.H.P. & Mohase, L. 2022. Exogenous application of salicylic acid and *Puccinia triticina* pre-inoculation reduces *Diuraphis noxia* induced leaf damage in wheat. Paper delivered at the 25th International Plant Resistance to Insects Symposium. Hosted online by Malmö University, Sweden. 31 May–2 June 2022.

Boshoff, W.H.P., Terefe, T.G., Visser, B., Bender, C.M. & Pretorius, Z.A. 2022. Rust diseases of food and forage crops in South Africa: new threats and research to mitigate their impact. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Chiuraise, N., Visser, B., Maré, A. & Boshoff, W.H.P. 2022. Status of resistance to *Puccinia triticina* in Zimbabwean wheat germplasm. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6–9 March 2022.

Cillié, C.D., Joubert, L. & Van der Merwe, R. 2022. Evaluation of *Hemerocallis* accessions towards breeding for pollinators. Paper delivered at the Annual Post-Graduate Symposium of the Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg. South Africa. 22–23 November 2022.

Cobbold, J.M., Rothmann, L.A. & Joubert, L. 2022. *To bee or not to bee – floral rewards and pollination efficiency in South African Macadamia*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University. 17-20 January 2022.

Coertzen, R.D., Van Biljon, A. & Van der Merwe, R. 2022. *Physiological and biochemical responses associated with water-limited-induced-stress tolerance in vegetable type soybean*. Paper delivered at the 14th Southern African Plant Breeding Symposium, Protea Hotel, Stellenbosch, South Africa (hybrid). 6-9 March 2022.

Cozien, R., Van der Niet, T., Steenhuisen, S. & Johnson, S. 2022. *Geographic variation in floral traits and pollinators of the Drakensberg's Hidden Flower: Evidence for reptile- and rodent-pollinated chemotypes in Guthriea capensis (Achariaceae)*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Edwards A., Swart, W.J. & Rothmann, L.A. 2022. *Characterising plant health promoting microorganisms (PGPM's) and potential biological control agents (BCA's) from the soybean microbiome*. Paper delivered at the Annual Post-Graduate Symposium of the Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg. South Africa. 22-23 November 2022.

Effiom, A.C., Neumann, F.H., Gensel, J., Bamford, M.K., Schefuß, E., Zabel, M. & Scott, L. 2022. *Pollen Analysis of the Mkhuze Swamps, KwaZulu-Natal, South Africa*. Paper delivered at the Southern African Society for Quaternary Research (SASQUA) XXIII, Biennial Conference, St Lucia KwaZulu-Natal, South Africa. 25-30 September 2022.

Ferreira, E.L., Van Aardt, A.C. & Joubert, L. 2022. *Possible effect of community composition on pollination rewards in three Nemesia species from Namaqualand*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University. 17-20 January 2022.

Figuroa, M., Dodds, P.N., Henningsen, E.C., Lewis, D., Hewitt, T., Mago, R., Sperschneider, J., Hyles, J., Dillon, S., Webers, C., McElroy, K., Stone, E., Steffenson, B.J., Kanyuka, K., Berlin, A., Huang, Y.-F., Hickey, L., Klos, K., Gordon, T., Kianian, S.F., Liachko,

I., Visser, B., Pretorius, Z.A., Boshoff, W., Pereira, D. & Stuckenbrock, E. 2022. *Delivering durable genetic resistance to oat crown rust: leveraging an extensive network of scientists and efforts*. Paper delivered at the 11th International Oat Conference (OAT2022), Perth, Australia. 10-13 October 2022.

Gerrano, A.S., Mbuma, N.W., Mumm, R., Thungo, Z., Mashilo J. & Mathew, I. 2022. *Variability and influence of environment on nutritional quality in fresh leaves and immature green pods of cowpea (Vigna unguiculata L. Walp)*. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

Glennon, K.L., Mtileni, P., Mathura, S., Payne, S., Le Matire, N. & Steenhuisen S. 2022. *Drakensberg confetti: What drives flower colour variation in a mountain endemic?* Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Grobler, H., Jackson, M. & Joubert, L. 2022. *Nectar spur development in Nemesia (Scrophulariaceae)*. Paper delivered at the Annual Conference of the Microscopy Society of South Africa (MSSA). Johannesburg, South Africa. 5-9 December 2022.

Grobler, H., Jackson, M. & Joubert, L. 2022. *Nectar spur development in Nemesia Vent. (Scrophulariaceae)*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University, South Africa. 17-20 January 2022.

Hlahla, J.M., Mafa, M.S., Van der Merwe, R. & Moloi, M.J. 2022. *The photosynthetic efficiency and carbohydrate responses of edamame cultivars under drought stress*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University, South Africa. 17-20 January 2022.

Herselman, L. 2022. *The omics of molecular plant breeding*. Plenary paper delivered at the University of Limpopo's 12th Faculty of Science and Agriculture Research Day, Polokwane, South Afrika. 21-23 September 2022.

Herselman, L. 2022. *The ongoing battle against destructive cereal killers*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Khajoane, T.J., Labuschagne, M., Ramburan, S. & Mbuma, N.W. 2022. *Genotype and environmental effects on maize hybrids for grain yield, nutritional value and milling quality in South Africa*. Paper delivered at the Annual Post-Graduate Symposium of the Department of Botany and Plant Biotechnology at the University of Johannesburg, Johannesburg. South Africa. 22-23 November 2022.

Labuschagne, M., Matongera, N., Ndhela, T. & Van Biljon, A. 2022. *Incorporating zinc into provitamin A, quality protein maize and normal maize hybrids*. Paper delivered at the 36th European Federation of Food Science and Technology (EFFoST) International Conference, Dublin, Ireland, 7-9 November 2022.

Mafa, M.S. 2022. *The carbohydrates alarm signals in grain crops exposed to the biotic and abiotic conditions. What doesn't kill plants makes them weaker*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Makhetha, T., Boshoff, W.H.P. & Marè, A. 2022. *The phenotypic and genotypic validation of leaf rust resistance in wheat varieties*. Paper delivered at the Annual Post-Graduate Symposium of the Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg. South Africa. 22-23 November 2022.

Mapaura, A., Canavan, K., Richardson, D.M., Clark, V.R. & Steenhuisen, S. 2022. *Climate change and predicted changes in distribution of invasive Nassella species in South Africa and Lesotho*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Mbuma, N.W., Moloi, M.J., Gerrano, A.S. & Labuschagne, M.T. 2022. *Preliminary results on the investigation of the effect of drought stress on physiological parameters and nutritional quality traits of cowpea genotypes*. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

McLean, C.C., Van Tol, J.J., Van Aardt, A.C., Kotze, E., Edwards, A., Swart, W. & Kotze, J.J. 2022. *Quantifying soil degradation through microbial activity of alpine soils in the Northern Drakensberg, South Africa*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Meiring, M.C., McLaren, N.W. & Rothmann, L.A. 2022. *Bibliographical analysis of Sclerotinia sclerotiorum disease management on oilseed crops*. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Meyer, W.B., Boshoff, W.H.P. & Visser, B. 2022. *Identification of new Puccinia helianthi race variants in South Africa and their impact on sunflower hybrids*. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Meyer, W.B., Boshoff, W.H.P. & Visser, B. 2022. *Puccinia helianthi race variants and sunflower hybrid responses*. Paper delivered at the Annual Post-Graduate Symposium of the Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg. South Africa. 22-23 November 2022.

Meyer, W.B., Boshoff, W.H.P. & Visser, B. 2022. *South African sunflower rust race variants and hybrid responses*. Paper delivered at the 33rd South African National Seed Organization (SANSOR) Congress, President Hotel, Cape Town, South Africa. 7-9 June 2022.

Minnaar-Ontong, A. 2022. *Screening and breeding soybean for disease resistance*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Mmboyi, A., Bijzet, Z., Labuschagne, M.T. & Boooyse, M. 2022. *Effect of storage temperatures on pollen viability of four litchi cultivars*. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

Mngomezulu, N.T., Veldkornet, D.A., Rajkaran, A. & Peer, N. 2022. *Salt marsh vegetation loss at the Berg Estuary, South Africa*. Paper delivered at the Annual Post-Graduate Symposium, Department of Botany and Plant Biotechnology at the University of Johannesburg, Johannesburg. South Africa. 22-23 November 2022.

Mohase, L., Masupha, P., Kemp, G. & Jankielsohn, A. 2022. *Salicylic and abscisic acids regulate defence responses of wheat to Diuraphis noxia*. Paper

delivered at the 25th International Plant Resistance to Insects Symposium. Hosted online by Malmo University, Sweden, 31 May–2 June 2022.

Moloi, K.T., Martin, G., Clark, V.R. & Steenhuisen, S. 2022. *Reproductive ecology of Cotoneaster pannosus in montane grasslands of eastern Free State*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Moloi, K.T., Martin, G., Clark, V.R. & Steenhuisen, S. 2022. *Seed biology and dispersal of Cotoneaster pannosus in grasslands of eastern Free State*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University, South Africa. 17–20 January 2022.

Moloi, M.J. 2022. *Applications of photosynthesis in production of grain crops*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Mosikidi, T., Le Maitre, N., Steenhuisen, S., Clark, V.R., Lloyd, K. & Le Roux, A. 2022. *Environmental factors affecting the onset of dawn chorus of warblers in a high-elevation wetland*. Paper delivered at the African Bioacoustics Conference, Kruger National Park, South Africa. 2–8 October 2022.

Müller, M., Van Tol, J.J. & Van Aardt, A.C. 2022. *Community distribution along topographical units in the Golden Gate Highlands National Park, Free State Province, South Africa*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Ngara, R. 2022. *Sorghum responses to abiotic stresses: fitting one puzzle piece at a time*. Plenary paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University, South Africa. 17–20 January 2022.

Payne, S., Alison, J., Høye, T. & Steenhuisen, S. 2022. *Camera surveillance of invertebrate abundance and plant phenology within a montane climate change experiment*. Paper delivered at the International Mountain Conference (IMC), Innsbruck, Austria. 11–15 September 2022.

Radebe, N., Steenhuisen, S. & Cozien, R. 2022. *Pollination ecology of the rare Drakensberg Nerine*

bowdenii subspecies wellsii. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Rothmann, L.A. 2022. *Field pathology: diseases of sorghum, soybean and sunflower*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Rothmann, L.A. 2022. *Syllabus redesign: A quest to conquer a 'wee beastie' in plant health education*. Paper delivered at the University of the Free State Annual Learning and Teaching Conference, Bloemfontein. 16 September 2022.

Rothmann, L.A. 2022. *The South African Sclerotinia Research Network: progress and the way forward*. Paper delivered at the Rhizobium Symposium, Council for Scientific and Industrial Research International Convention Centre, Pretoria, South Africa. 7 September 2022.

Rothmann, L.A. & McLaren, N.W. 2022. *Assessment of Sclerotinia sclerotiorum sclerotia recovered from soybean and sunflower silos across South Africa*. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Sadler, R., Verboom, G.A., Manning, J., Parker, T., Jackson, M., Van Zyl, J., Bergh, N.G. & Ellis, A.G. 2022. *Phylogeny of the southern African marigolds: the daisy tribe Calenduleae*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North West University, South Africa. 17–20 January 2022.

Scott, L. & Van Aardt, A.C. 2022. *Updating the African Pollen Database (APD) for the Quaternary in the South African interior*. Paper delivered at the Workshop held of the French Institute of South Africa (IFAS), Pleistocene Archaeology and Palaeoecology of the Free State, Florisbad, Free State. 14 July 2022.

Sedimo, G., Jackson, M., Bester, S.P. & Joubert, L. 2022. *Taxonomic revision and molecular phylogenetic analysis of Nemesia species in the Free State*. Paper delivered at the 47th Annual Conference of the South African Association of Botanists (SAAB). Hosted online by North-West University, South Africa. 17–20 January 2022.

Steyn, C. & Minnaar-Ontong, A. 2022. *Improvement*

of South African soybean cultivars against Sclerotinia stem rot. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Terefe, T.G., Visser, B., Pretorius, Z.A. & Boshoff, W.H.P. 2022. *The continual emergence of new Puccinia triticina races on wheat in South Africa*. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Theron, N., Swart, W.J., Gryzenhout, M. & Marais, G.J. 2022. *Members of the genus, Cladosporium, and their role in pecan scab in South Africa*. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Van der Merwe, R. 2022. *Vegetable-type soybean research and breeding at the UFS*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Van der Merwe, R., Van der Merwe, J.B. & Van Biljon, A. 2022. *Combining ability of nutritional components in vegetable-type soybean*. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6–9 March 2022.

Veldkornet, D.A., Adams, J.B., Boatwright J.S. & Rajkaran, A. 2022. *Barcoding of estuarine macrophytes and phylogenetic diversity of estuaries along the South African coastline*. Paper delivered at the Southern African Marine Science Symposium, Elangeni Hotel, Durban, South Africa. 20–24 June 2022.

Venter, K., Maré, A., Herselman, L., Pretorius, Z.A. & Boshoff, W.H.P. 2022. *Rust response of the Watkins Core Collection of wheat landraces*. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6–9 March 2022.

Visser, B. 2022. *Rust research at the UFS*. Paper delivered at the 1st National Grain Research Programme Research Day, Future Africa, University of Pretoria, South Africa. 9 May 2022.

Visser, B., Bender, C.M., Boshoff, W.H.P. & Pretorius, Z.A. 2022. *Back to the future: using herbarium*

specimens to reconstruct the genetic development of two wheat rusts in South Africa. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Walle, T. & Labuschagne, M. 2022. *Trends and advances in maize biofortification in Southern Africa*. Paper delivered at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6–9 March 2022.

Wood, A.R., Boshoff, W.H.P., Visser, B., Bender, C.M. & Pretorius, Z.A. 2022. *The heteroecious life cycle of Puccinia digitariae on Digitaria eriantha and Solanum species, the first to be elucidated in South Africa in a century*. Paper delivered at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Posters presented

Achilonu, C.C., Marais, G.J., Ghosh, S., Cason, E.D., Madisha, T. & Gryzenhout, M. 2022. *Random amplified microsatellites (RAMS) analysis showed no link to geographical location of Alternaria alternata populations causing black spot of pecans (Carya illinoensis) in South Africa*. Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Achilonu, C.C., Marais, G.J., Ghosh, S., Johar, D., Hassanin, S.O. & Gryzenhout, M. 2022. *In vitro fungicide evaluation and antifungal activities of pecan leaf and husk extracts against Alternaria alternata: HPLC analysis of phenolic compounds*. Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1–3 August 2022.

Adams, L.D., Martin, G., Steenhuisen, S. & Downs, C. 2022. *Community perceptions on invasive alien plant Pyracantha angustifolia in the eastern South African grasslands*. Poster presented at Oppenheimer Research Conference, Johannesburg, South Africa. 5–7 October 2022.

Basson, H.J., Maré, A., Van der Merwe, R. & Minnaar-Ontong, A. 2022. *Fusarium sudden death syndrome: A pre-breeding approach for resistance in South African soybeans*. Poster presented at the 14th

South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

Chiuraise, N., Visser, B., Maré, A. & Boshoff, W.H.P. 2022. *Status of resistance to Puccinia triticina in Zimbabwean wheat germplasm.* Poster presented at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

Clayton, J. & Swart, W.J. 2022. *Exploring the cannabis (Cannabis sativa) microbiome for beneficial microorganisms.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Coertzen, J., Slippers, B., Gryzenhout, M. & Marais, G.J. 2022. *Neofusicoccum parvum and other members of the Botryosphaeriaceae associated with dieback in pecans in South Africa.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Du Toit, I., Boshoff, W.H.P., Rothmann, L.A. & Visser, B. 2022. *Fungicide sensitivity among South African Puccinia graminis f. sp. tritici isolates.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Edwards, A. & Swart, W.J. 2022. *Characterising the effect of salicylic acid on Sclerotinia stem rot of soybean.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Edwards, A., Swart, W.J., & Rothmann, L.A. 2022. *Characterising plant health promoting microorganisms (PGPM's) and potential biological control agents (BCA's) from the soybean microbiome.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Fosa, H., Swart W.J. & Coetzer, G. 2022. *Biocontrol of Rhizopus rot on spineless cactus pear (Opuntia ficus-indica L.).* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of

Pretoria, Pretoria, South Africa. 1-3 August 2022.

Fosa, H., Swart, W.J., & Coetzer, G. 2022. *Isolation and identification of three Bacillus spp. causing soft rot of spineless cactus pear.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Fosa, H., Swart, W.J., & Coetzer, G. 2022. *Root growth promotion of spineless cactus pear cladodes using Debaryomyces fabryi and Aureobasidium pullulans.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Hlongwane, N.V., Swart, W.J., Rothmann, L.A., & Edwards, A. 2022. *Exploring soybean and sunflower microbiomes for beneficial bacterial microorganisms.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Lessing, A., Swart, W.J. & Marais, G.J. 2022. *Evaluation of fungi for dry retting of kenaf.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Masisi T.V., McLaren, N.W., Jackson, M. & Rothmann, L.A. 2022. *Sorghum grain mold: identifying fungal colonisers, quantifying concomitant mycotoxins and exploring conducive weather periods.* Poster presented at the 3rd African Society of Mycotoxicology joint Mytox-South Conference Stellenbosch, South Africa. 3-8 September 2022.

Masisi, T.V., Rothmann, L.A., McLaren, N.W. & Jackson, M. 2022. *Identification and occurrences of fungi and mycotoxin contamination in sorghum grain fractions.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Mbambo, S.T., Tedder, M.J. & Steenhuisen, S. 2022. *Effects of drought stress on flowering phenology and growth of grassland forbs.* Poster presented at the 57th Grassland Society of Southern Africa (GSSA) Congress, Aldam Holiday Resort & Conference Centre, Free State, South Africa. 26-28 July 2022.

Meyer, W.B., Boshoff, W.H.P. & Visser, B. 2022. *Occurrence and pathogenicity of Puccinia helianthi*

on sunflower in South Africa. Poster presented at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

Mishasha, T., Zhou, M. & Van der Merwe, R. 2022. *Family by environment interactions for brix content in sugarcane breeding.* Poster presented at the 14th South African Plant Breeders' Association (SAPBA) Symposium, Protea Hotel, Stellenbosch, South Africa. 6-9 March 2022.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Characterization of mucilage proteins and carbohydrates responsible for capacity and stability of foam food systems.* Poster presented at the Xth International Congress on Cactus Pear and Cochineal: Cactus the new green revolution in drylands, Brazil, 26-29 September 2022.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Correlation of Opuntia ficus-indica Mill. and O. robusta mucilage yield to different physico-chemical characteristics.* Poster presented at the Xth International Congress on Cactus Pear and Cochineal: Cactus the new green revolution in drylands, Brazil, 26-29 September 2022.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Opuntia cladode mucilage: Proteins.* Poster presented at the Xth International Congress on Cactus Pear and Cochineal: Cactus the new green revolution in drylands, Brazil, 26-29 September 2022.

Miya, S., De Wit, M., Van Biljon, A., Venter, S.L. & Amonsou, E. 2022. *Opuntia ficus-indica Mill. and O. robusta cladode mucilage: Carbohydrates.* Poster presented at the Xth International Congress on Cactus Pear and Cochineal: Cactus the new green revolution in drylands, Brazil, 26-29 September 2022.

Mohotloane, M.M. & Mafa, M.S. 2022. *Formulation of holocellulolytic enzyme cocktail for hydrolysis of HRP delignified rooibos bagasse for production of value added chemicals.* Poster presented at the 32nd Catalysis Society of South Africa (CATSA), Champagne Sports Resort, Central Drakensberg, South Africa. 13-16 November 2022.

Spelman, Z., Visser, B., Terefe, T., Pretorius, Z.A. & Boshoff W.H.P. 2022. *Pathogenicity and microsatellite characterization of Puccinia hordei in South Africa.* Poster presented at the 52nd Congress of the Southern African Society for Plant

Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Tsotetsi, M.E., Boshoff, W.H.P. & Visser, B. 2022. *Functional analysis of the AvrSr50 avirulence gene in South African Puccinia graminis f. sp. tritici isolates.* Poster presented at the 52nd Congress of the Southern African Society for Plant Pathologists (SASPP), Future Africa, University of Pretoria, Pretoria, South Africa. 1-3 August 2022.

Research Reports

Van der Merwe, R. & Fourie, J.B. 2022. *Evaluating the effect of enOrmus on plant biomass and yield of vegetable-type soybean under glasshouse conditions.* Report delivered to TransfOrmus.

Van der Merwe, R. & Lombaard, R. 2022. *Evaluating the effect of enOrmus and Soil Life Combo on plant biomass and yield of maize and vegetable-type soybean under field conditions.* Report delivered to TransfOrmus.

Industry Papers

Boshoff, W.H.P., Visser, B. & Pretorius, Z.A. 2022. *Barley leaf rust - latest research on rust fungus (in Afrikaans).* Koringfokus 40.4 Jul/Aug 10-11. (Awarded best article in edition)

Pretorius, Z.A. & Boshoff, W.H.P. 2022. In: *History of Plant Pathology in South Africa. Cereal Rust Pathology: 85-89.* 1st Edition. Briza Publications, Pretoria, South Africa.

Terefe, T. & Boshoff, W.H.P. 2022. *New leaf rust races detected on wheat in South Africa.* SA-Grain 49(5): 48-49.

Visser, B., Boshoff, W.H.P. & Pretorius, Z.A. 2022. *Lessons from the past: herbarium samples share light on wheat rust in South Africa (in Afrikaans).* Koringfokus 40.6 Nov/Dec 22-23.



STAFF (2022)

Head of Department:
Prof L Herselman

BLOEMFONTEIN CAMPUS

Professors:	Prof L Herselman, Prof MT Labuschagne and Prof WJ Swart
Associate Professors:	Prof WHP Boshoff and Prof B Visser
Affiliated Professor:	Prof PW Crous
Senior Lecturers:	Dr L Joubert, Dr GJ Marais, Dr A Minnaar-Ontong, Dr L Mohase, Dr MJ Moloji, Dr AC van Aardt, Dr A van Biljon and Dr R van der Merwe
Lecturers:	Dr M Jackson, Dr MS Mafa, Dr A Maré, Dr NW Mbuma (Contract), Dr L Rothmann and Dr DA Veldkornet
Senior Researcher:	Dr EP Abdi (Contract)
Mentor:	Prof L Scott (Contract)
Chief Officer – Professional Services:	Dr CM Bender
Senior Officers – Professional Services:	M Frylinck and HP Pretorius
Officer – Professional Services:	Dr C Steyn
Senior Assistant Officers:	LP Mbingeleli and OML Taylor
Assistant Officer:	K Mbatha
Technical Aid:	PR Chakane
Cleaners:	NH Dlamini, NS Macwili and LHA Molale

Research Fellows:	Dr ME Cawood, Dr GP Potgieter, Prof ZA Pretorius, Dr R Ramburan, Dr L Rossouw, Dr AM Venter and Prof HJT Venter
--------------------------	---

QWAQWA CAMPUS

Subject Head:	Dr S Steenhuisen
Associate Professor:	Prof AOT Ashafa
Senior Lecturers:	Dr A Gokul, Dr R Ngara and Dr S Steenhuisen
Lecturers:	Dr PJ Mojau and TR Pitso
Academic Facilitator:	NG Mochologi
Officers – Professional Services:	D Mosea and NP Mzizi
Research Fellows:	Prof LV Komoreng, Prof RT Moffett, Dr RJ McKenzie, Dr TM Mokotjomela, Dr T Ramakuwela and Dr JD Vidal Jr.



DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

BLOEMFONTEIN CAMPUS

Prof Liesl van As

Department of Zoology and Entomology

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 3460

E: Vanasll@ufs.ac.za

W: www.ufs.ac.za/ze

QWAQWA CAMPUS

Dr Patricks Voua Otomo

Department of Zoology and Entomology

Faculty of Natural Sciences

University of the Free State

Private Bag X13 | Phuthaditjhaba 9866

South Africa

T: +27 58 718 5132

E: OtomoPV@ufs.ac.za

W: www.ufs.ac.za/ze

OVERVIEW OF 2022

During 2022 we welcomed two new staff members on the Bloemfontein Campus – Dr Ed Netherlands was appointed as Senior Lecturer and Dr Sibonginhlhla Mahlobo-Shwabede was appointed as Officer (Technician) for the running and maintenance of our molecular laboratory.

Numerous conferences were attended, including some abroad. Staff from Zoology and Entomology,

in collaboration with the Centre for Environmental Management, hosted the 59th Annual Conference of the South African Society of Aquatic Sciences (SASAqS), which took place from 26 to 30 June 2022 at Amanzi Private Game Reserve, Brandfort.

Members of the Department (staff and postgraduate students) were involved in outreach to schools to market the Department of Zoology and Entomology to senior learners.

On the maintenance side, we were very excited when the contractors finally started with the long overdue upgrade and renovation of our Insectarium on the Bloemfontein Campus. On the Qwaqwa Campus, work on a new animal housing facility began in mid-2022. The building houses three laboratories, with two labs dedicated to the Department of Zoology and Entomology, to be handed over to the Faculty in January 2023.

During 2022 staff, students and research associates of the Department produced 84 research articles, including two book chapters, 47 conference abstracts, and four were published in conference proceeding. In addition, invited talks were delivered.

ACHIEVEMENTS

Staff Achievements

Dr Candice Jansen van Rensburg was promoted to Senior Lecturer and Prof Liesl van As to Full Professor.

Dr Nthatsi Nyembe was elected as an Additional Member in the portfolio of Social Media Manager for the Parasitological Society of Southern Africa (PARSA).

Prof Aliza le Roux received Knowledge Interchange and Collaboration funding support from the NRF to host a visiting researcher, Dr Nick Friedman, a bioacoustics expert from the Leibniz Institute for Biodiversity Change in Germany. During his visit, valuable new connections were formed between the Department and the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON), as well as BirdlifeSA. During the UFS Learning and Teaching Excellence Conference, Aliza won the Best Paper for the Qwaqwa Campus and a second-place in the cross-campus category, for her presentation on 'Innovating my curriculum through a redesign or renewal of my module'.

Prof Peter Taylor was awarded the Campus Principal's Lifetime Research Achievement Award from the Qwaqwa Campus, and his NRF-rating improved from B3 to B2.

In November 2022, Dr Patricks Voua Otomo was awarded the prize for the Most Productive Researcher of the Faculty of Natural Sciences and Agriculture (Qwaqwa Campus) for the year 2021.

Student Achievements

Five students from the Bloemfontein Campus attended and gave presentations at the Suid

Parasitological Society of Southern Africa new committee members, from the left, Prof Marinda Oosthuizen, Faith Nkosi, Dr Raksha Bhoora, Prof Kgomotso Sibeko-Matjila, Prof Kerry Malherbe, Dr Nthatsi Nyembe and Prof Courtney Cook.



Afrikaanse Akademie vir Wetenskap en Kuns annual student symposium that was held in Centurion. Runé van der Merwe, Chanel Lewis (both PhD students) and Elizna Theron (MSc Student) received CTEt (Afrikaanse SkryfGoed) software prizes for their respective presentations.

Keletso Makaota (MSc student) attended and made a poster presentation at the National Symposium on Biological Invasions 2022, and delivered an oral presentation respectively at the 17th Kimberley Biodiversity Research Symposium. At the latter, she was awarded the first prize for the best MSc presentations (<https://www.sanbi.org/news/sanbi-co-hosts-the-17th-kimberley-biodiversity-research-symposium/>).

During the meeting of the Microscopy Society of southern Africa (MSSA), Gerhard de Jager (PhD student) won the student prize for the best oral presentation in Life Sciences with his talk on 'Novel insights into the genus *Leiotrocha* (*Mobilida*: *Urceolariidae*)'.

On the Qwaqwa Campus, two of the PhD students received awards. Monday Mdluli received the Bat Conservation International Award, with a monetary prize of USD3000, and Alexandra Howard received the American Society of Mammalogists student award (USD 15000).

TEACHING AND LEARNING

Prof Daryl Codron (ZLGY3734) and Dr Candice Jansen van Rensburg (ZLGY3714) led the first joint third-year ecology excursion to the Umgeni Valley Nature Reserve in Howick, KwaZulu-Natal, from 27 March to 1 April 2022.

Wildlife and Environmental Society (WESSA) staff at Umgeni organised a day programme where they firstly showed the students methods and techniques



From the left, Baamogetswe Bogatsu, Gomolemo Ramokoka, Gaopelelwe Motshegwa and Ntandoyenkosi Zuma, testing the clarity of the water in the Umgeni River

for measuring water quality, including miniSASS (South African Scoring System) along three sections of the Umgeni River with varying levels of environmental disturbance.

Dr Jansen van Rensburg instructed the students on the sampling and surveying of aquatic invertebrate communities, and Prof Codron assigned them projects to uncover patterns of dispersal at increasing levels of organisational complexity. At the end of the week, student groups presented their results via Poster and PowerPoint presentations. To ensure continued development of these skills, and to foster greater enthusiasm for Zoology, the combined excursion is scheduled to be an annual event.



Monique Barnard using a SASS net to collect macro-invertebrates for the miniSASS method at Umgeni Valley Nature Reserve

joined up with the North-West University (NWU) Herpetology excursion to the Lajuma Research Station in the Soutpansberg, during the last week of September. The aim of the excursion was to train and equip students with the necessary knowledge and skills to work with various herpetofauna in a premier biodiversity hotspot and conservation area. The students were shown different sampling and monitoring techniques, taught how to collect and handle both amphibians and reptiles ethically, and received lectures from experts on different topics – including bioacoustics, sampling methods, conservation ecology, project planning and data possessing. Students were also asked to present on certain topics and participate in debates individually



Dr Ed Netherlands and Hennie Butler with Thabo Moabi, Johanco Viljoen, Sethu Stemla and Leon Gwanya after successfully setting up the drift fence during the Biodiversity excursion on Bankfontein Farm in the Nama Karoo

From the left, Sethu Stemla, Thabo Moabi, Johanco Viljoen and Leon Gwanya during the feedback session at the end of the Biodiversity excursion



Prof Charles Haddad (ENT03714) and PhD student, Ruan Booysen, supervised the third-year Entomology excursion to the Namaqua National Park in the Northern Cape. Students had the opportunity to visit the Succulent Karoo biome for the first time, and the researchers expanded on a 2021 NRF-funded project to collect arachnids in the Park. The students sampled arthropods using three methods in three contrasting biotopes, and the material collected will contribute to establishing baseline arthropod data for this understudied park.

As part of the Honours Herpetology (ZLGY6844) course, Dr Ed Netherlands and Sethu Stemla

Dr Candice Jansen van Rensburg (back row on the left) and Prof Daryl Codron (seated on the left) together with postgraduate and third-year Zoology students at Wildlife and Environmental Society facility in Umgeni Valley Nature Reserve in Howick, KwaZulu-Natal



or as a group. This was a valuable experience for any student interested in herpetology and conservation.

Dr Ed Netherlands and Dr Hennie Butler joined Prof Liesl van As on the Honours Biodiversity and Evolution excursion (ZLGY6862) to Bankfontein Farm in the Nama Karoo in the first week of October. The programme included water and terrestrial ecology with academic campfire discussions. At the end of the excursion the students gave feedback on the week's activities by means of Power Point presentations.

During the October recess, Dr Vaughn Swart was accompanied by De Villiers Fourie and two postgraduate students on the biannual-Entomology career excursion. This excursion provides second- and third-year entomology students (18 in total) with an introduction and exposure to various institutes and companies involved in entomology. The excursion included visits to the National Institute for Communicable Diseases (NICD), Regulatory Aspects, Ditsong National Museum of Natural History, the chemical company Syngenta, various Agricultural Research Council (ARC) facilities, such as the Vegetable, Industrial and Medicinal Plants (VIMP), Biosystematics, Biological Control and Onderstepoort Veterinary Research Institute (OVI). After the excursion, the students were assessed on their participation, and as usual, the feedback was exceptionally positive.

Another academic activity via ShareScreenAfrica (SSA) involved the Rethinking Conservation talks

that took place once a month. This was open to all students in the Faculty, who participated online via Zoom. These talks were interactive, as the students could participate in the questions and discussion sessions that followed. All of the presentations are now available on *YouTube* (<https://www.youtube.com/@ShareScreenAfrica/playlists>).

During one of the practical sessions of ZLGY2616, Krish Lewis of the Two Oceans Aquarium was invited to present a lecture as part of the SSA initiative. This live, interactive presentation on jellyfish was held on 17 May 2022. The very up-to-date laboratory setup of BL28 was successfully utilised for this online presentation. Students were invited to ask questions afterwards, and they participated so enthusiastically that we had to call a halt after almost 40 minutes of lively discussion.

Virtual field trips and interactions with guest experts have become integral features of the ZLGY2626 module, providing authentic learning experiences to second-year Zoology students. Through ShareScreen Africa live events, the students attended virtual visits to the Western Cape, Zambia and Kenya. Students got up close with rescued raptors at Eagle Encounters in Stellenbosch, spent an afternoon with a wildlife veterinarian (Dr Bouvy Clauhuis) and white rhinoceroses at Sukula Game Reserve, and learned unique facts about giraffe from Joseph Mochoge at the Kigio Wildlife Conservancy.

On the Qwaqwa Campus in the first semester, Prof Aliza le Roux took the third-year Animal Behaviour

class (Z00L3714) on an excursion to the Golden Gate Highlands National Park. In the second semester, Dr Mpho Ramoejane took his third-year Macroevolution and speciation class (BIOL3724) on a three-day excursion to the Cradle of Mankind in Gauteng.

RESEARCH AND INNOVATION

Bloemfontein Campus Research Groups

Aquatic Ecology / Parasitology

A cooperative project was started in 2022 between Prof Linda Basson and scientists from the University of Marseille, titled 'Prevalence and perception of parasitism in two Mediterranean climates, France and South Africa'. This one-year research entailed three research trips. The first was in March 2022, during which data was collected in the Mossel Bay area by members of the South African team – Prof Linda Basson, Prof Liesl van As, Gerhard de Jager (from the UFS) and Prof Piet King, from the Sefako Makgatho Health Sciences University.

For the second trip, Prof Linda Basson visited Marseille from 16 to 25 July, during which she investigated two localities in the Mediterranean, together with two colleagues from the University of Marseille, Prof Delphine Thibault and Prof Sandrine Ruitton. A third research trip was organised to the De Hoop Nature Reserve from 22 October to 2 November. The research team from South Africa consisted of Linda Basson, Piet King and Gerhard de Jager. Members of the French team – Prof Thibault and Prof Ruitton – joined them for a part of the visit. Thereafter, the South African team returned for a brief period to Reebok, Mossel Bay to finalise some results.



From left: Gerhard de Jager (UFS), Delphine Thibault and Sandrine Ruitton (University of Marseille), Linda Basson (UFS) and Piet King (Sefako Makgatho Health Sciences University) during fieldwork on the south coast of South Africa

Second- and third-year Entomology students and some postgraduates with Dr Vaughn Swart (left front) visiting Agriculture Research Centre in Pretoria during the biannual Entomology career excursion



Qwaqwa BIOL3724 students during the field excursion to the Cradle of Humankind, Moropeng, led by Dr Mpho Ramoejane (second from right)



Zeiss microscope and camera set up during Mossel Bay fieldwork, with video recording (by Prof Liesl van As) of starfish mouth movement

Prof Linda Basson has been involved with a H2020 (Next Generation Taxonomy: Ciliophora and their bacterial symbionts as a proof of concept) since 2020. PhD student Gerhard de Jager was seconded for two three-month periods to Italy at the end of 2021 and the Max Planck Institute in Germany at the beginning of 2022. During August/September 2022 a team of one Russian and four Italian scientists, all from Pisa University, joined us as part of this project. All these scientists and the two of postgraduate students (Jade Hastings and Gerhard de Jager) gave very productive presentations, which were attended by guests from various departments on campus. As part of the research endeavours, they also collected

material and data from various water bodies in and around the Bloemfontein area, as well as in the Groot Brak and Klein Brak Rivers in the Western Cape.



Scientists from the University of Pisa during a research trip to the Klein Brak River, from the left, Gerhard de Jager (UFS), Prof Sergei Fokin, Dr Leandro Gammuto, Alessandro Allievi and Dr Valentina Serra



Staff and students from the Department of Zoology and Entomology attending the Parasitological Society of Southern Africa in the Kruger National Park, from the left, Dr Ed Netherlands, Luthando Bopheka (PhD student), Prof Liesl van As, Dr Ntathisi Nyembe and Anna Seeti (PhD student)

Precious Aywaei, a shared PhD student from NWU, visited Prof Liesl van As, and they spent an entire week working at the Centre for Microscopy as well as in the Parasitology lab.

The first conference our group attended in 2022 was South African Society of Aquatic Sciences (SASAqS) conference at the end of June, delivering seven papers. During September, the Parasitological Society of Southern Africa (PARSA) was attended in Kruger National Park, during which the Society also celebrated its 50th anniversary. This annual conference was co-hosted to include the 4th International Congress on Parasites of Wildlife (ICPOW). The first ICPOW was organised and hosted by the Aquatic Parasitology group of the UFS in 1990, and in 2012, PARSA decided to proceed with the initiative. Presentations were made by Prof Liesl van As, Luthando Bopheka (PhD student) and Precious Ayawei (joint PhD student).

Prof Linda Basson and two students, Gerhard de Jager and Jade Hastings, attended the conference of the Microscopy Society of southern Africa (MSSA) held from 5 to 8 December 2022 at Gold Reef City, Johannesburg, where all three delivered oral presentations, and Jade Hastings a poster as well. Gerhard de Jager won the student prize for the best oral presentation in Life Sciences.

Applied Agricultural Entomology

This group, led by De Villiers Fourie, focuses on modern applied pest management in the agricultural sector and holistic management with an emphasis on sustainability and novel pest management practises. Current research is investigating the sucking bug complex of several nut and sub-tropical crops (pistachio, pecan, macadamia, avocado, mango, litchi, etc.). Collaborative work continues with agricultural working groups and state-owned centres. There is also research interest in bio-control (biological agents and plant derived compounds) and resistance management, which is emerging at the forefront of plant and animal health research.

A comprehensive study on possible pyrethroid resistance developing in the two-spotted stinkbug on macadamia in the Nelspruit region,

will be completed in 2023 as De Villiers Fourie's PhD thesis. The aim of this study was to examine, in collaboration with the stinkbug working group and Macadamia South Africa (SAMAC), whether multi-generational genetic resistance is developing towards synthetic pyrethroids, and to aid in the development and establishment of a sustainable resistance management program to assist growers in the future. Pieter van der Merwe (MSc student) is conducting a study on the armoured scale complex and management options on walnuts in the Free State. This study is on-going.

Arachnology

During October 2022, Prof Charles Haddad hosted Dr Danilo Harms (Leibniz Museums, Hamburg) and Prof Stefan Foord (University of Venda) for a field trip to investigate the species richness and turnover of non-acarine arachnids in Afromontane forests and fynbos. The focus was on litter sifting, as species inhabiting the litter layer typically have lower dispersal capabilities and are more likely to be range endemics, a key consideration in evaluating their diversity and species turnover in fragmented forest patches. They were assisted by former student, Jan-Andries Neethling (National Museum, Bloemfontein) and Ruan Booysen (PhD student) in the field.



Ruan Booysen (PhD student) sifting a leaf litter sample for arachnids in the Kirstenbosch Botanical Gardens

The visit also included a day-trip to sample arthropods in the Wynberg Caves on Table Mountain, during which more than 10 species of non-acarine

arachnids were sampled, including a cave-endemic pseudoscorpion last collected in the 1930s. The field trip was followed by a week-long writing retreat in Bloemfontein, during which a paper was prepared on non-acarine arachnids in the Cape Floristic Kingdom as an example of an Old Climatically-Buffered Ancient Landscape (OCBIL).



Danilo Harms (Hamburg Museum) and caving guide Parry Pavlis (Cape Speleological Association) preparing to enter the Wynberg Caves on Table Mountain

Etho-ecology

Under the supervision of Dr Hennie Butler, Kristen Darker completed her MSc on enzootic geophagy by elephants (*Loxodonta africana*) in relation to geochemical composition of mineral licks in Addo Elephant National Park, South Africa.

As part of her MSc, Klinette Sutherland continued to monitor the feeding preferences of various antelope species by means of camera traps. The objective of this study is to determine the response of South African game species towards flavoured feed formulations. The findings might assist with passive capturing of game species, which will not only save costs but will also lower the risk of injuries to animals during capture procedures.

Honours student, Johanco Viljoen, completed a study on determining the trap duration needed to

sample small mammal community composition in grassveld. Johanco also presented a paper on his work at the symposium of the South African Academy of Science.

Environmental Entomology and Dipterology

The Environmental Entomology research group, led by Dr Vaughn Swart, is a subfield of Entomology that focuses on studying insects and their interactions with the environment. It encompasses a wide range of topics, including insect ecology, population dynamics, pest management, and the impacts of human activities on insect populations and ecosystems. Environmental entomologists use their knowledge of insects and the environment to develop strategies for preserving biodiversity, reducing pest damage to crops and forests and promoting sustainable agriculture. They also play an essential role in controlling the spread of insect-borne diseases by understanding the interactions between insects, pathogens and the environment. Dipterology is the scientific study of flies, including their biology, behaviour, classification and evolution. Flies belong to the order Diptera and are among the most diverse and abundant groups of insects in the world, with over 160 000 species described to date.

Dipterologists study flies in various habitats and they play an essential role in understanding the ecology and evolution of insects. They also investigate the relationships between flies and other organisms, including plants, animals and humans.

Liezl Whitehead, graduated and received her MSc degree *cum laude*. Her thesis was based on the phylogenetic analysis of South African *Aedes* Meigen, *Anopheles* Meigen and *Culex* L. mosquitoes (Culicidae) based on COI, ITS2 and ND4 sequences, which coincides with optimising DNA profiling techniques for the identification of mosquito species in the Free State. Her study contributed to the knowledge of South African mosquitoes, particularly to the foundation of phylogenetic and ecological data that can be incorporated into other epidemiological, biogeographical and evolutionary investigations.

Leon Gwanya, an Honours student, and Adriaan Stander, an MSc student, both researched the management of the brown locust (*Locustana*

pardalina). Gwanya examined the use of a particular experimental light source to attract this species, while Stander performed bioassays on various plant-based products to manage the brown locust.



A swarm of brown locusts that were spotted during field work in the Eastern Cape

Gary Edwards is finalising his MSc on ecological aspects of arthropod soil meso-fauna in nut orchards in the Free State and the Eastern Cape. During 2022, he investigated the effectiveness of using eDNA metabarcoding to detect, identify and determine the composition and diversity of soil-dwelling arthropods in pecan orchards.

PhD projects include those of Burgert Muller, studying the systematics of Afrotropical water snipe flies from the family Athericidae (Diptera), and De Villiers Fourie's investigation of pyrethroid resistance in two-spotted stinkbug, *Bathycoelia distincta* from the family Pentatomidae (Hemiptera), on macadamia nuts in South Africa.

The XXVI International Congress of Entomology took place in Helsinki, Finland, and was attended by Dr Vaughn Swart, partially funded by the NRF

KIC Travel Grant. As part of the Congress, Dr Swart also participated in a workshop, which is part of the Global Insect Threat-Response Synthesis (GLITRS) project, that is gathering the available evidence for trends in insect populations globally and the threats which are driving them, run by attendees from the University of Cambridge.

Herpetology

Tamson Foster (PhD student) focused on collecting DNA data in the laboratory of her co-supervisor, Prof Paul Grobler of the UFS Department of Genetics. This is the last data type for completing the datasets on which her project is based. The project deals with the phylogeny, morphology, reproduction and movement patterns of the tortoise species, *Homopus femoralis*. Statistical analyses of the datasets commenced and will continue into 2023. Consultations with Prof Neil Heideman (her supervisor) continued.

Dr Zhonging Zhao (Postdoctoral Fellow) worked on two manuscripts for publication ('How paleoclimate, paleogeography and habitat shaped diversification and distribution patterns of turtles globally' and 'Diversification of the African legless skinks in the subfamily Acontinae'). The former was completed with collaborators from other UFS departments and the Nelson Mandela University, and the latter with collaborators from other UFS departments and the Universities of Pretoria, Rhodes, Nelson Mandela and the Western Cape. When Dr Zhao's postdoctoral fellowship with Prof Neil Heideman was completed, he joined the Department of Genetics in May 2022.

From 23 May to 6 June 2022, Dr Ed Netherlands and Prof Louis du Preez (NWU) undertook a research visit to Auburn University (Alabama, USA). Dr Netherlands spoke at the Summit on Aquatic Pathogens and Parasites of the Southeastern United States, and did field-based sampling of local fish, amphibians and reptiles. Sampling included parasite screening of American alligators, *Alligator mississippiensis*, in partnership with the Louisiana Department of Wildlife & Fisheries from the Rockefeller Wildlife Refuge in southwestern Louisiana, bordering the Gulf of Mexico. They

also met up with the Arkansas Game and Fish Commission for parasite sampling of invasive Silver carp (*Hypophthalmichthys molitrix*) and Northern Snakehead (*Channa argus*) fishes.

In September, the 4th International Congress on Parasites of Wildlife (ICPOW) and the 50th Annual Congress of the Parasitological Society of Southern Africa (PARSA) took place in the Kruger National Park. In November, all the African amphibian specialists gathered for the 19th Meeting of the African Amphibian Working Group (AAWG) in Windhoek, Namibia. Dr Netherlands attended these two conferences and presented talks together with his students from NWU.

Insect Physiological Ecology / Biocontrol

In the week of 17 to 21 October 2022, Dr Nontembeko Dube attended the 48th Annual Research Meeting on the Biocontrol of Weeds Workshop, where she presented on three projects (*Dolichandra unguis-cati*, *Cylindropuntia pallida* and *Gledetsia triacanthos*) of the Weeds Research community. This resulted in strengthened and newly-formed partnerships with the Agricultural Research Council – Plant Health and Protection (ARC-PHP) and the Centre for Biological Control (CBC), respectively. This workshop, held at the Golden Gate Highlands National Park, was a joint venture between the ARU-PHP, CBC and various universities, namely, Rhodes, Witwatersrand, Cape Town, Free State, Fort Hare and Mpumalanga.



Dr Nontembeko Dube (third from the left in the back), together with other participants at the 48th Weeds workshop on biological control of invasive alien plants in South Africa

To cultivate their enthusiasm in insect physiology, Dr Dube invited ENTO2626 students to her lecture on the Biological Control of Invasive Alien Plants in South Africa. Students who attended commented on how inspirational the talk was, which was demonstrated by improved concentration in class and writing skills that were observed in the students that attended.



ENTO2626 student attendees of Dr Dube's lecture, from the left, Sanele Duba Lulama Mvelase, Lucas Morutle, Sisanda Mbuqana, Dr Nontembeko Dube, Palesa Motlhabi and Yedwa Gwil

Dr Nontembeko Dube at ARC-PHP preparing leaf clips to measure the photosynthesis capacity of plants using a chlorophyll fluorometer



Thabo Moabi (Honours student) completed a study investigating the biological control agents, *Carvalhotingis visenda* and *Hedwigiella jureceki*, as vectors for the adventive pathogen, *Cercospora unguis-cati*, in South Africa. This study was conducted in collaboration with plant pathologists from the UFS Department of Plant Sciences.

Dr Dube and Dr Makoena Moloi visited Dr Costas Zachariades at the ARC-PHP laboratories at Cedara on 4 January 2022, and Anthony King at the ARC-PHP laboratories in Roodeplaat on 10 June 2022. Both meetings related to investigating impacts of herbivory by natural enemies (insects and pathogens) on the physiology of invasive alien plants *Chromolaena odorata* and *Dolichandra unguis-cati*, respectively. This initiative is important for developing more research related to the modules Insect Physiology and Plant Physiology lectured by Dr Dube and Dr Moloi, respectively.

Nematology

Dr Candice Jansen van Rensburg and Anke de Smit (PhD student) attended and presented their work at the 7th International Congress of Nematology in Antibes, France from 1 to 6 May 2022. Dr Jansen van Rensburg also acted as co-chair with Dr Thomae Kakouli-Duarte in the parallel session on 'Ecology of Free-living Nematodes'.

Anke de Smidt attended and presented a poster at the 59th SASAQS conference hosted by the UFS at Amanzi Private Game Reserve in June 2022.

Terrestrial Ecology

Following on from previous years' work, conducted under the supervision and leadership of Prof Daryl Codron, to delve deeper into the conundrum of species coexistence, a new NRF-funded project, looking at the role of individual-level variance in both stabilising and equalising multi-species communities, was initiated. Preliminary models rooted in game theory revealed that, under conditions that favour individual niche generalism, populations of individual specialists suffer greater competitive setbacks so that generalists permeate the system in ever-increasing frequencies. This explains the persistence of mammalian communities comprising both generalist and specialist species, even in the absence of a life history-based

mechanism, as uncovered by Runé van der Merwe for her MSc research. Similarly, Chanel Lewis' MSc validated the expected difference in foraging strategies of carnivores compared to herbivore populations if the generalist-favouring model conditions were to hold. For their excellent contributions, both students graduated with distinction.

As part of her research on the acoustic niche, Dr Aileen van der Mescht (Postdoctoral Fellow) showed that not only diversity, but also patterns of niche expansion and contraction in orthopterans, are driven by topological features. Whether these environmental effects outweigh differences in life history remain to be determined, as does the question of whether expansions are individual- or population-level phenomena. It is nevertheless now clear that the acoustic niche does play a stabilising role for these populations.

The macroevolutionary implications of the lab's research continues to be realised in the form of studies on tooth wear and digestive physiology, which culminated in the first-ever empirical evidence for a dust-washing mechanism in the rumen. This process not only reduces tooth wear, reducing the necessity for elaborate dentition, but also overrides most existing notions about the digestive advantages and evolution of the ruminant digestive system.

Tick Research Unit

Testing of tick resistance to chemical control again formed the backbone of activities in this group after the previous drop in tick collections received during 2020 and 2021. Renewed conversations between Dr Ellie van Dalen and Roaland Jooste, a Veterinary Product and Ruminant Specialist at Elanco Animal Health, led to twenty tick collections received for resistance testing from Limpopo, Mpumalanga, Eastern Cape and KwaZulu Natal, to add to the current information on tick resistance distribution maps of South Africa. The methodology for chemical resistance testing of tick larvae was also refined by Elizna Terblans (MSc student), to involve

electronic technology in the evaluations of larval survival. This caused the tedious counting of larvae to be streamlined and completed in less than half the time usually spent on larval evaluation.

Elizna Terblans started her MSc studies under supervision of Dr Van Dalen and Leon Kruger (associated with the Department of Animal Science), on the investigation of the effect of hormone levels on tick infestations of cattle in different age classes. This investigation initiated a new avenue to combat tick resistance to chemical control, focusing more on the host resistance to tick infestations as a possible alternative for tick control, thereby reducing applications of chemicals for this purpose. The project is conducted on the Paradys Experimental Farm of the UFS, making use of animals from the Afrikaner cattle on the farm. Although ethical clearance and experimental farm difficulties delayed the start of the project, all was sorted towards the latter half of the year, and we are looking forward to what the results will reveal in 2023.



Tick collection from the Afrikaner cattle on the Paradys Experimental Farm, from the left, Johan Barnard (Farm Manager), Elizna Terblans (MSc student), Emile Wentzel (volunteer) and William Lesoana (Technician)

Another year was added to monitoring the invasion of the alien species, *Rhipicephalus microplus*, on a farm in the Eastern Cape, and 10 years after this species was found on the farm, distribution was still limited. This contradicts other published data that found invasion of the species to be quick, and in most places to totally displace the native species, *R. decoloratus*. We found *R. decoloratus* to still be the dominant blue tick species on this farm.

Qwaqwa Campus Research Groups

Kokonyana (Applied Entomology)

The Kokonyana research group is led by Dr Emile Bredenhand, with two PhD students. Serero Modise handed in his thesis, an ecological analysis of Afromontane grasslands making use of the Biotope Quality Index. Veli (Monday) Mdluli has been working hard on data collection of possible insect food sources available for bats, and will correlate results with bat activity and faecal samples to determine the important roles bats play in pest control.

The group was actively involved in the Witsieshoek Bioblitz project. Dr Samuel Motitsoe, a former Qwaqwa colleague currently working at Rhodes University, brought a group of his students to join the 2022 trip. The project studies variation in diversity, species richness and any other ecological differences between three high altitude environments (YouTube videos based on the work can be access on: <https://youtu.be/PSRGE7bbPcg> and https://youtu.be/a-gOMH_8rNg).

Serero Modise represented the research group at the Maloti-Drakensberg – Safeguarding and Preservation of the Dragon Heritage Workshop in December 2022. Monday Mdluli attended the 1st Southern African Mountain Conference (SAMC2022), 11th Oppenheimer Research Conference and AfriPopo Student Symposium, for which he was also part of the organising committee.

Projects are being developed on long-term insect monitoring stations in collaboration with the Agricultural Research Council (ARC: Bethlehem Small Grain Institute), and some vector-based projects will be started in collaboration with the Parasitology Lab, as well as still continue exploring the possibilities of collaboration with the Mountain Bat Lab.



Ecotoxicology

The Ecotoxicology research laboratory, led by Dr Patrick Voua Otomo, included six Master's and four PhD students in 2022. Student projects covered a variety of topics, including the influence of gravity on chemical avoidance by ants, the beneficial effects of starvation in annelid species exposed to pesticides, and the effects of river sediment from the Qwaqwa region on the survival and reproduction of laboratory test organisms.

Two ongoing PhD projects worth highlighting are a mycofiltration (i.e. use of fungi for water filtration) project conducted by Sanele Mnkandla and a plastic bioremediation project led by Nozipho Kheswa. Using the oyster mushroom *Pleurotus ostreatus*, Mnkandla created and optimised a mycofilter column capable of removing 30% of the insecticide imidacloprid, 5% of a select food colouring agent and up to 94% of iron ions from aqueous solutions. Her work was presented at the annual conference of the Society of Environmental Toxicology and Chemistry held in Copenhagen, Denmark in May 2022. A technical note on the mycofilter optimisation has been submitted to the *Bioremediation* journal for publication. From soils collected in the eastern Free State, Kheswa successfully isolated 20 fungal species with varying degrees of efficiency for plastic degradation. After the morphological description and DNA identification of the isolates, Kheswa is currently preparing a paper reporting her findings. She has submitted a review paper on plastic pollution, the integrated management plan thereof and promising plastic bioremediation opportunities in South Africa. Her preliminary findings will be presented at the 5th National Global Change Conference to be hosted in late January 2023 by the University of the Free State.

Two other postgraduate students continued their research, which they presented at SAMC2022 – Nomasonto Dlamini delivered a paper on 'Biochar amendment as a means to decrease terrestrial pollution from sewage sludge in Maluti-a-Phofung' and Ngitheni Nyoka on 'The state of aquatic pollution in Qwaqwa region: Physico-chemical parameters and chemical quantification'.

In August 2022, Dr Voua Otomo was invited to deliver the annual UNISA African Scholar Lecture (an event hosted by the College of Agriculture and Environmental Sciences); his lecture was titled

'Behavioural Ecotoxicology: Recent developments and perspectives'. In June 2022, under the auspices of the Risk and Vulnerability Science Centre, he invited Tello Mphuthi (Wastewater Treatment Plant Superintendent, Maluti-a-Phofung Municipality) to join a research visit to Israel to explore advances in water and wastewater treatment technologies. Subsequently, Mphuthi enrolled for a degree in integrated water management at the UFS Centre for Environmental Management.

Mammal Cognition / Behavioural Ecology

The Mammal Cognition research group of Prof Aliza le Roux had a 'facelift' and is now a mountain, i.e. the Behavioural Ecology Research Group (BERG), as mammals are no longer our main focus. In terms of small carnivore research, MSc student Rasekuwane Mosia landed an excellent project on meerkat behaviour at the Kalahari Meerkat Project (currently directed and owned by the University of Zurich), and Alex Botha finalised his PhD thesis on black-backed jackal behaviour in a montane grassland. Ruan de Bruin graduated in 2022 with a thesis on bat-eared fox behavioural endocrinology.

New projects are sprouting everywhere, including the excellent multi-disciplinary research by Sphindile Dlamini (MSc) on water management in the Upper Tugela River catchment. She conducted in-depth qualitative research, combined with traditional SASS assessments of water quality. This research included taking part in workshops and learning experiences led by SANBI's Living Catchments Project, which Prof Le Roux also attended to make sure that the UFS has a visible and real presence in these hands-on projects within our local communities.

Vertebrate Haemoparasite Biology

Dr Johann van As and Michelle van As continued their research 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. They also describe new species as yet unknown to the scientific world and look at other health aspects of the vertebrate hosts involved. This group has actively been part of the ARU's Witsieshoek BioBlitz project.

Animal Molecular Genetics

The research group leader, Dr Mpho Ramoejane, has been accepted in the Emerging Scholar Accelerator Programme (ESAP) for the period 2023 to 2024. This is intended to accelerate the publication output of the group. Nkanyiso Sishange completed his Honours degree and will be continuing his MSc with the research group. The research group is also actively taking part in the Witsieshoek Bioblitz project.

Parasitology

The research group of Dr Nthatisi Nyembe includes two Master's students, Thlonolofatso Sefojane and Thokozane Ncongwane, who are continuing with their studies. Their sample collection has been delayed due to ethical applications; nonetheless, good progress is being made.

Mountain Bats

The Mountain Bat Lab of Prof Peter Taylor and his students had a busy year. Under the ARU banner and funding, the group led two successful Bioblitz expeditions to Witsieshoek in March and November 2022, involving UFS students and researchers from Zoology and Entomology and Plant Sciences, as well as researchers from the University of Eswatini (UNESWA), University of Pretoria, Rhodes University, Albany Museum, University of KwaZulu-Natal and the Agriculture Research Centre.

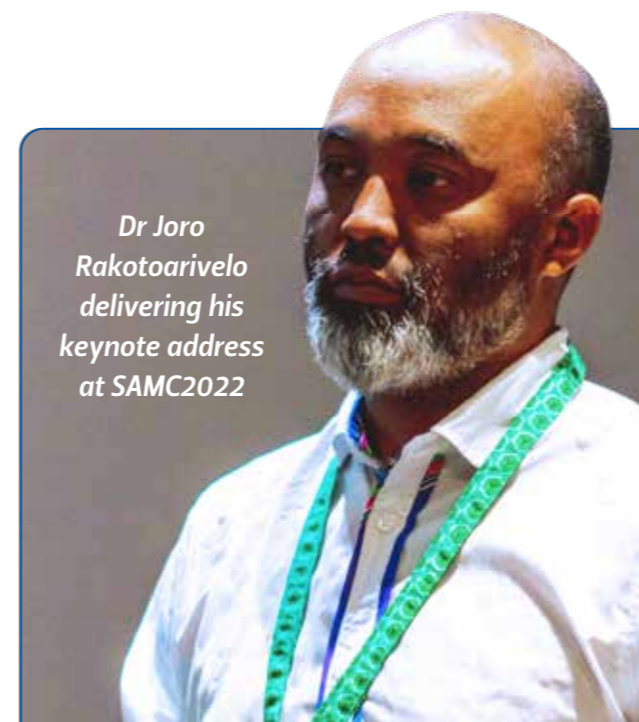
Videographer Luyanda Shabala produced a promotional video from the March Bioblitz that is featured on YouTube (https://www.youtube.com/watch?v=a-gOMH_8rNg).

Working on bats as ecosystem service providers and ecological indicators in agricultural, urban and conservation landscapes, PhD students Monday Mdluli and Alexandra Howard have completed much of their fieldwork. They presented papers at the 1st Southern African Mountains Conference (SAMC2022), the 3rd African Bioacoustics Conference, the 11th Oppenheimer Research Conference, and the 1st AfriPopo African Bats Student Conference.



PhD students Monday Mdluli and Alexandra Howard, during fieldwork in Witsieshoek

Participants in the Bioblitz, kneeling, from the left, Toka Mosakidi (UFS), Alexandra Howard (UFS), Veli Monday Mdluli (UFS) and, Thabethe Nokubonga (UKZN). Standing: Dewald Kleynhans (UP), Caswell Munyai (UKZN), Dr Emile Bredenhand (UFS), Dr Joro Rakotoarivelo (UFS), Prof Ara Monadjem (UNESWA), Prof Peter Taylor (UFS) and Dr Sandy Steenhuisen (UFS)



Dr Joro Rakotoarivelo delivering his keynote address at SAMC2022

Prof Peter Taylor presented at most of the above conferences, and was also invited as a plenary speaker at the 7th International Conference on Rodent Biology & Management. His talk was titled 'Convergence, allometry and phylogeny shape sensory morphology and brain size in African and North American rodents'.

Dr Joro Rakotoarivelo joined the group in 2022 on a contract from the Risk and Vulnerability Science Centre (RVSC) of the ARU. He presented a keynote talk at SAMC2022 titled 'How expansive were Malagasy Central Highland forests, ericoids, woodlands and grasslands? A multidisciplinary approach to a conservation conundrum'.

The research group published a new species of bat from Eswatini that featured in local and international press releases. In November, the Mountain Bat Lab hosted a world-renowned bat conservationist from Texas, Dr Merlin Tuttle. He presented seminars at Qwaqwa and Clarens and interacted with students and apple farmers where Alexandra is conducting her bat research. He also helped raise funds for Monday's children's book on bats, *QwaQwa's heroes after sunset*. Details of his visit can be found on the blog site of Merlin Tuttle's Bat Conservation (<https://www.merlintuttle.org/boosting-bats-in-south-africa/>).

ENGAGED SCHOLARSHIP

Academics from the Department were involved in reviewing articles for a range of scientific publications, including, *inter alia*, Prof Liesl van As processed articles as journal sub-editor of the *African Journal of Aquatic Sciences* and Prof Charles Haddad processed more than 20 articles as subject editor for the journals *Zootaxa* and *ZooKeys*.

Dr Candice Jansen van Rensburg and Prof Liesl van As visited the Academy for Environmental Leadership (AEL) SA near Upington. A variety of lectures and practical sessions were presented to the students with a focus on Freshwater Ecology.

Elizna Terblans and Dr Ellie van Dalen were invited to write a popular article for the annual *Angus Journal*



Dr Candice Jansen van Rensburg and Prof Liesl van As with the 2022 cohort of students at the Academy for Environmental Leadership

on the age-related and physiological differences that influence the tick load on cattle, with the aim to transfer scientific information in layman's terms to producers on ground level.

Prof Aliza le Roux continued to be an active steering group member of the Scientific Advisory Group on Emergencies (housed within ASSAf), publishing a very impactful advisory that contributed to the halting of seismic surveys off our Wild Coast (Le Roux, A., Singh, J.A., Ansorge, I., Bornman, T., Elwen, S., Gammage, L., Naidoo, S., Rajkaran, A., Vrancken, P., Kumar, P., and Manjoro., M. 2022. *Advisory on the use of deep-sea seismic surveys to explore for oil and gas deposits in South African Waters* (<https://www.assaf.org.za/files/2022/SAGE/SAGE%20Advisory%20on%20Shell%20Seismic%20Survey.pdf>).

This advisory led to her appearing on a podcast hosted by *The Academic Citizen* (<https://the-academic-citizen.org/2022/06/30/58-blue/>) and also writing a related commentary in the *South African Journal of Science* (refer to Research Articles for details).

Dr Patricks Voua Otomo served as Co-Chair of the Scientific Committee of the 1st Southern African Mountain Conference (SAMC2022) that was held in March 2022 under the auspices of the ARU.

Dr Ntatisie Nyembe served as a member of the SAMC2022 Scientific Committee, and reviewed abstracts for the conference. She is still a member



Patricks Voua Otomo (far right) together with fellow Co-Chair of the SAMC2022 Scientific Committee, Prof Samuel Adelabu (right), and Sandy Steenhuisen, Department of Plant Sciences

of the Macro Informative Youth Agency (MIYA) as a committee member for the community project.

Dr Mpho Ramoejane continued to serve as a member of the Golden Gate Highlands National Park Forum.

Funded by the UFS Interdisciplinary Grant, using bat houses as tools for data collection and environmental education in communities, Prof Peter Taylor and his students have engaged apple farmers and scholars in an engaged scholarship project in the Qwaqwa area. Monday Mdluli wrote a children's book about bats as part of an environmental education project. The book, *Qwa-Qwa's heroes after sunset*, soon to be available in English and Sesotho, was showcased at a Bat Tie fundraising gala event on 17 November 2022.



Dr Nontembeko Dube continues to serve as the advisory committee member of the Prince Edward Islands (PEIs), for which she reviews monthly reports of Environmental Conservation Officers (ECOs), and reviews and approves permits and Southern African National Antarctic Programme (SANAP) 3 applications (project proposals to take place in the PEIs and ongoing projects). She attended the Prince Edward Islands Advisory

Committee meeting held on 17 March 2022 at the Waterfront, Cape Town.

Under Prof Liesl van As' direction, Dr Dube, Dr Michael Vickers (Postdoctoral Fellow) and five Entomology postgraduate students assisted the Grade 6 pupils of Kingfisher Private School in Phalaborwa with their insect physiology projects. To demonstrate their gratitude, the pupils thanked the UFS team with a special gift made by a local artist's rendition of Bugs, Beetles and Butterflies, with a Phalaborwa twist, with the feathers of local birds signed by the headmistress and everyone involved in the project (pupils and teachers).



The UFS members that assisted with the Kingfisher Private School project, from the left, Dr Michel Vickers, Adriaan Stander, Keletso Makaota, Pieter van der Merwe, Dr Nontembeko Dube and Ruan Booysen

NATIONAL AND INTERNATIONAL COLLABORATION

National Collaboration

Prof Linda Basson and Prof Liesl van As continued with their long-standing collaboration with CapeNature (MoU renewed in 2022), SAIAB and with the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (FSDESTEA).

Dr Candice Jansen van Rensburg continued her collaboration with Prof Driekie Fourie from NWU and Dr Ed Netherlands has continued collaboration with Prof Louis du Preez and the African Amphibian Conservation Research Group from NWU. Dr Netherlands was appointed as an extraordinary lecturer at NWU, helping supervise several students and give postgraduate classes.

In 2022, a new collaboration was initiated between Dr Ed Netherlands and Dr Michael Bates and Dr Cora Stobie, both from the Department of Animal and Plant Systematics of the National Museum, Herpetology Division. During his visit to the Museum in Bloemfontein, valuable new connections were formed between the Department and the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON), as well as BirdlifeSA.

Dr Ellie van Dalen continued the collaboration with Elanco, Virbac and Zoetis animal health companies for testing of tick resistance on tick collections obtained from commercial producers after product queries. Determination of dip sample concentrations was also performed for these companies to ensure that chemical tick control breakdown was not due to incorrect dip preparations. The Tick Research Group was also subcontracted by Clinvet International to perform the larval packet test on tick samples collected from all over South Africa. This forms part of a greater molecular project that Clinvet embarked on to link actual resistance found in the field with mutations found in genes associated with tick resistance.

Dr Nontembeko Dube continues collaborating with Anthony King and Dr Costas Zachariades from

the ARC-PHP, with Dr Thabiso Mokotjomela from the South African National Biodiversity Institution (SANBI), Dr Grant Martin from the Centre for Biological Control, Rhodes University, Dr Caswell Munyai from the University of KwaZulu Natal, and Dr Makoena Moloji, UFS Department of Plant Sciences.

Dr Patricks Voua Otomo has an ongoing collaboration with researchers from the Technical University of Dresden (TUD, Germany), Cape Peninsula University of Technology (CPUT) and Dr Marinda Avenant from the Centre for Environmental Management on Bloemfontein Campus. This collaboration involves two postgraduate students – Nduduzo Kubheka and Ngitheni Nyoka.



Nduduzo Kubheka (MSc student) and Dr Dirk Jungmann (TUD) recording water quality measurements during the collaborative fieldwork in the Nahamadi River, Qwaqwa

International Collaboration

Prof Liesl van As, continued collaborating with colleagues from the Okavango Research Institute situated in Maun, Botswana. This Institute forms part of the University of Botswana, where she is also collaborating with Prof Maxwell Barson (Parasitologist) from the Biology Department.

Dr Ellie van Dalen collaborated with Corné Mostert, Product Manager at Ecto-parasiticides, Liver fluke products) and Marketing / Virbac RSA (Pty) Ltd, to present an online training session involving representatives of the company FIVAS, in Zimbabwe. An in-house video was produced for use in this presentation to virtually explain procedures to be followed during tick collection and initial field determination of possible tick resistance to the remedy in use. After the training session, the possibility of follow-up sessions was requested and will probably take place during 2023.

Dr Ed Netherlands has an ongoing collaboration with Prof Stephen A (Ash) Bullard from Auburn University, USA, where Dr Netherlands also holds a Graduate Faculty Research Fellow position at as well as at the School of Fisheries, Aquaculture and Aquatic Sciences in the USA.

In October 2022, a consortium of five Institutions, the Technical University of Dresden (Germany), the Arava Institute (Israel), the University of Wroclaw (Poland), the University of Salerno (Italy) and the UFS (with Dr Patricks Voua Otomo as Principal Investigator), submitted a 1.2 million Euro proposal in response to a call by the European Joint Programme Initiative (JPI) on 'Water4All'.

In December 2022, Dr Voua Otomo helped broker the Memorandum of Understanding between the UFS and Ecole de Management / EM-Gabon University. The signing ceremony was presided over by the UFS Rector and Vice-Chancellor, Prof Francis Petersen.

Prof Aliza le Roux strengthened her international collaboration through the NRF-KIC grant, which supported a visit by Dr Nick Friedman from the Leibniz Institute for Biodiversity Change. She also continued to work on papers with various collaborators from Michigan University and with Clara Grilo from Universidade Federal de Lavras, Brazil. As

leader of the women's mentorship programme for the Mountain-to-Mountain partnership with Appalachian State University, she led a team of mentors and mentees from the UFS to Boone in the USA for an excellent leadership summit.

Dr Nontembeko Dube continues her collaboration with Dr Osariyekemwen Uyi from the College of Agricultural and Environmental Sciences, University of Georgia.

Prof Peter Taylor collaborates actively with Prof Catrin Westphall and Prof Reinhard Rotter from the University of Göttingen and Prof Ingo Grass from University of Hohenheim, Germany, through the Southern African Limpopo Landscapes Network (SALLNET) of the SPACES project. In 2022, the collaboration entailed co-authored papers and book chapters (five in press and accepted), three co-supervised PhD students registered in South Africa and Germany, and Prof Taylor's participation in the final stakeholders workshop at SALLNET. Prof Grass will host a current PhD of Prof Taylor in Germany through a DAAD fellowship. Prof Taylor is a partner of the USDP Mountain Research staff doctoral programme (between UFS, University of Venda and three US institutions). Through this partnership, he has developed a new collaboration with Prof Kyran Kunkel from University of Montana, and they have submitted joint funding proposals to a number of



Prof Peter Taylor

funding agencies, including the Hoheisen Charitable Trust, which is still awaiting outcome. Prof Taylor's long-standing collaboration with Prof Monadjem from Eswatini continues, through co-supervision of two PhD students and one co-authored paper in 2022.

OTHER ACTIVITIES

59th Annual Conference of the South African Society of Aquatic Sciences

Together with the UFS Centre for Environmental Management (CEM), the Department of Zoology and Entomology, hosted the 59th Annual Conference of the South African Society of Aquatic Sciences (SASAqS), at Amanzi Private Game Reserve, Brandfort from 26 to 30 June 2022. Prof Liesl van As was the convenor of the Conference, and was very professionally assisted by Dr Candice Jansen van Rensburg and Dr Leon Barkhuizen (a Research Fellow in the Department). Keynote presentations were made by Dr Steve Mitchell and Prof Maitland Seaman (both former UFS staff members), as well as Prof Paul Skelton (Emeritus Professor, South African Institute of Aquatic Biodiversity [SAIAB]), Dr Nick

Rivers-Moore (University of KwaZulu Natal) and Prof Janine Adams (Nelson Mandela University). This very successful event was attended by 115 delegates from all over South Africa, with three colleagues from Tanzania and one from Belgium.

Outreach to schools

Dr Nontembeko Dube and Runé van der Merwe (PhD student) from the departmental marketing committee and Entomology students (Keletso Makaota, MSc and Ruan Booysen, PhD) visited Navalsig High School on 22 September 2022 and Christian Brothers College on 27 September 2022, to market the Department of Zoology and Entomology to the Grade 10 to 12 learners. In both schools, learners showed interest in what they learned from the presentation, which covered aspects taught and researched on both the Bloemfontein and Qwaqwa Campuses. However, the main challenge identified was that the subjects chosen by the learners were not in line with the admission requirements (Mathematics, Physical Sciences, Life Science and English), and most learners did not have the correct combination of subjects. Moving forward, the plan is to in future include the Grade 9's so they can select appropriate subjects in preparation for a BSc in Zoology and Entomology.



POSTGRADUATE STUDENTS

In 2022, the following postgraduate students were enrolled in the Department of Zoology and Entomology:

- **Honours:** Two in Zoology and two Entomology on the Bloemfontein Campus, and one in Zoology on the Qwaqwa Campus (Total: 5).
- **MSc:** Seven in Zoology and five in Entomology on the Bloemfontein Campus, with a further seven in Zoology on the Qwaqwa Campus (Total: 19).
- **PhD:** Seven in Zoology and eight in Entomology on the Bloemfontein Campus, and nine in Zoology on the Qwaqwa Campus (Total: 24).

Eight students graduated with the Honours degree on the Bloemfontein Campus (five in Zoology and three in Entomology), and three students graduated with an Honours in Zoology on the Qwaqwa Campus.

At Master's level, Aneke Kruger and Baily Weiss graduated in Zoology and Liezl Whitehead graduated in Entomology during the April graduation, while Runé van der Merwe and Chanel Lewis graduated during the December graduation. All five degrees on the Bloemfontein campus were awarded cum laude. On Qwaqwa Campus, Nomasonto Dlamini, Hendri Stander and Toka Mosikidi (cum laude) obtained their MSc degrees.

Two students graduated with the PhD in Zoology from the Bloemfontein Campus:

- **BUTLER, Hennie**
Thesis: Behavioural aspects of enzootic geophagy amongst large mammal herbivores.
Supervisor: Prof D Codron
Co-Supervisor: Prof WA van der Westhuizen
- **SWANEPOEL, Pieter**
Thesis: Assessing small-scale fisheries potential of Gariiep dam, South Africa's largest impoundment.
Supervisor: Dr LM Barkhuizen
Co-supervisors: Prof LL van As and Dr B Ellender

Two students graduated with PhD in Zoology from the Qwaqwa Campus:

- **BOTHA, Alex**
Thesis: Black-backed jackal (*Canis mesomelas*) ecology in the eastern Free State Afromontane grasslands, with specific reference to diet and behaviour.
Supervisor: Dr Aliza le Roux
- **KAMDEN, Michel**
Thesis: DNA barcoding investigation of South African hoverfly species and their use in environmental toxicology.
Supervisor: Dr Patrick Vouo Otomo

POSTDOCTORAL RESEARCH FELLOWS

The Department of Zoology and Entomology hosted two Postdoctoral Fellows, both in Bloemfontein:

- **Dr Aileen van der Mescht**, from South Africa, supervised by Prof Codron (ongoing).
- **Dr Michael Vickers**, from the USA, supervised by Prof Haddad (ongoing).

STAFF MATTERS

Hennie Butler obtained his PhD on 'Behavioural aspects of enzootic geophagy amongst large mammal herbivores', and graduated in December 2022.

Dr Ed Netherlands was appointed as Senior Lecturer (Herpetology, including parasitology of herpetofauna) in April 2022. He obtained his joint PhD degree from KU Leuven and NWU in 2019.

Dr Sibonginhlhla Mahlobo-Shwabede was appointed as Officer (Technician) for the running and maintenance of our molecular laboratory in August. She completed her undergraduate studies on the Qwaqwa Campus in 2014 and her PhD degree in 2020 from the University of KwaZulu-Natal.

RESEARCH OUTPUTS

Research Articles

Adams, L.D., Martin, G.D., Downs, C.T., Clark, V.R., Thabethe, V., Raji, I.A. & Steenhuisen S-L. 2022. Seed dispersal by frugivores and germination of the invasive alien shrub *Pyracantha angustifolia* (Franch.) C.K. Schneid, in Free State Province, South Africa. *Biological Invasions* 24: 2809–2819.

Alfimov, A.V. & Marusik, Y.M. 2022. Heat supply on the northern distribution limit of spiders (Arachnida: Aranei) living in xeromorphic habitats of the Kolyma River lower reaches, Northeastern Siberia. *Euroasian Entomological Journal* 21: 348–352. DOI: 10.15298/euroasentj.21.6.06.

Barkhuizen, L.M., Madzivanzira, T.C. & South, J. 2022. Population ecology of a wild population of red swamp crayfish *Procambarus clarkii* (Girard, 1852) in the Free State Province, South Africa and implications for eradication efforts. *Bio Invasions Records* 11: 181–191.

Bates, M.F., Alexander, G.J. & Bauer, A.M. 2022. Tribute to a legend of southern African herpetology: Wulf Dietrich Haacke (1936–2021), with a bibliography of his herpetological contributions. *African Journal of Herpetology* 71: 1–13. DOI: 10.1080/21564574.2022.2036825.

Bates, M.F. & Stobie, C.S. 2022. Current-day distribution of the rinkhals (*Hemachatus haemachatus*) in central South Africa and Lesotho: An evaluation based mainly on photographic and videographic records from social media. *African Journal of Herpetology* 71: 94–100. DOI: 10.1080/21564574.2021.1998237.

Bonaldo, A.B., Bosselaers, J., Ramírez, M.J., Labarque, F., Shimano, Y., Silva-Junior, C.J. & Haddad, C.R. 2022. Switching identities: a revision of the Afrotropical spider genus *Carteronius* Simon, 1897 (Araneae, Corinnidae), senior synonym of *Mandaneta* Strand, 1932, with a new genus of the Pronophaea group. *Zootaxa* 5205: 343–373.

Botha, A.E., Bruns, A. & Le Roux, A. 2022. The movement and space use of black-backed jackals (*Canis mesomelas*) in a protected mountainous grassland area. *African Zoology* 57: 43–55. DOI: 10.1080/15627020.2022.2057818.

Botha, A.E. & Le Roux, A. 2022. Black-backed

jackal niche analysis: A stable isotope approach to a generalist mesopredator. *Mammalian Biology* 102: 405–415. DOI: 10.1007/s42991-022-00241-7.

Botha, J., Choiniere, J.N. & Barrett, P.M. 2022. Osteohistology and taphonomy support social aggregation in the early ornithischian dinosaur *Lesothosaurus diagnosticus*. *Palaeontology* 65: e12619. DOI: 10.1111/pala.12619.

Botha, J., Choiniere, J.N. & Benson, R.B. 2022. Rapid growth preceded gigantism in sauropodomorph evolution. *Current Biology* 32: 4501–4507.

Canavan, K., Magengelele, N.M., Paterson, I.D., Williams, D.A. & Martin, G.D. 2022. Uncovering the phylogeography of *Schinus terebinthifolia* in South Africa to guide biological control. *AoB Plants* 14: plab078. DOI: 10.1093/aobpla/plab078.

Chapelle, K.E.J., Botha, J., Barrett, P.M. & Choiniere, J.N. 2022. Inter-elemental osteohistological variation in *Massospondylus carinatus* and its implications for locomotion and palaeoecology. *PeerJ* 10: e13918. DOI: 10.7717/peerj.13918.

Chikowore, G., Chidawanyika, F. & Martin, G.D. 2022. Contributions of black locust (*Robinia pseudoacacia* L.) to livelihoods of peri-urban dwellers in the Free State Province of South Africa. *GeoJournal* 87: 4565–4578.

Clauss, M., Tschuor, A., Codron, D. & Hummel, J. 2022. Reticular contraction frequency and ruminal gas dome development in goats do not differ between grass and browse diets. *Journal of Animal Physiology and Animal Nutrition* 106: 1208–1215. DOI: 10.1111/jpn.13663.

Cory-Toussaint, D. & Taylor, P.J. 2022. Anthropogenic light, noise, and vegetation cover differentially impact different foraging guilds of bat on an opencast mine in South Africa. *Frontiers in Ecology and Evolution* 10: DOI: 10.3389/fevo.2022.752665.

Cory-Toussaint, D., Taylor, P.J. & Barnhoorn, I.E.J. 2022. Non-invasive sampling of bats reflects their potential as ecological indicators of elemental exposure in a diamond mining area, northern Limpopo Province, South Africa. *Environmental Science and Pollution Research* 29: 13647–13660. DOI: 10.1007/s11356-021-16466-x.

Dlamini, N.P. & Otomo, P.V. 2022. High rates of biochar soil amendment cause increased incidences of neurotoxic and oxidative stress in *Eisenia*

fetida (Oligochaeta) exposed to glyphosate. *Applied Sciences* 12: 2381. DOI: 10.3390/app1205238.

Duque-Correa, M.J., Clauss, M., Hoppe, M.I., Buyse, K., Codron, D., Meloro, C. & Edwards, M.S. 2022. Diet, habitat and flight characteristics correlate with intestine length in birds. *Proceedings of Biological Sciences* 289: 20220675. DOI: 10.1098/rspb.2022.0675.

Fischer, J., Talal, G.D.A., Schnee, L.S., Otomo, P.V. & Filser, J. 2022. Clay types modulate the toxicity of low concentrated copper oxide nanoparticles towards springtails in artificial test soils. *Environmental Toxicology and Chemistry* 41: 2545–2465. DOI: 10.1002/etc.5440.

Fomichev, A.A. & Marusik, Y.M. 2022. *Cebrennus kazakhstanicus* sp. n. (Aranei: Sparassidae): the first record of the genus in Kazakhstan. *Caucasian Entomological Bulletin* 18: 321–324.

Fomichev, A.A., Ballarin, F. & Marusik, Y.M. 2022. A new genus of the family Nesticidae (Arachnida: Aranei) from the Caucasus. *Arthropoda Selecta* 31: 99–10. DOI: 10.15298/arthscl.31.1.12.

Goddards, M., Owen, C.A., Martin, G.D. & Coetzee, J.A. 2022. The thermal physiology of *Lysathia* sp. (Coleoptera: Chrysomelidae), a biocontrol agent of parrot's feather in South Africa, supports its success. *Biocontrol Science and Technology* 32: 837–846. DOI: 10.1080/09583157.2022.2054949.

Haddad, C.R. 2022. A preliminary survey of the ground-dwelling spider assemblages of the Ndumo Game Reserve, South Africa (Arachnida: Araneae). *Arachnology* 19: 517–526.

Haddad, C.R. 2022. Two new dionychnan spiders from arid western South Africa (Araneae: Prodidomidae, Trochanteriidae). *Arachnology* 19: 341–347.

Haddad, C.R. & Booysen, R. 2022. The ground spider genera *Leptodrassex* Murphy, 2007 and *Leptopilos* Levy, 2009 (Araneae: Gnaphosidae) in southern Africa, including the description of a new genus and seven new species. *Zootaxa* 5194: 1–32.

Haddad, C.R., Jin, C. & Platnick, N.I. 2022. A revision of the spider genus *Orthobula* Simon, 1897 (Araneae: Trachelidae) in the Afrotropical Region. I. Continental species. *Zootaxa* 5133: 355–382.

Hugo-Coetzee, E.A., Baumann, J., Neethling, J.A., Bardel-Kahr, I. & Pflingstl, T. 2022. Ontogeny of South African intertidal oribatid mite species (Acari,

Oribatida, Ameronothroidea) and supplements to adult morphology. *Acarologia* 62: 721–753.

Huttenlocker, A.K., Botha, J., Browning, C., Kulik, Z., Tshibalanganda, M. & Du Plessis, A. 2022. A Gulliver *Scaloposaurus* (Therapsida, Therocephalia) from the Katberg Formation of South Africa and its implication for Lilliput assemblages during the Early Triassic recovery. *Journal of African Earth Sciences* 196: 104720. DOI: 10.1016/j.jafrearsci.2022.104720.

Isla-Ortega, A.G., Marcotegui, P., Basson, L., De Jager, G.P. & Aguilar-Aguilar, R. 2022. Comparative exploration of the morphological plasticity of *Trichodina centrosrigeata* (Peritrichia: Mobilida) ectoparasite from the fills of two tilapia species (*Oreochromis niloticus* and *O. mossambicus*) in a global context. *Folia Parasitologica* 69: 022. DOI: 10.14411/fp.2022.022.

Khrulyova, O.A., Tanasevitch, A.V. & Marusik, Y.M. 2022. Spiders (Aranei) of Wrangel Island, Russia. 1. New data on the species composition and distribution. *Arthropoda Selecta* 31: 501–525. DOI: 10.15298/arthscl.31.4.12.

Lang, J., Chidawanyika, F., Khan, Z.R. & Schuman, M.C. 2022. Ecological chemistry of pest control in push-pull intercropping systems: what we know, and where to go? *Chemical Ecology* 76: 108.

Linden, B., Dalton, D.L., Van Wyk, A., De Jager, D., Moodley, Y. & Taylor, P.J. 2022. Potential drivers of samango monkey (*Cercopithecus albogularis*) population subdivision in a highly fragmented mountain landscape in northern South Africa. *Primates* 63: 245–260. DOI: 10.1007/s10329-022-00981-7.

Mammola, S., Malumbres-Olarte, J., Arabesk, V., Barrales-Alcalá, D.A., Barrion-Dupo, A.L., Benamú, M.A., Bird, T.L., Bogomolova, M., Cardoso, O.P., Chatzaki, M., Cheng, R.C., Chu, T.A., Classen-Rodríguez, L.M., Čupić, I., Dhiya'ulhaq, N.U., Picard, A.D., El-Hennawy, H.K., Elverici, M., Fukushima, C.S., Ganem, Z., Gavish-Regev, E., Gonnys, N.T., Hacala, A., Haddad, C.R., Hesselberg, T., Ho, T.A.T., Into, T., Isaia, M., Jayaraman, D., Karuaera, N., Khalap, R., Khalap, K., Kim, D., Korhonen, T., Kralj-fišer, S., Land, H., Lin, S.W., Lobod, S., Lowe, E., Lubin, Y., Martínez, A., Mbo, Z., Miličić, M., Kioko, G.M., Nanni, V., Norma-Rashid, Y., Nwankwo, D., Painting, C.J., Pang, A., Pantini, P., Pavlek, M., Pearce, R., Petcharad, B., Pétilion, J., Raberahona, O., Saarinen, J.A., Segura-

Hernández, L., Sentenská, L., Uhl, G., Walker, L., Warui, C.M., Wiśniewski, K., Zamani, A., Scott, C. & Chuang, A. 2022. An expert-curated global database of online newspaper articles on spiders and spider bites. *Scientific Data* 9: 109.

Mammola, S., Malumbres-Olarte, J., Arabesky, V., Barrales-Alcalá, D.A., Barrion-Dupo, A.L., Benamú, M.A., Bird, T.L., Bogomolova, M., Cardoso, P., Chatzaki, M., Cheng, R.C., Chu, T.A., Classen-Rodríguez, L.M., Čupić, I., Dhiya'ulhaq, N.U., Picard, A.D., El-hennawy, H.K., Elveric, M., Fukushima, C.S., Ganem, Z., Gavish-Regev, E., Gonnye, N.T., Hacala, A., Haddad, C.R., Hesselberg, T., Ho, T.A.T., Into, T., Isaia, M., Jayaraman, D., Karuaera, N., Khalap, R., Khalap, K., Kim, D., Korhonen, T., Kralj-fišer, S., Land, H., Lin, S.W., Loboda, S., Lowe, E., Lubin, Y., Martínez, A., Mbo, Z., Miličić, M., Kioko, G.M., Nanni, V., Norma-Rashid, Y., Nwankwo, D., Painting, C.J., Pang, A., Pantini, P., Pavlek, M., Pearce, R., Petcharad, B., Pétilion, J., Raberahona, O.C., Saarinen, J.A., Segura-Hernández, L., Sentenská, L., Uhl, G., Walker, L., Warui, C.M., Wiśniewski, K., Zamanl, A., Scott, C. & Chuang, A. 2022. The global spread of (mis)information on spiders. *Current Biology* 32: R855-R873.

Marsh, C.J., Sica, Y.V., Burgin, C.J., Dorman, W.A., Anderson, R.C. & Taylor, P.J. 2022. Expert range maps of global mammal distributions harmonised to three taxonomic authorities. *Journal of Biogeography* 49: 979-992. DOI: 10.1111/jbi.14330.

Martin, L.F., Winkler, D.E., Ackermans, N.L., Müller, J., Tütken, T., Kaiser, T., Codron, D., Schulz-Kornas, E., Hatt, J-M. & Clauss, M. 2022. Dental microwear texture analysis correlations in guinea pigs (*Cavia porcellus*) and sheep (*Ovis aries*) suggest that dental microwear texture signal consistency is species-specific. *Frontiers in Ecology and Evolution* 10: 958576.

Marusik, Y.M. 2022. On the identity of *Cheiracanthium orientale* Kulczyński, 1885 (Aranei: Cheiracanthiidae) from Kamchatka, northeastern Siberia. *Arthropoda Selecta* 31: 95-98. DOI: 10.15298/arthsels.31.1.11.

Marusik Y.M. 2022. On the three poorly known species of *Dictyna* Sundevall, 1833 (Araneae, Dictynidae) described from Armenia and Siberia. *Journal of Natural History* 56: 415-422. DOI: 10.1080/00222933.2022.2073479.

Marusik, Y.M. & Alfimov, A.V. 2022. Unexpected diversity of wandering spiders in the tundra zone

(Aranei: Gnaphosidae, Philodromidae, Salticidae) of Northeastern Siberia. *Arthropoda Selecta* 31: 527-532. DOI: 10.15298/arthsels.31.4.13.

Marusik, Y.M. & Omelko, M.M. 2022. Three new species of *Cybaeus* L. Koch, 1868 (Aranei: Cybaeidae) from the Maritime Province of Russia. *Arthropoda Selecta* 31: 335-341. DOI: 10.15298/arthsels.31.3.10.

Marusik, Y.M. & Sherwood, D. 2022. Matronymic genera in spiders (Araneae) named for arachnologists. *Arachnology* 19: 150-157.

Masole, P., Steenhuisen, S-L. & Martin, G.D. 2022. Current status of the invasive shrub *Berberis julianae* C.K. Schneid. (Berberidaceae) in Golden Gate Highlands National Park (Free State Province, South Africa). *South African Journal of Botany* 150: 99-105.

Mnkandla, S.M. & Otomo, P.V. 2022. Two novel bioassays useful for the quick assessment of chemical effects on the behavior of mosquito larvae (Culicidae) and adult earthworms (Lumbricidae). *MethodsX* 9: 101661. DOI: 10.1016/j.mex.2022.101661.

Mohale, N.E., Codron, D. & Horwitz, L.K. 2022. Stable isotope evidence for mid-Pleistocene paleoenvironmental conditions at the site of Kathu Pan 1 (central interior, South Africa). *Quaternary International* 614: 37-49. DOI: 10.1016/j.quaint.2021.02.027.

Mulaudzi, L., Mutamiswa, R., Zachariades, C. & Chidawanyika, F. 2022. Life-stage-related desiccation and starvation resistance in the biological control agent *Neolema abbreviata*. *Entomologia Experimentalis et Applicata* 170: 1055-1065. DOI: 10.1111/eea.13238.

Mutamiswa, R., Chikowore, G., Nyamukondiwa, C., Mudereri, B.T., Khan, Z.R. & Chidawanyika, F. 2022. Biogeography of cereal stem borers and their natural enemies: forecasting pest management efficacy under changing climate. *Pest Management Sciences* 78: 4446-4457. DOI: 10.1002/ps.7062.

Nadolny, A.A., Marusik, Y.M., Kronstedt, T., Kovblyuk, M.M. & Zamani, A. 2022. New cases of teratologic deformities in wolf spiders (Araneae: Lycosidae). *Arachnology* 19: 585-590.

Norton, L.A., Abdala, F., Rubidge, B.S. & Botha, J. 2022. Tooth replacement in the non-mammalian cynodont *Cynosaurus suppostus* (Therapsida) from the late Permian of South Africa. *Journal*

of Vertebrate Palaeontology 41: e2001650. DOI: 10.1080/02724634.2021.2001650.

Nyamukondiwa, C., Machezano, H., Chidawanyika, F., Mutamiswa, R., Ma, G. & Ma, C.-S. 2022. Geographic dispersion of invasive crop pests: the role of basal, plastic climate stress tolerance and other complementary traits in the tropics. *Current Opinion in Insect Science* 50: 100878. DOI: 10.1016/j.cois.2022.100878.

Omelko, M.M. & Marusik, Y.M. 2022. A new species of *Borboropactus* (Aranei: Thomisidae) from Malaysia, Borneo. *Far Eastern Entomologist* 459: 27-32.

Omelko, M.M. & Marusik, Y.M. 2022. First data on *Arctosa* wolf spiders (Aranei: Lycosidae) from Laos. *Raffles Bulletin of Zoology* 70: 397-406. DOI: 10.26107/RBZ-2022-0021.

Pekár, S., Martišová, M., Tóthová, A.S. & Haddad, C.R. 2022. Multiple mimetic traits of myrmecomorphic species and their co-evolution. *iScience* 25: 105126.

Pekár, S., Petráková, L., Machackova, T., Slaby, O., Garcia, L. & Haddad, C.R. 2022. Gut-content analysis in four species, combined with comparative analysis of trophic traits, suggests an araneophagous habit for the entire family Palpimanidae (Araneae). *Organisms Diversity and Evolution* 22: 265-274.

Petelle, M.B., Jacobs, P.J. & Le Roux, A. 2022. Innovative problem solving in a small, wild canid. *Animal Cognition* 26: 405-413. DOI: 10.1007/s10071-022-01678-6.

Pfingstl, T., Wagner, M., Baumann, J., Neethling, J.A., Bardel-Kahr, I. & Hugo-Coetzee, E.A. 2022. Contrasting phylogeographic patterns of intertidal mites (Acari, Oribatida) along the South African shoreline. *Organisms, Diversity & Evolution* 22: 789-801.

Ramírez, M.J., Magalhaes, I.L.F., Pizarro-Araya, J., Ballarin, F., Marusik, Y.M. & Eskov, K.Y. 2022. A new species of the spider genus *Tekellina* Levi, 1957 from Chile, with a broadened definition of the family Synotaxidae (Arachnida, Araneae). *Zoologischer Anzeiger* 301: 76-90. DOI: 10.1016/j.jcz.2022.08.005 IF 1.521

Ratto, F., Bruce, T., Chipabika, G.S., Mkandawire, R., Khan, Z.R., Mkindi, A., Pittchar, J., Chidawanyika, F., Sallu, S.M., Whitfield, S., Wilson, K. & Sait, S.M. 2022. Biological control interventions and botanical pesticides for insect pests of crops in sub-Saharan Africa: A mapping Review. *Systematic Review* 6:

883975. DOI: 10.3389/fsufs.2022.883975.

Rööslä, M., Fuhrmann, S., Atuhaire, A., Rother, H-A., Dabrowski, J., Eskenazi, B., Jørs, E., Jepson, P.C., London, L., Naidoo, S.J., Rohlman, D.S., Saunyama, I., Wendel de Joode, B., Adeleye, A.O., Alagbo, O.O., Aliaj, D., Azanaw, J., Beerappa, R., Brugger, C., Chaiklieng, S., Chetty-Mhlanga, S., Chitra, G.A., Dhananjayan, V., Ejomah, A., Enyoh, C.E., Galani, Y.J.H., Hogarh, J.N., Ihedioha, J.N., Ingabire, J.P., Isgren, E., Loko, Y.L.E., Maree, L., Ernest, N.M., Moda, H.M., Mubiru, E., Mwema, F.M., Ndagire, I., Olutona, G.O., Otieno, P., Paguirigan, J.M., Quansah, R., Ssemugabo, C., Solomon, S., Sosan, M.B., Sulaiman, M.B., Teklu, B.M., Isioma, T., Uyi, O., Cueva-Vásquez, H., Veludo, A., Viglietti, P. & Dalvie, M.A. 2022. Interventions to reduced pesticide exposure from the Agricultural sector in Africa: A workshop report. *International Journal of Environmental Research and Public Health* 19: 8973. DOI: 10.3390/ijerph19158973.

Sebata, S., Haddad, C.R., Foord, S.H. & Fitzpatrick, M.J. 2022. Weak negative responses of spider diversity to short-term 'kraaling'. *The Rangeland Journal* 44: 61-75.

Simmons, Z. & Marusik, Y.M. 2022. On a confusion with the type localities of spiders described from the material collected during the Second Yarkand Mission. *Arachnology* 19: 166-181.

Singh, J.A., Le Roux, A. & Naidoo, S. 2022. Marine seismic surveys for hydrocarbon exploration: What's at stake? *South African Journal of Science* 118: 13420. DOI: 10.17159/sajs.2022/13420.

Smith, R.M.H., Botha, J. & Viglietti, P.A. 2022. Taphonomy of drought-afflicted tetrapods in the Early Triassic Karoo Basin, South Africa. *Palaeogeography, Palaeoclimatology, Palaeoecology* 604: 111207.

Sutton, G.F. & Martin, G.D. 2022. Testing MaxEnt model performance in a novel geographic region using an intentionally introduced insect. *Ecological Modelling* 473: 110139. DOI: 10.1016/j.ecolmodel.2022.110139.

Taylor, P.J., Strydom, E., Richards, L., Markotter, W., Cory-Toussaint, D., Kearney, T., Cotterill, F.P.D., Howard, A., Weier, S.M., Keith, M., Neef, G., Mamba, M., Magagula, S. & Monadjem, A. 2022. Integrative taxonomic analysis of new collections from the central Angolan highlands resolves the taxonomy of African pipistrelloid bats on a continental scale. *Zoological Journal of the Linnean Society* 196: 1570-1590. DOI: 10.1093/zoolinnean/zlac071.

Tsotesti, P.A.A., Nyoka, N.W., Mazibuko, S.S., Mnkandla, S.M., Fouché, F. & Otomo, P.V. 2022. Behavioural changes and flight response of a mosquito (Culicidae) and an earthworm (Lumbricidae), respectively, after exposure to imidacloprid. *Ecotoxicology* 31: 367-375. DOI: 10.1007/s10646-021-02513-3.

Úngari, L.P., Netherlands, E.C., Quagliatto Santos, A.L., Paulino De Alcantara, E., Emmerich, E., José Da Silva, R. & O'Dwyer, L.H. 2022 Diversity of Haemogregarine parasites infecting Brazilian anurans, with a description of new species of *Dactylosoma* (Apicomplexa: Adeleorina: Dactylosomatidae). *Acta Parasitologica* 67: 1740-1755. DOI: 10.1007/s11686-022-00624-3.

Uyi, O., Lahiri, S., Ni, X., Buntin, D., Jacobson, A., Reay-Jones, F.P.F., Punnuri, S., Huseh, A.S. & Toews, M.D. 2022. Host plant resistance, foliar insecticide applications and natural enemies play a role in the management of *Melanoasphis sorghi* (Hemiptera: Aphididae) in grain sorghum. *Frontiers in Plant Science* 13: 1006225. DOI: 10.3389/fpls.2022.1006225.

Uyi, O., Ready-Jones, F.P.F., Ni, X., Jacobson, A., Punnuri, S. & Toews, M.D. 2022. Impact of planting date and insecticide applications methods on *Melanaphis sorghi* (Hemiptera: Aphididae) infestations and forage type sorghum yield. *Insects* 13: 1038. DOI: 10.3390/insects13111038.

Valerio, S.O., Hummei, J., Codron, D., Hatt, J-M. & Clauss, M. 2022. The Ruminant sorting mechanism protect teeth from abrasives. *PNAS* 119: 49.

Van der Mescht, A.C. & Codron, D. 2022. Mountains and their ecotones increase landscape heterogeneity and maintain a unique assemblage of grasshoppers in the southern Kalahari. *Ecological Entomology* 1-14 DOI: 10.1111/een.13217.

Van der Mescht, A.C., Lewis, C., Van der Merwe, R. & Codron, D. 2022. Hurry up and sing: early onset of diel calling behaviour and ecological drivers of calling behaviour of *Acanthopplus discoidalis*. *Bioacoustics* 1-17. DOI:10.1080/09524622.2022.2112289.

Venter, C., Haddad, C.R. & Codron, D. 2022. A novel approach to determine the surface area of buckspoor spider webs and other irregular-shaped two-dimensional objects. *MethodsX* 9: 101904.

Venter, G.J., Sebetsang, S.S., Swart, V.R., Boikanyo, S.N.B. & De Beer, C.J. 2022, Comparison of the

efficiency of the Onderstepoort- and Centres for Disease Control ultraviolet light traps for the collection of livestock associated *Culicoides* species in South Africa. *Medical and Veterinary Entomology* 36: 113-126.

Winter, N., Clauss, M., Codron, D., Hummel, J., Müller, J., Richter, H., Kircher, P.R., Hatt, J-M. & Martin, L.F. 2022. Sand accumulation in the digestive tract of rabbits (*Oryctolagus cuniculus*) and guinea pigs (*Cavia porcellus*). *Journal of Morphology* 283: 5-15. DOI: 10.1002/jmor.21423.

Zamani, A. & Marusik, Y.M. 2022. A new genus of Zodariidae (Arachnida: Araneae) from Tajikistan. *Journal of Natural History* 56: 1187-1198. DOI: 10.1080/00222933.2022.2115422.

Zamani, A. & Marusik, Y.M. 2022. A new species of *Plator* Simon, 1880 from Pakistan, with notes on *P. pandeae* Tikader, 1969 (Araneae: Trochanteriidae). *Revue Suisse de Zoologie* 129: 297-301. DOI: 10.35929/RSZ.0076.

Zamani, A. & Marusik, Y.M. 2022. New taxonomic considerations in *Zodariellum* Andreeva & Tyshchenko, 1968 (Araneae: Zodariidae), with notes on the presence of cymbial diverticulum in different zodariid genera. *Zootaxa* 5178: 161-177. DOI: 10.11646/zootaxa.5178.2.3.

Zamani, A. & Marusik, Y.M. 2022. New taxonomic data on Zodariinae (Araneae: Zodariinae) of Azerbaijan, Iran, Afghanistan and Pakistan. *Zootaxa* 5155: 423-438. DOI: 10.11646/zootaxa.5155.3.7.

Zamani, A. & Marusik, Y.M. 2022. On a small collection of spiders (Arachnida, Araneae) from Iraq, with new Species and records. *Zoodiversity* 56: 291-306. DOI: 10.15407/zoo2022.04.291.

Zamani, A., Nadolny, A., Esyunin, S.L. & Marusik, Y.M. 2022. New data on the spider fauna of Iran (Arachnida: Araneae), Part IX. *Arachnology* 19: 358-384.

Zarikian, N.A., Propistsova E.A. & Marusik Y.M. 2022. On spider families (Arachnida: Araneae) new to Armenia. *Israel Journal of Entomology* 51: 103-117. DOI: 10.5281/zenodo.6466083.

Zonstein, S.L. & Marusik, Y.M. 2022. Descriptions of *Sceliraptor* gen. nov. and two new species from Kenya (Araneae, Palpimanidae). *Arachnology* 19: 257-264.

Zonstein, S.L. & Marusik, Y.M. 2022. Redescription

of a poorly known genus *Ikuma* Lawrence, with synonymy and description of a new species from Namibia (Araneae, Palpimanidae). *African Invertebrates* 63: 105-119.

Books/Chapters in Books

Botha, A.E., Drouilly, M., Koepfel, K. & Le Roux, A. 2022. Trapping success of black-backed jackals (*Canis mesomelas*) in South Africa relative to land use type. In: *Mammal Trapping Wildlife Management, Animal Welfare & International Standards*. G. Proulx (Ed). Canada: Alpha Wildlife Publications. pp 161-172.

Canavan, K., Canavan, S., Clark, V.R., Gwate, O., Mapaura, A., Richardson, D.M., Steenhuisen, S.-L. & Martin, G.D. 2022. Chapter 14. Invasive Alien Plants in the Montane Areas of South Africa: Impacts and Management Options, In: *Human-Nature Interaction*: Misiune, I., Depellegrin, D., & Egarter Vigl, L. (Eds). Springer, Cham. DOI: 10.1007/978-3-031-01980-7_14.

Conference Contributions

Conference Papers/Posters

Ayawei, P.P., Smit, N.J., Van As, L.L. & Hadfield, K.A. 2022. *An integrated study on parasitic Crustacea infesting selected freshwater fish from Southern Africa*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11-15 September 2022.

Ayawei, P.P., Smit, N.J., Van As, L.L. & Hadfield, K.A. 2022. *Biodiversity and integrated systematics of parasitic Crustacea among selected commercial fish species in southern Africa*. Paper delivered at the 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Ayawei, P.P., Smit, N.J., Van As, L.L. & Hadfield, K.A. 2022. *Molecular and morphological characterisations of three species of *Lamproglana von Nordmann, 1832* from Southern Africa*. Poster presented at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11-15 September 2022.

Basson, L. & De Jager G.P. 2022. *Reports of*

introduced ciliate parasites from fish in the Free State River. Paper delivered at the 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Basson, L. & De Jager, G.P. & Ansorge, I. 2022. *Haeckling in the Antarctic*. Poster presented at the 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Bopheka, L., Van As, J., Cook, C.A. & Van As, L.L. 2022. *Austroglanis sclateri (Boulenger, 1901) from Wilge River, Free State, South Africa. The forgotten child*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11-15 September 2022.

Codron, D., Van der Merwe, R. & Lewis, C. 2022. *A causal link between individual variation and the maintenance of biodiversity in multispecies communities*. Poster presented at the 11th Oppenheimer Research Conference, Midrand, South Africa. 5-7 October 2022.

De Jager, G.P. & Basson, L. 2022. *Curious case of *Trichodina diaptomid (Dogiel, 1940)* Basson & Van As, 1991 from calanoid copepods*. Poster presented at 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

De Smidt, A. & Jansen Van Rensburg C. 2022. *Survey of free-living freshwater nematodes from the Okavango Delta, Botswana*. Poster presented at 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

De Smidt, A., Jansen Van Rensburg, C. & Van As, L.L. 2022. *Nematode survey of grassland habitats in two nature reserves of the Free State Province, South Africa*. Poster presented at the 7th International Congress of Nematology, Antibes Juan-Les-Pins, France. 1-6 May 2022.

Dlamini, N.P. & Voua Otomo, P. 2022. *Biochar amendment as a means to decrease terrestrial pollution from sewage sludge in Maluti-a-Phofung*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Dube, N. 2022. *A perspective on creeping*

Dolichandra unguis-cati), spiny (*Cylindropuntia pallida*), and Honey locust (*Gledetsia triacanthos*). Paper delivered at the 48th Annual Workshop on Biological Control of Weeds, Golden Gate, South Africa. 17–21 October 2022.

Du Buisson, J., Du Preez, L.H. & Netherlands, E.C. 2022. *The biodiversity of frog blood parasites from the Vhembe Biosphere, Limpopo, South Africa*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11–15 September 2022.

Haarhoff, T.J. Du Preez, L.H., Pretorius, M. & Netherlands, E.C. 2022. *The complete mitochondrial genome sequences of Hepatozoon theileri and Hepatozoon ixoxo (Adeleorina: Hepatozoidae) parasitising frogs from South Africa*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11–15 September 2022.

Jansen Van Rensburg C. 2022. *Protected areas of southern Africa: what do we know of the nematofauna?* Paper delivered at the 7th International Congress of Nematology, Antibes Juan-les-Pins, France. 1–6 May 2022.

Jordaan, B.J., Du Preez, L.H. & Netherlands, E.C. 2022. *Taxonomic re-evaluation of African anuran trypanosomes with the redescription and molecular diagnosis of Trypanosoma nelspruitense Laveran, 1904 and Trypanosoma grandicolor Pienaar, 1962*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11–15 September 2022.

Kruger, A.Z., Jansen Van Rensburg, C. & Van As, L.L. 2022. *Ceriodaphnia en siklomorfose*. Paper delivered at the Suid Afrikaanse Akademie vir Wetenskap en Kuns Studentesimposium in die Natuurwetenskappe, Centurion, South Africa. 3–4 November 2022.

Kruger, A.Z., Jansen Van Rensburg, C. & Van As, L.L. 2022. *Diversity of Daphnia spp. In six Free State Nature Reserves*. Poster presented at the 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve,

Brandfort, South Africa. 26–30 June 2022.

Le Roux, A., Mkotywa, A. & Botha, A. 2022. *Behaviour of a mesopredator (Canis Mesomelas) in a montane grassland*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022

Lewis, C. & Codron D. 2022. *Integrasie Van trofiese vlak met die nisvariasie hipotese: 'n Vergelyking Van individuele nisvariasie tussen soogdier herbivoor- en karnivoorbevolkings*. Paper delivered at the Suid Afrikaanse Akademie vir Wetenskap en Kuns Studentesimposium in die Natuurwetenskappe, Centurion, South Africa. 3–4 November 2022.

Lewis, C., Van der Merwe, R. & Codron, D. 2022. *Integrating trophic level with the niche variation hypothesis: a comparison of individual niche variation between mammal herbivore and carnivore populations*. Poster presented at the 11th Oppenheimer Research Conference, Midrand, South Africa. 5–7 October 2022.

Makaota, K., Mokotjomela, T. M., Dube, N. & Mbele, T. J. 2022. *Investigating relationship between population structure and impacts of Cylindropuntia pallida F.M. Knuth in South Africa*. Poster presented at the National Symposium on Biological Invasions, Alice, South Africa. 6–8 July 2022.

Makaota, K., Mokotjomela, T. M., Dube, N. & Mbele, T. J. 2022. *Investigating relationship between population structure and impacts of Cylindropuntia pallida F.M. Knuth in South Africa*. Paper delivered at the 17th Kimberley Biodiversity Research Symposium, Kimberley, South Africa. 9 November 2022.

Mdluli, V., Weier, S., Monadjem, A. & Taylor, P. 2022. *Quantifying the effects of elevation and anthropogenic disturbance on bat communities in a montane grassland ecosystem*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March, 2022.

Molefe-Nyembe N. 2022. *Evaluation of trypanocidal activity of Triclosan on animal trypanosomes*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11–15 September 2022.

Netherlands, E.C. & Du Preez, L.H. 2022. *Haemoparasites found parasitizing species of Leptopelis (Arthroleptidae) from southern*

Africa. Paper delivered at the 19th Meeting of the African Amphibian Working Group (AAWG) (Virtual Conference). 22–23 November 2022.

Netherlands, E.C. & Du Preez, L.H. 2022. *Xenopus laevis still full of surprises: The first report of a species of BabesiosomaJakowska and Nigrelli, 1956 (Apicomplexa: Adeleorina) from an African anuran*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11–15 September 2022.

Nyoka, N. & Voua Otomo, P. 2022. *The state of aquatic pollution in Qwaqwa region: Physico-chemical parameters and chemical quantification*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Ramoejane, M. 2022. *Molecular identification and extended distribution of Crocidura flavescens and Crocidura mariequensis (Soricidae) in the high-altitude garland of the Golden Gate Highlands national Park in the Maluti Mountains*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Swanepoel, P.J., Barkhuizen, L.M., Ellender, B.R. & Van As, L.L. 2022. *Understanding the biology of Clarias gariepinus (Burchell, 1822) to assess their use as potential inlands fisheries species from Gariiep Dam, South Africa*. Paper delivered at the 59th Annual Congress of Southern African Society of Aquatic Scientists (SASAqS), Amanzi Private Game Reserve, Brandfort, South Africa. 26–30 June 2022.

Swart, V.R., Haddad, C.R., Bredenhand, E. & Van der Merwe, S. 2022. *Soil Dwelling arthropods as indicators of erosion in a South African grassland habitat*. Paper delivered at the XXVIth International Congress of the Entomology, Helsinki, Finland. 17–22 July 2022.

Taylor, P.J., Kearney, T., Dalton, D.L., Chakona, G., Kelly, C.M.R., Barker, N.P., Ntombela, N. & Ramoejane, M. 2022. *Biomes, geology and past climate drive speciation of laminate-toothed rats on South African mountains (Murinae: Otomys)*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Taylor, P.J., Markotter, W., Kearney, T., Cotterill, F.P.D., Cory Troussaint, D., Weier, S.M., Keith, M., Neef, G., Richards, L., Strydom, E., Howard, A. & Monadjem, A. 2022. *The Okavango and Drakensberg water towers as speciation hotspots for pipstrelle-like bats (Chiroptera: Vespertilionidae; Pipistrellus, Neoromicia, Laephotis, Afroncyteris)*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14–17 March 2022.

Terblans, E., Van Dalen, E., & Kruger, L. 2022. *Het die ouderdom Van beeste 'n invloed op die bosluislading?* Paper delivered at the Suid Afrikaanse Akademie vir Wetenskap en Kuns Studentesimposium in die Natuurwetenskappe, Centurion, South Africa. 3–4 November 2022.

Úngarl, L.P., Netherlands, E.C., Santos, A.L.Q., De Alcantara, E.P., Emmerich, E., Da Silva, R.J. & O' Dwyer De Oliveira, L.H. 2022. *Diversity of Haemogregarines species (Apicomplexa: Adeleorina) species infecting Brazilian aquatic turtles*. Paper delivered at the 15th International Congress of Parasitology, Copenhagen, Denmark. 21–26 August 2022.

Van As, L.L., Hadfield, K.A. & Smit, N.J. 2022. *Chonopeltis lisikili Van As & Van As, 1996 previously collected from Namibia and Botswana, now recorded from Synodontis Cuvier in the Phongolo River, South Africa*. Paper delivered at the 4th International Congress on Parasites of Wildlife & 50th Annual Congress of the Parasitological Society of Southern Africa, Kruger National Park, South Africa. 11–15 September 2022.

Van As, L.L., Hadfield, K.A., Acosta, A., Jordaan, M. & Smit, N.J. 2022. *Morphological and molecular data reveals the first record of a co-invading Chonopeltis (Branchiura) in the Western Cape, South Africa*. Poster presented at the 15th International Congress of Parasitology and 10th International Symposium for Fish Parasitology (Joint conference), Copenhagen, Denmark. 21–26 August 2022.

Van der Merwe, R. & Codron, D. 2022. *Tande: 'n Geheime argief*. Paper delivered at the Suid Afrikaanse Akademie vir Wetenskap en Kuns Studentesimposium in die Natuurwetenskappe, Centurion, South Africa. 3–4 November 2022.

Van der Merwe, R., Lewis, C. & Codron, D. 2022. *The role of body size as a life-history trait influencing within-population niche variation in mammals*.

Poster presented at the 11th Oppenheimer Research Conference, Midrand, South Africa. 5-7 October 2022.

Van der Mescht, A.C., Lewis, C., Van der Merwe, R. & Codron, C. 2022. *Hurry up and sing: early onset of diel calling behaviour and ecological drivers of *Acanthopplus discoidalis* across an ecological gradient.* Paper delivered at the 3rd African Bioacoustics Community Conference, Kruger National Park, South Africa. 2-7 October 2022.

Viljoen, J., Avenant, N. & Butler, H.J. 2022. *Optimalisering Van vangstydperk met valdeurvalletjies ter bepaling Van kleinsoogdier gemeenskappe.* Paper delivered at the Suid Afrikaanse Akademie vir Wetenskap en Kuns Studentesimposium in die Natuurwetenskappe, Centurion, South Africa. 3-4 November 2022.

Voua Otomo P. 2022. *Ecological Significance of a Pesticide-Induced Geotaxis Reversal in Mosquito Larvae (*Culicidae*).* Paper delivered at the 1st African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March, 2022.

Voua Otomo P., Mazibuko, S.S. Ngounda E. 2022. *Mathematical modelling of geotaxis data from mosquito larvae reveals potentially useful and novel index in environmental toxicology.* Paper delivered at the 2022 Qwaqwa Campus Research Conference, Phuthaditjhaba, South Africa. 29-30 September 2022.

Weier, S. M., Linden, V. M. G., Hammer, A., Grass, I., Tschardtke, T. & Taylor, P.J. 2022. *Bat guilds respond differently to habitat loss and fragmentation at different scales in the Soutpansberg, South Africa.* Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Invited lectures

Voua Otomo, P. 2022. *Aquatic Biomonitoring: Peri-urban case studies from the greater QwaQwa area.* Lecture delivered during the German-Southern African 2022 Online Summer School on Surface Water monitoring, Bloemfontein, South Africa. 24-28 January 2022.

Voua Otomo, P. 2022. *Behavioural Ecotoxicology: Recent developments and perspectives.* Lecture delivered at the UNISA 2022 African Scholar

Lecture hosted by the College of Agriculture and Environmental Sciences. 21 October 2022.

Voua Otomo, P. 2022. *Quick Screening of the ecotoxicity of soil and water samples.* Lecture delivered at the Workshop on Environmental Pollution and Ecotoxicology, Hosted by the Tanzania Plant Health and Pesticide Authority, Arusha, Tanzania. 11 August 2022.

Conference Proceedings

Basson L. 2022. Parasitic fish protists – from bad to glam to downright peculiar. In: *Proceedings 57th Congress of the Microscopy Society of Southern Africa* 49: 7. Gold Reef City, Johannesburg, 5-8 December 2022.

De Jager, G.P., Basson, L., Colier, S. & Feldhaus, C. 2022. Novel insights into the genus *Leiotrocha* (Mobilida: Urceolariidae). In: *Proceedings 57th Congress of the Microscopy Society of Southern Africa* 49: 4. Gold Reef City, Johannesburg, 5-8 December 2022.

Hastings, J., Basson, L. & De Jager, G.P. 2022. *Tricky trichodinid with daunting denticles.* In: *Proceedings 57th Congress of the Microscopy Society of Southern Africa* 49: 31. Gold Reef City, Johannesburg, 5-8 December 2022.

Hastings, J., Basson, L. & De Jager, G.P. 2022. *Characteristic cavities no longer valid.* In: *Proceedings 57th Congress of the Microscopy Society of Southern Africa* 49: 5. Gold Reef City, Johannesburg, 5-8 December 2022.

STAFF (2022)

Head of Department:
Prof LL van As

BLOEMFONTEIN CAMPUS

Professor: Prof L Basson

Associate Professors: Prof D Codron, Prof CR Haddad and Prof LL van As

Senior Lecturers: Dr N Dube, Dr EC Netherlands and Dr VR Swart

Lecturers: Dr HJB Butler, I Heyns, Dr C Jansen van Rensburg and Dr EMP van Dalen

Technicians: TW Lesaona and PK Mohasi

Officers – Professional Services: L Bopheka, NW Mokhethe and Dr Sibonginhlanhla Mahlobo-Shwabede

Research Associate (Affiliated): Dr Y Marusik

Research Fellows (Affiliated): Dr M Bates, Dr LM Barkhuizen, Dr J Botha, Dr F Chidawanyika, Dr EA Hugo-Coetzee and Dr O Uyi

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 Nyembe, Dr M Ramoejane, Dr J van As and M van As

Officers – Professional Services: N Kheswa and MP Sithole

Research Fellow (Affiliated): Dr G Martin

The following people were appointed as interns for 2022 on the Qwaqwa Campus:

Dimpo Lesoma, Thokozani Magagula, Terenki Mofokeng, Mafube Mokoena and Princess Tshabala



ACADEMIC
CENTRES



CENTRE FOR

ENVIRONMENTAL MANAGEMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Prof Paul Oberholster

Centre for Environmental Management

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2863

E: cem@ufs.ac.za

W: www.ufs.ac.za/cem

OVERVIEW OF 2022

The year 2022 was once again accompanied with much success for the Centre for Environmental Management (CEM) as the global pandemic wound down. Research outputs have grown steadily over almost two decades – the eight research reports and two accredited articles produced in 2005 increased to 128 research reports, 13 book chapters and 80 articles in accredited journals by the end of 2014, and to 154 research reports, 75 book chapters and 467 articles in accredited journals by the end of 2022, of which ten book chapters and 52 accredited articles were produced during 2022. 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.

It is with great sadness that the Master’s of Environmental Management programme has finally come to an end as the last of the students handed in their mini-dissertations at the end of the year and will graduate in 2023.

The CEM once again co-hosted The Summer School with the Technical University Dresden (TUD) (Virtual this time), as well as co-hosting the Southern African Society of Aquatic Scientists Conference (SASAqS) with the Department of Zoology and Entomology. In addition, the CEM as involved in collaborating with efforts related to the Jagersfontein Tailings Dam disaster.

Marthie Kemp and Shaquille Barnes working in the new Dendrochronology Lab



The laboratories in the CEM underwent extensive renovations during 2022, in which the one large laboratory was split into two smaller, more functional laboratories – a Dendrochronology Lab and a Water Lab.

ACHIEVEMENTS

Staff Achievements

On 19 October 2022, Prof Paul Oberholster became the latest academic from the University of the Free State to be elected as a Member (among 28 other UFS scholars and scientists) of the Academy of Science of South Africa (ASSAf).

Prof Paul Oberholster with the Academy of Science of South Africa (ASSAf) membership award



Prof Shola Ololade went on sabbatical research leave to San Diego, California, from 1 August 2022 to 31 January 2023. During this period, she was appointed as a visiting Research Scholar at the Department of Environmental and Ocean Sciences, University of San Diego (USD) and a visiting Faculty Member at the Department of Geography, San Diego State University (SDSU).

Dr Marinda Avenant received a scholarship from the TUD to visit the Institutes of Water Chemistry and Hydrobiology during August 2022 as a 'Dresden Junior Fellow'. One of the main aims of the research visit was to strengthen and expand existing collaboration in the field of surface water monitoring. The focus of the present collaboration is developing a comprehensive surface water monitoring strategy for Qwaqwa by combining classical aquatic biomonitoring methods with innovative in-vitro bioassays and state-of-the-art chemical analyses.



Dr Marinda Avenant (right) working in the laboratory at the Technical University Dresden



Dr Althea Grundling with National Wetland Award

Dr Althea Grundling received the National Wetland Award in the category Education & Skills Development during the National Wetland Indaba (24 to 27 October 2022). The conference was held at the Golden Gate Highlands National Park.

Student Achievements

Jason le Roux received an award for the second-best presentation by a student during the National Wetland Indaba (24 to 27 October 2022).

During the Faculty Prize-Giving ceremony, the Maitland Seaman Prize for the best MSc student majoring in Environmental Management (2021) was awarded to Martha Maria Oberholzer. Ntsu Mokhehle, from Lesotho, won both the Centre for Environmental Management Prize for the best mini-dissertation in the MSc majoring in Environmental Management (2021) and the Dr Limpho Letsela Prize for the best foreign African Student in the MSc majoring in Environmental Management (2021). The winner of the Centre for Environmental Management Prize for the best student in the Postgraduate Diploma in Integrated Water Management (2021) was Hloniphekile Madonsela.

The top CEM students at the 2022 graduation – Hloniphekile Madonsela, Ntsu Mokhehle and Martha Maria Oberholzer



RESEARCH AND INNOVATION

Through Prof Paul Oberholster, the UFS is involved in a collaborative project with the Council for Scientific and Industrial Research (CSIR) and four Southern African Development Community (SADC) countries, titled 'Alternative low cost solution to rural sewage wastewater treatment using phycoremediation'. The aim of the study is to reduce the health risks that Waste Water Treatment Works (WWTWs) pose to communities and to reduce poverty through innovation. The project involves participation by local communities to assess and reduce health risks, and cooperation with local governments to assess and implement options. The objectives also include improving the operational efficiency of pond-based WWTWs, implementing biotic cultures to pond systems to reduce pathogens and nutrients, developing operational guidelines and procedures for roll-out to other WWTW's in SADC countries, and transferring technology and building local capacity to support local entrepreneurs and local government capacity.

In a related long-standing collaboration, started in 2016 and completed in 2022, Prof Oberholster was the principal investigator and project leader of the African Development Bank and African Climate Technology Centre (ACTC) project (financed by the Global Environment Facility [GEF]), which examined phycoremediation as an adaptation measure for climate change vulnerability at rural wastewater treatment plants in SADC countries. With locations and activities in Botswana (Gaborone), Malawi (Zomba) and South Africa (Mossel Bay), the principal objective of the project was to facilitate efficient reduction of nutrients (nitrates and phosphates) and certain pathogens (protozoa, helminths, bacteria and viruses) that have increased in effluents in the identified WWTWs due to climate change, thereby reducing human health risks and improving water resource quality for reclamation, to be re-used in irrigation.

A collaborative project between the CSIR, UFS (CEM – Prof Oberholster), Sasol Group Technology and Sasol Mining, (which focusses on determining source, pathway and receptors of a mixture of pollutants), examines the source of water seepage to the Leeuspruit stream, wetlands and the Rietspruit stream at Sasol's defunct Sigma Coal Mine at Sasolburg.

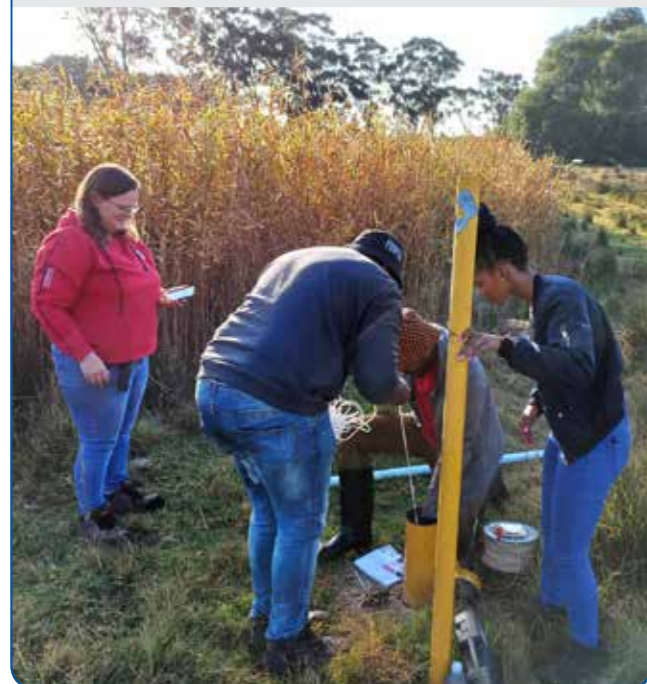
Prof Oberholster collaborated as part of the UFS team with the Department of Forestry, Fisheries and Environment (DFFE) on the Jagersfontein Tailings Dam disaster.

Prof Oberholster is also involved in a research collaboration between the Geological Survey of Denmark and Greenland (GEUS), 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 Managed Aquifer Recharge in Southern Africa (MARSAs) 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 MARSAs project which was initiated in 2021. The primary aim of MARSAs 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.



Fieldwork for the MARSA project



Prof Shola Ololade is a co-principal investigator with Prof Bethany O’Shea from USD and Dr Amy Quandt from SDSU on the project titled ‘The Salton Sea Crisis through the Water-Energy-Food nexus lens’. The location of the study is based in San Diego, California.

Prof Ololade was also part of a team of five representing the UFS that visited Israel during June 2022 to investigate that country’s approach to water resource management.

Dr Marinda Avenant is leading 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). The project team includes researchers from the UFS 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 TUD. The project investigates the potential risks associated with extreme weather events on service delivery in Qwaqwa and seeks to develop a risk reduction strategy for the area.

Dr Surina Esterhuysen is involved in the Petroleum Agency SA (PASA) project, ‘Development and design of a regional groundwater monitoring network for the Central Karoo’, working together with the Institute for Groundwater Studies (IGS).

Dr Bimo Nkhata is a co-principal investigator on a project funded by the WRC that is looking at ‘Water Use in Food Value Chains of Indigenous Crops’. The collaborative research project also includes researchers from Unisa and CPUT.

ENGAGED SCHOLARSHIP

The CEM co-hosted (with the UFS Department of Zoology and Entomology) the Southern African Society of Aquatic Scientists Conference (SASAqS), ‘Rivers from land to sea’, from 26 to 30 June 2022 at Amanzi Private Game Reserve, Brandfont, South Africa. Prof Paul Oberholster and Dr Marinda Avenant were part of the organising team.



Group from the CEM attending the Southern African Society of Aquatic Scientists Conference (SASAqS) Conference

The CEM (as part of the UFS team) were acknowledged by the DFFE for their expert views and collaboration as part of the Environmental Assessment team that looked into the Jagersfontein Tailings Dam disaster.

Prof Paul Oberholster was mentioned in the article ‘Water, Africa’s Gold: South Africa seeks to increase water through recycling, reuse’ by Engela Duvenage, that appeared in *DownToEarth* on 10 February 2022.

Prof Shola Ololade was part of a four-member group from the UFS which undertook a five-day study tour on transboundary water and wastewater management in Israel, during the latter part of June 2022. During her research leave, Prof Ololade presented two guest lectures, one on 26 September at SDSU and another on 6 October at USD, on a research topic centered on the ‘Water-Energy-Food Nexus’ which was well-attended and -received by the audience.

Prof Ololade was appointed as a WRC Water Reference Group Panel Member in July 2022 and was invited as a panel member for the Virtual Peer Review for the NRF-Thuthuka grant in August 2022, the Equipment-related Travel and Training Grants in September 2022, and the Freestanding, Innovation and Scarce Skills Postdoctoral Fellowships in September 2022. Prof Ololade was also invited to evaluate submissions for the South African Research Chairs Initiative (SARChI) and the performance of grant recipients (five-year

evaluation) in October 2022. She was also appointed as Associate Editor for *Frontiers in Sustainable Resource Management* – section Natural Resources and invited as a guest editor to both *Frontiers in Water* (section: Water Resources Management: Emerging trends on adaptive capacity and water security measures under a looming climate change threat), and *Frontiers in Research Metrics and Analytics* (section: Research Policy and Strategic Management: Engaging Scientific Diasporas for Development: Policy and Practices).

Dr Marinda Avenant and Dr Dirk Jungmann (from the TUD) received funding from the Volkswagen Foundation

Members of the project team taking water samples in the Elands River at Phuthaditjhaba



Dr Dirk Jungman (back left) and Dr Marinda Avenant (back right), with Master’s students from the UFS, TUD and CPUT, who helped with the organisation of the Summer School



in Germany to present a virtual Summer School on Blackboard, titled 'Monitoring of surface water quality: General framework, tools and implementing disaster management aspects in urban areas'. The Summer School was attended by 30 participants from the UFS and other tertiary institutions, including the TUD, CPUT, Unisa, the University of the Western Cape, Stellenbosch University, the National University of Lesotho, the University of Zimbabwe, as well as the CSIR. The presenters included Prof Paul Oberholster (CEM), Dr Marinda Avenant (CEM), Dr Patrick Voua Otomo (Zoology and Entomology, Qwaqwa Campus), Prof Johannes Belle (DiMTEC) and Dr Alice Ncube (DiMTEC). Prof Tony Turton (Affiliated Professor at the CEM) delivered the keynote address.

Dr Marinda Avenant served as curriculum advisor for the review of a Master's in Climate Change and Sustainable Development, developed earlier by the Southern African Regional Association of Universities (SARUA). The project team, under the leadership of Prof René Pellissier (SARUA), also developed a new innovative curriculum together with developers from other South African universities, as well as from Botswana, Eswatini, Namibia, Mauritius, Zambia and Zimbabwe.



Dr Bimo Nkhata

Dr Surina Esterhuyse collaborated on the Editors' introduction to the IWRA Mentored Articles section. *Water International* 47(4): 510-511. DOI: 0.1080/02508060.2022.2087853.

Dr Bimo Nkhata and Dr Yolandi Schoeman (CEM Postdoctoral Fellow), were involved in the delivery of an international training workshop designed to prepare participants from North Africa for the UN Climate Change Conference (COP27) that was held in Sharm El Sheikh, Egypt, from 6 to 20 November 2022. The UN annual conference, which was held in Africa for the fifth time, served

as a platform for African leaders to voice their concerns regarding the climate crisis. The virtual training workshop, which was jointly organised with Griffith University, Australia, targeted participants from seven North African countries – Egypt, Eritrea, Sudan, Tunisia, Libya, Algeria and Morocco. Dr Nkhata and Dr Schoeman presented talks, covering topics such as climate adaptation and nature-based solutions, to the over 45 international participants. The international workshop commenced on 24 October 2022 and provided participants with the opportunity to build knowledge and skills in climate change and water management in readiness for COP 27.

Dr Nkhata is a member of the editorial board of the *International Journal of the Commons*. He was invited as a Guest Editor to develop a special issue for *Ecology and Society*. He reviewed manuscripts for the *South African Geographical Journal*, *Ecology and Society* and *International Journal of the Commons*. He is also a member of the International Union for the Conservation of Nature's (IUCN) Commission on Ecosystem Management.

Since April 2017, Dr Tascha Vos has acted as the Vice-Chair of the Modder-Riet Catchment Management Forum, coordinated by the Department of Water and Sanitation, Free State.

Prof Anthony Turton was involved in several interviews in the South African media on various topics, such as 'Water security in South Africa' – An interview on Solutions with David Ansara. Podcast #36, 23 January 2022; 'SA's water crisis: Typhoid fever outbreak' on ENCA, 7 March 2022; 'Water scarcity: Impact on the country' on ENCA, 20 June 2022; 'Who to blame for the Jagersfontein mine waste tragedy: Prof Anthony Turton' on SABC News, 13 September 2022; 'Reaction to Jagersfontein mine dam disaster: Dr Anthony Turton' on SABC News, 15 September 2022; 'Jagersfontein tragedy focuses attention on some important policy issues for mining' on *Classic Business*, 20 September 2022; and 'No official word on the water situation in Gauteng' on *Newzroom Africa*. 17 October 2022.

Dr Piet-Louis Grundling was one of the organisers of the International Mire Conservation Group (IMCG) Field Symposium for the Southern African Mires and Peatlands, which was held from 13 to 30 March 2022 in various places in South Africa, and included ore- and post-conference tours.

Dr Grundling acted as a peer reviewer and was a co-author of Chapter 3 of the United Nations Environmental Programme (UNEP) led Global Peatlands Initiative report on *Global Peatlands Assessment: The State of the World's Peatlands. Evidence for action toward the conservation, restoration, and sustainable management of peatlands. Summary for policy makers*. During the National Wetland Indaba (24 to 27 October 2022) that was held at the Golden Gate Highlands National Park (GGHNP), he delivered a keynote address and led a workshop with J Smuts on 'NEMA, NWA and their regulations: Conserving wetlands or feeding a wetland community of practice?'

Prof Maitland Seaman delivered a keynote address on 'The position of temporary waters in the wider ecosystem' at the 59th Southern African Society of Aquatic Scientists (SASAqS) conference that was held from 26 to 30 June 2022 at the Amanzi Private Game Reserve.

NATIONAL AND INTERNATIONAL COLLABORATION

Over and above the collaborative research projects reported above in which Prof Paul Oberholster is actively involved, he is also a collaborator on the USA-South Africa University Partnership (sponsored by the US Embassy). The project focuses on increasing science, technology, engineering and mathematics (STEM) capacity, as well as improving knowledge and skills in university administration in South Africa.

At a national level, Prof Shola Ololade collaborated with Dr Julio Castillo Hernandez (UFS Department of Microbiology and Biochemistry), Prof Saheed Oke (Central University of Technology), Dr Mathapelo Seopela (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 from the Department of Ocean and Environmental Resources, University of San Diego, California, and Dr Amy Quandt from the Department of Geography, San Diego State University.



Prof Shola Ololade (left) with the Geochem class of 2022 at the Anza Borrego Desert Research Station, California, USA

Dr Marinda Avenant collaborates with Prof Johannes Belle (DiMTEC), Dr 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, TUD), Dr Hilmar Boernick (Institute of Water Chemistry, TUD) and Dr Noma Chico (BA ISAGO University, Botswana).

Dr Surina Esterhuyse finalised a book chapter on the impact of hydrocarbon extraction on freshwater resources for the *Encyclopedia of Inland Waters* with researchers from Belgium and Brazil. She is also involved in the PASA project, 'Development and design of a regional groundwater monitoring network for the Central Karoo', on which she is

working together with the IGS. She is also co-writing a book chapter on artificial recharge for the Monograph on *Artificial Recharge to Groundwater and Rain Water Harvesting: Issues & Learning from Developing Countries* together with personnel from the Department on Water and Sanitation for the Non-Aligned Movement (NAM) S&T Centre.

Dr Bimo Nkhata leads the secretariat of the INSAKA International Research Consortium involving six universities (IIE MSA, University of KwaZulu-Natal, University of Namibia, Copperbelt University, University of Montana and Clemson University). Dr Nkhata also collaborated with colleagues from Brock University (Canada) and University of Montana (USA) in developing a special issue for *Ecology and Society*.

PhD Graduates, Dr Yolandi Schoeman (left) and Dr Beatrice Otunola (right), with Prof Paul Oberholster



POSTGRADUATE STUDENTS

In 2022, a total of 21 students were registered for the Postgraduate Diploma in Integrated Water Management, and 13 for the Master of Environmental Management. Ten candidates were registered for the PhD in Environmental Management and three for the PhD in Integrated Water Management.

Nineteen (19) students were registered for the two new structured Master of Science degrees – six for the MSc majoring in Environmental Management and 13 for the MSc majoring in Integrated Water Management. A further six students were registered for the full MSc – two majoring in Environmental Management and four majoring in Integrated Water Management.

Dr Beatrice Otunola and Dr Yolandi Schoeman were conferred with the PhD degree during the December 2022 graduation. Dr Otunola's thesis, supervised by Prof O Ololade and co-supervised by Dr M Aghoghovwia and Dr M Thwala, was on 'Attapulgite and bentonite assisted phytoremediation of heavy metal polluted soil and water: Case study of a post-mining area in the Free State Province, South Africa'. Dr Schoeman was supervised by Prof PJ Oberholster and co-supervised by Prof VS Somerset; her thesis was titled 'A zero-waste multi-criteria decision-support model for the Iron and Steel Industry in developing countries in Southern Africa'.

POSTDOCTORAL RESEARCH FELLOWS

The CEM hosted four postdoctoral research fellows during 2022 – Dr Israel Orimoloye (from Nigeria), Dr Nicolette Vermaak (from South Africa), Dr Gladys Belle (from Congo) and Dr Yolande Schoeman (from South Africa).

STAFF MATTERS



Reflole Mariti

Veena Padayachee left the Centre in mid-2022 and we welcomed Reflole Mariti as our new Course coordinator in July 2022.

Dr Bimo Nkhata joined the Centre's team as a Senior Lecturer in September 2022.

RESEARCH OUTPUTS

Research Articles

Adetoro, A.A., Ngidi, M.S.C., Ojo, T.O., Danso-Abbeam, G., Ogundeji, A.A. & Orimoloye, I.R. 2022. Weather-index insurance as an adaptation strategy to climate change: a global insight. *Climate Research* 88: 73-85. DOI: 10.3354/cr01697.

Afuye, G.A., Kalumba, A.M., Busayo, E.T. & Orimoloye, I.R. 2022. A bibliometric review of vegetation response to climate change. *Environmental Science and Pollution Research* 29(13): 18578-18590. DOI: 10.1007/s11356-021-16319-7.

Afuye, G.A., Kalumba, A.M., Ishola, K.A. & Orimoloye, I.R. 2022. Long-term dynamics and response to climate change of different vegetation types using GIMMS NDVI3g data over Amathole District in South Africa. *Atmosphere* 13(4): 1-28 (Article # 621). DOI: 10.3390/atmos13040621.

Agunbiade, M., Oladipo, B., Ademakinwa, A.N., Awolusi, O., Adesiyun, I.M., Oyekola, O., Ololade, O. & Ojo, A. 2022. Bioflocculant produced by *Bacillus velezensis* and its potential application in brewery wastewater treatment. *Scientific Reports* 12(1): 1-12 (Article # 10945). DOI: 10.1038/s41598-022-15193-8.

Atangana, E. 2022. With the continuing increase in Sub-Saharan African countries, will Sustainable Development of Goal 1 ever be achieved by 2030? *Sustainability* 14(16): 1-28 (Article # 10304). DOI: 10.3390/su141610304.

Avenant, N.L. & Morwe, J.B. 2022. Black-backed jackal diet in the Maria Moroka Nature Reserve, Free State Province: Implications for managing depredation on small stock farms. *Indago* 37: 55–66. DOI: 10.38140/00679208/indago.v37.a4.

Belle, G.N., Oberholster, P.J., Fossey, A., Esterhuizen, L. & Moodley, R. 2022. Using pollution indices to develop a risk classification tool for gold mining contaminated soils. *Journal of Environmental Science and Health, Part A* 57(12): 1047–1057. DOI: 10.1080/10934529.2022.2151283.

Bessah, E., Donkor, E., Raji, A.O., Taiwo, O.J., Ololade, O.O., Strapasson, A., Amponsah, S.K. & Agodzo, S.K. 2022. Factors affecting farmers' decision to harvest rainwater for maize production in Ghana. *Frontiers in Water* 4: 1–11 (Article # 966966). DOI: 10.3389/frwa.2022.966966.

Bonokwane, L.P. & Ololade, O.O. 2022. Socio-economic factors affecting smallholder farmers' willingness to adopt biogas technology in South Africa. *Journal of Energy in Southern Africa* 33(1): 10–20. DOI: 10.17159/2413–3051/2022/v33i1a8860.

Busayo, E.T., Kalumba, A. M., Afuye, G.A., Olusola, A.O., Ololade, O. & Orimoloye, I.R. 2022. Rediscovering South Africa: Flood disaster risk management through ecosystem-based adaptation. *Environmental and Sustainability Indicators* 14:1–10 (Article # 100175). DOI: 10.1016/j.indic.2022.100175.

De Weerd, J., Calambokidis, J., Pouplard, E., Pouey-Santalou, V., Patulny, C., Vanschoenwinkel, B., Kochzius, M. & Clapham, P. 2022. Abundance, distribution and behaviour of humpback whales (*Megaptera novaeangliae*) along the Pacific coast of Nicaragua, Central America. *Marine and Freshwater Research* 73(8): 1041–1055. DOI: 10.1071/MF21326.

Deboelpaep, E., Partoens, L., Koedam, N. & Vanschoenwinkel, B. 2022. Highway(s) overhead: Strong differences in wetland connectivity and protected status challenge waterbird migration along the four Palearctic-Afrotropical flyways. *Diversity and Distributions* 28(5): 1067–1080. DOI: 10.1111/ddi.13508.

Esterhuysen, S., Vermeulen, D. & Glazewski, J. 2022. Developing and enforcing fracking regulations to protect groundwater resources. *npj Clean Water* 5(1): 1–11 (Article # 3). DOI: 10.1038/s41545-021-00145-y.

Green, A., Avenant, N.L. & Melville, H. 2022. Ranging

behaviour of a territorial male Black-Backed Jackal in a small stock farming area in the Southern Free State. *Indago* 37: 67–76. DOI: 10.38140/00679208/indago.v37.a5.

Guzman, L.M., Thompson, P.L., Viana, D.S., Vanschoenwinkel, B., Horváth, Z., Ptacnik, R., Jeliaskov, A., Gascón, S., Lemmens, P., Anton-Pardo, M., Langenheder, S., De Meester, L. & Chase, J.M. 2022. Accounting for temporal change in multiple biodiversity patterns improves the inference of metacommunity processes. *Ecology* 103(6): 1–16 (Article # e3683). DOI: 10.1002/ecy.3683.

Haindongo, P.N., Kalumba, A.M. & Orimoloye, I.R. 2022. Local people's perceptions about Land Use Cover Change (LULCC) for sustainable human wellbeing in Namibia. *GeoJournal* 87(3): 1727–1741. DOI: 10.1007/s10708-020-10337-7.

Henschel, J.R. & Maggs-Kölling, G. 2022. Namibia Scientific Society and Gobabeb: Science in Transition. *Journal Namibia Scientific Society* 69:9–18.

Henschel, J.R. & Wassenaar, T.D. 2022. Tenebrionid Beetle Diversity Increases with Aridity Across the Namib Desert. *Journal Namibia Scientific Society* 69: 65–88.

Idris, O.A., Opute, P., Orimoloye, I.R. & Maboeta, M.S. 2022. Climate Change in Africa and Vegetation Response: A Bibliometric and Spatially Based Information Assessment. *Sustainability* 14(9): 1–19 (Article # 4974). DOI: 10.3390/su14094974.

Kafula, Y.A., Philippe, C., Pinceel, T., Munishi, L.K., Moyo, F., Vanschoenwinkel, B., Brendonck, L. & Thoré, E.S. 2022. Pesticide sensitivity of *Nothobranchius neumanni*, a temporary pond predator with a non-generic life-history. *Chemosphere* 291(Part 1): 1–8 (Article # 132823). DOI: 10.1016/j.chemosphere.2021.132823.

Lalumbe, L., Oberholster, P.J. & Kanyerere, T. 2022. Feasibility assessment of the application of groundwater remediation techniques in rural areas: a case study of rural areas in the Soutpansberg region, Limpopo Province, South Africa. *Water* 14(15): 1–12 (Article # 2365). DOI: 10.3390/w14152365.

Mataba, G. R., Munishi, L., Brendonck, L. & Vanschoenwinkel, B. 2022. The role of anthropogenic container habitats as mosquito oviposition habitats in rural settlements in northern Tanzania. *Journal of Vector Ecology* 47(1): 69–80. DOI: 10.52707/1081-1710-47.1.69.

Meyer-Milne, E., Brendonck, L. & Pinceel, T. 2022. Egg banks in dryland wetlands provide information on the diversity and vulnerability of branchiopod communities along a longitudinal aridity gradient. *Wetlands Ecology and Management* 30(4): 813–826. DOI: 10.1007/s11273-021-09852-2.

Mnyango, S.S., Thwala, M., Oberholster, P.J. & Truter, C.J. 2022. Using Multiple Indices for the Water Resource Management of a Monomictic Man-Made Dam in Southern Africa. *Water* 14(21): 1–20 (Article # 3366). DOI: 10.3390/w14213366.

Mofokeng, S., Oberholster, P. & Hill, L. 2022. Seasonal influence on the nutrient removal efficiency of a SPRAS wastewater treatment plant in the Free-State Province, South Africa. *West African Journal of Applied Ecology* 30(2): 32–46.

Mohale, N.E., Codron, D. & Horwitz, L.K. 2022. Stable isotope evidence for mid-Pleistocene paleoenvironmental conditions at the site of Kathu Pan 1 (central interior, South Africa). *Quaternary International* 614: 37–49. DOI: 10.1016/j.quaint.2021.02.027.

Oberholster, P.J., Schoeman, Y., Truter, J.C. & Botha, A-M. 2022. Using periphyton assemblage and water quality variables to assess the ecological recovery of an ecologically engineered wetland affected by acid mine drainage after a dry spell. *Processes* 10(5): 1–22 (Article # 877). DOI: 10.3390/pr10050877.

Oberholzer, M.M., Oberholster, P.J., Ndlela, L.L., Botha, A-M. & Truter, J.C. 2022. Assessing alternative supporting organic materials for the enhancement of water reuse in subsurface constructed wetlands receiving acid mine drainage. *Recycling* 7(3): 1–25 (Article # 41). DOI: 10.3390/recycling7030041.

Orimoloye, I.R. 2022. Agricultural drought and its potential impacts: Enabling decision-support for food security in vulnerable regions. *Frontiers in Sustainable Food Systems* 6: 1–11 (Article # 838824). DOI: 10.3389/fsufs.2022.838824.

Orimoloye, I.R. 2022. Water, Energy and Food Nexus: Policy Relevance and Challenges. *Frontiers in Sustainable Food Systems* 5: 1–10 (Article # 824322). DOI: 10.3389/fsufs.2021.824322.

Orimoloye, I.R., Belle, J.A., Olusola, A.O. & Ololade, O.O. 2022. Navigating nature's complexities through Terra MODIS information and downscaled regional climate model: Mainstreaming space-based information for drought disaster risk management. *Physics and*

Chemistry of the Earth, Parts A/B/C 126:1–11 (Article # 103136). DOI: 10.1016/j.pce.2022.103136.

Orimoloye, I.R., Belle, J.A., Orimoloye, Y.M., Olusola, A.O. & Ololade, O.O. 2022. Drought: A Common Environmental Disaster. *Atmosphere* 13(1): 1–21 (Article # 111). DOI: 10.3390/atmos13010111.

Orimoloye, I.R., Olusola, A.O., Belle, J.A., Pande, C.B. & Ololade, O.O. 2022. Drought disaster monitoring and land use dynamics: identification of drought drivers using regression-based algorithms. *Natural Hazards* 112(2): 1085–1106. DOI: 10.1007/s11069-022-05219-9.

Otunola, B.O., Aghoghovwia, M.P., Thwala, M., Gómez-Arias, A., Jordaan, R., Hernandez, J.C. & Ololade, O.O. 2022. Influence of clay mineral amendments characteristics on heavy metals uptake in Vetiver grass (*Chrysopogon zizanioides* L. Roberty) and Indian mustard (*Brassica juncea* L. Czern). *Sustainability* 14(10): 1–13 (Article # 5856). DOI: 10.3390/su14105856.

Otunola, B.O., Aghoghovwia, M.P., Thwala, M. & Ololade, O.O. 2022. Heavy metal phytoremediation potential of Vetiver grass and Indian mustard update on enhancements and research opportunities. *Water, Air & Soil Pollution* 233(5): 1–15 (Article # 154). DOI: 10.1007/s11270-022-05620-x.

Philippe, C., Thoré, E. S., Verbesselt, S., Grégoir, A. F., Brendonck, L. & Pinceel, T. 2022. Combined effects of global warming and chlorpyrifos exposure on the annual fish *Nothobranchius furzeri*. *Ecotoxicology and Environmental Safety* 248: 1–7 (Article #114290). DOI: 10.1016/j.ecoenv.2022.114290.

Quandt, A., O'Shea, B., Oke, S.A. & Ololade, O.O. 2022. Policy interventions to address water security impacted by climate change: adaptation strategies of three case studies across different geographic regions. *Frontiers in Water* 4: 1–15 (Article # 935422). DOI: 10.3389/frwa.2022.935422.

Ramaekers, L., Pinceel, T., Brendonck, L. & Vanschoenwinkel, B. 2022. Direct effects of elevated dissolved CO₂ can alter the life history of freshwater zooplankton. *Scientific reports* 12(1): 1–10 (Article # 6134). DOI: 10.6084/m9.figshare.14885142.v1.

Rogers, D.C. & Meyer-Milne, E. 2022. Review of the Limnadiidae (Crustacea: Branchiopoda: Spinicaudata) of southern Africa. *Journal of Crustacean Biology* 42(1): 1–10 (Article # ruac019). DOI: 10.1093/jcbl/ruac019.

Salami, S.O., Adegbaju, O.D., Idris, O.A., Jimoh, M.O., Olatunji, T.L., Omonona, S., Orimoloye, I.R., Adetunji, A.E., Olusola, A., Maboeta, M.S. & Laubscher, C.P. 2022. South African wild fruits and vegetables under a changing climate: the implications on health and economy. *South African Journal of Botany* 145: 13-27. DOI: 10.1016/j.sajb.2021.08.038.

Seymour, C.L., Joseph, G.S., Calitz, W., Henschel, J.R., Ramaswiela, T. & Van der Merwe, H. 2022. Mean height increase in saplings of a keystone woody savanna species over 15 years similar to that over a single season. *Ecosphere* 13(9): 1-11 (Article # e4173). DOI: 10.1002/ecs2.4173.

Sirunda, J., Oberholster, P. & Wolfaardt, G. 2022. Assessing the adverse effects of land use activities on the water quality of selected sub-Saharan Africa reservoirs using a combination of water quality indices. *Water, Air, & Soil Pollution* 233(7): 1-19 (Article # 267). DOI: 10.1007/s11270-022-05703-9.

Strauss, A.J., Avenant, N.L. & De Waal, H.O. 2022. The impact of predation on Merino and Dorper sheep flocks in the central Free State Province, South Africa. *Indago* 37: 43-53. DOI: 10.38140/00679208/indago.v37.a7.

Toerien, D.F. 2022. Linking entrepreneurial activities and community prosperity/poverty in United States Counties: Use of the Enterprise Dependency Index. *Sustainability* 14(5):1-16 (Article # 2812). DOI: 10.3390/su14052812.

Toerien, D.F. 2022. Linking microeconomic characteristics, entrepreneurship and community prosperity/poverty of South African towns. *Development Southern Africa* 39(2): 182-208. DOI: 10.1080/0376835X.2021.1914552.

Toerien, D.F. 2022. Temporal and geographic stress testing of entrepreneurial proportionalities in United States counties. *World* 3(3): 403-433. DOI: 10.3390/world3030022.

Tshikalange, B., Ololade, O., Jonas, C. & Bello, Z.A. 2022. Effectiveness of cattle dung biogas digestate on spinach growth and nutrient uptake. *Heliyon* 8(3): 1-10 (Article # e09195). DOI: 10.1016/j.heliyon.2022.e09195.

Van Den Berg, M.F., Botha A-M., Bierman A., Oberholster, P.J. 2022. Determining biota succession in a domestic wastewater pond system after treatment with a specific consortium microalgae. *Journal of Environmental Health Science and*

Engineering 20(2): 963-981. DOI: 10.1007/s40201-022-00840-z.

Van der Stocken, T., Vanschoenwinkel, B., Carroll, D., Cavanaugh, K.C. & Koedam, N. 2022. Mangrove dispersal disrupted by projected changes in global seawater density. *Nature Climate Change* 12(7): 685-691. DOI: 10.1038/s41558-022-01391-9.

Van Deventer, H., Nortje, K., Naidoo, L., Apleni, P., Tsele, P., Bester, J., Grundling, P-L., Janse Van Rensburg, S. & Aucamp, I. 2022. Bringing science, policy and society closer together for the Maputaland Coastal Plain's wetlands management. *The Water Wheel* 21(3): 30-32.

Wilkinson, J.L., Boxall, A.B., Kolpin, D W., Leung, K M., Lai, R.W., Galbán-Malagón, C., ..., Thwala, M., ... & Teta, C. 2022. Pharmaceutical pollution of the world's rivers. *Proceedings of the National Academy of Sciences of the United States of America* 119(8): 1-10 (Article # e2113947119). DOI: 10.1073/pnas.2113947119.

Worthmann, C. & Esterhuysen, S. 2022. A mobile application to protect groundwater during unconventional oil and gas extraction. *Royal Society Open Science* 9(9): 1-18 (Article # 220221). DOI: 10.1098/rsos.220221.

Chapters in Books

Breil, P., Pons, M-N., Armani, G., Amer, G., Pienaar, H., Oberholster, P. & Namour, P. 2022. Natural-based solutions for bioremediation in water environment. In: *Sustainable solutions for environmental pollution, Volume 2: Air, water and soil reclamation*. N.S. El-Gendy (Ed). Wiley-Scrivener Publishing. pp. 1-94.

Brendonck, L., Rogers, C., Vanschoenwinkel, B. & Pincheel, T. 2022. Large branchiopods. In: *Fundamentals of tropical freshwater wetlands from ecology to conservation management*. T. Dalu & R.J. Wasserman (Eds). Elsevier. pp. 273-305.

Ekundayo, T.C., Orimoloye, I.R., Ololade, O.O. & Okoh, A.I. 2022. Prioritization of health emergency research and disaster preparedness: a systematic assessment of corona virus disease 2019 (COVID-19) pandemic. In: *Data Science for COVID-19. Volume 2: Societal and medical perspectives*. U. Kose, D. Gupta, V.H.C De Albuquerque & A. Khanna (Eds). Elsevier - Academic Press. pp. 465-486.

Esterhuysen, S. & Buschke, F. 2022. Coal and water:

exploiting one precious natural resource at the expense of another? *Coal and energy in South Africa: Considering a just transition*. In: L. Marais, P. Burger, M. Campbell, S. Denoon-Stevens & D. Van Rooyen (Eds). Edinburgh University Press, UK. pp. 88-101.

Esterhuysen, S., Redelinghuys, N., Charvet, P., Fearnside, P., Daga, V., Braga, R., Okello, W., Vitule, J., Verheyen, E. & Van Steenberge, M. 2022. Effects of Hydrocarbon Extraction on Freshwaters. In: *Encyclopedia of inland waters: Volume 4 (2nd ed.)*. T. Mehner & K. Tockner (Eds). Amsterdam, Elsevier. pp. 189-209.

Olaoluwa, E.E., Durowoju, O.S., Orimoloye, I.R., Daramola, M.T., Ayobami, A.A. & Olorunsaye, O. 2022. Understanding weather and climate extremes. In: *Climate Impacts on Extreme Weather*. V. Ongoma & H. Tabari (Eds). Elsevier. pp. 1-17.

Ololade, O.O. & Orimoloye, I.R. 2022. Contribution of a well-managed landfill to sustainable development. In: *Handbook of solid waste management: Sustainability through circular economy*. C. Baskar, Ramakrishna, S. Baskar, R. Sharma, A. Chinnappan & R. Sehwat (Eds). Springer. pp. 943-958.

Orimoloye, I.R., Belle, J.A., Olusola, A.O. & Ololade, O.O. 2022. Space-based drought disaster risk and climate change assessments: Strategies for environmental conservation. In: *Handbook of climate change mitigation and adaptation (3rd ed.)*. M. Lackner, B. Sajjadi & W-Y. Chen (Eds). Springer, New York, NY. pp. 2815-2830.

Orimoloye, I.R., Ololade, O.O., Ekundayo, O.Y., Busayo, E.T., Afuye, G.A., Kalumba, A.M. & Ekundayo, T.C. 2022. Assessment of global research trends in the application of data science, deep and machine learning to COVID-19 pandemic. In: *Data Science for COVID-19. Volume 2: Societal and medical perspectives*. U. Kose, D. Gupta, V.H.C. De Albuquerque & A. Khanna (Eds). Elsevier - Academic Press. pp. 531-546.

Senbore, S., Oke, S., Malebo, N. & Ololade, O. 2022. Guidelines on Assessment of Urban Development Impact on Water Security and Environmental Sustainability. In: *Water-Energy-Nexus in the Ecological Transition. Advances in Science, Technology & Innovation*. V. Naddeo, K.H. Choo & M. Ksibi (Eds). Springer, Cham. pp. 119-122.

Research Reports

Akwany, L., Elshehawi, S., Grundling, P-L., Suspense, I.A., Adam, J., Botula, Y-D., Van Deventer, H., Dinesen, L., Farmer, J., Lourenco, M., Ntara, E. & Rebelo, A.J. 2022. Chapter 3: Regional Assessment for Africa. In: UNEP (United Nations Environment Programme). *Global Peatlands Assessment - The State of the World's Peatlands: Evidence for action toward the conservation, restoration, and sustainable management of peatlands*. Main Report. Global Peatlands Initiative. United Nations Environment Programme, Nairobi.

Grundling, A., Beckedahl, H., Le Roux J. & Le Roux, J. 2022. *Determining climate change aspects on the ecosystem resilience of headwater wetlands in two catchments in Eswatini (Swaziland) and in South Africa respectively*. Water Research Commission (WRC) Report No. 2831/1/22. ISBN 978-0-6392-0198-6.

Conference Contributions

Conference Papers/Posters

Allio, R., Deluc, F., Tilak, M-K., Koual, R., Weyer, N., Panino, W & Avenant, N.L. 2022. *Shallow metagenomics of fecal samples allows finescale diet characterization of myrmecophagous mammals in two South African reserves*. Poster presented at the 11th Oppenheimer Research Conference, Midrand, South Africa. 5-7 October 2022.

Avenant, M.F. 2022. *Assessing the ecological integrity of headwater streams in QwaQwa as a first step towards ecosystem-based adaptation*. Paper delivered at the 1st Southern African Mountain Conference 2022 (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Avenant, M.F. 2022. *Assessing the ecological integrity of headwater streams in QwaQwa as a first step towards improving climate resilience*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Avenant, M.F. 2022. *Biomonitoring of peri-urban rivers: a South African perspective*. Paper delivered at the German-Southern African Summer School, Bloemfontein, South Africa. 24-28 January 2022.

Avenant, N.L. 2022. *Conserving mountain biodiversity in southern Lesotho: Mammals*. Paper

delivered at the 1st Southern African Mountain Conference 2022 (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Avenant, N.L. 2022. *Small mammal community composition as a reflection of environmental change*. Paper delivered at the 7th International Conference on Rodent Biology and Management, Arusha, Tanzania. 05-08 July 2022.

Avenant, N. & MacFadyen, D. 2022. *Small mammals as an indicator of habitat change in the Kalahari: further support for our hypothesis*. Poster presented at the 11th Oppenheimer Research Conference, Midrand, South Africa. 05-07 October 2022.

Belle, G.N., Oberholster, P.J. & Schoeman, Y. 2022. *Assessing the pollution risk of potential harmful elements in surface water: A case study of the Matjhabeng Mining area, South Africa*. Paper delivered at the Environment, Climate Change and Health Conference (ENCLIMAH) 2022, Accra (& Virtual), Ghana. 12-13 October 2022.

Boernick, H., Jungmann, D., Opeolu, B. & Avenant, M. 2022. *Chemical monitoring: an essential element for the comprehensive water quality assessment in view of river ecosystems*. Paper delivered at the 1st Southern African Mountain Conference 2022 (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Both, P., Grundling, P-L. & Brown, L.R. 2022. *Applying key hydro-geomorphological characteristics in the rehabilitation of a sloping spring mire in the Waterberg Mountains, Limpopo Province, South Africa*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Buschke, F., Vanschoenwinkel, B. & Pinceel, T. 2022. *The stability and predictability of temporary ponds have distinct effects on biodiversity*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Chakona, A., Smit, N., Malherbe, W., Daniels, S., Mlambo, M., Milne, B., Deacon, C., De Necker, L., Bragança, P.H.N., Telford, N. & Van de Colff, D. 2022. *REFRESH: Renewing data and filling knowledge gaps for freshwater species of South Africa to inform species and ecosystem conservation*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi

Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Gangathele, A., Grundling, A., Grundling, P-L. & Le Roux, J. 2022. *Gully erosion impact on selected peat properties: a case study of Waterkloof Spruit peatland in Kgaswane Mountain Reserve*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Grundling, A., Kotze, D., Grundling, P-L., Le Roux, J. & Sekaleli, T.S. 2022. *Management of Palmiet wetland types in South Africa*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Grundling, A.T. & Grundling, P. 2022. *Peat research in South Africa: Challenges and needs*. Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13-30 March 2022.

Grundling, A.T., Le Roux, J.P., Gibson, L., Van Deventer, H., Rebelo, A.J., Gangathele, A.M. & Stevenson, R. 2022. *The status and understanding of peatland degradation in South Africa: from catchment land-use change to peat fire responses and working towards recommendations*. Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13-30 March 2022.

Grundling, P-L. 2022. *Finger in the Dyke: knowledge generation, compliance and enforcement initiatives in conserving wetlands in South Africa*. Keynote address delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Grundling, P-L. 2022. *The challenges facing peatland restoration in South Africa*. Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13-30 March 2022.

Grundling, P-L. 2022. *The Malahlapanga and Mfayeni Hot Spring Mires – monitoring beyond the present: Is current megafauna induced change a matter for concern?* Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Grundling, P-L. 2022. *Twenty-five years of IMCG involvement in southern Africa- how will the legacy continue?* Paper delivered at the IMCG Field

Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13-30 March 2022.

Grundling, P-L. & Sekaleli, T. 2022. *Wetlands of the Orange-Senqu River Basin: local action for regional satisfaction?*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Grootjans, A.P., Bootsma, A., Elshehawi, S. & Grundling, P. 2022. *Ecohydrology of Matlabas mire and consequences for management and restoration*. Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13-30 March 2022.

Henschel, J.R. & Duncan, F.D. 2022. *Managing brown locusts in the anthropogenic world*. Paper delivered at the 57th annual congress of the Grassland Society of Southern Africa (GSSA), Aldam Resort, Ventersburg, South Africa. 25-29 July 2022.

Henschel, J.R. & Wassenaar, T.D. 2022. *Tenebrionid beetle diversity increases with aridity across western southern Africa*. Paper delivered at the annual Arid Zone Ecology Forum (AZEF) Conference, Vredendal, South Africa. 11-13 October 2022.

Jungmann, D., Graumntz, S., Vouo Otomo, P., Schubert, S. & Avenant, M. 2022. *Monitoring of surface water quality: general framework, methods, tools, and strategies*. Paper delivered at the 1st Southern African Mountain Conference 2022 (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Kafula, Y.A., Mataba, G.R., Mwajjengo, G.N., Munishi, L.K., Moyo, F., Dube, T., Vanschoenwinkel, B. & Brendonck, L. 2022. *Occurrence and diversity of large branchiopods in relation to land use types in temporary ponds of northern Tanzania*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Kafula, Y., Philippe, C., Pinceel, T., Minishi, L., Moyo, F., Vanschoenwinkel, B., Brendonck, L. & Thoré, E. 2022. *Pesticide sensitivity of Nothobranchius neumanni, a temporary pond predator with a non-generic life-history*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South

Africa. 26-30 June 2022.

Khosa, S.D., Grundling, P-L. & Brown, L.R. 2022. *Assessment of long-term and short-term progress of wetlands rehabilitation work in Marakele National Park, Limpopo Province, South Africa*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Le Roux, J., Grundling, A. & Grundling, P-L. 2022. *The patterns of degradation and recovery at the Vasi Pan Peatland*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Malise, T., Brown, L. & Grundling, A. 2022. *Hydrogeomorphic wetland types in Kgaswane Mountain Reserve*. Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24-27 October 2022.

Mataba, G.R., Munishi, L., Brendonck, L. & Vanschoenwinkel, B. 2022. *Native aquatic predators can maintain low mosquito densities in temporary ponds in Northern Tanzania*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Meyer-Milne, E., Brendonck, L. & Pinceel, T. 2022. *Dormant egg banks reveal encrusted secrets of temporary aquatic life: a branchiopod perspective*. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Mitchell, S. & Seaman, M. 2022. *The position of temporary waters in the wider ecosystem*. Keynote address delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26-30 June 2022.

Moloi, M.S., Raisibe, L.F., Seopela, M.P., Hansen, R., Kuehnel, D., Erasmus, M., Oberholster, P.J. & Thwala, M. 2022. *Aquatic risk assessment of engineered nanomaterials released from commercial products: The South African case study*. Paper presented at the 8th International Conference on Nanoscience and Nanotechnology in Africa (NanoAfrica 2022), Cape Town, South Africa. 26-28 October 2022.

Mwajjengo, G.N., Njau, K.N., Vanschoenwinkel, B. & Brendonck, L. 2022. *Seasonal river connections modulate community structure in tropical temporary*

pools. Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26–30 June 2022.

Ndlela, T., Beckedahl, H., Grundling, A.T. & Grundling, P-L. 2022. *Peatland hydrological processes in Malolotja Nature Reserve, The Kingdom of Eswatini.* Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13–30 March 2022.

Nkhase, T., Moeletsi, M., Clulow, A. & Grundling, A. 2022. *Dynamics of carbon dioxide fluxes from two selected South African wetlands.* Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24–27 October 2022.

Oberholster, P.J. 2022. *Assessing the treatment capacity of an ecological engineered wetland receiving AMD over a period of five years.* Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26–30 June 2022.

Sauvage, D., Le Roux, J. & Grundling, P. 2022. *Mire in Mauritius: Current threats and future actions.* Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13–30 March 2022.

Schoeman, Y. & Oberholster, P.J. 2022. *Floating treatment wetlands as a nature-based solution addressing water quality challenges in water infrastructure a case study in South Africa.* Paper delivered at the Environment, Climate Change and Health Conference (ENCLIMAH) 2022, Accra (& Virtual), Ghana. 12–13 October 2022.

Sekaleli, T. & Grundling, P-L. 2022. *Mires of Lesotho: from the fen to the pen – talking bog.* Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24–27 October 2022.

Shabalala, N. 2022. *Assessing the invasion risk of four alien *Hypericum* species detected in South Africa.* Paper delivered at the National Symposium on Biological Invasions 2022, University of Fort Hare, Alice, South Africa. 6–8 July 2022.

Stephenson, R., Gibson, L., Grundling, A., Grenfell,

S. & Grundling, P-L. 2022. *Hydrology and peat characteristics of the Onrus peatland, Western Cape, South Africa.* Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24–27 October 2022.

Teullet, S., Tilak, M-K., Magdeleine, M., Schaub, R., Weyer, N.M., Panaino, W., Fuller, A., Loughry, W.J., Avenant, N.L., De Thoisy, B. & Delsuc, F. 2022. *Studying the gut microbiota of ant- and termite-eating mammals to understand convergent dietary adaptations.* Poster presented at the 11th Oppenheimer Research Conference, Midrand, South Africa. 05–07 October 2022.

Van Deventer, H., Adams, J., Durand, J.F., Grobler, R., Grundling, P., Janse Van Rensburg, S., Jewitt, D., Kelbe, B., MacKay, F., Naidoo, L., Nel, J.L., Pretorius, L., Ridden, T. & Van Niekerk, L. 2022. *Red listing of wetland ecosystem types: the forested wetlands of Maputaland as an example.* Paper delivered at the IMCG Field Symposium & General Assembly Southern African Mires and Peatlands, Various places in South Africa. 13–30 March 2022.

Vermaak, N., Oberholster, P.J., Fourie, F., Magingi, A., Aamand, J., Jensen, B.K., Bech, T.B., Bollmann, U.E., Kürstein, J., Terkelsen, M., Van der Schyff, M., Clarke, S. & Kanyerere, T. 2022 *Understanding the Black Box of the MAR infiltration process.* Paper delivered at the IAH-SA virtual conference [Current and recent Groundwater Research in Southern Africa], Virtual, South Africa. 13–15 September 2022.

Vermaak, N., Oberholster, P.J., Mathivha, T., Fourie, F. & Magingi, A. 2022. *Ensuring the health of groundwater dependent wetlands when using MAR to increase water supply security.* Paper delivered at the National Wetlands Indaba, Golden Gate Highlands National Park, South Africa. 24–27 October 2022.

Vos, T. & Cawood, S. 2022. *Saving sacred waters: The future of Mohokare Valley sacred sites and water resources.* Paper delivered at the 59th Southern African Society of Aquatic Scientists (SASAqS) Conference, Amanzi Private Game Reserve, Brandfort, South Africa. 26–30 June 2022.

Zweig, T., De Villiers, L., Grundling, A. & Stephenson, R. 2022. *The Onrus Peat-Palmiet Wetland: ruin to restoration.* Paper delivered at the National Wetland Indaba, Golden Gate Highlands National Park, South Africa. 24–27 October 2022.



STAFF (2022)

Director:
Prof PJ Oberholster

Professor:	Prof PJ Oberholster
Associate Professor:	Prof OO Ololade
Affiliated Professors:	Prof NA Kgabi and Prof A Turton
Senior Lecturers:	Dr MF Avenant, Dr S Esterhuysen and Dr BA Nkhata
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 Pincheel, Prof MT Seaman, Dr M Thwala, Dr DF Toerien, Prof BJ Vanschoenwinkel and Dr PC Zietsman
Senior Officer:	ME Kemp (Professional Services)
Officer:	Dr AT Vos (Professional Services)
Researcher:	Dr E Atangana
Course Coordinator:	V Padayachee (until mid-2022) and RI Mariti (from mid-2022)
Senior Assistant Officer:	DM Kolesky
Messenger:	PS Thibiri

CENTRE FOR MICROSCOPY

FACULTY OF NATURAL AND AGRICULTURAL SCIENCE



CONTACT DETAILS

Prof Koos Terblans
Centre for Microscopy

Faculty of Natural and Agricultural Sciences
University of the Free State
PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2321
E: terblansjj@ufs.ac.za
W: <https://www.ufs.ac.za/natagri/departments-and-divisions/centre-for-microscopy-home>

OVERVIEW OF 2022

The year 2022 was accompanied by much success for the Centre for Microscopy. Equipment utilisation from researchers grew significantly, almost returning to pre-pandemic periods. The Centre also saw the completion of equipment installations which had been started in 2021.

The Centre for Microscopy is a research facility specialising in gathering structural information on a micro- to nano-meter scale using microscopes, such as a scanning electron microscope (SEM), transmission electron microscope (TEM) and confocal laser scanning microscope (CLSM). Additionally, the Centre has specialised specimen preparation equipment, such as critical point dryers, an ultra-microtome and a newly installed focused ion beam (FIB) to accompany the microscopy, which ensures that the specimens are correctly prepared for the type on analysis needed. While the Centre primarily supports researchers from the University of the Free State (UFS), other local and international institutes outside the UFS also utilise the facilities.

ACHIEVEMENTS

Staff Achievements

Hanlie Grobler received her MSc degree with distinction in Plant Sciences (Botany) in December 2022, for her dissertation 'Nemesia (Scrophulariaceae) nectar spur development and function in a phylogenetic context'. Her supervisors were Dr Lize Joubert and Dr Mariëtte Jackson.

Grobler received an award for the best photograph in the photo competition in the category 'Laboratory work: Our magnificent world', at the 47th South African Association of Botanists held online from 17 to 20 January 2022. In addition, she was awarded the Fiona Graham Prize for First Time Accepted Abstract at the Annual Meeting of the Microscopy Society of Southern Africa, held at Gold Reef City in Johannesburg from 5 to 8 December 2022.

ACTIVITIES

User Support

Having an easy-to-use SEM (JEOL IT200) to work alongside the high-resolution SEM (JEOL JSM 7800F) has significantly helped improve the workflow for the Centre's staff. The IT200 SEM has been ideal for specimens that do not require high magnifications and, due to the system's user-friendly interface, researchers can easily be trained to operate the SEM. This frees up time for the Centre's staff to work on other equipment.

Work resumed on the Philips CM100 TEM after a filament replacement was performed in late 2021. As seen from the microscope usage hours indicated in Table 1, the SEM remains the more popular microscope for researchers due to its ability to deliver impressive, high-resolution 3-dimensional

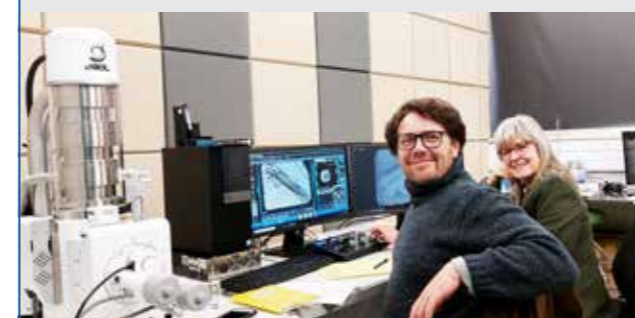
images compared to the TEM and CLSM. Both the TEM and CLSM are very specimen-specific, requiring specialised preparation techniques to utilise the full capabilities of the system. However, the Zeiss LSM 900 CLSM and JEOL F200 HRTEM have only recently been installed and thus utilisation of these instruments will increase in future.

Table 1: Microscope usage (2022)

USER	USAGE HOURS				
	HRSEM	SEM	TEM	CLSM	Total
UFS Department					
Animal Sciences	-	-	14	-	14
Cardiothoracic Surgery	4	-	9	-	13
Chemistry	50	9	9	-	68
Genetics	4	27	-	-	31
Geology	9	-	-	-	9
Institute for Groundwater Studies	2	-	-	-	2
Microbiology and Biochemistry	20	69	9	44	142
Pharmacology	6	-	3	-	9
Physics	419	12	21	-	452
Plant Sciences	2	38	-	-	40
Soil, Crop and Climate Sciences	1	-	-	-	1
Sustainable Food Systems and Development	6	11	-	-	17
Zoology and Entomology	82	101	-	-	183
External researchers/projects					
Central University of Technology (CUT)	21	8	1	-	30
TOTAL USAGE	626	275	66	44	1011

In 2022 our staff supported 75 researchers and students covering a range of disciplines involving microscopy research. The combined hours spent on all the microscopes totalled 1011 hours, a significant increase

The JEOL IT200 SEM operated by Gerhard de Jager (left) and Prof Linda Basson (right) from the Department of Zoology and Entomology



from the previous two years and almost returning to pre-pandemic numbers, as reflected in Table 2 below.

Table 2: Total number of users and hours (2019 – 2022).

	2019	2020	2021	2022
Users	86	55	62	75
Hours	1179	391	655	1011

Sample Preparation

In addition to operating the microscopes, our staff also handle the necessary sample preparation requirements for each microscope, as prearranged with the researchers. The Centre keeps stock of the chemicals and consumables needed for electron microscopy sample preparation. Having all the necessary supplies available saves researchers time and money, as some supplies can be costly, with limited shelf life. This forms an integral part of the support service provided by the Centre and has proven to be very successful as it provides researchers with an economically viable route to incorporate microscopy in their research.

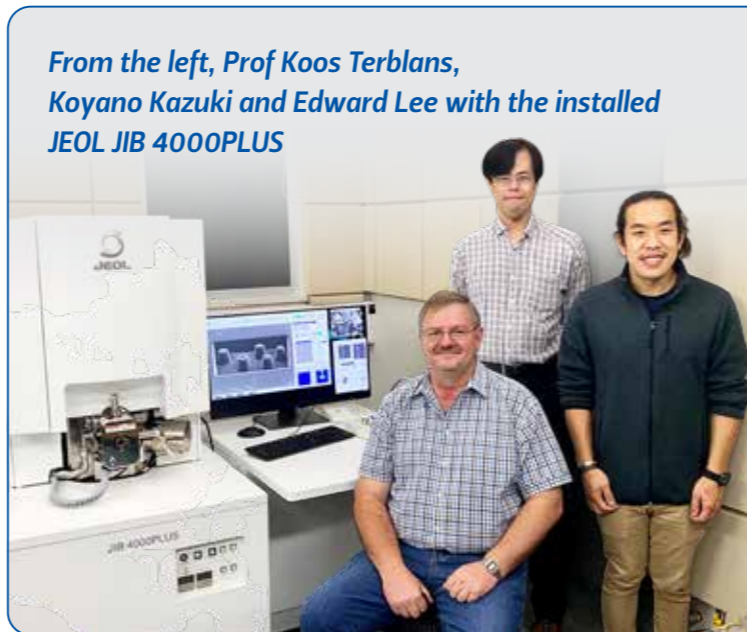
MSSA 2022

The Centre's staff attended the 57th Conference of the Microscopy Society of Southern Africa (MSSA 2022) held from 5 to 8 December 2022 at Gold Reef

City, Johannesburg. Attending this conference was of great importance to the Centre, as it is the only local conference that targets microscopists from all science disciplines and allowed the Centre to build connections for future collaborations.

Installation of Equipment and Training

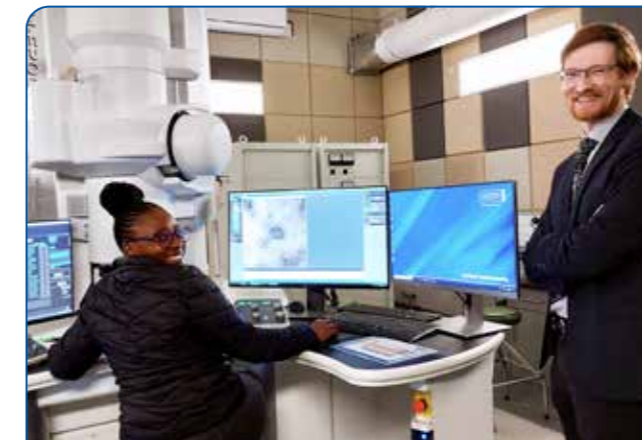
There was much excitement at the Centre for Microscopy as the installation of the all the equipment delivered in 202, was finally completed in October 2022.



From the left, Prof Koos Terblans, Koyano Kazuki and Edward Lee with the installed JEOL JIB 4000PLUS

The JEOL JIB 4000PLUS FIB installation was completed in March, followed by basic operations training presented by Koyano Kazuki (Service Engineer from JEOL).

Installation of HRTEM continued through most of 2022, due to the various attachments with which the system is equipped being manufactured by different companies. The installation was ultimately completed in October. Training on the basic operations of the HRTEM took place in November, presented by Dr Eudri



Nonkululeko Phili receiving training from Dr Eudri Venter on the basic operation of the JEOL F200 HRTEM

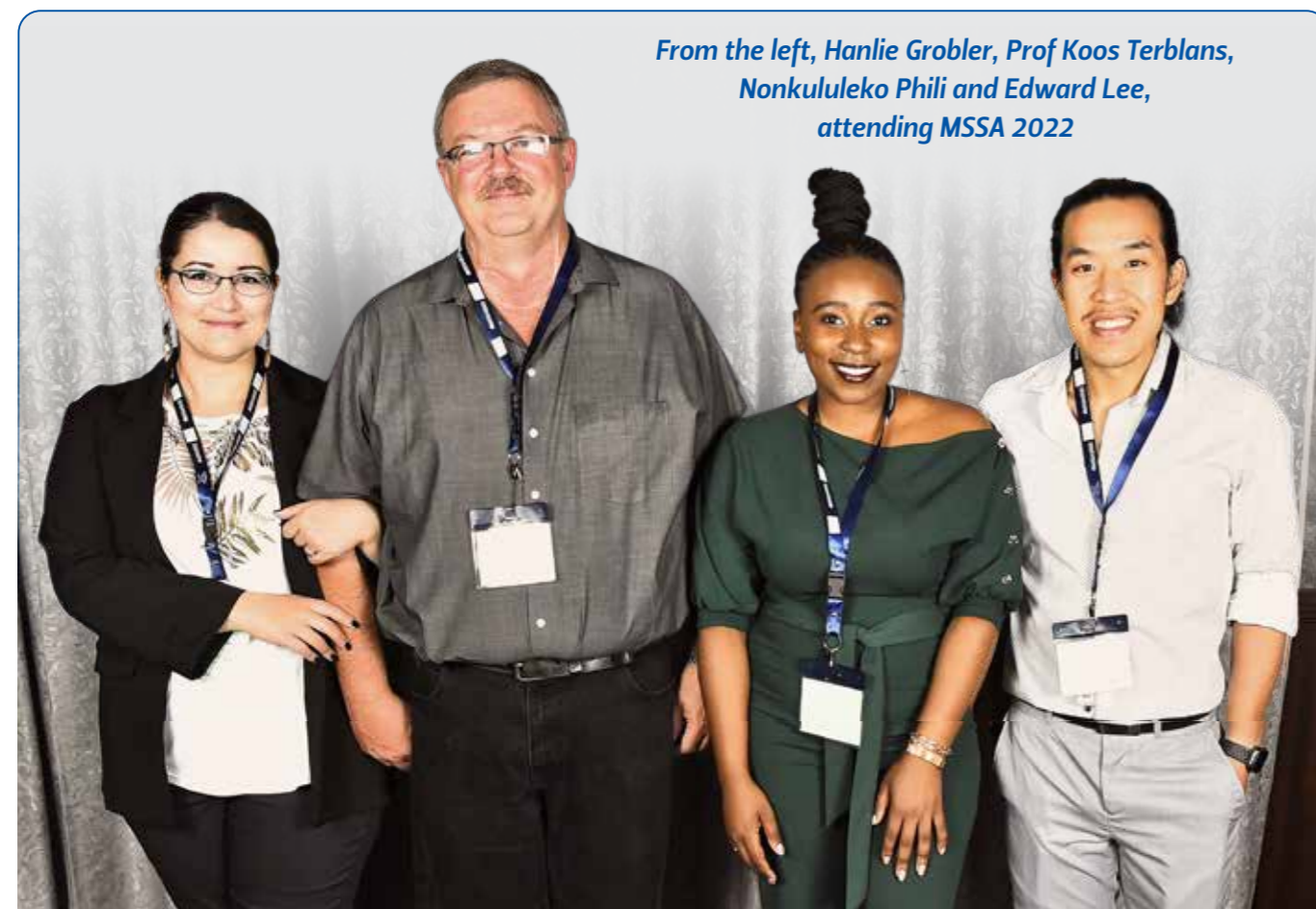
Venter (Application Specialist from JEOL UK). Further application training will be scheduled for 2023.

Practical Sessions

Upon request, the Centre's staff also present practical sessions to different departments in the Faculty of Natural and Agricultural Sciences. These sessions typically consist of a tour through the Centre, during which the researchers and/or students are shown the equipment available at the facility. The tour also covers a basic demonstration on how the equipment works, what information one would expect to obtain, and the sample preparation required for each instrument.

Examples of such practical sessions are the annual visit by the Honours students from the Department of Zoology and Entomology (ZLGY6814 and ENTO6814) and the Department of Microbiology and Biochemistry (MCBT6804 and BOCT6804), requested by Prof Linda Basson and Prof Olihile Sebolai, respectively.

The Zoology and Entomology students collect and prepare their own SEM specimens, after which Hanlie Grobler assists them with operating the SEM to view and image their samples. This allows students to operate an electron microscope. For



From the left, Hanlie Grobler, Prof Koos Terblans, Nonkululeko Phili and Edward Lee, attending MSSA 2022



From the left, Nonkululeko Phili, Hanlie Grobler, Edward Lee, Prof James Wesley-Smith, J Troup, Prof Koos Terblans and Dr Eudri Venter after completion of HRTEM operations training



The 2022 Zoology and Entomology Honours students at the JEOL JSM-7800F SEM – back, from the left, H Grobler and J Viljoen, and front, from the left, L Gwanya and S Stemla

some, this will be a once-in-a-lifetime experience while for others it is a first introduction to many more SEM sessions as they continue with further studies.

STAFF (2022)

Director:
Prof JJ Terblans

Junior Researcher/

Lecturer: E Lee

Senior Officer: H Grobler

Assistance Officer: N Phili

RESEARCH OUTPUTS

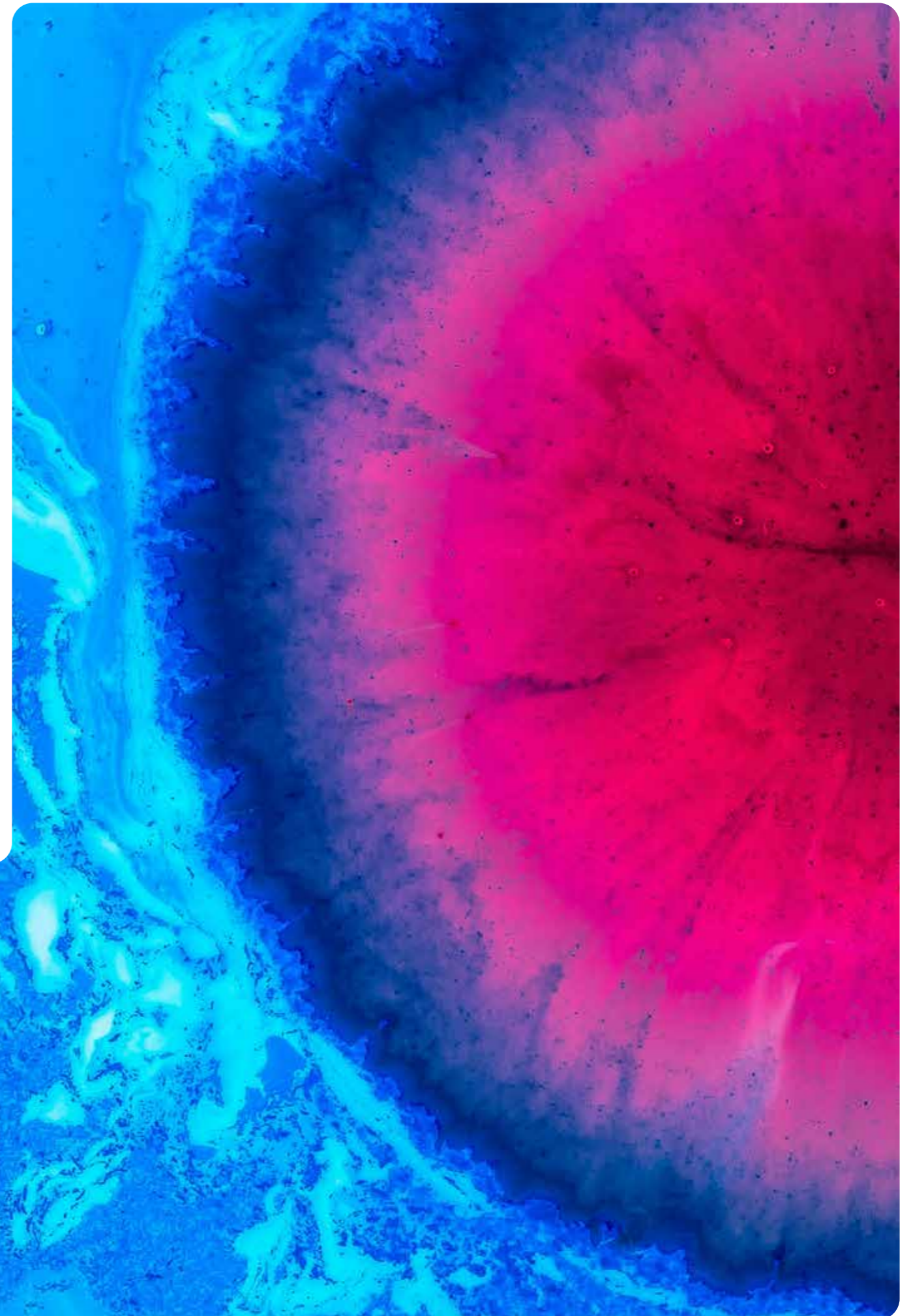
Conference Contributions

Papers/Posters

Grobler H., Jackson M. & Joubert L. 2022. *Nectar spur development in Nemesia Vent. (Scrophulariaceae)*. Paper delivered at the 47th South African Association of Botanists Conference (Online). 17-20 January 2022.

Grobler H., Jackson M. & Joubert L. 2022. *Nectar spur development in Nemesia (Scrophulariaceae)*. Paper delivered at the 57th Microscopy Society of Southern Africa Conference, Gold Reef City, Johannesburg, South Africa. 5-8 December 2022.

Lee E., Harris R.A., Terblans J.J. & Swart H.C. 2022. *Production of SrVO₃ through co-precipitation synthesis and annealing in reducing atmosphere*. Paper delivered at the 57th Microscopy Society of Southern Africa Conference, Gold Reef City, Johannesburg, South Africa. 5-8 December 2022.



DISASTER MANAGEMENT TRAINING AND EDUCATION CENTRE FOR AFRICA (DiMTEC)

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Prof Abiodun Ogundeji
DiMTEC

Faculty of Natural and Agricultural Sciences
University of the Free State
PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 3352 / 2721
E: OgundejiAA@ufs.ac.za
W: www.ufs.ac.za/dimtec

OVERVIEW OF 2022

In 2022, the Disaster Management Training and Education Centre for Africa (DiMTEC) made significant progress and achievements. In March 2022, Prof Abiodun Ogundeji was appointed as the Director of the Centre. He is an astute, versatile, applied economist and National Research Foundation (NRF)-rated researcher. Prof Ogundeji obtained his PhD in Agricultural Economics from the University of the Free State. Before joining DiMTEC as Director, he was a guest lecturer presenting classes on the economic impact assessment of disasters and the managing of floods.

The devastating floods and landslides in KwaZulu-Natal in April 2022, as well as the collapse of the Jagersfontein Dam wall in the Free State, *inter alia*, highlighted the importance of disaster management, particularly as these events occurred when the nation was trying

to recover from the COVID-19 pandemic. DiMTEC responded and offered assistance at various levels.



Prof Abiodun Ogundeji, the new Director of DiMTEC

DiMTEC is proud to announce that research output increased significantly in 2022, with DiMTEC staff and affiliated researchers publishing 58 articles and making several international and local conference presentations.

At DiMTEC, we can proudly say that 2022 was a more successful academic year, and we look forward to another significant performance in 2023.

ACHIEVEMENTS

Staff Achievements

Dr Olivia Kunguma was appointed as a Programme Director of the 1st Annual Advocacy for Risk Management, Business Continuity and Disaster Management Workshop held on 4 November 2022. The workshop was organised as a hybrid event, with the physical attendance being at the UFS Bloemfontein Campus.

Prof Abiodun Ogundeji was invited to chair the session on climate change and adaptation at the 12th International Society for the Integrated Disaster Risk Management Conference (IDRiM).

Dr Alice Ncube was appointed as a member of the Editorial Board of *Jàmbá*, a trans-disciplinary publication in the field of disaster risk reduction and resilience, aimed at serving as a platform for discussion and debate in this relatively new study field.

Prof Johannes Belle was appointed as a member of the Standing Committee on Health of the Academy of Science of South Africa (ASSAF) and actively participates in the committee activities.

Student Achievements

Sanchay Kalicharan was employed as a Presidential Youth Employment Intervention (PYEI) Intern at DiMTEC in August 2022. He is currently studying towards his Master's degree in Disaster Management. As an intern, his responsibilities include assisting the Programme Director in managing assessments, preparing contact sessions and liaising with the students regarding their academic activities. Kalicharan also assists with conducting research in DiMTEC and presenting the findings on various research platforms, while also presenting at academic conferences.

TEACHING AND LEARNING

13th Annual Block Course

The Centre, in collaboration with the United Nations University – Institute for Environment and Human Security (UNU-EHS) based in Bonn, Germany, held a block course at the Bloemfontein Campus from 26 February to 4 March 2022. The theme was 'Sustainable resilience building as we emerge from the complex global pandemic: Towards the 2030 global agenda for Sustainable Livelihood Development'. The annual block course focuses on building resilience, sustainable development and the reduction of vulnerabilities. This was the first face-to-face attendance since the disruption of the pandemic. The course was attended by 17 participants from Namibia, Zimbabwe, South Africa, South Sudan and Cameroon. The participants were PhD candidates, Master's in disaster management students and disaster management practitioners working for different institutions.

During the course, participants from diverse backgrounds and the facilitators engaged in information sharing and transfer of knowledge regarding current affairs and inputs to solve some resilience building problems. Besides the University facilitators, the course included facilitators from UNU-EHS, the National University of Public Service, Budapest, Hungary and the South African National Disaster Management Centre.



Facilitators of the 13th Annual Block course, front from the left Dr A Ncube, Prof AA Ogundeji, Dr T Raphela and ZV Poto; back from the left, Dr Y Nyam, Prof A Restas, Prof JA Belle, Prof AJ Jordaan and Prof J Szarzyński

Short Learning Programme: Introduction to disaster management

The Centre presented a Short Learning Programme (SLP) titled 'Introduction to disaster management', which was attended by 11 participants from the Alfred Nzo District Municipality Disaster Management Centre and the South African Defence Force. The three-day course was held on the Bloemfontein Campus from 14 to 16 September 2022. The short training programme aimed to enhance the knowledge and skills of the participants in the

Participants in the 'Introduction to disaster management' Short Learning Programme



disaster management field to be more efficient in their roles and responsibilities.

RESEARCH AND INNOVATION

As a socio-ecologist, Dr Tlou Raphela is currently working on a range of projects, including, 'The prevalence of trauma symptoms and coping used in a disaster affected community in South Africa' (submitted to *Spectrum*), 'The Health Care System vulnerabilities exposed by the COVID-19 pandemic aka Evaluating the resilience of hospitals during COVID-19 pandemic' (submitted to *Jamba* special issue), 'The prevalence of trauma symptoms and coping used in a Disaster-affected community in Johannesburg, South Africa' and 'Ecological impacts and conservation implications of *Lantana camara* inside the Groenkloof Nature Reserve, South Africa' (submitted to *Conservation Journal*).

Prof Johannes Belle's research focuses primarily on nature-based solutions for disaster risk reduction and climate change adaptation to build community and system resilience. He is part of the project team

of the Water Research Commission Project, titled 'Threats of extreme weather events: improving resilience to the multiple risks of climate change'. The overarching theme of this study is to understand how river ecosystem services (including water provisioning) may be influenced by the possible cumulative impacts of successive extreme weather events in the future, the effect this may have on the vulnerability and resilience of local communities in the area, and how these impacts may be ameliorated through risk reduction planning.

Prof Abiodun Ogundeji completed an NRF-funded project titled 'Farmers' coping and adaptation strategies to drought and other water-related risks in a changing climate'. His current research focuses on projects aimed at assisting farmers and other stakeholders to adapt to extreme climate events, thereby ensuring food security and sustainable food production. He has students from four different African countries (Cameroon, Nigeria, Ghana and Botswana) working on different topics.

The research interest of Dr Alice Ncube focuses on social vulnerability and climate change, international forced migration, gender issues, climate change and adaptation, resilience and sustainable livelihoods of disadvantaged communities. She is involved in the Southern African Resilience Academy (SARA) project, an initiative by the Global Resilience Partnership coordinated by the Centre for Sustainability Transitions at Stellenbosch University and supported by regional partners such as the USAID Resilient Water Program and the Southern African Program on Ecosystem Change (SAPECS). The main goals of the project are to strengthen regional expert networks and collaboration in the areas of resilience and development, support the co-production of policy- and practice-relevant knowledge and enhance knowledge exchange between Global South regions and knowledge transfer from the Global South to the Global North.

ENGAGED SCHOLARSHIP

Global Network Civil Society for Disaster Risk Reduction (GNDR)

Prof Belle is the National Focal Point for South Africa and the Regional Advisory Group Member of the GNDR, the largest Civil Society Organisation Network in the world with headquarters in the United Kingdom. Activities included holding meetings, capacity building, and preparing a position paper for the Climate Change CoP27 in Egypt.

Global Platform for Disaster Risk Reduction (DRR)

Prof Belle was the only member from Africa to form part of the organising Committee for the Global Platform for Disaster Risk Reduction, under thematic Group Four on Nature-Based Solutions. The Global Platform for DRR is the highest United Nations-led platform to discuss global disaster issues.

Integrated Fire Management Awareness Launch

DIMTEC participated and exhibited at the Integrated Fire Management Awareness Launch (#IFMAL) for the 2022 fire season on 26 May 2022, at Middelwater Farm, Free State.

Risk Informed Urban Development (RUID)

Prof Belle is a founding and active member of RUID, a network of researchers and practitioners looking into urban disaster risks and sustainable development, which forms part of the Sustainable Cities Network in the UN system. He made a presentation on 'Risk Assessment during the RUID meeting coordinated from Germany.



NATIONAL AND INTERNATIONAL COLLABORATION

Intra-Africa Mobility Projects

Prof Johannes Belle attended the Intra Africa Regional Cluster Meeting on the 30 November 2022 in Johannesburg. This meeting brought together the European Union (EU) delegation and their African counterparts to examine the implementation of the various Intra-Africa Mobility projects in Africa. This is a joint venture between the EU and the Africa Union (AU) to foster the mobility of African scholars in Master's and PhD programmes within the continent. Delegates agreed on key success areas of the various projects but also noted constraints, such as draconian funding conditions that do not take into account local African conditions, delays in processing student visas, delays in evaluating foreign qualifications for admission in host institutions and lack of a comprehensive credit transfer schemes among Higher Education Institutions (HEIs) in Africa. The EU has made more funding available for Intra-Africa Mobility and called on HEIs in Africa to form consortiums and apply for such funding. Prof Belle coordinates the FRAME project at UFS, which is one of the *Intra Africa* Mobility projects.

Erasmus Staff Mobility Program

The Erasmus Staff Mobility Program supports the educational, professional, and personal development of people in education in Europe and beyond, through lifelong learning. It thus provides academic staff with an opportunity to contribute to and to learn from the best practices of other countries' education systems. In June 2022, Lulia Ajtai, Ioana Cristina Pisteu and Ioan Mihai Harsan from Babeş-Bolyai University, Romania, visited the Centre as part of the programme.

Prof Pasztor from the National University of Public Service, Hungary, visited DiMTEC on a staff mobility programme on July 2022. As a way of fostering Internationalisation, the visit was beneficial to the Centre, as he will be co-supervising one of the DiMTECs' PhD students with Dr Kunguma.



Prof Belle (far left), Dr Raphela (third from left), Prof Ogundeji (centre together with their Hungarian hosts, in the Budapest Parliament)

Prof Johannes Belle, Prof Abiodun Ogundeji and Dr Tlou Raphela travelled to the National University of Public Service, Budapest, Hungary, in July 2022.

First Annual Advocacy for Risk Management, Business Continuity and Disaster Management Workshop

The Centre signed a Memorandum of Understanding (MOU) with the UK-based Institute of Risk Management to conduct a one-day workshop on 4 November 2022. The workshop, presented as a hybrid event, was hosted by the Bloemfontein Campus for the physical attendees. It was a great honour having MA Dukwana, the Member of the Executive Council (MEC) of the Free State Department of Cooperative Governance and Traditional Affairs (COGTA), as the Keynote

Participants of the 1st Annual Advocacy for Risk Management, Business Continuity and Disaster Management Workshop, on the Bloemfontein Campus



Speaker. His speech highlighted the importance of collaboration, doing away with working in silos, and mandating business continuity in disaster management legislation, among other issues.

Collaboration with South African Municipalities

DiMTEC is on a drive to establish relationships with South African Municipalities in order to capacitate them with issues pertaining management of disasters, in particular Disaster Risk Reduction. Onke Diko, Head of the Disaster Management Centre of the Alfred Nzo Municipality in the Eastern Cape, and Pumza Maquvana (a manager in that Centre) visited DiMTEC on the 16 August 2022 and a Memorandum of Understanding was agreed upon and was signed in October 2022.



Prof Ogundeji (centre front), Dr Raphela (back row – fourth from right) and Dr Ncube (back row – third from right) with participants at the Alfred Nzo DiMTEC collaboration meeting

OTHER ACTIVITIES

KwaZulu Natal April flood disaster

On 13 April 2022, the National Disaster Management Centre (NDMC) classified the KwaZulu (KZN) Natal floods as a provincial disaster in terms of Section 23 of the Disaster Management Act, 57 of 2002. For more than four days, there was heavy rainfall on the eastern side of South Africa, and KwaZulu-Natal Province was affected the most. The persistent rains triggered flooding and mudslides. Several compounding impacts of the flooding and mudslides were recorded, including the death of more than 300 people, damage to infrastructure (telecommunications towers, roads, bridges, homes, power lines etc.), car accidents, business and school closures, and missing people. In response to the disaster, the Centre called for donations from the UFS, the Bloemfontein community and beyond. Donations of clothes, food, cash and blankets were received, and were handed over to the KwaZulu-Natal Disaster Management Centre personnel on 4 August 2022.



DiMTEC staff members lending a helping hand to KZN Flood Disaster

POSTGRADUATE STUDENTS

S Kalicharan (Master's student and Intern) and M Maisiri (PhD candidate and research assistant) presented papers at the 5th Free State Province Research Colloquium, held on 29 September at the Central University of Technology.

Thirty-five (35) postgraduate students from the 2022 class will be graduating during the April 2023 graduations. Two students were enrolled for the PhD in 2022.

STAFF MATTERS

DiMTEC Women's Day celebration

National Women's Day on 9 August 2022, did not go unnoticed at DiMTEC and was celebrated in style by the DiMTEC ladies. The Centre continues to encourage the participation of women in disaster management-related programmes.



Celebrating Women's Day, from the left, Dr Annelene van Straten, Phumla Gonya, Dr Olivia Kunguma, Dr Alice Ncube and Zukiswa Poto

DiMTEC Commemorates World Suicide Day

World Suicide Day is commemorated on 10 September every year. DiMTEC, in support of the Faculty of Health Sciences, commemorated the day on 9 September 2022. DiMTEC is committed to action toward the prevention of suicide by offering a healthy environment for its students and staff members.



RESEARCH OUTPUTS

Research Articles

Adetoro, A.A., Ngidi, M.S.C., Danso-Abbeam, G., Ojo, T.O. & Ogundeji, A.A. 2022. Impact of irrigation on welfare and vulnerability to poverty in South African farming households. *Scientific African* 16: 01177. DOI: <https://doi.org/10.1016/j.sciaf.2022.e01177>.

Adetoro, A.A., Ngidi, M.S.C., Ojo, T.O., Danso-Abbeam, G., Ogundji, A.A. & Orimoloye, I.R. 2022. Weather-index insurance as an adaptation strategy to climate change: a global insight. *Climate Research* 88:73-85. DOI: 10.3354/cr01697.

Bano, R., Khiadani, M. & Nyam, Y.S. 2022. System archetypes underlying formal-informal urban water supply dynamics. *Water Resources Management* 36: 4995-5010. DOI: 10.1007/s11269-022-03288-w.

Danso-Abbeam, G., Asale, M.A. & Ogundeji, A.A. 2022. Determinants of household food insecurity and coping strategies in Northern Ghana. *GeoJournal*. DOI: 10.1007/s10708-022-10742-0.

Danso-Abbeam, G., Ogundeji, A.A. & Fosu, S. 2022. Cashew contract farming in Ghana: Implications on farm performance and household welfare. *Journal of Agribusiness in developing and Emerging Economics*. DOI: 10.1108/JADEE-12-2021-0339.

Hlatshwayo, S.I., Ojo, T.O., Modi, A.T., Mabhaudhi, T., Sotow, R. & Ngidi, M.S.C. 2022. The determinants of market participation and its effect on food security of the rural smallholder farmers in Limpopo and Mpumalanga provinces, South Africa. *Agriculture* 12(7): 1072. DOI: 10.3390/agriculture12071072.

Joseph, R.-A. & Szarzynski, J. 2022. Clean Water Crisis: Exploring green solutions for Haiti. *Crisis Response Journal* 13(4): 30-32.

Kehinde, M.A., Akinola, A., Kehinde, A.D. & Ogundeji, A.A. 2022. Agricultural organizations and adaptation of soil conservation practices among smallholder farmers in Oyo state, Nigeria. *Tropical and Subtropical Agroecosystems* 25 (3):125. DOI: 10.56369/tsaes.4148.

Kehinde, A.D. & Ogundeji, A.A. 2022. Distributive impacts of non-farm income on output and farm income of cassava farmers in Southwestern Nigeria. *Scientific African* 19(e01535): 1-17. DOI: 10.1016/j.sciaf.2022.e01535.

Kehinde, A.D. & Ogundeji, A.A. 2022. Social capital networks (SCNS) reducing the poverty on cocoa producing households: Evidence from Osun and Ondo states of Southwestern Nigeria. *Tropical and Subtropical Agroecosystems* 25(2) :082. DOI:10.56369/tsaes.3936.

Kehinde, A.D. & Ogundeji, A.A. 2022. The simultaneous impact of access to credit and cooperative services on cocoa productivity in South-western Nigeria. *Agriculture & Food Security* 11(11).DOI: 10.1186/s40066-021-00351-4.

Kehinde, D.A., Tijani, A.A. & Ogundeji, A.A. 2022. The effects of farmers' organization and access to credit on farmers' preference for attributes of improved rice varieties in Ekiti state, Nigeria. *Tropical and Subtropical Agroecosystems*. 25(1): 014. . DOI: 10.56369/tsaes.3794.

Kunguma, O. 2022. A South African disaster legislative perspective of information management and communication systems. *South African Journal of Information Management* 24(1): a1540. DOI: 10.4102/sajim.v24i1.1540

Kunguma, O. 2022. COVID-19 disaster, an opportunity for the South African disaster management legislation betterment? *Academia Letters* Article 4645. DOI: 10.20935/AL4645.

Mereuta, A., Ajtai, N., Radovici, A.T., Papagiannopoulos, N., Deaconu, L.T.; Botezan, C.S., Stafnie, H.I., Nicolae, D. & Ozunu, A. 2022. A novel method of identifying and analyzing oil smoke plumes based on MODIS and Calipso satellite data. *Atmospheric Chemistry and Physics* 22(7): 5071-5098. DOI: 10.5194/acp-22-5071-2022.

Miller, V.L., Joseph, E.P., Sapkota, N. & Szarzynski, J. 2022. Challenges and Opportunities for Risk Management of Volcanic Hazards in Small Island Developing States. *Mountain Research and Development* 42(2): D22-D31. DOI: 10.1659/MRD-JOURNAL-D-22-000011.

Mncube, L.N., Ngidi, M.S.C., Ojo, T.O. & Nyam, Y.S. 2022. Addressing food insecurity in Richmond area of KwaZulu-Natal, South Africa: The role of cash transfers. *Scientific African* 19:1-9. DOI: 10.1016/j.sciaf.2022.e01485.

Moises, D.J. & Kunguma, O. 2022. Strengthening Namibia's Flood Early warning system through a critical gap analysis. *Sustainability* 15(524): 1-22. DOI: 10.3390/su15010524.

Mokati, J.T.W., Ncube, A. & Bahta, Y.T. 2022. Is it really feminization of agriculture? The issue of household food security in Lesotho's Southern Lowland District. *Journal of Asian and African Studies*. 0(0): 1-4. DOI: 10.1177/0021909622111359.

Muyambo, F., Belle, J., Nyam, Y.S. & Orimoloye, I.R. 2022. Climate-Change-Induced Weather Events and Implications for Urban Water Resource Management in the Free State Province of South Africa. *Environmental Management* 71: 40-54. DOI: 10.1007/s00267-022-01726-4.

Ncube, A. 2022. The "Murky" New Orleans: A community reliving and experiencing the 2005 Hurricane Katrina. *Jamba* (14(1)): 1-4.

Nohamba, S.O., Musara, J.P., Bahta, Y.T. & Ogundeji, A.A. 2022. Drivers of postharvest loss among citrus farmers in Eastern Cape province of South Africa: A zero-inflated poisson (ZIP) regression model analysis. *Agriculture* 12(120): 1651. DOI: 10.3390/agriculture12101651.

Nyam, Y.S., Bahta, Y.T., Oduniyi, O.S., & Matthews, N. 2022. Smallholder sheep farmers' perception of production constraints and competitiveness strategies in South Africa. *Scientific African* 16: e01192. DOI: 10.1016/j.sciaf.2022.e01192.

Nyam, Y.S., Kotir, J.H., Jordaan, A.J. & Ogundeji, A.A. 2022. Identifying behavioral patterns of coupled water-agriculture systems using system archetypes. *Systems research and behavioral science* 39(2): 305-323. DOI: 10.1002/sres.2753.

Nyam, Y.S., Ojo, T.O., Belle, J.A., Ogundeji, A.A. & Adetoro, A.A. 2022. Determinants of profit efficiency among smallholder sheep farmers in South Africa. *African Journal of Science, Technology, Innovation and Development* 14(3): 620-629. DOI:10.1080/20421338.2021.1879510.

Oduniyi, O.S., Ojo, T.O. & Nyam, Y.S. 2022. Awareness and adoption of sustainable land management practices among smallholder maize farmers in Mpumalanga province of South Africa. *African Geographical Review* (Online). DOI:10.1080/19376812.2021.2018661.

Ogundeji, A.A. 2022. Adaptation to climate change and impact on smallholder farmers' food security in South Africa. *Agriculture*. 12(5): 589. DOI:10.3390/agriculture12050598.

Ogundeji, A.A., Danso-Abbeam, G. & Jooste, A. 2022. Climate information pathways and farmers'

adaptive capacity: insights from South Africa. *Environmental Development* 44:100743. DOI: 10.1016/j.envdex.2022.

Ogundeji, A.A. & Okolie, C.C. 2022. Perception and adaptation strategies of smallholder farmers to drought risk: A scientometric analysis. *Agriculture* 12(8):1129. DOI: 10.3390/agriculture12081129.

Ojo, T.O., Adetoro, A.A., Ogundeji, A.A., Belle, J.A. & Ngidi, M.S.C. 2022. Unlocking the commercialization potentials of Moringa Oleifera production in Southwestern Nigeria. *African Journal of Science, Technology, Innovation and Development* 14(4):1129-1138. DOI: 10.1080/20421338.2021.1937812.

Ojo, T.O., Ogundeji, A.A. & Emenike, C.U. 2022. Does adoption of climate change adaptation strategy improve food security? A Case of rice farmers in Ogun State, Nigeria. *Land* 11(11): 1875. DOI: 10.3390/land1111875.

Okolie, C.C., Danso-Abbeam, G., Groupson-Paul, O. & Ogundeji, A.A. 2022. Climate-smart agriculture amidst climate change to enhance agricultural production: A bibliometric analysis. *Land* 12 (50): 1-23. DOI: 10.3390/land12010050.

Okolie, C.C. & Ogundeji, A.A. 2022. Effect of COVID-19 on agricultural production and food security: A scientometric analysis. *Humanities & Social Sciences Communications* 9: 64. DOI: 10.1057/s41599-022-01080-0.

Orimoloye, I.R., Belle, J.A., Olusola, A.O. & Ololade, O.O. 2022. Navigating nature's complexities through Terra MODIS information and downscaled regional climate model: Mainstreaming space-based information for drought disaster risk management. *Physics and Chemistry of the Earth, Parts A/B/C* 126. DOI:10.1016/j.pce.2022.103136.

Orimoloye, I.R., Belle, J.A., Orimoloye, Y.M., Olusola, A.O. & Ololade, O.O. 2022. Drought: A common environmental disaster. *Atmosphere* 13(1): 111. DOI: 10.3390/atmos13010111.

Orimoloye, I.R., Olusola, A.O., Belle, J.A., Pande, C.B. & Ololade, O.O. 2022. Drought disaster monitoring and land use dynamics: identification of drought drivers using regression-based algorithms. *Natural Hazards* 112: 1085-1106. DOI: 10.1007/s11069-022-05219-9.

Owolabi, S.T., Belle, J.A. & Mazinyo, S. 2022. Quantifying Intra-Catchment streamflow processes and response to climate change within a climatic

transitional zone: A case study of Buffalo catchment, Eastern Cape, South Africa. *Mathematics* 10(16): 3003. DOI: 10.3390/math10163003.

Owusu, V., Donkor, E., Owusu-Sekyere, E., Ogundeji, A.A. & Asante, B.O. 2022. Editorial: Climate change, variability, and sustainable food systems. *Frontiers in Sustainable Food Systems* 6: 1-23.

Raphela, T.D. & Duffy, K.J. 2022. Effects of the density of invasive Lantana camara plants on the biodiversity of large and small mammals in the Groenkloof Nature Reserve in South Africa. *Biology* 12(2): 296. DOI: 10.3390/biology12020296.

Raphela T.D. & Duffy, K. 2022. The Impact of *Lantana camara* on Invertebrates and Plant Species of the Groenkloof Nature Reserve, South Africa. *Zoological Studies* 61(e33). DOI: 10.6620/ZS.2022.61-33

Szarzynski, J., Alcántara-Ayala, I., Nüsser, M. & Schneiderbauer, S. (Eds.) 2022. Focus Issue: Addressing Challenges of Hazards, Risks, and Disaster Management in Mountain Regions. *Mountain Research and Development* 42(2). DOI: 10.1659/mrd.4202.

Tabe-Ojong, M.P., Nyam, Y.S., Lokossou, J.C. & Gebrekidan, B.H. 2022. Farmer advisory systems and pesticide use in legume-based systems in West Africa. *Science of The Total Environment* 867: 161282. DOI: 10.1016/j.scitotenv.2022.161282.

Terzi, S., de Angeli, S., Miozzo, D., Massucchielli, L.S., Carturan, F., Szarzynski, J. & Boni, G. 2022. Learning from the Covid-19 pandemic to advance multi-hazard risk management: a critical analysis of the Italian Red Cross emergency management data. *Progress in Disaster Sciences* PDISAS-D-22-00071

Tshuma, M., Belle, J.A. & Ncube, A. 2022. An analysis of factors influencing household water, sanitation, and hygiene (WASH) experiences during flood hazards in Tsholotsho district using a seemingly unrelated regression model. *Water* 15(2): 371. DOI: 10.3390/w150203071.

Tshuma, M., Belle, J.A., Ncube, A., Nyam, Y.S. & Orimoloye, I.R. 2022. Building resilience to hazards in the water, sanitation, and hygiene (WASH) systems: a global review. *International Journal of Environmental Health Research* (Online ahead of print). DOI: 10.1080/09603123.2022.2153809.

Zondi, N.T.B., Ngidi, M.S.C., Ojo, T.O. & Hlatshwayo, S.I. 2022. Factors influencing the extent of the

commercialization of indigenous crops among smallholder farmers in the Limpopo and Mpumalanga provinces of South Africa. *Frontiers in Sustainable Food Systems* 5 DOI: 10.3589/tsuf.2021.777790.

Zulu, S.S., Ngidi, M., Ojo, T. & Hlatshwayo, S.I. 2022. Determinants of consumers' acceptance of indigenous leafy vegetables in Limpopo and Mpumalanga provinces of South Africa. *Journal of Ethnic Foods* 9:13. DOI: 10.1186/s42779-022-00128-5.

Books/Chapters in Books

Jordaan, A.J. 2022. Drought Risk Reduction: Case of South Africa. In: *Routledge Handbook of Environmental Hazards and Society* (Chapter 7). T.K. McGee & E.C. Penning-Rowsell (Eds). Taylor and Francis. London and New York. pp 106-124.

Ogundeji, A. A. & Ojo, T. O. 2022. The impact of drought on urban agriculture: A case study of urban livestock farmers in Bloemfontein, Free State Province. *Food Security and Food Sovereignty Challenges in Africa*. pp 176-201.

Research Reports

Jordaan, AJ. 2022. *From Drought Response to Drought Mitigation: Drought Monitoring for Extensive Livestock Farming: Review of Drought Indicators*. Water Research Commission. Contract No. 2022/2023-00732. WRC, Pretoria.

Narvaez, L., Szarzynski, J. & Sebesvari, Z. 2022. *Tonga volcano eruption - Technical Report*. Interconnected Disasters Risks Report 2021/2022. United Nations University Institute for Environment and Human Security. Bonn, Germany.

Conference Contributions

Conference Papers/Posters

Heunis, C., Joubert, M. & Ncube, A. 2022. *Essential health and social work services to mitigate vulnerability during COVID-19 in the Free State, South Africa*. Paper delivered at the Joint World Conference on Social Work Education and Social Development (SWESD), Seoul, South Korea (Virtual). 26-28 October 2022.

Muyambo, F., Belle, J. & Orimoloye, I.R. 2022. *Climate-change-induced weather events and*

implications for urban water resource management in the Free State Province of South Africa. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Raphela, T. 2022. *Crop-raiding by rodents on subsistence farmers on hilly terrains in the northern KwaZulu-Natal Province, South Africa*. Paper delivered at the 1st Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Raphela T.D. 2022. *Evaluating the resilience of hospitals during COVID-19 Pandemic*. Paper. 12th International Conference of the international society for the Integrated Disaster Risk Management. Japan, Tokyo, Asia, 21-23 September 2022.

Raphela, T.D. 2022. *Farming on hilly terrains of South Africa*. Paper delivered at the First Southern African Mountain Conference (SAMC2022), Champagne Sports Resort, South Africa. 14-17 March 2022.

Raphela, T.D. 2022. *Relationship between mental health and COVID-19 amongst the University students in South Africa*. Paper delivered at the 5th International Conference on Research in Social Sciences (RSSCONF), Paris, France (France). 08-10 April 2022.

Raphela, T.D. 2022. *The Health Care System vulnerabilities exposed by COVID-19*. Paper delivered at the 5th Biennial Southern Africa Society for Disaster Reduction (SASDiR), Blantyre, Malawi. 26-28 October 2022

Raphela, T.D. 2022. *The well-being of university students amidst the COVID-19 pandemic in South Africa*. Paper delivered at the 13th Dealing with Disaster Conference, Newcastle, UK. 09-10 June 2022.

Raphela, T.D. & Hlalele, B.M. 2022. *Modelling external risk to agricultural development projects using a Reconnaissance Drought Index (RDIs) and Standardised Precipitation Indices (SPI)*. Paper delivered at the Lucerne University of Applied Sciences & Arts, Switzerland. 21-25 June 2022.

Raphela, T.D. & Ncube A. 2022. *The Health Impact of shack fires on an informal settlement in Bloemfontein, South Africa*. Pre-recorded paper delivered at the 2nd Fire Engineering and Disaster Management International Scientific Conference,

University of Public Services, Institute of Disaster Management, Hungary. 26 April 2022.

Raphela, T.D. & Pillay, N. 2022. *The levels of crop raiding by rodents and primates in a subsistence farming community, in South Africa.* Paper delivered at Intersol2022: EAI the 5th International conference on innovations and interdisciplinary solutions for underserved areas, Abuja, Nigeria (Virtual). 22-24 March 2022.

Conference Proceedings

Heunis C, Joubert M & Ncube A. 2022. Essential health and social work services to mitigate vulnerability during COVID-19 in the Free State, South Africa. Joint World Conference on 'Social Work Education and Social Development' (SWESD). Seoul: 26-28 October 2022.

Jordaan, A.J. 2022. Review of the disaster management institutional arrangements and coordination modalities for the COVID-19 response at national, provincial, and local levels: March to December 2020. In: *Proceedings of the 12th International Conference of the International Society for Integrated Disaster Risk Management.* Babeş-Bolyai University of Cluj-Napoca, Romania. 21-22 September 2022.

Jordaan, A.J. 2022. Review of the functionality and efficiency of disaster management institutional arrangements and coordination modalities for the COVID-19 response at national, provincial, and local levels in South Africa: March to December 2020. In: *Proceedings of the 12th International Conference of the International Society for Integrated Disaster Risk Management.* Babeş-Bolyai University of Cluj-Napoca, Romania. 21-22 September 2022.

Joubert M, Heunis C & Ncube A. 2022. Towards bridging policy-practice gaps: Evidence of neglect of vulnerable groups by social workers during COVID-19 in Mangaung. 10th Annual Free State Provincial Health Research Day on 'COVID-19 and Beyond.' Bloemfontein: UFS and FSDoH, 17 November.

Raphela, T.D. 2022. The effects of COVID-19 on mental health of students in the Free State Province, South Africa. In: *Social Sciences international research Conference 19 - 21 October 2022, Mauritius Hybrid Conference.* P482-509. e-ISBN 978-0-620-96741-9.

Raphela, T.D. & Maisiri, M.K. 2022. The changes in

evening screen exposure and sleep disturbances during the COVID-19 pandemic. In: *Social Sciences international research Conference 19 - 21 October 2022, Mauritius Hybrid Conference.* e-ISBN number: 978-0-620-96741-9

Wong, I., Greve, K. & Szarzynski, J. 2022. Evolution of Spatial Disaster Risk Assessments: a Bibliometric Analysis. In: *Enviroinfo 2022: Lecture Notes in Informatics (LNI), Gesellschaft für Informatik.* Bonn: Gesellschaft für Informatik. V. Wohlgemuth, S. Naumann, K-K. Arndt, G. Behrens & M. Höb (Eds). pp. 77-87.

STAFF (2022)

Director:
Prof AA Ogundeji

Associate Professors: Prof JA Belle and Prof AA Ogundeji

Associate Professor (Part time): Prof AJ Jordaan

Affiliated Professors: Prof R Bragg, Prof B Grové, Prof A Ozunu and Prof J Szarzynski

Senior Lecturer: Dr A Ncube

Lecturers: Dr O Kunguma and Dr TD Raphela

Junior Lecturers: D Banyane, M Joubert and Z Poto

Affiliated Senior Lecturers: Dr H Booysen, Dr T Kama and Dr M Khangale

Affiliated Lecturers: L de Wet, W Ellis and Dr N Matthews

Affiliated Junior Lecturer: L Nogabe

Programme Director: Dr A Ncube

Senior Assistant Officer: Dr A van Straten

Officer: P Gonya

Research Assistants: C Ekang and M Maisiri

Auxiliary Staff: CS Mkhafu



INSTITUTE FOR
GROUNDWATER STUDIES
 FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Dr Eelco Lukas
 Institute for Groundwater Studies

Faculty of Natural and Agricultural Sciences
 University of the Free State
 PO Box 339 | Bloemfontein 9300 | South Africa

T: +27 51 401 2793
E: LukasE@ufs.ac.za
W: www.ufs.ac.za/igs

OVERVIEW OF 2022

The Institute for Groundwater Studies (IGS) is the only institute in South Africa dedicated to geohydrology. Founded in 1974 by Prof FDI Hodgson, the IGS is the oldest institute on the Bloemfontein Campus and has produced more than 1 000 postgraduate students. The IGS operates like any other academic department on the Campus in the sense that its main task is to educate students and its secondary task is to do research. The IGS educates students in the field of geohydrology and does research on South Africa's aquifers.

ACHIEVEMENTS

Student Achievements

The IGS Dux Prize for the Best MSc student in Geohydrology was awarded to PH Mabotja, who achieved a final mark of 90%. The title of his dissertation was 'The development of Groundwater transport model using Caputo-Fabrizio and Atangana-Baleanu fractional derivatives with Julia mapping'.



Mabotja receiving his award from Dr Eelco Lukas

TEACHING AND LEARNING

The IGS is a postgraduate institution offering BSc Honours, MSc and PhD degrees in Geohydrology. Our BSc Honours degree consists of seven modules – Groundwater Hydraulics, Hydrochemistry and Pollution, Groundwater Geophysics, Mining Geohydrology and Hydrology, Groundwater Modelling, Groundwater Management, and a Research Report in Geohydrology.

All Honours students are required to attend the lectures conducted in the six modules. Our

courses are presented in two- or three-week blocks to enable working students to attend the lectures. 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 also required to attend these classes.

It is important that IGS students are exposed to the practical issues of groundwater, and the annual field trip for the Honours students, which takes place in July, is always a highlight. Students spend the first two days in the field, studying the interaction between geology and groundwater flow. The aims of the Barkly East excursion were to:

- Enable the student to link the geology to the occurrence of groundwater in that specific geology,
- Visually observe the water bearing geological structures in the field,
- Enable the student to understand the origin of stream/rivers from groundwater,
- Understand deep groundwater circulation and the origin of hot water springs,
- Understand different processes of water purification to comply with drinking water standards, and
- Understand the operation and construction of oxidation dams for the treatment of sewerage water.

The second part of the field trip may include a visit to a mine, a power station or a petrochemical site. Groundwater plays an important role in the industry, especially regarding water volumes and the availability and contamination thereof.



Honours students on the field trip to the Barkly East area, on the Otto du Plessis Pass

The highest elevation point of the excursion was the boundary between water catchments (water divide) and one of the origin points of the drainage system (Saalboom River) draining the catchment. At this point, the groundwater contribution to the origin of the Saalboom River can be visualised/observed. Moving down the mountain range, students will observe the change in geometry of the streams and rivers. The change in water quality will also be recorded moving down the mountain range. The concept of interflow and baseflow will also be explained and visualised.



Groundwater contribution to the origin of the Saalboom River

RESEARCH AND INNOVATION

It is important for lecturing personnel at the IGS to stay at the forefront of geohydrology; the only way to achieve this is by research. Research at the IGS can be divided into two major streams – namely, public- and private sector research, depending on the origin of the funding. Public sector research includes research related to the Water Research Commission (WRC), while the private sector research includes research for Coaltech, SASOL and the International Groundwater Resources Assessment Centre (IGRAC). All research projects are used for capacity building and many form part of an MSc or a PhD study.

Petroleum Agency of South Africa (PASA) project

In 2020, independent specialists and researchers from the IGS, in partnership with specialists from CBSS, were appointed by PASA to design a

regional groundwater monitoring network for the Central Karoo.

This project has been cancelled by mutual agreement between the UFS and PASA. Due to the resistance experienced by landowners, stakeholders and organised agriculture, access to locations to carry out field work became problematic. Alternative options on a way forward that were presented to PASA were unfortunately not acceptable due to procurement procedures and policies. Legal representatives of both parties are currently communicating on final deliverables and the format thereof as well as a final payment for work done.

Bloemwater

The project at the town of Excelsior to drill additional boreholes and test them, experienced long delays due to heavy rain in the area, which made access to drill location with the drill rig impossible. Three boreholes were successfully drilled, of which two have already been tested. Once the final results of the water quality have been received, a final report will be submitted to Bloemwater. This is expected to be before the end of June 2023.

ENGAGED SCHOLARSHIP

The Groundwater Division (GWD), in collaboration with the IGS, held a Drilling Supervision, Practical Field demonstration from 14 to 15 July 2022 on the Bloemfontein Campus. This Short Learning Programme (SLP) was designed for all professionals within the groundwater industry. The course provides hands-on experience and theoretical background for site selection, drilling, drilling supervision and borehole construction and development.



POSTGRADUATE STUDENTS

2022 started with a much-reduced intake of Honours students, mainly due to the COVID-19 pandemic, resulting in only 50% of the seats in our classroom being available for teaching. Fourteen (14) students were enrolled at Honours level, with 35 for Master's level and 22 for the PhD.

At the 2022 graduation ceremonies during April and December, 22 BSc Honours degrees were awarded, while 12 MSc students graduated. These were:

- De Lange, J
- Den Boogert, L
- Holloway, MT (with distinction)
- Jordaan, LW (with distinction)
- Koko, HJ
- Madanda, T
- Mafika, MI
- Maphala, LH
- Mogatusi, I
- Ngaka, TRK
- Schreunder, H (with distinction)
- Stander, F

The PhD degree was conferred on two candidates:

BUDELI, Tshanduko

Thesis: Modelling the up flow of leakage from carbon dioxide repository in saline aquifers along fractured rock media

Supervisor: Prof A Atangana

MORAKALADI, Makosha Ishmaeline Charlotte

Thesis: Piecewise and stochastic approaches to modelling a conversion of flow from confined to unconfined

Supervisor: Prof A Atangana



Dr Trevor Chiweshe, Laboratory Analyst in the IGS Lab



Prof Francois Fourie

STAFF MATTERS

2022 brought one new permanent appointment and a promotion. Dr Trevor Chiweshe was appointed as a Laboratory Analyst in the IGS Lab. His journey as a researcher started in 2014 whilst working as a Postdoctoral Fellow in the UFS Department of Chemistry. During this period, he developed various techniques of separating and quantifying different sample types using inhouse measurement techniques. Dr Chiweshe has presented at several regional and international conferences and has published most of his work in accredited journals. In his new position, Dr Chiweshe is involved in the formulation and development of new analytical techniques for the analysis of drinking water as well as wastewater.

Dr Francois Fourie was promoted to Associate Professor.

RESEARCH OUTPUTS

Research Articles

Aatif, A, Ullah, S. & Khan, M. 2022. The impact of vaccination on the modeling of COVID-19 dynamics: a fractional order model. *Nonlinear Dynamics* 110: 3921-3940.

Atifa, A., Khan, M., Iskakova, K., Al-Duais, F. & Ahmad, I. 2022. Mathematical modeling and analysis of the SARS-Cov-2 disease with reinfection. *Computational Biology and Chemistry* 98: 109678.

Abro, K. & Atangana, A. 2022. A computational technique for thermal analysis in coaxial cylinder of one-dimensional flow of fractional Oldroyd-B nanofluid. *International Journal of Ambient Energy* 43(1): 5357-5365.

Abro, K. & Atangana, A. 2022. Strange Attractors and Optimal Analysis of Chaotic Systems based on Fractal verses Fractional Differential Operators.

International Journal of Modelling and Simulation 42(5): 716–724.

Adadzi, P., Allwright, A. & Fourie, F.D. 2022. Multivariate and Geostatistical Analyses of Groundwater Quality for Acid Rock Drainage at Waste Rock and Tailings Storage Site. *Journal of Ecological Engineering* 23(12): 203–216.

Alharthi, N., Atangana, A., & Alkahtani, B. 2022. Numerical analysis of some partial differential equations with fractal-fractional derivative. *AIMS Mathematics* 8(1): 2240–2256.

Ali, A., Islam, S., Khan, R., Rasheed, S., Allehiany, F.M., Baili, J., Khan, M. & Ahmad, H. 2022. Dynamics of a fractional order Zika virus model with mutant. *Alexandria Engineering Journal* 61(6): 4821–4836.

Alrabaiah, H., Bilal, M., Khan, M., Muhammad, T. & Legas, E.Y. 2022. Parametric estimation of gyrotactic microorganism hybrid nanofluid flow between the conical gap of spinning disk-cone apparatus. *Scientific Reports* 12: Art 59.

Atangana, A. & Akgul, A. 2022. Analysis of a derivative with two variable orders. *AIMS Mathematics* 7(5): 7274–7293.

Atangana, A. & Akgul, A. 2022. Transfer Functions by Laplace and Fractal Laplace Transforms. *International Journal of Applied and Computational Mathematics* 8: Art: 58

Atangana, A. & Araz, S. 2022. Advanced analysis in epidemiological modeling: detection of waves. *AIMS Mathematics* 7(8): 10810–18030.

Atangana, A. & Araz, S. 2022. Deterministic–Stochastic modeling: A new direction in modeling real world problems with crossover effect. *Mathematical Biosciences and Engineering / MBE* 19(4): 3526–3563.

Atangana, A. & Araz, S. 2022. Rhythmic behaviors of the human heart with piecewise derivative. *Mathematical Biosciences and Engineering / MBE* 19(3): 3091–3109.

Atangana, A. & Araz, S. 2022. Step forward in epidemiological modeling: Introducing the rate indicator function to capture waves. *Results in Physics* 28:105638.

Atangana, A. & Goufo, E. 2022. Modern and generalized analysis of exogenous growth models. *Chaos, Solitons and Fractals* 163: 112605.

Atangana, A. & Koca, I. 2022. Analytical and numerical investigation of the Hindmarsh–Rose model neuronal activity. *Mathematical Biosciences and Engineering* 20(1): 1434–1459.

Atangana, A. & Mekkaoui, T. 2022. A piecewise heat equation with constant and variable order coefficients: A new approach to capture crossover behaviors in heat diffusion. *AIMS Mathematics* 7(5): 8374–8389.

Atangana, A. & Rashid, S. 2022. Analysis of a deterministic–stochastic oncolytic M1 model involving immune response via crossover behaviour: ergodic stationary distribution and extinction. *AIMS Mathematics* 8(2): 3236–3268.

Awan, A., Aziz, M., Ullah, N., Nadeem, S. & Abro, K. 2022. Thermal analysis of oblique stagnation point flow with slippage on second-order fluid. *Journal of Thermal Analysis and Calorimetry* 147: 3839–3851.

Batool, A., Talib, I., Riaz, M. & Tunc, C. 2022. Extension of lower and upper solutions approach for generalized nonlinear fractional boundary value problems. *Arab Journal of Basic and Applied Sciences* 29(1): 249–256.

Bentout, S., Djilali, S., Touaoula, T.M., Zeb, A. & Atangana, A. 2022. Bifurcation analysis for a double age dependence epidemic model with two delays. *Nonlinear Dynamics*.

Chen, C., Rehman, A.U., Riaz, Jarad, F. & Xiang-E Sun. 2022. Impact of Newtonian Heating via Fourier and Fick's Laws on Thermal Transport of Oldroyd-B Fluid by Using Generalized Mittag-Leffler Kernel. *Symmetry* 14(4): 766.

Chiweshe, T. 2022. Fusion–Extraction Technique of Vanadium(III) Using Ammonium Phosphate Salt as Flux. *Crystals* 12(10): 1464.

Chiweshe, T., Welman Purchase, M.D. & Deysel, L.M. 2022. Extraction of Tungsten from Wolframite Sample Using Ammonium Phosphate Salt as Flux. *International Journal of Applied and Computational Mathematics* 74: 283–292.

Chu, Y., Yassen, M., Ahmad, I., Sunthrayuth, P. & Khan, M. 2022. A Fractional SARS–COV–2 Model with Atangana–Baleanu derivative: Application to Fourth Wave. *Fractals* 30(08): 2240210.

DarAssi, M.H., Safi, M.A., Khan, M., Beigi, A, Aly, A. & Alshahrani, M. 2022. A mathematical model for SARS–CoV–2 in variable–order fractional derivative.

European Physical Journal–Special Topics 231: 1905–1914.

El-Dessoky, M.M. & Muhammad, K. 2022. Modeling and analysis of an epidemic model with fractal–fractional Atangana–Baleanu derivative. *Alexandria Engineering Journal* 61(1): 729–745.

Farman, M., Amin, M., Akgul, A., Ahmad, A., Riaz, M. & Ahmad, S. 2022. Fractal–fractional operator for COVID–19 (Omicron) variant outbreak with analysis and modelling. *Results in Physics* 39(11): 105630.

Gu, Y., Ullah, S., Khan, M., Alshahrani, M., Abohassan, M. & Riaz, M.B. 2022. Mathematical modeling and stability analysis of the COVID–19 with quarantine and isolation. *Results in Physics* 34(5): 105284.

Huber, M.S., Kovaleva, E., Clark, M., Riller, U. & Fourie, F.D. 2022. Evidence from the Vredefort Granophyre Dikes points to crustal relaxation following basin-size impact cratering. *ICARUS* 219(1): 168–180.

Karolyte, R., Warr, O., Van Heerden, E., Flude, S., de Lange, S., Webb, S., Ballentine, C.J. & Lollar, B. 2022. The role of porosity in H₂/He production ratios in fracture fluids from the Witwatersrand Basin, South Africa. *Chemical Geology* 595(3): 120788.

Khan, M. & Atangana, A. 2022. Mathematical modeling and analysis of COVID–19: A study of new variant Omicron. *Physica A–Statistical Mechanics and its Applications* 599: 127452.

Koca, I. & Atangana, A. 2022. Analysis of a COVID–19 model with nonlocal and stochastic behaviors. *Waves in Random and Complex Media* (Online).

Li, X-P., Alrihieli, H., Algehyne, E.A., Khan, M., Alshahrani, M., Alraey, Y. & Riaz, M. 2022. Application of piecewise fractional differential equation to COVID–19 infection dynamics. *Results in Physics* 39(01): 105685.

Li, X-P., DarAssi, M., Khan, M., Chukwu, C.W., Alshahrani, M., Shahrani, M. & Riaz, M. 2022. Assessing the potential impact of COVID–19 Omicron variant: Insight through a fractional piecewise model. *Results in Physics* 38: 105652.

Koca, I. & Atangana, A. 2022. Some chaotic mathematical models with stochastic resetting. *Fractals* 30(08): 2240212.

Lubbe, R., De Lange, S.S. & Vivier, J.P. 2022. A review of slug tests analysis on South African aquifers in potential yield and transmissivity estimations. *Journal of Hydrology–Regional Studies* 40: 101008.

Meihua, H., Sunthrayuth, P., Pasha, A. & Khan, M. 2022. Numerical solution of stochastic and fractional competition model in Caputo derivative using Newton method. *AIMS Mathematics* 7(5): 8933–8952.

Panda, S., Atangana, A. & Abdeljawad, T. 2022. Existence results and numerical study on novel Coronavirus 2019–NCOV / SARS–COV–2 Model using differential operators based on the generalized Mittag-Leffler Kernel and fixed points. *Fractals* 30(08).

Rafiq, M., Javaid, A., Riaz, M. & Awrejcewicz, J. 2022. Numerical analysis of a bi-modal covid-19 SITR model. *Alexandria Engineering Journal* 61(8).

Rehman, A., Jarad, F., Riaz, M. & Shah, Z. 2022. Generalized Mittag-Leffler Kernel Form Solutions of Free Convection Heat and Mass Transfer Flow of Maxwell Fluid with Newtonian Heating: Prabhakar Fractional Derivative Approach. *Fractal and Fractional* 6(2): 98.

Rehman, A.U., Riaz, M. & Atangana, A. 2022. Time fractional analysis of Casson fluid with Rabotnov exponential memory based on the generalized Fourier and Fick...s law. *Scientific African* 17: e01385.

Rehman, A., Riaz, M., Atangana, A., Jarad, F. & Awrejcewicz, J. 2022. Thermal and concentration diffusion impacts on MH Maxwell fluid: A generalized Fourier's and Fick's perspective. *Case Studies in Thermal Engineering* 35(1): 102103.

Rehman, A., Riaz, M., Saeed, S., Jarad, F., Jasim, H. & Enver, A. 2022. An Exact and Comparative Analysis of MHD Free Convection Flow of Water-Based Nanoparticles via CF Derivative. *Mathematical problems in Engineering*.

Riaz, M. & Atangana, A., Jahngeer, A., Jarad, F. & Awrejcewicz, J. 2022. New optical solitons of fractional nonlinear Schrodinger equation with the oscillating nonlinear coefficient: A comparative study. *Results in Physics* 37(7): 105471.

Riaz, M., Jhangeer, A., Atangana, A., Awrejcewicz, J & Munawar, M. 2022. Supernonlinear wave, associated analytical solitons, and sensitivity analysis in a two-component Maxwellian plasma. *Journal of King Saud University Science* 34(5): 102108.

Singh, D., Sultana, F., Pandey, R. & Atangana, A. 2022. A comparative study of three numerical

schemes for solving Atangana–Baleanu fractional integro-differential equation defined in Caputo sense. *Engineering with Computers* 38: 149–168.

Sun, T., DarAssi, M., Bilal, M. & Khan, M. 2022. The study of Darcy–Forchheimer hybrid nanofluid flow with the thermal slip and dissipation effect using parametric continuation approach over a rotating disk. *Waves in Random and Complex Media* (Online).

Sunthrayuth, P., Khan, M. & Alshammari, F. 2022. Mathematical Modeling to Determine the Fifth Wave of COVID-19 in South Africa. *Biomed Research International* 2022:: 1–14.

Talib, I., Jarad, F., Mirza, M., Nawaz, A. & Riaz, M. 2022. A generalized operational matrix of mixed partial derivative terms with applications to multi-order fractional partial differential equations. *Alexandria Engineering Journal* 61(1) 135–145.

Talib, I., Raza, A., Atangana, A. & Riaz, M. 2022. Numerical study of multi-order fractional differential equations with constant and variable coefficients. *Journal of Taibah University for Science* 16(1): 608–620.

Xia, F., Jarad, F., Hashemi, M. & Riaz, M. 2022. A reduction technique to solve the generalized nonlinear dispersive $mK(m,n)$ equation with new local derivative. *Results in Physics* 38(3–4): 105512.

Zeb, A., Atangana, A. & Khan, Z.A. 2022. Deterministic and Stochastic Analysis of a Covid-19 Spread Model. *Fractals* 30(05): 2240163.

Zeb, A., Atangana, A., Khan, Z.A. & Djillali, S. 2022. A robust study of a piecewise fractional order COVID-19 mathematical model. *Alexandria Engineering Journal* 61(8): 5649–5665.

Zhao, Y., Elattar, E.E., Khan, M., Fatmawati, F., Asiri, M. & Sunthrayuth, P. 2022. The dynamics of the HIV/AIDS infection in the framework of piecewise fractional differential equation *Results in Physics* 40: 105842.

Books

Atangana, A. & Araz, S.I. 2022. Fractional Stochastic Differential Equations: Applications to COVID-19 Modeling. Springer Singapore.

Chapters in Books

Amakali, S. & Atangana, A. 2022. Stochastic Modeling in Confined and Leaky Aquifers. *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 28.

Chaka, D.V. & Atangana, A. 2022. Modelling Groundwater Flow in a Confined Aquifer with Dual Layers. *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 25.

Deyi, M. & Atangana, A. 2022. A New Groundwater Transport in Dual Media with Power Law Process. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 17.

Deyi, M. & Atangana, A. 2022. A New Model for Groundwater Contamination Transport in Dual Media. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 15.

Deyi, M. & Atangana, A. 2022. Groundwater Contamination Transport Model with Fading Memory Property. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 16.

Deyi, M. & Atangana, A. 2022. New Groundwater Transport in Dual Media with the Atangana–Baleanu Differential Operators. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 18.

Magingi, A. & Atangana, A. 2022. Modelling a Conversion of a Confined to an Unconfined Aquifer Flow with Classical and Fractional Derivatives. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 22.

Mahantane, M. & Atangana, A. 2022. A New Method for Modeling Groundwater Flow Problems. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 21.

Makahane, R.V. & Atangana, A. 2022. A new model of the 1-d Unsaturated–Saturated Groundwater Flow with Crossover from Usual to Sub-Flow Mean Square Displacement. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 4.

Makahane, R.V. & Atangana, A. 2022. Analysis of the Existing Model for the Vertical Flow of Groundwater in Saturated–Unsaturated Zones. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 1.

Makahane, R.V. & Atangana, A. 2022. Application of the Fractional–Stochastic Approach to a Saturated–Unsaturated Zone Model. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 6.

Makahane, R.V. & Atangana, A. 2022. New model of the 1-d Unsaturated–Saturated Groundwater Flow with Crossover from Usual to Confined Flow Mean Square Displacement. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 3.

Makahane, R.V. & Atangana, A. 2022. New Model of the Saturated–Unsaturated Groundwater Flow with Power Law and Scale-Invariant Mean Square Displacement. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 2.

Makahane, R.V. & Atangana, A. 2022. New Model of the 1-d Saturated–Unsaturated Groundwater Flow Using the Fractal–Fractional Derivative. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 5.

Makahane, R.V. & Atangana, A. 2022. Transfer Function of the Sumudu, Laplace Transforms and Their Application to Groundwater. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 7.

Manundu, S.S. & Atangana, A. 2022. The Dual Porosity Model. *Mathematical Analysis of Groundwater Flow Models*. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 26.

Mathobo, M.C. & Atangana, A. 2022. Analysis of General Groundwater Flow Equation within a Confined Aquifer Using Caputo Fractional Derivative and Caputo–Fabrizio Fractional Derivative. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 12.

Mathobo, M.C. & Atangana, A. 2022. Analysis of General Groundwater Flow Equation with Fractal Derivative. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 13.

Mathobo, M.C. & Atangana, A. 2022. Analysis of General Groundwater Flow Equation with Fractal–Fractional Differential Operators. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 14.

Mbah, H. & Atangana, A. 2022. One-Dimensional Modelling of Reactive Pollutant Transport in Groundwater: The Case of Two Species. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 27.

Morakaladi, M.I.C. & Atangana, A. 2022. New Model to Capture the Conversion of Flow from Confined to Unconfined Aquifers. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 23.

Mutandanyi, T. & Atangana, A. 2022. Modeling Soil Moisture Flow. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 19.

Myeko, P. & Atangana, A. 2022. Modeling the Diffusion of Chemical Contamination in Soil with Non-Conventional Differential Operators. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 24.

Ramakatsa, D. & Atangana, A. 2022. Deterministic and Stochastic Analysis of Groundwater in Unconfined Aquifer Model. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 20.

Ramotsho, M.A. & Atangana, A. 2022. Analyzing the New Generalized Equation of Groundwater Flowing within a Leaky Aquifer Using Power Law, Exponential Decay Law and Mittag–Leffler Law. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 8.

Ramotsho, M.A. & Atangana, A. 2022. Application of the New Numerical Method with Atangana–Baleanu Fractal–Fractional Derivative on the Self-Similar Leaky Aquifer Equations. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 11.

Ramotsho, M.A. & Atangana, A. 2022. Application of the New Numerical Method with Caputo Fractal–Fractional Derivative on the Self-Similar Leaky Aquifer Equations. In: *Mathematical Analysis of Groundwater Flow Models*. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 9.

Ramotsho, M.A. & Atangana, A. 2022. Application of the New Numerical Method with Caputo-Fabrizio Fractal-Fractional Derivative on the Self-Similar Leaky Aquifer Equations. In: *Mathematical Analysis of Groundwater Flow Models*. A. Atangana (Ed). Boca Raton, CRC Press. Chapter 10.

based exploration of deep groundwater within the eastern limb of the Bushveld Igneous Complex for hydrogeological characterisation and potential future water resource identification: Deliverable No. 1 (Inception Report). WRC Project No. 2022/2023-00812.

Conference Contributions

Conference Papers/Posters

Gómez-Arias, A., Yesares, L., Castillo, J., Vermeulen, D. & Purcell, W. 2022. *Phalaborwa Complex: from Rock Drainage Characterization to Waste Revalorization*. Paper delivered at the Conference of the International Mine Water Association (IMWA), Christchurch, New Zealand. 6-10 November 2022.

Ligavha-Mbelengwa, L., Madzivire, G., Nolakana, P.M Coetzee, H. & Gomo. M. 2022. *Potential Use of Emerging Organic Contaminants as Pollution Source Tracers*. Paper delivered at the Conference of the International Mine Water Association (IMWA), Christchurch, New Zealand. 6-10 November 2022.

Lukas, E. & Vermeulen, D. 2022. *Recharge Flooding*. Paper delivered at the Conference of the International Mine Water Association (IMWA), Christchurch, New Zealand. 6-10 November 2022.

Nolakana, G., Ligavha-Mbelengwa, L., Madzivire, G. & Coetzee, H. 2022. *Evaluation of the Water Quality Impacts Associated with Relaxation of Environmental Critical Levels: A Case Study in the West Rand Basin, South Africa*. Paper delivered at the Conference of the International Mine Water Association (IMWA), Christchurch, New Zealand. 6-10 November 2022.

Conference Proceedings

Allwright, A., De Lange, S.S., Lubbe, R., Mbonambi, L., Vivier, K., Witthuser, K.T., Webb, S., Ashwal, L., Roelofse, F., Khosa, D., Trumbull, R. & Klemd, R. 2022. Research-based deep drilling in the Bushveld Igneous Complex. In: *Proceedings of the 2022 IAH-SA Virtual Conference – Current and Recent Research in Southern Africa*. 13-15 September 2022.

Research Reports

Allwright, A.J., De Lange, S., Lubbe, R., Mbonambi, L., Vivier, K. & Witthuser, K.T. 2022. Research-

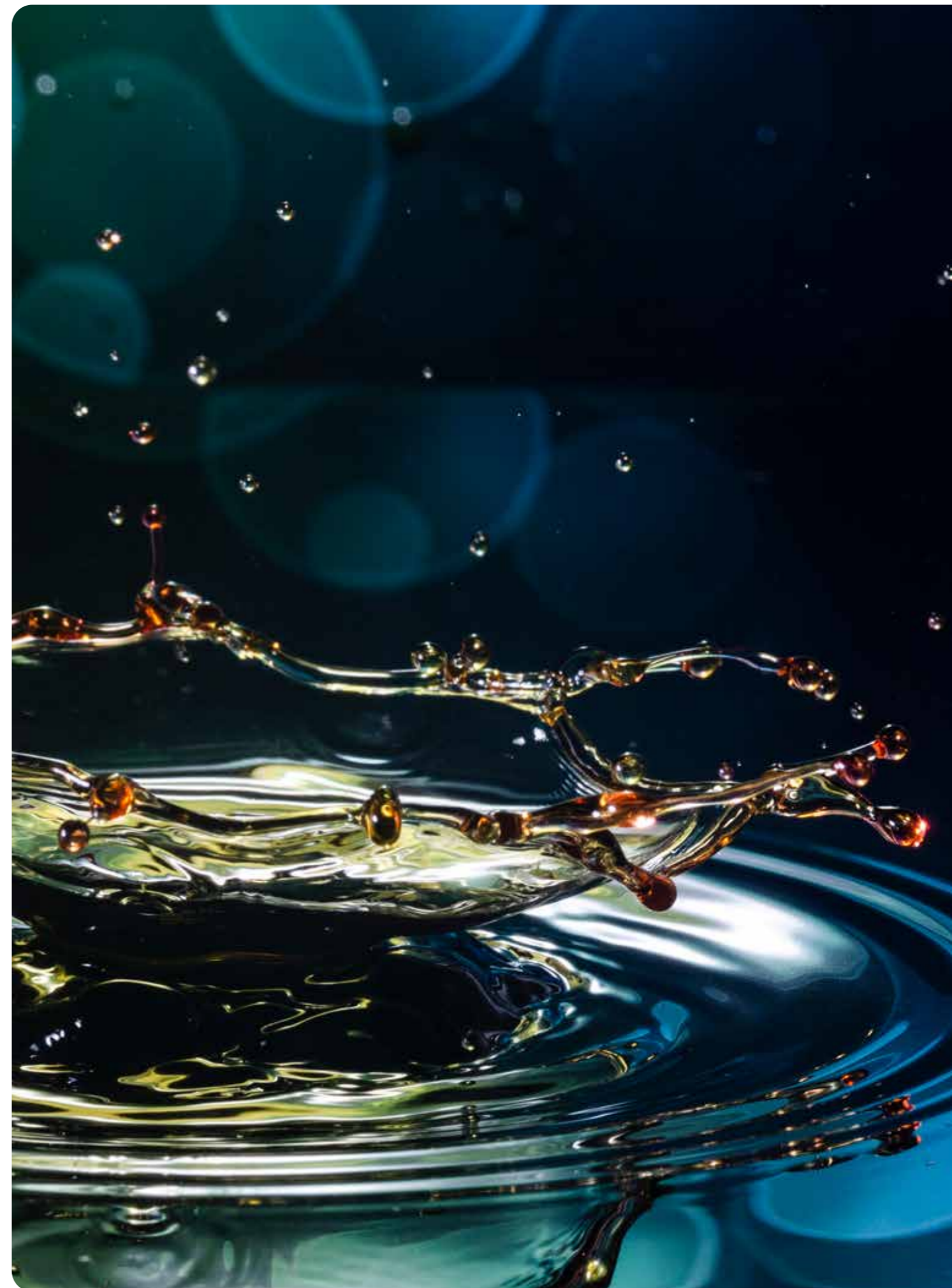
STAFF (2022)

Director:
Dr E Lukas

Professor:	Prof A Atangana
Associate Professors:	Prof FD Fourie and Prof M Gomo
Lecturers:	Dr AJ Allwright; Dr SS de Lange and PJH Lourens
Affiliated Researcher:	Prof JF Botha
Affiliated Associate Professor:	Prof KT Witthuser
Chief Officer:	
Financial Manager:	L Rust
Officer: Professional Services:	AB Rossouw
Assistant Officers (Contract):	M Smit and T Viljoen
Messenger/Cleaner:	TP Mosala

IGS LABORATORY:

Deputy Director:	Dr L-M Deysel
Analyst:	Dr T Chiweshe
Junior Assistant Analysts:	B Moruri and Dr T Hill (Contract)
Quality Manager:	S Ntshingila
Senior Officers:	W Geyer and N Koagile
Officer:	T Lelebele



UFS PARADYS EXPERIMENTAL FARM

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

Johan Barnard
Department of Animal Science

Faculty of Natural and Agricultural Sciences
University of the Free State
PO Box 339 | Bloemfontein
9300 South Africa

T: +27 82 669 2235
E: barnardj@ufs.ac.za
W: www.ufs.ac.za/animal



Johan Barnard receiving the Community Engagement Award from Prof Frikkie Neser

community engagement projects that were conducted on the Paradys Experimental Farm.

ACTIVITIES DURING 2022

Research Trials

Various 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 and the growth of individual animals. A combination

of a weaner and ox production system is followed. DNA is collected from all the animals born on the farm and used in a national database to investigate growth, milk quality and quantity, weaning weight, maternal and reproductive traits. Animals that were sold from the Paradys Experimental Farm have adapted extremely well to other areas of the country, which in itself is a very rare occurrence.

Currently the farm uses an Angus bull as part of our terminal crossbreeding plan and a chance to breed some Afrigus cattle.

Collection of data on the dairy herd:

The data collected on the dairy herd includes fertility, the mating of heifers and cows using artificial insemination (AI), ensuring a respectable inter-calving period and outstanding genetics. Other data collected include 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

The Department of Animal Science obtained a GrowSafe™ automated feeding and weighing system for conducting research on beef and dairy cattle on the Paradys Experimental Farm. This system allows for the automated determination of feed intake and weighing of the animals on a continuous basis, in contrast to current practice where feed intake and animal live weight are measured on a weekly basis. The system consists of eight feeding nodes that are fixed to weighing cells which determine the feed an animal consumes every time it visits a node. It also records when the animal eats and the time it spends eating. This opens the door for a new study field in animal feeding behaviour, which can help feedlot operators to manage feeding time of finishing cattle to ensure optimum intake, minimise wastage, obtain maximum animal growth response

and feedlot profits. The Growsafe™ system provides more accurate data and less animals are required for research purposes as individual animal intake, weight gain and feed efficiency are measured, resulting in more repetitions allowing for accurate statistical evaluation of data.

The Growsafe™ system will also be used for undergraduate training and teaching, ensuring that students gain the necessary 'day-zero' skills and familiarise themselves with state-of-the-art equipment used in industry.

Community Service

Paradys Experimental Farm presents various training courses to the community, such as the correct handling of animals, breeding goals, vaccination of animals, branding and marking of animals, stockmanship, practical days for schools, and short courses – such as faecal egg counts and small stock diseases.

OVERVIEW OF 2022

During 2022, the UFS Paradys Experimental Farm saw the completion of its own fermentation unit, Container Park and GrowSafe™ system. The crop production area was expanded by 105 hectares to increase fodder production for the farm's growing animal numbers. In the beef cattle enterprise, the conception rate dropped to 65% – due to the high rainfall and low-quality veld – while an 85 % heifer pregnancy rate was achieved in the dairy herd. The conception rate of sheep also fell to 75% this season, due to an undiagnosed virus.

ACHIEVEMENTS

Staff Achievements

Johan Barnard received the UFS Community Engagement Award in acknowledgement of all the

Four feed intake nodes



Weighing cells and water crib



In addition, several farmers' days were held on the Experimental Farm, covering topics such as awareness, information about certain goods and services, and marketing. These included lucerne (crop for cultivated pastures), pig production, branding of animals, agricultural engineering (irrigation systems), feed catalogues (various feeds and supplying companies), animal health, as well as some other topics.

Kovsie Brewery

Revamping of the brewery building, including the installation of the brewery equipment, finally came

Current state of brewery installation



Glycol chilling plant and compressor installed on outside of the building

to an end, mostly in late 2022. Essential wiring for the semi-automated brewing process was put in place, including the installation of pumps, a compressor and a glycol cooling plant. The compressor provides air to operate the hydraulic valves that direct fluids throughout the system, while the glycol cooling plant regulates fermentation temperatures. The stainless-steel welding work, including piping between brewing vessels, water sources and cleaning solution tanks, has also been successfully completed. The steam generator, which will be used to heat liquids and boil wort, has been installed and will be calibrated once the system is 100% complete.

Before the plant becomes fully operational, a few final steps need to be taken – such as fixing any leaks in the system and chilling plates, servicing the pumps and potentially installing new ones, and calibrating the steam generator. If no major issues arise, the brewery is expected to be up and running by mid-2023.

Dairy Processing Unit

The Dairy Processing Unit on the Paradys Experimental Farm was set up as a training facility for UFS students. The processing plant runs on the latest Austrian Giovanelli cheese-making equipment installed in May 2021. The large-scale cheese production officially started in December 2021.

There are officially four members in the dairy

Dairy Processing Unit and the dairy processing equipment



Cheese ripening in the ripening room



Packaged cheese with the Paradys Dairy label and logo

processing team (two dairy assistants, a cheesemaker, and a production manager).

The Jersey cow herd on the Experimental Farm consists of 59 females, of which 20 are currently in lactation. The outstanding quality of the Jersey milk on the farm allows for an average cheese yield of 13.5% or 7.5 litres of milk used to produce 1 kg of cheese, that consists of ~28% butterfat and 43% moisture. In terms of production for the period December 2021 to December 2022, 52 545 litres of milk were processed, and 6.9 tons of cheese produced. Due to consumer demand, a yellow-coloured cheese was included in the production line-up. Herb and spiced flavoured cheeses are also produced, including cumin or caraway seeds, crushed black pepper, chilli, fenugreek, thyme, onion flakes, garlic and even mango.

In the future, the production of more exotic cheeses can be expected, as well as fermented drinks, such as yoghurt and amasi. The yoghurt recipe was developed in conjunction with the Department of Sustainable Food Systems and Development and evaluated by a sensory panel. Ten different flavours have been evaluated and compared with commercial yoghurt brands. The panel indicated that they were most likely to buy UFS Paradys Dairy yoghurts than the well-known commercial ones.

Paradys Dairy's products are available from the Department of Animal Science, as well as from outlets and markets in and around Bloemfontein. The market continues to expand, even as far as the Western Cape. During 2022, we developed the branding, labels and logo for the Paradys Dairy, and since it must adhere to the UFS requirements, we collaborated with Martie Nortje (Communication and Brand Management), Naqita Fernandes (Department of Business Management) and the students of the Faculty of Economic and Management Sciences. A logo and label were designed and approved and went into print.

Paradys Dairy also collaborated with Kovsie Health to participate in the 'No Student Hungry' project on the Bloemfontein Campus.

Innovation on Paradys Experimental Farm

Over the last few years, the Faculty of Natural and Agricultural Sciences has invested substantially in the transformation of the Paradys Experimental Farm, to be a fully operational farm that provides a platform for students from the Bloemfontein Campus to learn and gain experience in agriculture.

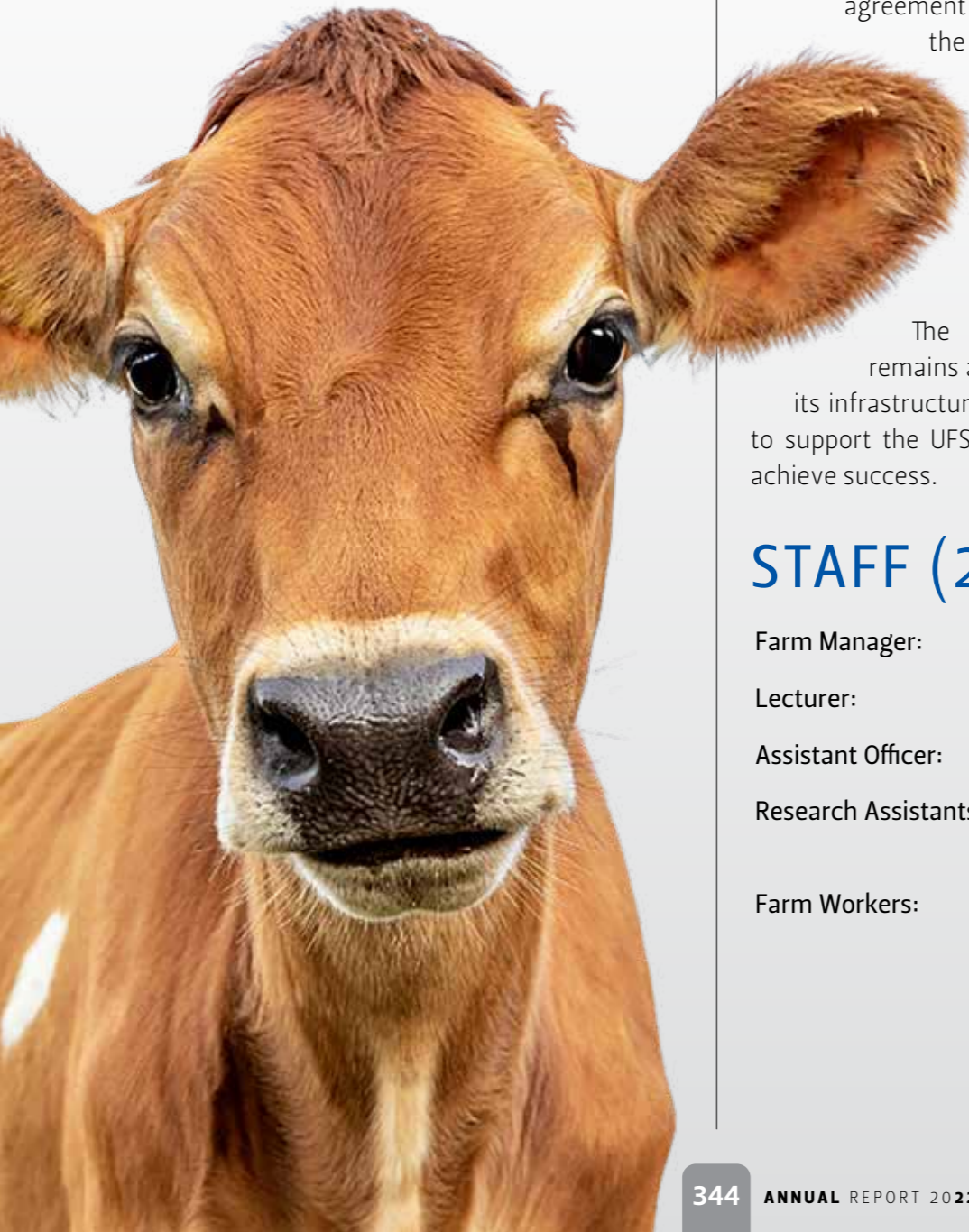
Recently the focus has shifted to find a nexus point between innovation, commercialisation, entrepreneurship, teaching and learning and research, and the farm now houses new initiatives such as a fully operational cheese factory, wool processing unit and fermentation unit (among others). These will provide students with the opportunity not only to learn advanced skills in agricultural practices, but also experience an entire value chain and provide an opportunity for entrepreneurship and industry engagement.

To enable cutting edge research and development, a science park is planned which will give researchers the opportunity for product development, with field labs and incubation space to allow for a creative environment.

In addition to the product innovation, the Faculty will soon join hands with the Faculty of Economic and Management Sciences and the Business School to enable researchers and product developers to meet leading business developers and entrepreneurs, in order to collaborate in spin-off business models, and for an entrepreneurial incubator to assist students and staff in taking research to the next step, and beyond.

Wool Project

The Paradys Experimental Farm plays a crucial role in providing a strong platform for hands-on training



and research opportunities for students in all aspects of the agricultural production chain. One such project hosted by the Paradys Experimental Farm is the RUFORUM wool project. The Experimental Farm plays a pivotal role in providing infrastructure and daily operations management to ensure that the outcome of the project is achieved.

The project is focused on transforming communal wool growers' production, from subsistence ventures to successful and sustainable businesses. This vision became a reality in 2022, when local wool growers and project leaders managed to expand the project to selling products made from wool and felt to the local community and businesses, at a profit. We are proud of the women involved in the project, as their continuous commitment, together with the infrastructure on the Experimental Farm has developed the project beyond the original agreement and expectations. The growth of the project led to the appointment of seven full-time community ladies to perform a variety of tasks, including operating the sewing machines, washing and cleaning of wool and making felt skins.

The Paradys Experimental Farm remains a beacon of innovation, through its infrastructure and personnel. We are proud to support the UFS staff and project initiatives to achieve success.

STAFF (2022)

Farm Manager:	J Barnard
Lecturer:	L Krüger
Assistant Officer:	AM Smith
Research Assistants:	L Chavula and K Sibande
Farm Workers:	TF Kubheka, LE Maqala, B Mateyesi, YS Motswari, R Papa, KP Ramatekoane, K Salamane, J Soato and PM Somi





ACADEMIC
SUPPORT DIVISIONS



ELECTRONICS DIVISION

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

CONTACT DETAILS

Innes Basson

Workshop: Electronics Division

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein | South Africa 9300

T: +27 51 401 3831

E: bassoni@ufs.ac.za

OVERVIEW OF 2022

2022 was a prosperous year filled with exciting projects, new personnel as well as bidding farewell to Adriaan Hugo, who retired after 42 years of service to the University. He will be greatly missed, and we wish him a happy retirement. After Hugo's retirement, Innes Basson was appointed as acting head for the Divisions of Electronics and Instrumentation. He assumed the position as Head of the Divisions from 1 December 2022. We welcomed two new personnel members to the Division of Electronics, namely Elias Liew and Virgil Afrikaner. We wish them all the best for their future at the Division.

Two new personnel members - Elias Liew and Virgil Afrikaner

Two of our members were closely involved with the Solar Car Project, namely Mark Jackson and Denver de Koker. Mark was responsible for all the electrical and electronic designs, as well as building and installing these designs into the car. He accompanied the team as a support member on the two-week race. Denver helped with the construction of the vehicle and was one of the drivers of the car during testing, as well as a driver in the race. We are very proud of their achievement and we are looking forward to the next solar car challenge in 2024.



Mark Jackson who took part in the Sasol Solar Challenge 2022

Denver de Koker (on the right), driver of the Lengau solar car



Many hours were also spent on the brewery project, which is almost completed.

WORK ACTIVITIES

Table 1 below illustrates the time spent on work for the 43 departments, divisions and others that made use of the services of the Electronics Division in 2022.

A total of 467 work requisitions were received in 2022, representing 638 pieces of apparatus. Nineteen (19) 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 5 215 working hours (based on 7.5 hours per day per person present), 4 973 were actively used (i.e. 95.36%).

A total of 4 141 hours was spent on maintenance (79.40%), 832 hours on development (15.95%), and 242 hours on administration (4.65%).

Work for the Faculty of Natural and Agricultural Sciences amounted to 4 681 hours (89.76%), while 534 (10.24%) hours were spent on work for departments and divisions outside the Faculty.



Table 1: Use made of the Electronics Division (2022)

CLIENT	TOTAL TIME SPENT (HOURS)	% TIME SPENT
Physics	1294	24.81%
Chemistry	529	10.14%
Brewery	505	7.80%
Booms	407	9.68%
Soil, Crop and Climate Sciences	314	6.02%
Microbiology and Biochemistry	246	4.72%
Internal Administration	242	4.64%
Animal Sciences	207	3.97%
Electronics Division	185	3.55%
Instrumentation Division	142	2.72%
Institute for Groundwater Studies (IGS)	136	2.61%
University Estates	118	2.26%
Protection Services	95	1.82%
Technical	94	1.80%
Plant Sciences	80	1.53%
Zoology and Entomology	64	1.23%
External Work	63	1.21%
Sustainable Food Systems and Development	44	0.84%
Computer Science and Informatics	41	0.79%
Geography	41	0.79%
Geology	41	0.79%
Medical Virology	41	0.79%
Centre for Microscopy	40	0.77%
ICT Services	31	0.59%
Architecture	29	0.56%
Engineering Sciences	29	0.56%

Centre for Environmental Management (CEM)	22	0.42%
South African Doping Control Laboratory (SADoCoL)	21	0.40%
University Estates	18	0.35%
Agricultural Economics	18	0.35%
Health Sciences	17	0.33%
Urban and Regional Planning	12	0.23%
Industrial Psychology	11	0.21%
Centre of Mineral Biochemistry	8	0.15%
Public Administration Management	6	0.12%
Student Academic Services	5	0.10%
Library Services	4	0.08%
Kovsie Gear	4	0.08%
Genetics	3	0.06%
Pharmacology	3	0.06%
Business Management	2	0.04%
National Control Laboratories	2	0.04%
Flippie Groenewoud Building	1	0.02%
TOTAL	5 215	100.00%



The table below provides information on the projects completed in 2022 per department/division.

Table 2: Completed projects (2022)

DEPARTMENT / DIVISION	APPARATUS
Chemistry	2 x Flow cabinet alarms 3 x UV Lights 1 x Upgrade to fish hatching incubator 1 x Extension of access control
Computer Science and Informatics	1 x Extension of access control
Engineering Sciences	2 x Lecture Timers
Geography	1 x Extension of access control
Institute for Groundwater Studies (IGS)	
Microbiology and Biochemistry	1 x Extension of access control
Physics	1 x Upgrade to fish hatching incubator 1 x Extension of access control 1 x Upgrade to photo electric effect experiment 1 x LED lighting on exhibitions at Boyden Observatory 1 x BOOTES 6 at Boyden Observatory 1 x Solar Car Project 1 x Compressor Control System
Plant Sciences	1 x Extension of access control
Soil, Crop and Climate Sciences	1 x Plant Growth Chamber 1 x Remote trigger for cellphone 3D scanner

By the end of 2022, there were eleven unfinished projects, as listed in Table 3 below.

Table 3: Unfinished projects (2022)

DEPARTMENT / DIVISION / CAMPUS	APPARATUS
Brewery	1 x Commission brewery plant
Centre for Microscopy	1 x Wireless dimmable light switch 1 x HR TEM gas alarm 1 x Power monitoring system
Chemistry	1 x Incubator temperature alarm 1 x Temperature controlled pellet press
Microbiology and Biochemistry	1 x O2 Monitor
Physics	1 x Adjustable water flow meter 1 x remote TV On/Off
Soil, Crop and Climate Sciences	1 x Upgrade growth cabinet 1 x Soil moisture sensor

STAFF (2022)

Head of Division:
I Basson

Assistant Head:	MH Jackson
Control Technician:	HJ Roodt
Technicians:	Virgil Afrikaner and Elias Liee
Technical Assistant:	D de Koker
Secretary:	A Kasper (shared with the Instrumentation Division)

INSTRUMENTATION DIVISION

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES



CONTACT DETAILS

Innes Basson

Workshop: Instrumentation Division

Faculty of Natural and Agricultural Sciences

University of the Free State

PO Box 339 | Bloemfontein | South Africa 9300

T: +27 51 401 3831

W: bassoni@ufs.ac.za

OVERVIEW OF 2022

2022 was a prosperous year filled with some challenges due to large projects and a steady flow of maintenance work. Adriaan Hugo retired after 42 years of service to the University; he will be greatly missed, and we wish him a happy retirement. After Hugo's retirement, Innes Basson was appointed as acting head for the both the Division of Instrumentation and the Division of Electronics and took up the position of head of both Divisions in December 2022.



Pieter Lotz, part of the Sasol Solar Team

A major highlight of 2022 was the design and manufacturing of the Lengau Solar car that competed in the 2022 Sasol Solar Challenge. The UFS team completed the race without any major break downs and did us proud. We would like to thank Pieter Lotz from the Sasol Solar Team, who spent many hours

building the car before the race and maintaining it during the race.

We are also nearing the completion of the brewery, which is another large and time-consuming project. Some other exciting projects include the building of exhibits for the new Science Park, a rainfall simulator for the Department of Soil, Crop and Climate Sciences and various upgrades to apparatus, such as BOOTES-6 at the Boyden Observatory.



Wicus Storm and Lucas Odendaal at the Brewery on the UFS Paradys Experimental Farm

The personnel of the Division worked tirelessly to repair and maintain equipment from all the departments, as well as external clients. We thank the University for being our primary client and all the departments for their continued support.

WORK ACTIVITIES

Table illustrates the time spent on work for the 30 departments and divisions that made use of the services of the Instrumentation Division in 2022.

A total of 351 work requisitions were received in 2022, thirty-five (35) of which were for development projects. Some were new projects and others were upgrades to older instruments and apparatus, as reflected in Table 2.

Table 1: Use made of the Instrumentation Division (2022)

DEPARTMENT/DIVISION	TOTAL TIME SPENT (HOURS)	% TIME SPENT
Kovsie Act	1123	17.24%
Physics	1047	16.07%
Brewery	751	11.53%
Animal Sciences	602	9.24%
Internal Administration	501	7.69%
Microbiology	473	7.26%
External Work	401	6.16%
Soil, Crop and Climate studies	233	3.58%
Chemistry	225	3.45%
Instrumentation Division	222	3.41%
Engineering Sciences	140	2.15%
Mineral Biochemistry	140	2.15%
Technical	78	1.20%
Fine Arts	66	1.01%
Plant Sciences	64	0.98%
Institute for Groundwater Studies (IGS)	54	0.83%
Centre for Microscopy	53	0.81%
Zoology and Entomology	47	0.72%
Pharmacology	45	0.69%
Electronic Division	42	0.65%
Centre for Environmental Management (CEM)	37	0.57%
Sustainable Food Systems and Development	36	0.55%
Medical Virology	29	0.45%
South African Doping Control Laboratory (SADoCoL)	26	0.40%
University Estates	23	0.35%
Geology	23	0.35%
Office of the Dean	22	0.34%
Genetics	8	0.12%
Animal Research Centre	2	0.03%
National Control Laboratory (NCL)	1	0.02%
TOTAL	6514	100.00%

Work for the Faculty of Natural and Agricultural Sciences amounted to 3 721 hours (62%). A total of 2 292 hours (38%) were spent on work for departments/divisions outside the Faculty.

The table on the right provides a list of the completed projects in 2022 per department/division.

Table 2: Completed projects (2022)

DEPARTMENT/DIVISION	APPARATUS
Animal Science	1 x Roof Extension over vacuum pumps 3 x Trolleys 1 x Refurbish Plough
Centre for Environmental Studies	8 x Perspex Water Columns
Centre for Microscopy	2 x UPS stands 2 x Battery Boxes
Chemistry	3 x UV Lamps 1 x Combi Flash Tube Holder
Engineering Sciences	10 x Concrete Moulds
Fine Arts	2 x Stainless Steel Printing Basin 1 x Levigator
Kovsie Act	500 x Crowd Barriers
Microbiology	12 x Perspex Stands 2 x Incubator Tables 1 x Hoist 1 x drying Trolley 1 x Hammer Mill 1 x Steam Tank Upgrade
Mineral Biochemistry	20 x Aluminium and Stainless-Steel Spoons 15 x Peg Boards
Pharmacology	2 x TLC Applicator
Physics	1 x Current balance 1 x Upgrade to Photo Electric Experiment 2 x PLD Target Holders 1 x Upgrade to Millikan Experiment 1 x Upgrade to 60" Telescope 1 x Compressor Backup System 1 x Solar Car
Plant Sciences	1 x Autoclave Vessel

Soil, Crop and Climate studies	1 x Manure Bed 100 x Scalpel Holders 1 x Gas Box
Sustainable Food Systems and Dev	3 x Sensory Booths
Virology	1 x Mosquito Catcher 1 x 3D Printer Table
Zoology and Entomology	20 x Fishing Net Frames
IGS	1 x Load deck for SDV

The unfinished projects at the end of 2022, are listed in Table 3 below.

Table 3: Unfinished projects (2022)

DEPARTMENT/DIVISION	APPARATUS
Animal sciences	Felt Machine
Brewery	Beer fomenters
Centre for Microscopy	Cutting and Mounting of CEM
Chemistry	Hydro Cyclone, Stabilised wood press
Finances	Lucerne Cutter and Rake for Lilla Theron Trust
Kovsie ACT	Rickshaws, Ecocar Upgrade
Physics	Mini Dome for BOOTES-6
Science Park	Sundial
Soil, Crop and Climate studies	Rainfall Simulator, Gas Boxes
Solar car project	Solar car

Barry Crous at the Sundial for School of Mathematics Natural Sciences and Technology Education



Kobus Kruger with the Spectograph for the Boyden 60" Telescope



STAFF (2022)

Head of Division:
I Basson

Assistant Head:	BJ Crouse
Control Technicians:	NJ Kruger, P Lotz, S Luthuli and L Odendaal
Technical Assistants:	P Matlwane and WJR Storm
Technical Aid:	L Mokoena
Secretary:	A Kasper (shared with the Electronics Division)

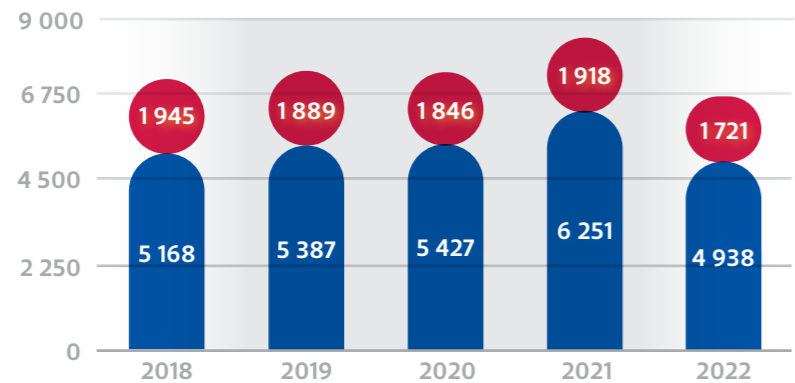
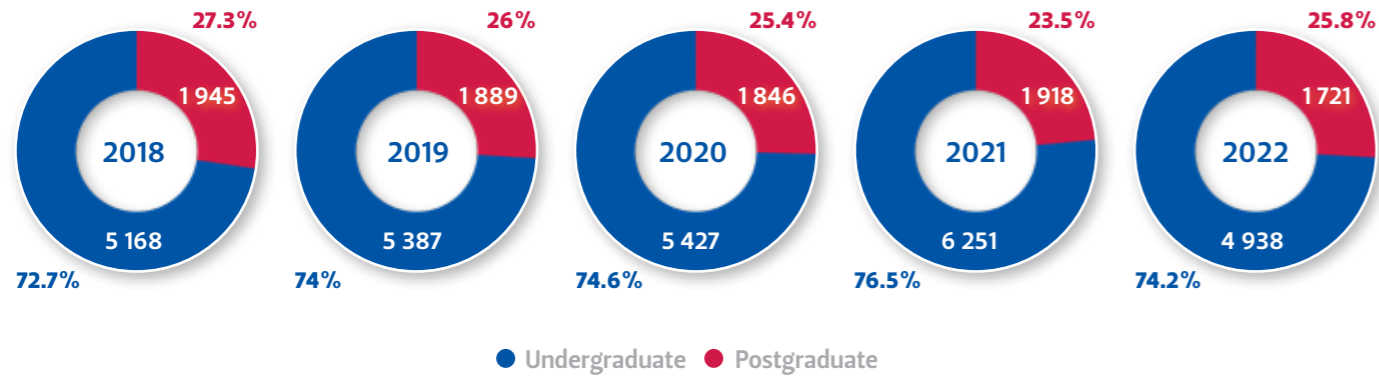
A candlestick chart with blue and orange bars on a dark blue grid background. The chart shows price fluctuations over time, with some bars being solid and others hollow.

FACULTY
STATISTICAL DATA

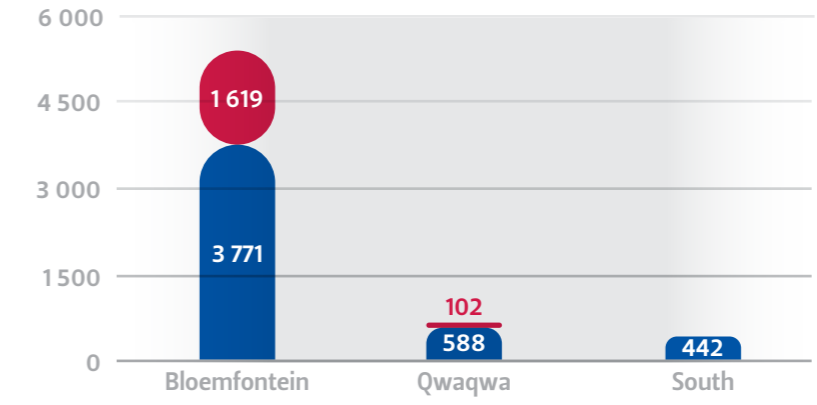
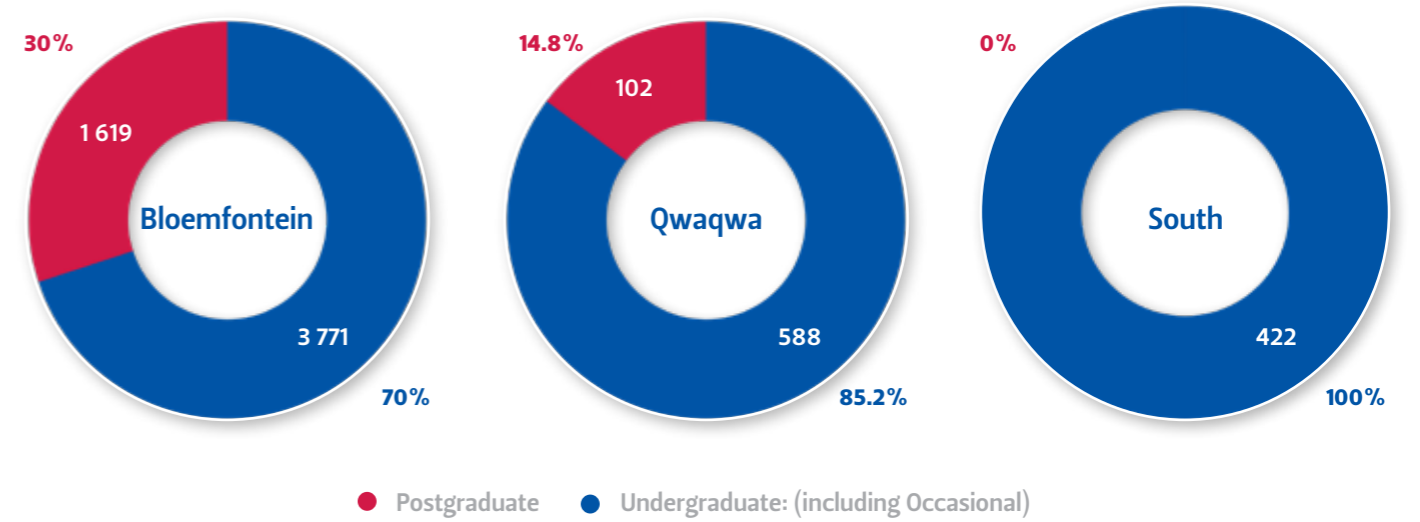


STUDENT STATS

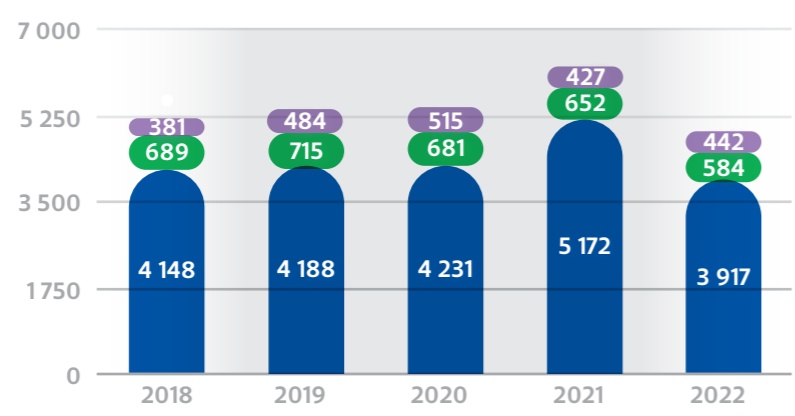
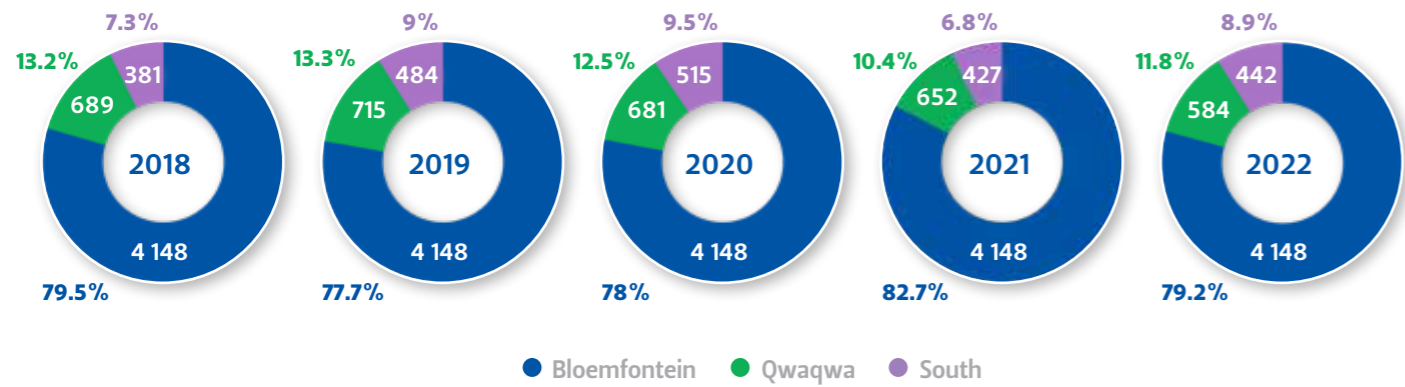
REGISTRATIONS BY STUDY LEVEL (2018-2022)



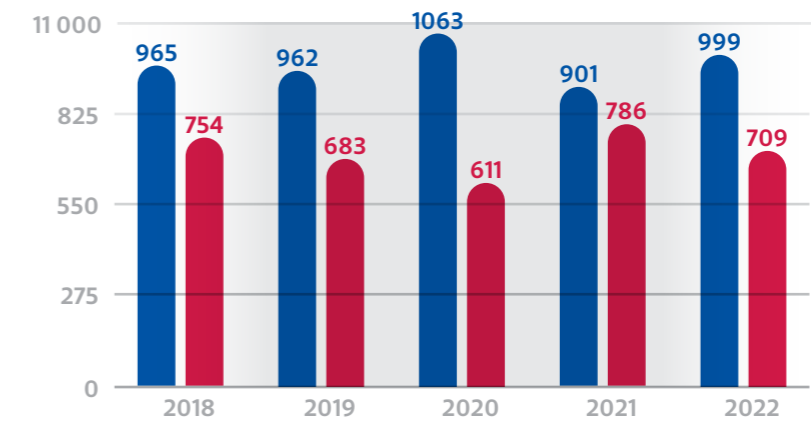
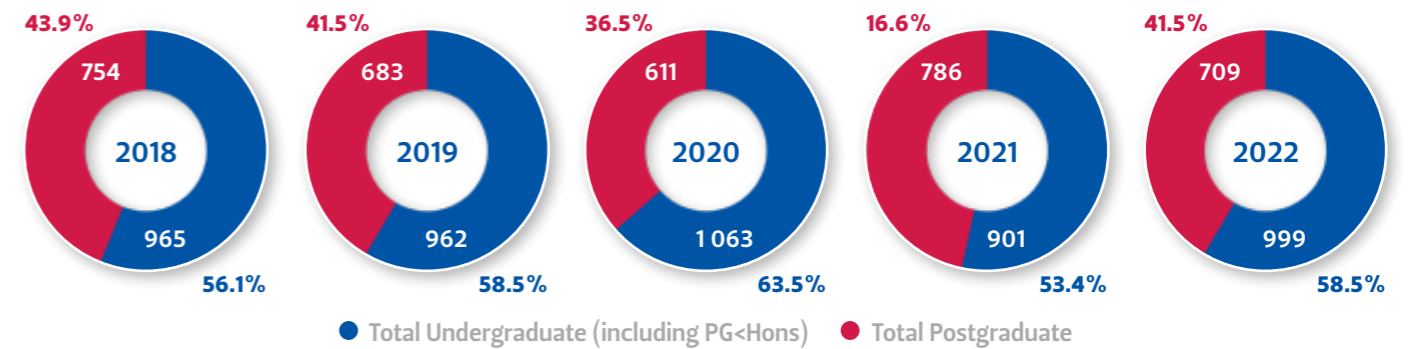
TOTAL REGISTRATIONS BY LEVEL OF STUDY PER CAMPUS (2022)



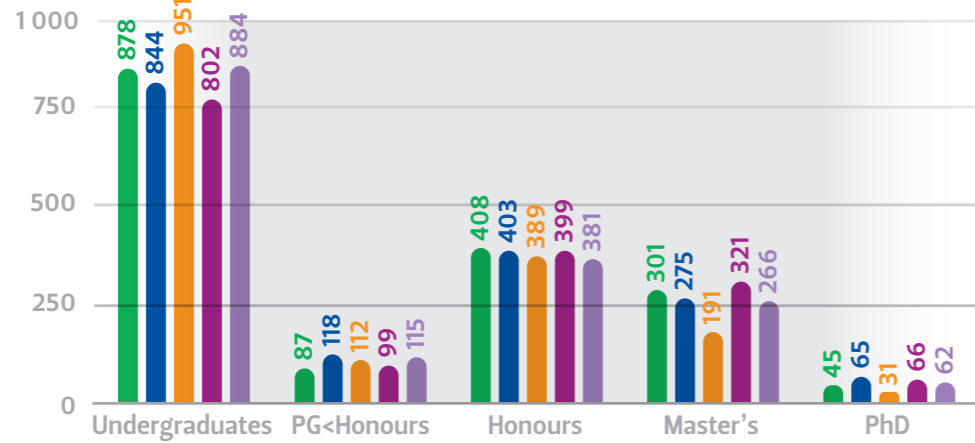
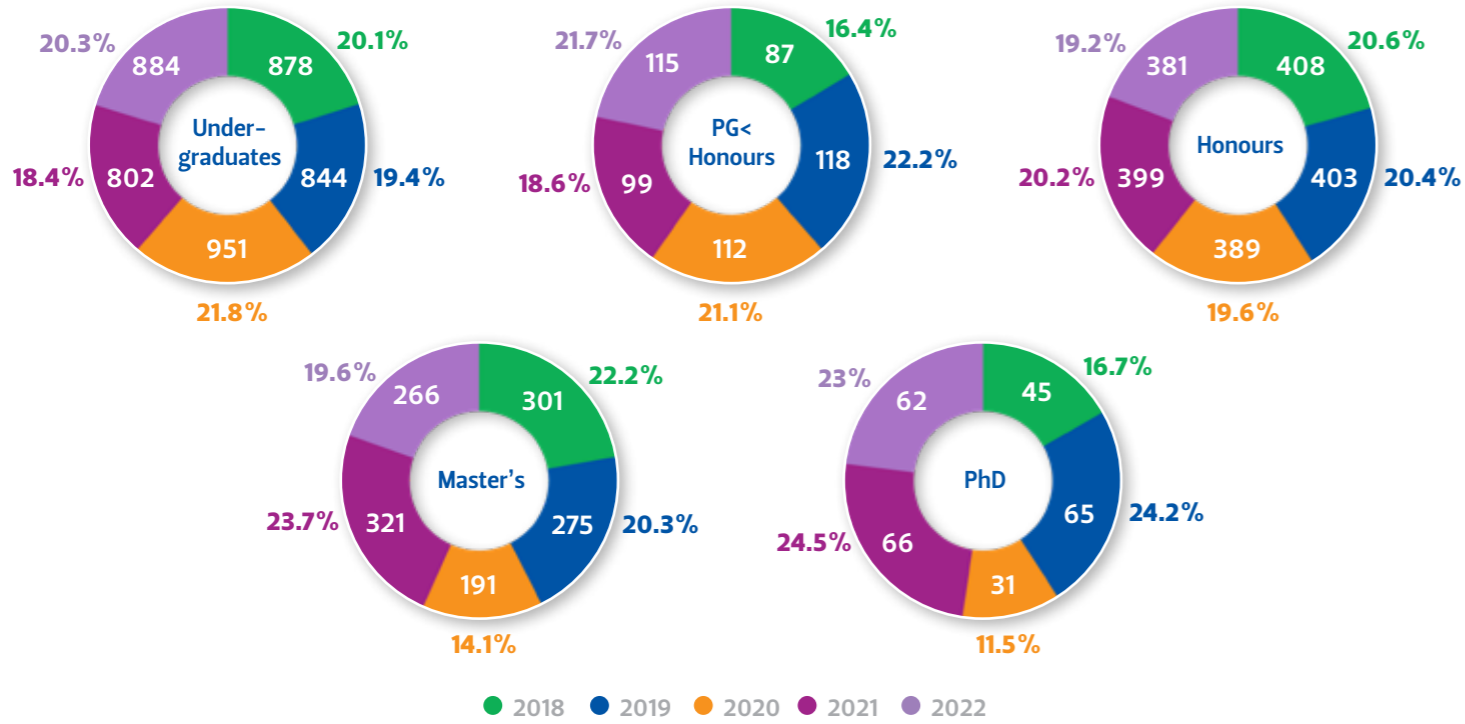
UNDERGRADUATE REGISTRATIONS BY CAMPUS (2018-2022)



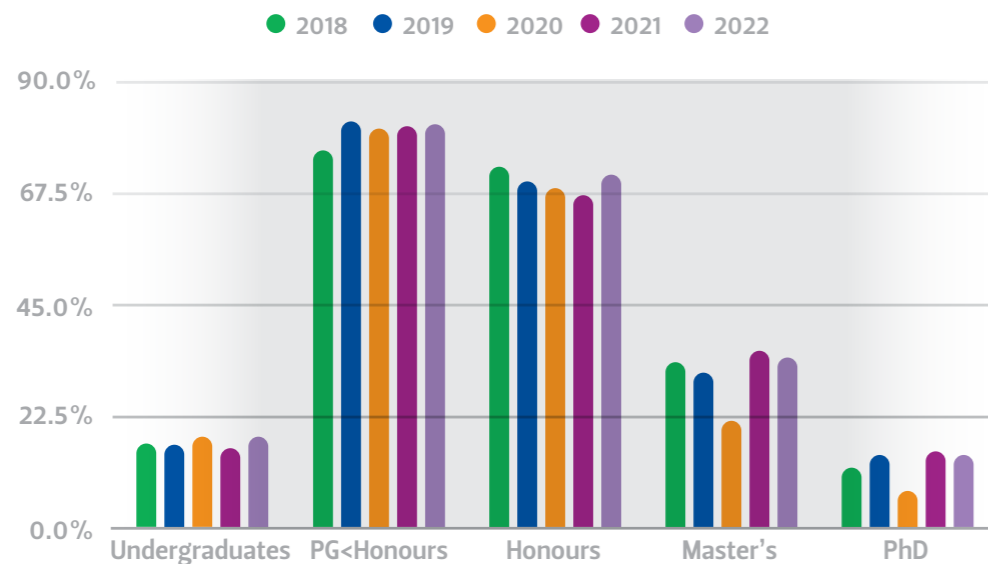
GRADUATIONS BY QUALIFICATION LEVEL (2018 - 2022)



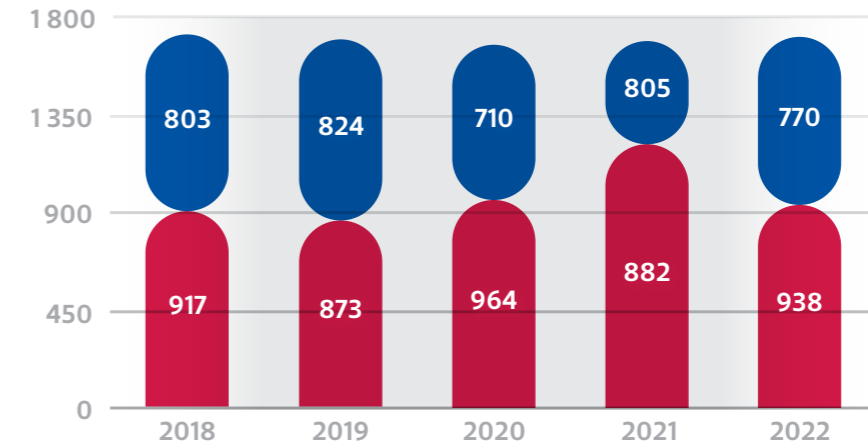
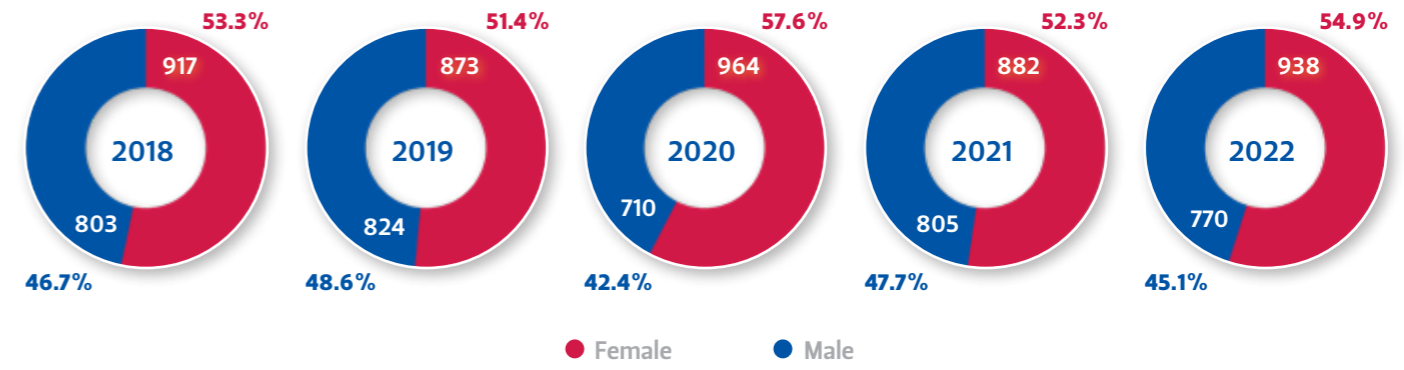
GRADUATIONS BY QUALIFICATION LEVEL (2018 - 2022)



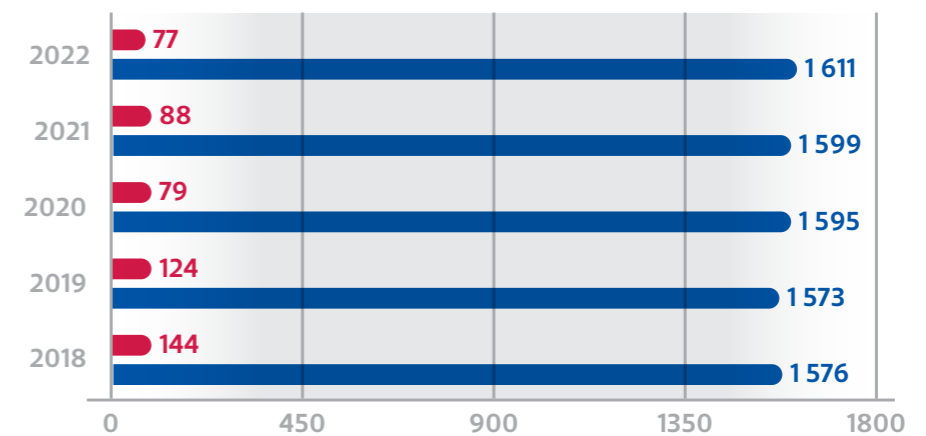
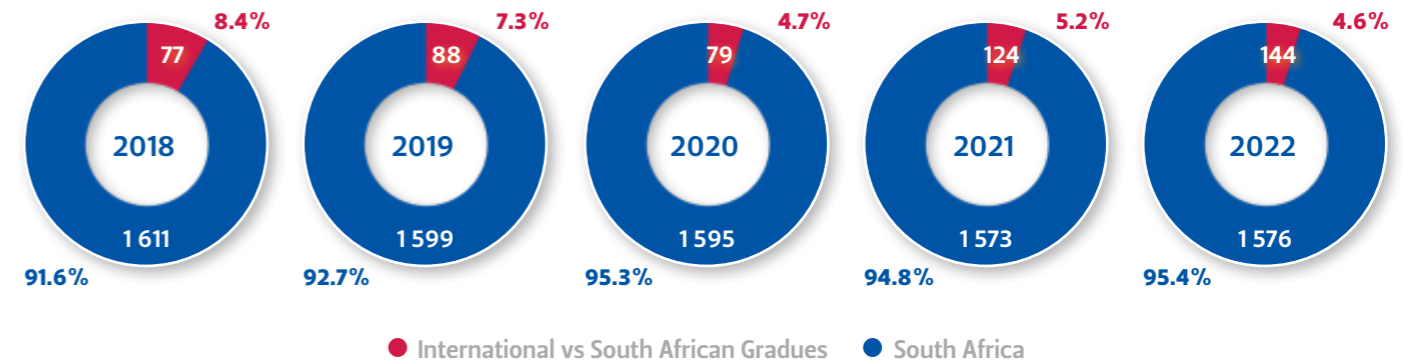
GRADUATION RATE (2018 - 2022)



GRADUATIONS BY GENDER (2018 - 2022)

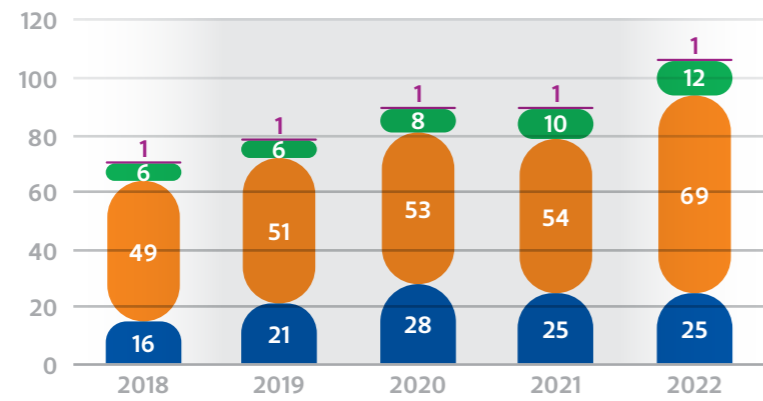
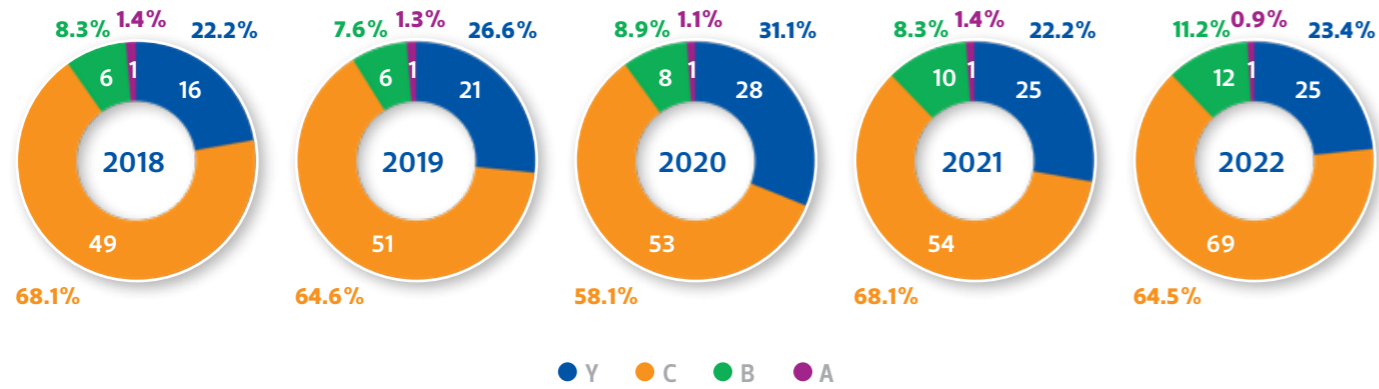


INTERNATIONAL VS SOUTH AFRICAN GRADUATES (2018 - 2022)

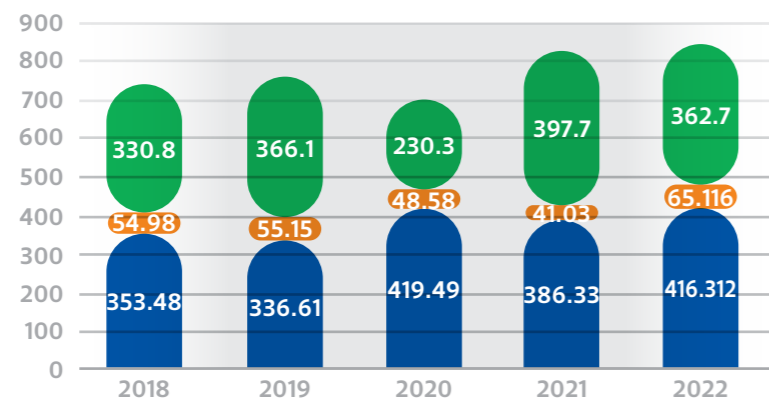
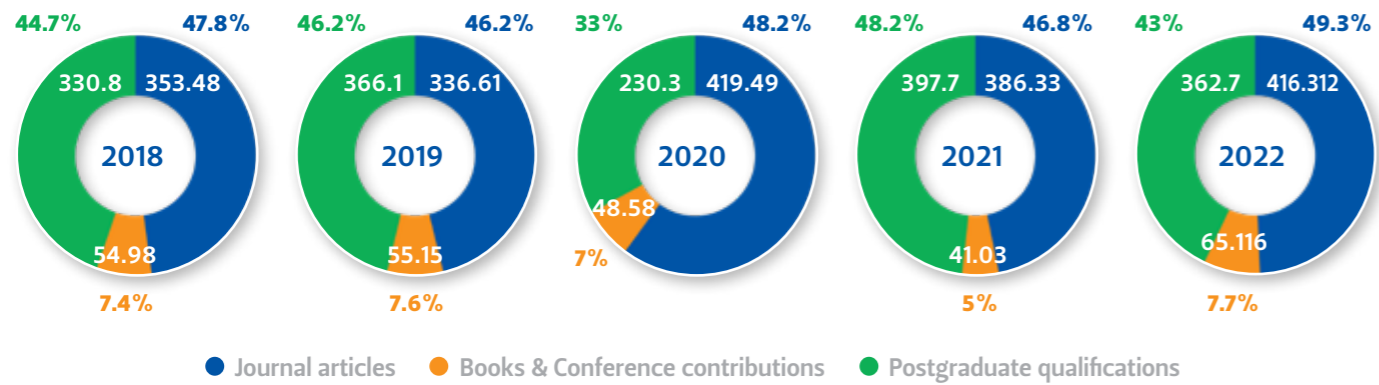


RESEARCH STATS

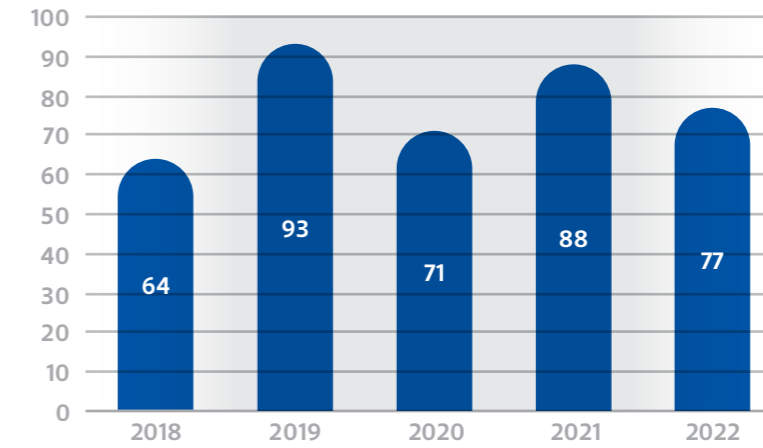
NRF-RATED RESEARCHERS (2018-2022)



RESEARCH OUTPUT UNITS (2018-2022)



POSTDOCTORAL RESEARCH FELLOWS (2018-2022)



LIST OF ACRONYMS

Principal acronyms and abbreviations used in this Report

0 – 9

2D Two-dimensional

A

A4U Alliance 4 Universities
AAWG African Amphibian Working Group
ABT Alternative building technologies
ACE Architecture and Engagement
ACTC African Climate Technology Centre
ADM Agricultural derivatives market
AEASA Agricultural Economics Association of South Africa
AEE Association of Energy Engineers
AEL Academy for Environmental Leadership
AEMG Applied and Environmental Microbiology Group
AES Auger electron spectroscopy
AfAS African Astronomical Society
AfRota Antigens and reassortant strains for rotaviruses circulating in Africa
AGN Active Galactic Nuclei
AHL Acyl homoserine lactone
AI Artificial insemination
AI Artificial Intelligence
AIMS African Institute of Mathematical Science
ANSTO Australian Nuclear Science and Technology
APECX Application of knowledge for the management of Extreme Climate Events
APR Adult plant resistant
ARC Agricultural Research Council
ARC-PHP Agricultural Research Council – Plant Health and Protection
ARC-SG Agricultural Research Council – Small Grain

ARU Afromontane Research Unit
ASAQS Association of South African Quantity Surveyors
ASSAf Academy of Science of South Africa
ASU Appalachian State University
AU African Union

B

BCV Basotho Cultural Village
BEP Business Energy Professional
BERG Behavioural Ecology Research Group
BITM Business Intelligence and Text Mining
BotSoc Botanical Society of South Africa
BRGM Bureau de Recherches Géologiques et Minières
BVDP Bushveld drilling project

C

CAZymes Carbohydrate-Active Enzymes
CBC Centre for Biological Control
CDDE Centre for Digital and Data Engineering
CEM Centre for Environmental Management
CHE Council for Higher Education
CHEM-LAB Carbohydrates and Enzymology Laboratory
CIMERA Centre of Excellence for Integrated Mineral and Energy Resource Analysis
CIMMYT International Maize and Wheat Improvement Centre
CIMPA Centre International De Mathématiques Pures et Appliquées
CLEP Certified Lighting Efficiency Professional
CLSM Con-focal laser scanning microscope
CoE Centre of Excellence
COGTA Department of Cooperative Governance and Traditional Affairs and Human Settlements

COIL	Collaborative Online International Learning
CoPES	Community of Practice for Engaged Scholarship
COVID	Coronavirus disease
CPRR	Competitive Programme for Rated Researchers
CPUT	Cape Peninsula University of Technology
CRP	Crop Research Platform
CSE	Computer Science Education
CSIR	Council for Scientific and Industrial Research
CSL	Community Service Learning
CUT	Central University of Technology
CYP	Cytochrome P450

D

DAAD	Deutscher Akademischer Austauschdienst / German Academic Exchange Service
DESTEA	Department of Economic, Small Business Development, Tourism and Environmental Affairs
DFFE	Department of Forestry, Fisheries and Environment
DFG	Deutsche Forschungsgemeinschaft / German Research Foundation
DFT	Density functional theory
DHET	Department of Higher Education and Training
DIFFER	Dutch Institute for Fundamental Energy Research
DiMTEC	Disaster Management Training and Education Centre for Africa
DON	Deoxyvalenol
DRR	Disaster Risk Reduction
DSSC	Dye-sensitized solar cells
DSI	Department of Science and Innovation

E

EAT	Energy Audit Technician
eCG	Equine chorionic gonadotropin
ECLA	Electronic Computer Literacy Assessment

ECM	European Crystallographic Meeting
ECO	Environmental Conservation Officer
ECSA	Engineering Council of South Africa
EFFOST	European Federation of Food Science and Technology
EFTEON	Expanded Freshwater and Terrestrial Environmental Observation Network
EIS	Exploration Information System
EMS	Environmental Monitoring Site
EMPA	Electron Probe Microanalyser
EnSci	Engineering Sciences
ESAP	Emerging Scholars Accelerator Programme
ESDAR	European Society for Domestic Animal Reproduction
ESSRP	Earth Systems Science Research Programme
ETH	Swiss Federal Institute of Technology
EU	European Union

F

F2F	Face-to-Face
FABI	Forestry and Agricultural Biotechnology Institute
FHB	Fusarium head-blight
FIB	Focused ion beam
FOSC	Food Systems and Climate
FPP	Future Professors Programme
FSDESTEA	Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs

G

GCCS	5 th National Global Change Conference
GEF	Global Environment Facility
GEUS	Geological Survey of Denmark and Greenland
GFZ	GeoForschungsZentrum / German Research Centre for Geosciences
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GMI	Green Manufacturing Index
GNDR	Global Network Civil Society for Disaster Risk Reduction

GPI	Global Peatlands Initiative
GRB	Gamma ray bust
GRRG	Grid Related Research Group
GSSA	Geological Society of South Africa
GSSA	Grassland Society of Southern Africa
GWD	Groundwater Division

H

HCI	Human-Computer Interaction
HEASA	High Energy Astrophysics in Southern Africa
HEI	Higher Education Institution
H.E.S.S.	High Energy Stereoscopic System
HLF	Heidelberg Laureate Forum
HOMO	Highest occupied molecular orbitals
HPC	High-performance Computing
HPEM	High-Performance Engineering Materials
HRTEM	High-resolution transmission electron microscope

I

IAA	Institute of Astrophysics of Andalusia
IBH	Industrial Biocatalysis Hub
ICCO450	International Conference on Cytochrome P450s
ICDF	Interdisciplinary Centre for Digital Futures
ICDP	International Continental Scientific Drilling Programme
ICPOW	International Congress on Parasites of Wildlife
ICT	Information and Communications Technology
IDRiM	Integrated Disaster Risk Management
IEPA	Institute of Energy Professionals Africa
IGRAC	International Groundwater Resources Assessment Centre
IGS	Institute for Groundwater Studies
IHSP-SA	Institute of Human Settlements Practitioners of Southern Africa
IMA	International Mineralogical Association
IMCG	International Mre Conservation Group

INR	Institute of Natural Resources
INTI	National Institute of Industrial Technology (Argentina)
IoT	Internet of Things
IR	Infra-red
IRWH	In-field rainwater harvesting
IT	Information Technology
ITSL	Information Technology Service Learning
IUBMB	International Union of Biochemistry and Molecular Biology
IUCN	International Union for Conservation of Nature

J

JICA	Japan International Cooperation Agency
JPI	Joint Programme Initiative
JSE	Johannesburg Stock Exchange

K

KAUST	King Abdullah University of Science and Technology
KZN	KwaZulu-Natal

L

LIS-HURS	Library and Information Science Honours and Undergraduate Research Seminar
LTE	Long-term experiment
LTSER	Long-Term Socio-Ecological Research
LUCID	Lund University Centre for the Integration of Social and Natural Dimensions of Sustainability
LUMO	Lowest unoccupied molecular orbitals

M

MAGIC	Merensky Group for Airborne Geological Image Classification
MAR	Management aquifer recharge
MARSA	Management of aquifer recharge in South Africa
MEC	Member of the Executive Council

merSETA	Manufacturing, Engineering and Related Services Skills Education Training Authority
METF	Minerals Education Trust Fund
MINSA	Mineralogical Association of South Africa
MIYA	Macro Informative Youth Agency
MLPM	Master in Land and Property Development Management
MOU	Memorandum of Understanding
MRM	Mineral Resource Management
MSSA	Microscopy Society of Southern Africa

N

NALN	National Afrikaans Literary Museum and Research Centre
NAM	Non-Aligned Movement
NCL	National Control Laboratory
NDMA	National Disaster Management Agency
NDMC	National Disaster Management Centre
NELGA	Network of Excellence on Land Governance in Africa
NEP	National Equipment Programme
nGAP	New Generation of Academics Programme
NGS	Next Generation Sequencing
NICD	National Institute for Communicable Diseases
NIHSS	National Institute for the Humanities and Social Sciences
NIR	Near-infrared
NIRS	Near-infrared reflectance spectroscopy
NISER	National Institute of Science Education and Research
NITHeCS	National Institute for Theoretical and Computational Sciences
NMR	Nuclear Magnetic Resonance
NPA	National Prosecuting Authority
NRF	National Research Foundation
NWGA	National Wool Growers Association
NWU	North-West University
NZG	National Zoological Garden

O

OAC	Oilseeds Advisory Committee
OCBIL	Old, climatically buffered infertile landscape
OPDT	Oil and Protein Seeds Development Trust
OVI	Onderstepoort Veterinary Research Institute

P / Q

PARSA	Parasitological Society of Southern Africa
PASA	Petroleum Agency SA
PCR	Polymerase chain reaction
PEIs	Prince Edward Islands
PEOPLE	Palaeoecology and Open-Landscape adaptations of Pleistocene humans in South Africa
PGE	Platinum-group element
PI	Primary / Principal investigator
PMI	Post-mortem interval
PMU	Phasor Measurement Unit
ppb	Part per billion
PrEng	Professional Engineer
PSSA	Palaeontological Society of South Africa
PV	Photovoltaic
PYEI	Presidential Youth Employment Intervention

R

RangeX	Range-expanding plant species
RDP	Reconstruction and Development Plan
RMRD SA	Red Meat Research and Development South Africa
RPO	Red Meat Producers' Organisation
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
RUID	Risk Informed Urban Development
RVSC	Risk and Vulnerability Science Centre

S

SAAB	South African Association of Botanists
SAAFoST	South African Association of Food Science and Technology
SAAO	South African Astronomical Observatory
SAAWK	Suid-Afrikaanse Akademie vir Wetenskap en Kuns
SABI	South African Irrigation Institute
SACAIR	Southern African Conference for Artificial Intelligence Research
SACAP	South African Council for the Architectural Profession
SACI	South African Chemical Institute
SACQOVP	South African Council for Property Valuation Professions
SACQSP	South African Council for Quantity Surveyor Professions
SACS	South African Committee for Stratigraphy
SADC	Southern African Development Community
SADoCoL	South African Doping Control Laboratory
SAEEC	South African Energy Efficient Confederation
SAFEX	South African Futures Exchange
SAIAB	South African Institute of Aquatic Biodiversity
SAIAE	South African Institute for Agricultural Engineers
SAICSIT	South African Institute of Computer Scientists and Information Technologists
SAIP	South African Institute of Physics
SAJS	South African Journal of Science
SALCI-NRF	Sub-Antarctic Landscape Climate Interactions-National Research Foundation
SALLNET	Southern African Limpopo Landscapes Network
SALT	South African Large Telescope
SAMAC	Macadamias South Africa
SAMC2022	Southern African Mountain Conference 2022

SAMRC	South African Medical Research Council
SAMS	South African Mathematical Society
SANAP	South African National Antarctic Programme
SANBI	South African National Biodiversity Institute
SANEDI	South African National Energy Development Initiative
SANSOR	South African National Seed Organization
SAPBA	South African Plant Breeders' Association
SAPECS	Southern African Program on Ecosystem Change
SAPPA	South African Pecan Nut Producers Association
SAPS	South African Police Services
SARA	Southern African Resilience Academy
SARCHI	South African Research Chairs Initiative
SARUA	Southern African Regional Universities Association
SASA	South African Statistical Association
SASAE	South African Society for Agricultural Extension
SASAqS	South African Society of Aquatic Sciences
SASCP	South African Society of Crop Production
SASPP	Southern African Society for Plant Pathology
SASRN	South African Sclerotinia Research Network
SASS	South African Scoring System
SATMO	South African Tertiary Maths Olympiad
SAWCIT	South African Winter Cereal Industry Trust
SAWMA	Southern African Wildlife Management Association
SCA	Sperm Class Analyzer
SCU	Statistical Consultation Unit
SDG	Sustainable Development Goal
SDS	Sudden death syndrome
SDSU	San Diego State University

SEL	Schweitzer Engineering Labs
SEM	Scanning electron microscope
SERS	Surface-enhanced Raman spectroscopy
SLP	Short Learning Programme
SMO	Semiconductor metal oxides
SSA	ShareScreenAfrica
START	Synchrotron Techniques for African Research and Technology
STEM	Science, technology, engineering and mathematics
SWAT	Soil and Water Assessment Tool

T

TEM	Transmission electron microscope
TIA	Technology Innovation Agency
TOF Sims	Time of Flight Secondary Mass Spectroscopy
TUD	Technical University of Dresden
TVU	Technical and Vocational University

U

UAV	Unmanned aerial vehicle
UCD	University College, Dublin
UCD	University of California Davis
UCDP	University Capacity Development Programme
UCT	University of Cape Town
UFS	University of the Free State
UJ	University of Johannesburg
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UN	United Nations
UN-Habitat	United Nations Human Settlements Programme
UNEP	United Nations Environment Programme
UNESWA	University of Eswatini
UNISA	University of South Africa
UNU-EHS	United Nations University – Institute for Environment and Human Security
UNZA	University of Zambia

UP	University of Pretoria
US	United States
USA	United States of America
USD	United States dollar
USD	University of San Diego
USDA	United States Department of Agriculture
USDA-ARS	United States Department of Agriculture – Agricultural Research Service
USDP	University Staff Doctoral Programme
UV	Ultraviolet

V

VIMP	Vegetable, Industrial and Medicinal Plants
VR	Virtual reality
VUB	Vrije Universiteit Brussel
VNSCare	Free State Residential Care Centre

W

WCT	Winter Cereal Trust
WESSA	Wildlife and Environmental Society of South Africa
WG	Working Group
WIL	Work-integrated-learning
WIPiSA	Women in Physics in South Africa
Wits	University of the Witwatersrand
WP	Work Package
WRC	Water Research Commission
WSN	Wireless Sensor Network
WWTW	Waste Water Treatment Works

X / Y / Z

XPS	X-ray photoelectron spectroscopy
XR	Extended Reality
YAFF	Youth Agriculture, Forestry and Fisheries
ZIF	Zeolite imidazolate framework

ACKNOWLEDGEMENTS

The departmental reports were prepared with the assistance of many people (Academic Heads of Department, Directors, Heads, and departmental academic and support staff), whose contributions are gratefully acknowledged.

ISSUED BY

Faculty of Natural and
Agricultural Sciences
University of the Free State

EDITORIAL COMPILATION

Cheryl Lombard and
Elfrieda van den Berg

DESIGN AND LAYOUT

Andreas Viljoen Design

PHOTOGRAPHS

Individual contributions,
UFS Marketing and
Communications, and photo
libraries (Unsplash, Pexels,
Dreamstime and Freepik)

