



GENUS

DSI-NRF CoE Palaeo

Directors Report

2022

Interim Director: Professor Jennifer Botha

We are GENUS.

Knowledge centre. Network leader. Explorer.

GENUS is a collective knowledge hub and inclusive network for Palaeosciences in Africa. Dedicated to studying the origins of species, we see beyond the science to inspire researchers and citizens to find meaning in the past and inform our decisions for a better future.

With South Africa's unmatched fossil and archaeological record at our feet, we enable ground-breaking discoveries that move Palaeosciences forward, encourage cross-discipline collaboration, and make knowledge accessible to all.

We provide access to a valuable repository of tools, information, funding, technology, and support through our broad international and local network. This empowers emerging researchers, postdoctoral fellows, and postgraduate students to further their research, grow their network and contribute to discovering sustainable solutions for society and the environment.

We are making a **BOUNDLESS IMPACT** for now and the future.

Our ambition

To transform Palaeosciences in South Africa by creating value for all stakeholders and undertaking a comprehensive study of the evolution of life on Earth.

Our vision

We will be the **network leader** of an **inclusive and thriving palaeoscience community** that **enriches our world** and **preserves our future**.

Network leader – We are network leaders who are at the centre of creating collaborative partnerships beyond our discipline. Where we embrace the power of sharing, cooperating and collaborating. Where we break down barriers, encourage diversity, and share demonstrable, practical thinking that contributes to a hopeful future—becoming the storytellers of our generation and inviting the world to join us in building a future worth preserving.

Inclusive and thriving Palaeocommunity – Building a dynamic network of research experts collaborating from around the world in the heart of Africa, where we have an unmatched geographical advantage. We invest in people, programmes and research to discover our ancient past while guiding and nurturing our network to turn knowledge into practical solutions. We do all this from South Africa, a nation with an unmatched fossil heritage and a land endowed with evidence of the planet's evolution. With a fossil heritage that will ignite even the wildest of imaginations. We are setting a new standard in research excellence.

Enriches our world – Enabling us to instil national pride, where citizens have the potential to become a custodian of their heritage.

Preserves our future – Connecting the story of life to the future of humanity. Wherewith every discovery, prediction, and resolve, we can impact solutions and contribute towards a future fit for generations to come.

Our mission

We invest in people, research, and programmes that move Palaeosciences forward that impact South Africa and the global community.

Our values

We believe in a world where everyone has a role to play in preserving the future of our planet. From researchers, collaborators and partner institutions to ordinary citizens, aspiring students and young children. We aim to break down barriers and make a real contribution to a more hopeful future by:

Igniting Wonder - We capture imaginations and spark curiosity, opening minds to the limitless world that still needs to be explored.

Fuelling Discovery - We support our network with the resources and partners required to make ground-breaking discoveries.

Driving Inclusivity - We create an open culture of collaboration that represents the rich diversity of South Africa.

Enabling Real Impact - We empower our network to make a boundless impact – not only in the world of science but the bigger story of life itself.

Where to find us

Location:	First Floor, Palaeoscience Building University of the Witwatersrand, Johannesburg Wit 2050
Email:	info.genus@wits.ac.za
Office:	011 717 6695
Facebook, Twitter & Instagram:	GENUS
YouTube:	GENUS Palaeosciences
Websites:	www.genus.africa www.wits.ac.za/genus/

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1. Executive Summary

GENUS, the rebranded DSI-NRF Centre of Excellence in Palaeosciences, continued to push forward in 2022 by increasing the number of partner institutions and thus palaeoscience researchers and collaborations and the number of overall grantees.

The Centre continued to provide an enabling research environment resulting in 70 palaeoscientists receiving funding for their research. Approximately half of these grantees are female, within each level (e.g. MSc, PhD, postdoc, researchers), and a new We Dig Fossil grant system was created specifically to support women. This grant was given to two female palaeoscientists in 2022, indicating that GENUS has improved its gender imbalance considerably.

More than half of the MSc and PhD students were black (53.5%), which bodes well for the future. A new postdoctoral fellowship, the New Generation Palaeoscientist, was implemented in 2022, and these funds supported 10 researchers, 30% black and 40% female, which is a vast improvement from 2021. One concern, however, is the technical issue with the NRF system that is causing GENUS to lose Honours students. This has a knock-on effect on future generations and is, thus, a notable problem. Discussions with the NRF and the online process are necessary to resolve this issue to ensure that GENUS meets its Honours student quotas to ensure successful succession planning and a balanced, inclusive future South African palaeoscience community.

GENUS partnered with the University of the Free State and the University of Pretoria in 2022. This has opened opportunities for researchers at their neighbouring museums, namely the National Museum Bloemfontein and the Ditsong Museums of South Africa, to connect with these universities as Research Associates and use the incentive funding from scientific publications.

Given the breadth of research at the various partner institutions, our grantees and students covered a broad range of palaeoscience subjects, from the origins of life, invertebrate and vertebrate evolution using cutting-edge techniques such as isotope analysis, CT and synchrotron scanning, South African palaeobotany, human evolution and the development of material culture, continuing to emphasise the uniqueness of the South African fossil record. This research garnered global interest and sparked new collaborations, thus, increasing the overall network within which South African palaeoscientists could create new hypotheses, challenge old ideas and resolve some of the most contentious issues in Palaeoscience.

GENUS is proud of our members' productivity and quality, reflected in the many researchers with National Research Foundation (NRF) ratings: five 5 A-rated, ten B-rated, ten C-rated, four Y-rated, and 1 P-rated. This large number of rated palaeoscientists, despite the paucity of palaeoscience positions relative to that of other developing countries around the world, attests to the excellence of the research undertaken in this country and the international esteem of our palaeoscientists.

As science communication and public awareness are part of all grantees' conditions, numerous public engagements were held. The latest discoveries were publicised through press releases and other social media platforms. Researchers regularly posted updates in the field or snapshots of their latest research, ensuring that the rest of the world knew South Africa's productivity. Numerous students and researchers published popular articles for various magazines, ensuring the public was up-to-date about South Africa's palaeoscience community. These community engagements also included several outreach programmes, a fundamental part of broadcasting palaeoscience information. These endeavours encourage school learners to continue with their STEM subjects and choose science as a career.

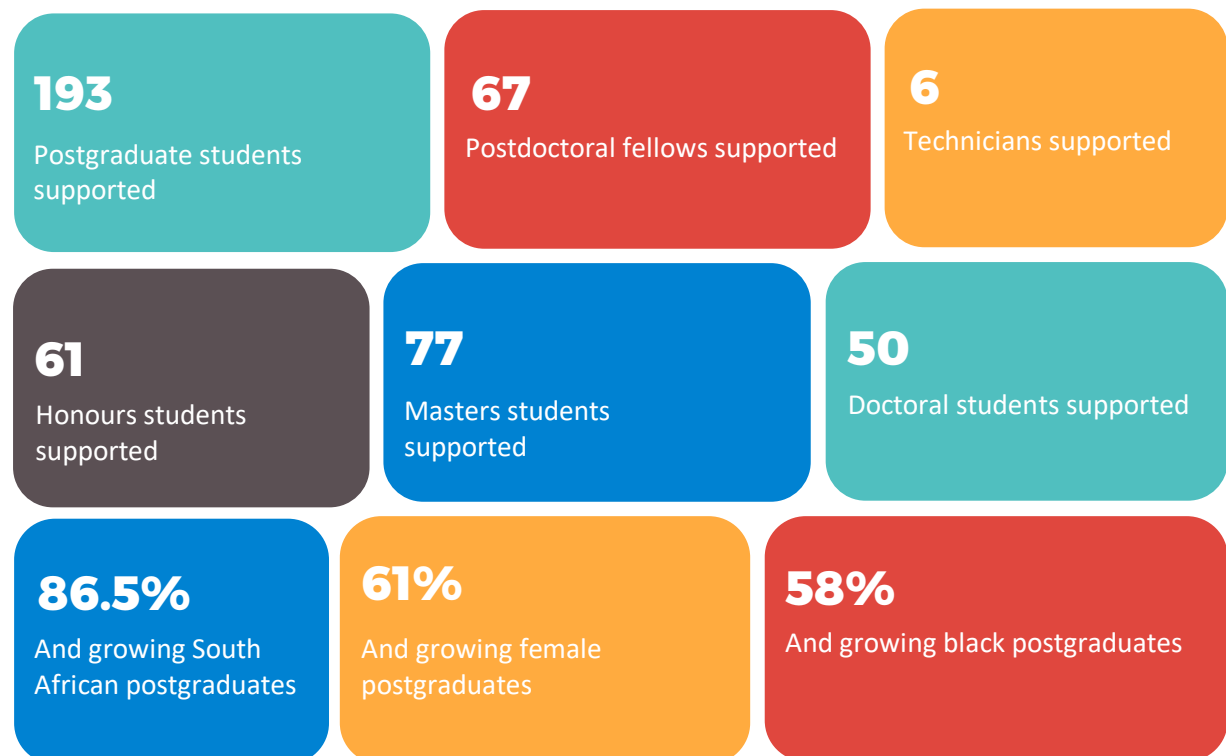
Apart from supervising more than 28 postgraduate students and hosting ten postdoctoral fellows, members of GENUS also teach in undergraduate and Honours programmes in the archaeology, geosciences, and biological sciences of Rhodes University, University of Cape Town, University of Pretoria, University of the Free State, Nelson Mandela University, and the University of the Witwatersrand.

In summary, the South African palaeoscience community continues to show how unique this country's fossil and archaeological record is. GENUS is pivotal in enabling these palaeoscientists to broadcast this message nationally and internationally. The Centre provides fundamental support for globally excellent research and

thus scientific publications in a wide range of subfields; expansion and custodianship of South African fossil collections; palaeoscience training at various levels (tourism guides, technicians, schools, undergraduate students, postgraduate students, postdoctoral fellows, emerging researchers); and science communication and developing sites for palaeotourism. It is clear from their NRF ratings and high-profile research that GENUS supports some of the world's leading palaeoscientists, who bring a vast network of collaborating researchers worldwide, encouraging an influx of expertise into South Africa.

The visionary decision of the DSI and NRF to establish a Centre of Excellence in Palaeosciences has been truly successful in many different spheres, from research to education and outreach. GENUS is now well-established as an entity that supports palaeoscience excellence, and there is no doubt that future phases will continue to bear fruit.

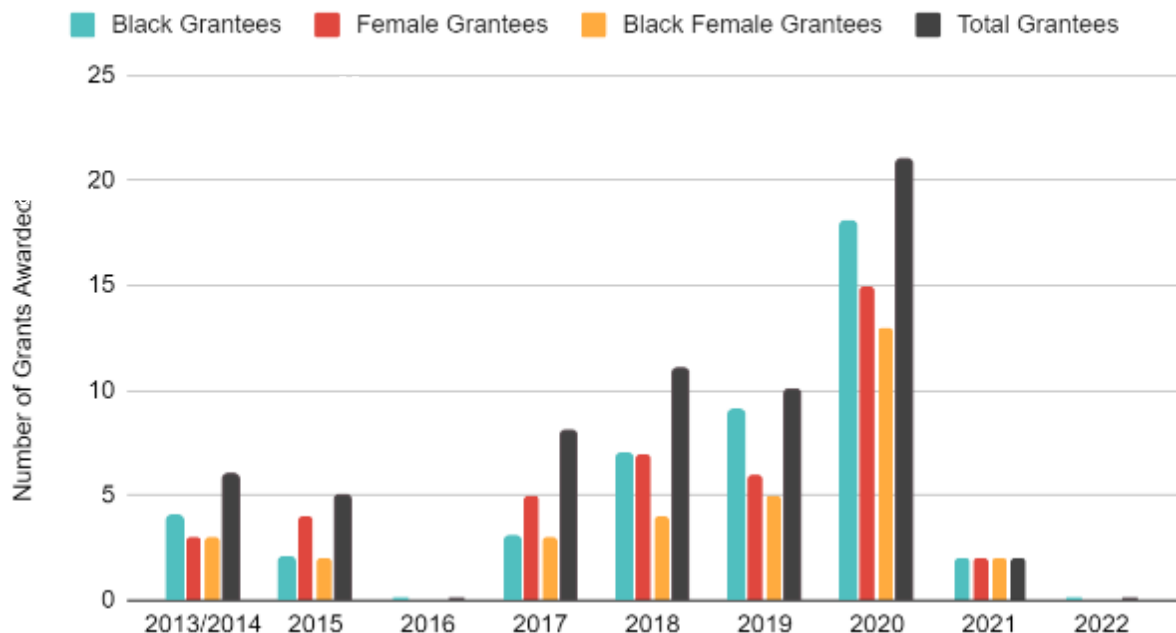
1.1 Celebrating 10 years of CoE in Palaeoscience



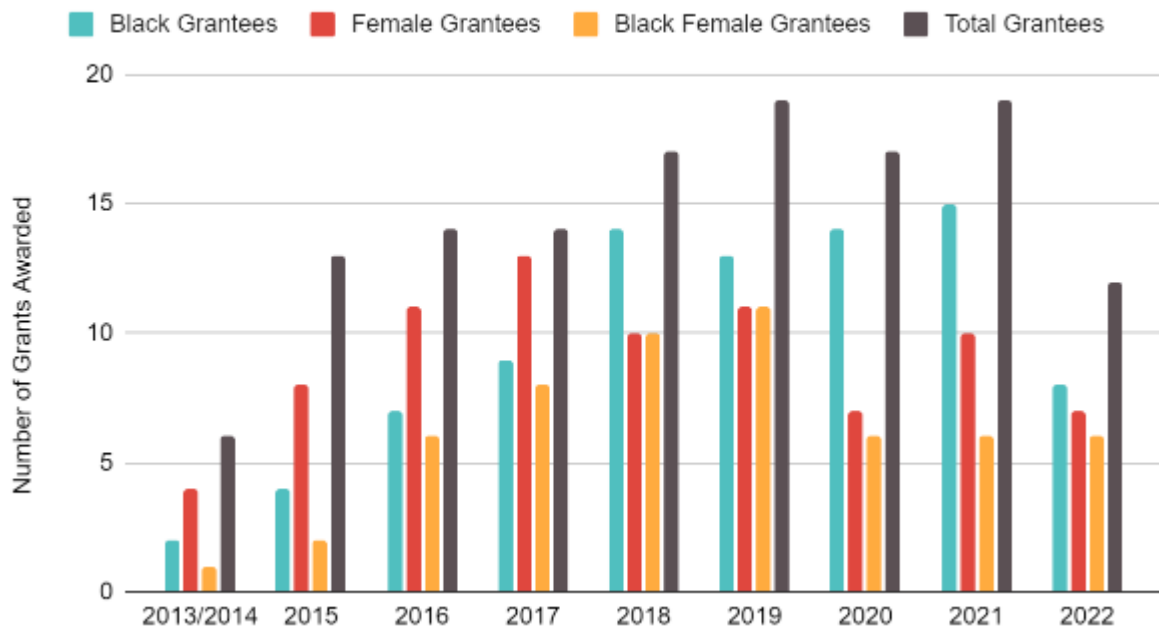


1.2 Postgraduate Student and Postdoctoral Fellowship Demographics

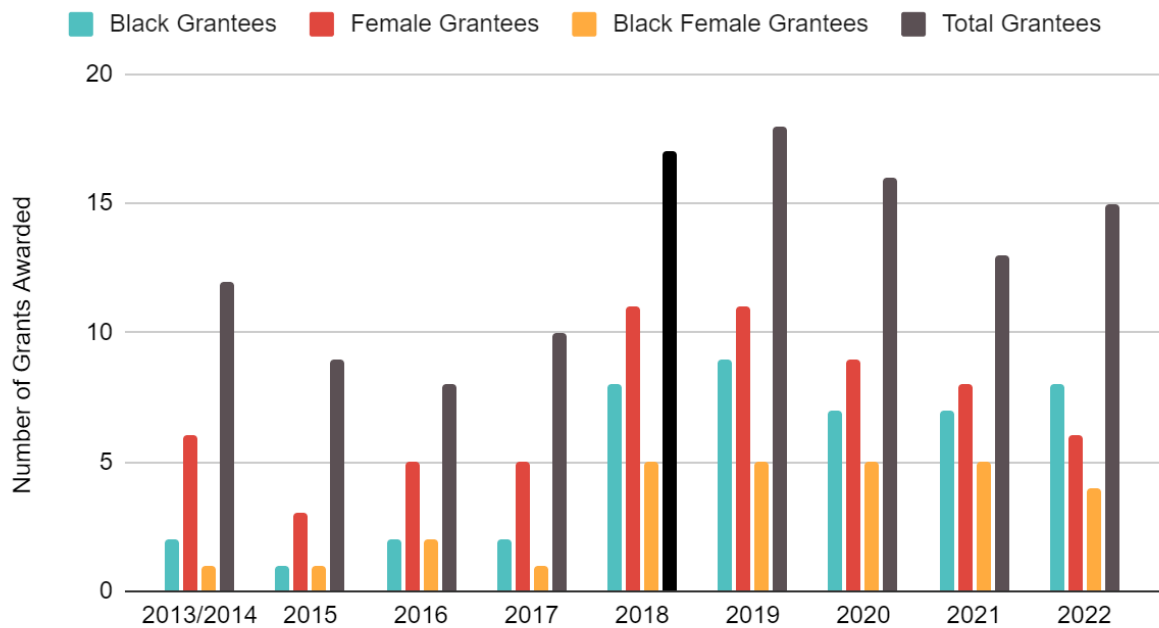
Honours Grantee Demographics 2013-2022



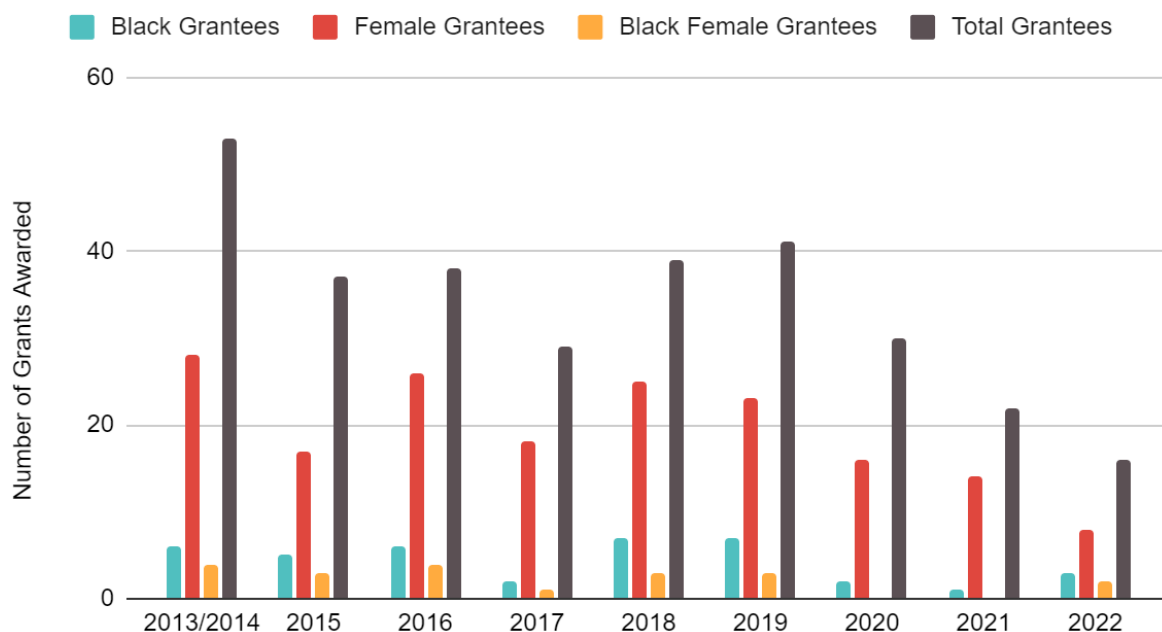
Masters Grantee Demographics 2013-2022



Doctoral Grantee Demographics 2013-2022



Postdoctoral Fellow Grantee Demographics 2013-2022



2. Our Networks

The Centre's distinctive character aligns with its value system of visibly committed palaeoscience communities that are research productive and socially engaged. It depends on its academic and museum partnerships to reach excellence through research programmes, human development, and science engagement initiatives.

Date of formation	SLA stage	Host University	
2013	4	University of the Witwatersrand, Johannesburg	

CoE Academic Partnerships	CoE Natural Science Museum Partnerships	CoE Funding Partnerships	Seeking Out New Partnerships for 2023-2024
The University of the Witwatersrand, University of Cape Town, Rhodes University, University of Pretoria, University of the Free State, Nelson Mandela University	Iziko South African Museums, Ditsong National Museum of Natural History, National Museum, Bloemfontein & Albany Museum	DSI, NRF, University of the Witwatersrand, Millennium Trust Foundation, SapienCE, University of Bergen, Norway, Centre National de la Recherche Scientifique (CNRS)	North-West University
<div>Collaborators</div> SapienCE, University of Bergen, Council for Geosciences		Institut Francis d'Afrique du Sud Research (IFAS)	University of Johannesburg

In 2020, our CoE added three new university partners that were formalised. Wits and representative universities signed a Memorandum of Agreements. To build research capacity at two partner museums (National Museum and Ditsong Museum), we strategically partnered with two universities closely aligned with these museums: the Universities of the Free State and Pretoria. In addition, the CoE partnered with South African Coastal Palaeosciences at Nelson Mandela University. This partnership builds on the strong Middle Stone Age Archaeology research conducted by South African researchers and international collaborators (SapienCE, University of Bergen, Norway). This research holds the key to understanding our ancient biomes and climate change's effects on human behaviour.

The CoE collaborates with the Centre of Excellence for Integrated Mineral and Energy Resource Analysis (CIMERA). Together, we are supporting new research areas, such as the early evolution of life. We are engaging with North-West University and re-engaging with the University of Johannesburg as potential partners.

The CoE has numerous informal collaborations with researchers from national and international organisations that add to the Centre's output through research publications and laboratory facilities for research. Our members' collaboration network includes over 400 international and national researchers.

The CoE continues looking for new South African universities, particularly historically black universities and smaller natural science museum partnerships that will continue strengthening palaeoscience throughout the country.

3. Effective Funding

3.1 2022 Cash Flow

The last instalment of the second tranche (R3 583 000.00) was given in late-January 2022. The net surplus funding for 2022 will be used for postdoctoral fellowships, research grants and science engagement initiatives such as a TED x Johannesburg Salon Talks scheduled for August 2022.

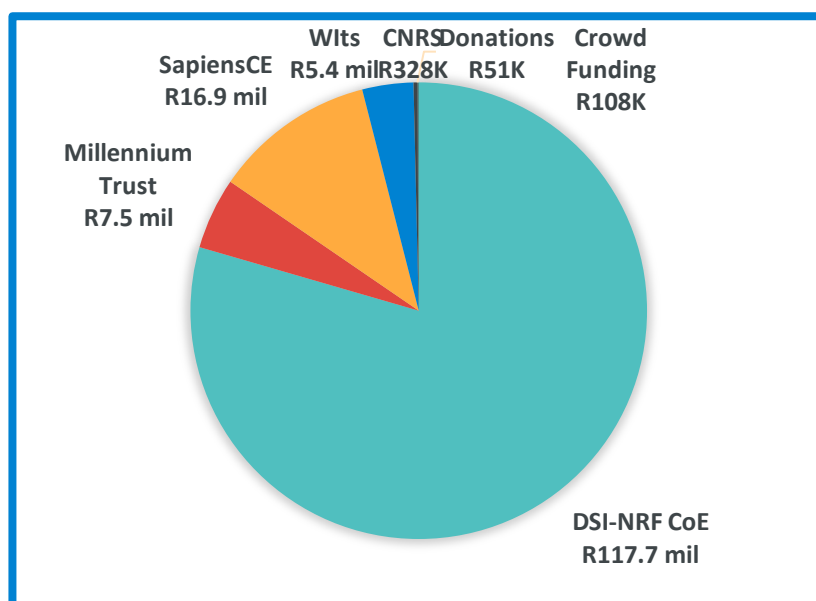
Description of Revenue & Expenses	NRF	Wits Council 10%	Total
Revenue 2022	R10 667 317	R1 340 096	R12 007 412
Balance Brought Forward 2021	R3 624 275	R0	R3 624 275
Total	R14 291 592	R 1 340 096	R15 631 687
Human Cap Dev	R3 865 440	R499 270	R4 364 710
Conferences & Travel	R227 251	R118 000	R345 251
Salaries	R1 922 312	R180 000	R2 102 312
Equipment	R0	R0	R0
OPEX	R8 367 603	R430 547	R8 798 150
Research Grants	R4 129 071	R0	R4 129 710
Total	R14 382 606	R1 227 817	R15 610 423
Surplus	-R56 368	R0	-R56 368
¹ Revenue 2023	-R56 368	R0	-R56 368
¹ Net Surplus	R0	R0	-R56 368

¹Council funding was inaccessible due to the Wits computer system upgrade. A journal of R112 000.00 was processed in December to transfer this balance into the NRF funding. Still, due to Wits accounting issues due to the

system upgrade, it was rejected. This would have left us a balance in the NRF funding of approximately R60 000. This is in the process of being amended.

3.2 Leveraging Funds

The total funding provided by the DSI-NRF from 2013 to 2022 is R 117.7 million. R30 million comes from leveraged funds (Figure 1).



Our CoE actively explores opportunities to support various research and science engagement initiatives. Our CoE has leveraged funding from the University of the Witwatersrand, the Norwegian Centre of Excellence in Modern Human Behaviour (SapienCE), the Millennium Trust, the Centre National de la Recherche Scientifique (CNRS), and crowdfunding. These funds are linked to specific research projects. In addition, our grantees are encouraged to use their CoE funds as leverage to source additional funds.

Our two significant research projects that leverage funding support are:

Professor Christopher Henshilwood - The Norwegian Centre of Excellence in Modern Human Behaviour (SapienCE) at the University of Bergen provides the CoE R16.9 million for ten years from 2018 to 2027 to support personnel and research and excavations at Blombos Cave Klipdrift Cave and Klasies River Cave. These caves have yielded significant Middle Stone Age finds that have pushed back the dates of novel human innovations such as art, ornamentation, production of tools, and hunting strategies. This project collaborates with colleagues from the University of the Witwatersrand at the School for Geography, Archaeology and Environmental Sciences and the Evolutionary Studies Institute.

Dr Robert Gess - The Millennium Trust funds the Origin of Land Ecosystems Project. This funding provides the salary for a scientist, technicians, and operational research funding to assist Dr Robert Gess's work at the Albany Museum in Makanda. Dr Gess continually makes ground-breaking discoveries of plant, early fish, and basal tetrapod fauna from the Devonian-aged Witteberg Group. Several of his findings are published in prestigious journals such as Nature.

A large portion of CoE grants fund:

- Postgraduate Bursaries (Honours, Masters, & Doctoral)

- Postdoctoral Fellowships
- Next Generation Palaeoscientist Postdoctoral Fellowships
- We Dig Fossils Grant – open to Black Principal Investigators who identify as a woman
- Research Grants

4. Key Performance Areas

4.1 Research and Knowledge Production

South Africa has rich natural palaeo-resources. The CoE and our partners continue to create and distribute new knowledge to understand our unique fossil and archaeological heritage, ensuring information is published in the public domain and used by the scientific community.

Plan of Action: Research and Knowledge Production

The CoE aims to continue to produce research of the highest quality.

Origin of Life & Multicellularity	Fossil Plants	Devonian Animals & Plants	Karoo Therapsids	Early Dinosaurs	Human Evolution & Middle Stone Age	Earth Systems
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Due to the diverse nature of palaeoscience, there are three broad themes:

- Evolutionary Processes - This theme includes increasing knowledge of South African palaeobiodiversity, studying the timing of evolutionary events in major clades and climatic events, characterising the global geographic distribution of fossil taxa, and investigating the nature of functional morphology and key innovations in morphological evolution.
- Cultural and Behavioural Evolution - This theme explains key long-term hominid behaviour transitions and how they led to modern human behaviour.
- Palaeo-environments and Palaeoclimates - This theme explains how earth systems change dynamically and when stretched beyond thresholds, leading to changes (and potentially collapses) in ecosystems and biodiversity.

The Executive Committee has discontinued two themes in the original agreements and business plans. As the field evolves, themes, Applications & Innovations, and Palaeosciences & its Public are commonly incorporated into all research projects. Almost all our researchers and students use techniques once thought of as novel and are now mainstream practices. In addition, we expect all our researchers to incorporate science engagement in their applications.

- Application and Innovations - This theme focuses on applying technologies to pursue new, innovative information extraction and analysis methods. The Executive Committee felt that current research implements new techniques to address questions. It was decided to remove this theme, which the Steering Committee approved.
- Palaeosciences and its Publics - Palaeosciences add a sense of value and prestige. To redefine how we communicate, we need to acknowledge, understand, and be attentive to society's different sectors and their attitudes towards and understanding of the deep past. All researchers and students receiving funding from the CoE are expected to participate in science engagement. The Executive Committee felt this

theme should be incorporated into the grant application. Thus, this theme has been removed and approved by the Steering Committee.

The themes pertain to areas where the palaeoscience record of South Africa gives us a geographic advantage, particularly with the Cape and Karoo Supergroups, the Tertiary and Quaternary fossil record, including cultural and behavioural evolution of *Australopithecus* and *Homo* and the development of Oldowan, Acheulean, and Middle Stone Age industries. In addition to these "traditional" areas of research of the South African palaeo record, the CoE has encouraged exploration into the origins of life and multicellularity (including investigating the Precambrian Nama and Vanrynsdorp Groups). It has inspired a strong focus on the Devonian biodiversity of the Cape Supergroup. Also of significance is research into establishing effective knowledge brokerage and information dissemination mechanisms about the palaeosciences, particularly in a South African context.

The CoE has an excellent record of turning research into publications. Many articles are published in high-impact journals for palaeosciences with an impact factor of ≥ 3 .

As is evident from Figure 3, despite the relatively few employed palaeoscience researchers, the CoE is exceptionally productive in publishing new knowledge. This is then available to the international scientific community. The result is that this country's fossil and archaeological record is increasingly featured in textbooks (most published overseas) on the subject. Ultimately, this knowledge is used to set up new school and university curricula and palaeo-tourism sites and develop palaeo-tourism routes.

South Africa's unique combination of a rich palaeoscience heritage and research excellence positions this country as one of the top leaders in international palaeoscience research. The enabling research environment created by the CoE builds on opportunities provided by the temporally diverse southern African record and the many world-class researchers in this country.

4.2 Education and Training

Education and training form a central component of CoE activities. Human capital development focuses on support for Honours, Masters, Doctoral students, postdoctoral fellows, emerging researchers, interns, and technical staff. Our funding supports postgraduate students from the Honours to Doctoral level through bursaries. In addition, we support postdoctoral fellows and two-year salaries for emerging researchers and technicians.

Education and Training	
The CoE is committed to building a diverse, equitable, and inclusive palaeoscience landscape.	
Postgraduate Bursaries (Honours, Masters, & Doctoral)	Internships in Research Assistants, Collection Management, and Big Data Analysis, & Science Communication
Next Generation Palaeoscientist Postdoctoral Fellowships	Upskilling Workshops
GENUS Research Grant	Development of the Courageous Conversation
We Dig Fossils	Student Participation in National competitions
Emerging Research two-year salary	2022 Palaeontological Society of South Africa Conference
Technician Salaries	

The CoE has increased in South African, Black, and Black Female students in the last ten years (Figure 4). When the CoE first started, we saw an increase in female students. In the past few years, as students move from Honours to Doctoral candidates, we have seen an increase in black students. Though we have made great strides, there is much room for improvement. We continue to address these challenges with our initiatives:

- Internships - Support black female postgraduates through active participation to provide a range of opportunities and experience in palaeosciences. The CoE has various internship options that offer experience as a research assistant, collection management, big data analyst and science communication.
- **Courageous Conversation: Digging for the Truth** – This video will encourage difficult conversations within departments, schools, universities, and museums to transform palaeosciences to build an enriching environment.
- Increased the participation of black women principal investigators (PI) by providing a two-year **We Dig Fossil Grant** that assists the PI in offering time and resources to achieve their research goals.
- GEN(US) Upskilling Workshops - Provide upskilling workshops to grantees to increase employment success in the academy or industry. These include composing an academic *Curriculum Vitae*.
- Support the 2022 Palaeontological Society of South Africa Conference for student attendance.
- The CoE provides funds to postgraduates to attend and participate in national competitions. Some competitions that our postgraduate grantees have attended have been the 3-Minute Thesis Competition (SAASTA), SAASTA Young Communicators Competition, FameLab and the Wits Science Slam.



Recognise Sambo collecting data on modern bovids (top left), Nompumelelo Maringa identifying fossil rodents from Kromdraai (top right), Sori La examining multicellularity samples (bottom right). Chande Montgomery examining coprolites from the Karoo (bottom left). Photo by Chris Collingridge.

4.3 Information Brokerage

Informational brokerage is an essential function of the CoE, and our science engagement initiatives have expanded yearly. We remain active through our science communication via our website, social media platforms, and newsletters.

Plan of Action: Information Brokerage

We are finding innovative new ways of engaging the public on the fossil wealth of southern Africa.

Website	TEDxJohannesburgSalon Talks on Life past. Present. Future.
Social Media Platforms	Developed Wonders of Palaeoscience Series Tours
Newsletters	SuperScientist playing cards and comic book

Wonders of Palaeoscience Tour Series

GENUS & Safari Odyssey developed The Wonders of Palaeosciences Tour Series – tour packages to ignite ongoing curiosity and adventure into the world of fossils, archaeological artefacts and rock art. On this, The Human Journey Tour - South Africa, the first in the series, the guests have joined the experienced Palaeontologists, Archaeologists, Conservationists and Storytellers working in South Africa showcasing their research in this fossil-rich landscape – the only place in the world where one can take an evolutionary journey through a single country.

SuperScientist

The award-winning SuperScientists and CoE Palaeo have partnered to highlight young researchers as superheroes to engage young people and show the importance and power of science (<https://www.superscientists.org/>). We are developing a comic book with SuperScientists. The comic will introduce readers to young black scientists who are new leaders in the field and share some science.



SuperScientists of Palaeoscientists: Dr Keneiloe Molopyane, Silindokuhle Mavuso, Aviwe Matiwane, Dr Tebogo Makhubela, and Kimberleigh Tomm.

4.4 Networking

The Centre continues to expand its partnerships with universities, museums and industry. We assist our research in building networks to enhance the quality and scope of research projects and provide opportunities to train postgraduate students, postdoctoral fellows, and emerging researchers. These collaborations offer an additional funding stream and enable access to equipment and expertise not available in South Africa to students and researchers.

Through research collaborations of the CoE at various partner institutions, beneficial synergies and cooperation are actively encouraged. Many high-impact peer-reviewed publications have stemmed from this collaboration.

It is the policy of the CoE to develop and involve partnerships as the opportunity arises. The CoE members have an extensive network of over ~400 active collaborations, both national and international.

Existing Collaborations

- Olduvai Landscape and Palaeo-anthropology Project (OLAPP)
- Multinational team working at Laetoli, Tanzania.
- Three separate projects are currently running in Kenya at Koobi Fora, East Turkana Basin, Rusinga and Mfwangano and Lukeino. All the projects include local and international collaborators.
- Links exist between CoE and African museums, universities, and institutions, particularly in Angola, Botswana, Egypt, Ethiopia, Kenya, Mozambique, Mali, Namibia, Tanzania, Uganda, Zambia, and Zimbabwe.
- The CoE and Wits have collaborated closely with Professor Christopher Henshilwood, Director of the Norwegian Centre of Excellence in Modern Human Behaviour (SapienCE) at the University of Bergen.
- Continued international collaborations: e.g. MIT, University of Washington, SUNY at Stony Brook, Field Museum in Chicago, University of Chicago, Rutgers University, University of Georgia, Colby College, John Hopkins University, University of Milwaukee, University of Minnesota, Oxford University, George Washington University, University of North Carolina, American Museum of Natural History, University of Bergen, Natural History Museum in London, University of Toulouse, CNRS (Paris), University of Southern California, Palaeontological Institute in Moscow and Institute of Vertebrate Palaeontology and Palaeo-Anthropology (China).

Attendance at conferences and workshops, locally and abroad, and presenting papers are encouraged and supported. Conferences and workshops allow emerging researchers to connect with others in similar fields and build future collaborations.

Developing a National Science Collections Facility and the PanAfrican curatorial network have increased curatorial efficiency. We are collaborating with the Southern African Association of Science and Technology Centres (SAASTEC), the South African Museums Association (SAMA), and the South African Heritage Resource Agency (SAHRA).

4.5 Service Rendering

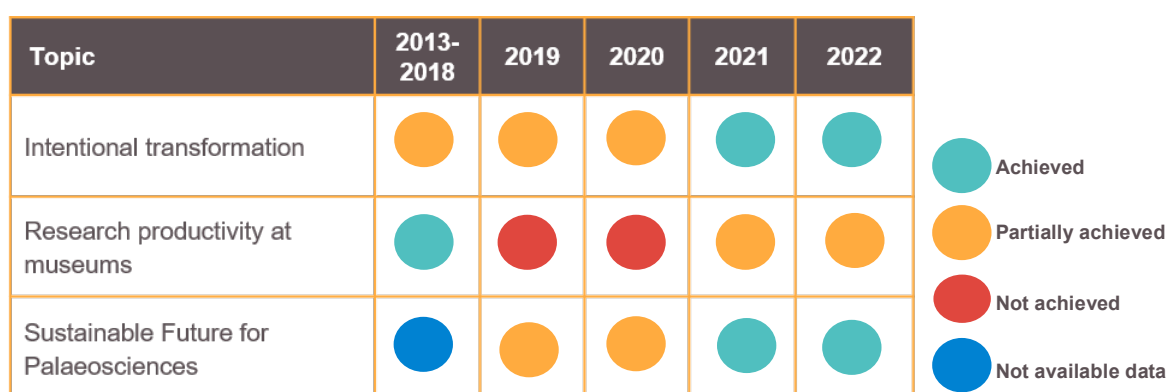
Our CoE members provide academic services by serving as editors, participating on committees, undertaking reviews, and participating in mentorship to students, fellows, and emerging researchers.

The CoE has established itself as a source of information to its stakeholders and the broader scientific community using various approaches. Our members know and understand the importance of service to the South African public, governance, and academia.

The CoE and our partners have been providing guidance and comments on many government policies for the South African Heritage Resources Agency, Palaeontological Heritage in the Western Cape, and the Cradle of Humankind World Heritage Site's Integrated Management Plan.

5. Moving Forward

As our Centre looks forward, we reflect on the last ten years. Though we continue to make strides, we still have areas that need improvement. Below is a dashboard of how well the CoE achieved its goals (Figure 2).



5.1 Intentional Transformation

Human Capacity Development

In the CoE's short existence, the number of students from designated groups has dramatically increased. It plays a vital role in the CoE's vision of palaeosciences. Every effort is made to ensure that the postgraduate students represent the demographics of South Africa. Our strategy is to:

- Encourage researchers at our partner institutions to lecture undergraduate courses. Many students have entered palaeosciences because our dynamic researchers show them a career path. These researchers teach biology, geology, climatology, botany, geography, and anatomy.
- Assist our postgraduate students in finding additional sources of funding.
- Maintain our extensive science engagement programmes that draw attention to palaeosciences as a viable career.
- Engage with students during their final undergraduate or honours years through roadshows highlighting grant and career opportunities.

Enabling Research Environments

Through engagements with our partner institutions and committees, strong efforts continue to address race and gender imbalances. While the CoE has limited staff recruitment capacity at our partner institutions, significant advances have been made in employing previous CoE grantees from designated groups into palaeoscience positions. It takes at least ten years to

develop a scientist from a postgraduate to an emerging researcher. In the ten years of our existence, the CoE has seen positive trends amongst our previous grantees. Many black female doctoral candidates have been offered academic posts before graduation or prestigious international postdoctoral fellowships. In the last few years, we have noticed a trend in which many black applicants have declined postdoctoral fellowship awards to take up university academic positions. These are positive developments.

In addition, we have seen more women taking up leadership positions at universities and museums.

Current Initiatives to Improve the Palaeoscience Landscape

- Promote representativity through our grant-making processes. A strong research application for funding is one that actively commits to a strategy that builds a diverse, equitable, and inclusive palaeoscience landscape.
- Increase the participation of black women principal investigators (PI) by providing a two-year We Dig Fossil Grant that assists the PI in offering time and resources to achieve their research goals.
- Support black female postgraduates through active participation to provide opportunities and experience in palaeosciences. The CoE offers various internship options that offer experience as a research assistant, data analyst and science communication.
- Continue to increase the participation of black women on evaluation panels, committees, and societies.
- Continuation of *Courageous Conversation: Digging for the Truth* focusing on an inclusive, respectful environment for students and researchers. The videos and worksheets are currently being developed. They will be available in early 2023 for the palaeoscience community through our website. These videos and worksheets encourage difficult conversations within departments, schools, universities, and museums to transform palaeosciences to build an enriching environment.
- Provide upskilling to grantees to increase employment success in the academy or industry.

The CoE and its partners are breaking boundaries and driving inclusivity. Our commitment to creating opportunities and enabling access through open collaboration and inclusive research programmes knows no bounds.

5.2 Research Productivity at Natural Science Museums

Museums house priceless fossils and artefacts from South Africa; however, many fossils and other scientifically significant finds go unstudied and are vulnerable to loss as museum budgets decrease.

The CoE has strategically partnered with universities near our museum partners to build and increase research collaborations and productivity between the institutions. These include the University of the Free State and the University of Pretoria, aligned with the National Museum, Bloemfontein, and Ditsong National Museum of Natural History.

Palaeoscience research productivity in South African natural science museums is notably lower than in universities. Several key factors have led to a decrease in research productivity:

- Reduction in government budgets given to museums to operate, preserve, and conserve national fossil and archaeological heritage
- No funding allocations for research initiatives, resources, or equipment to analyse material

- Lack of hiring Curators with advanced postgraduate degrees with a willingness to conduct research
- Insufficient industry-based salaries centred on education level, experience, and skillsets
- The decrease in positions and decent salaries to employ lab & exhibition technicians, and science communication staff
- Low morale due to the lack of drive from museum CEOs and staff to build sustainable research programmes at their institutions

The natural science museums curate the excavated South African palaeoscience record and were set up to undertake this important function. In the past, they employed the most significant number of palaeoscientists in the country. However, the past decade has witnessed a dramatic decline in palaeoscience research undertaken by the museums, which would have been even more devastating had the CoE not intervened. Despite this intervention, our partner museum administrators do not understand the requirements to nurture research in a museum environment.

Natural science museums traditionally undertook research. By utilising and building up their biological reference collections through multidisciplinary research programmes, they offer answers to the impact of climate change in any specific country. Apart from research, these collections play a vital role in education. For the public, seeing real objects in proximity has a potent effect on people. The power of this authenticity is emphasised in an increasingly virtual world. To date, high-impact museum exhibits are the products of research undertaken by scientists using the scientific collections curated in the museum. Increasingly around the world, museums require collections curators to have a PhD degree and undertake research in addition to curation.

A worrying trend in South Africa has been the steady decline in palaeoscience research productivity of all the museums over the past 15 years – ever since the establishment of the Flagship museums. This decline in research productivity is linked to the number of palaeontologists employed, particularly at Iziko and Ditsong Museums. This trend is reflected in the palaeoscience departments of these museums and all the other natural science departments. Less senior scientists are employed to curate the collections, and this task is left to technical staff who lack the necessary qualifications and experience. Sadly, the number of palaeontological technical staff employed and paid by these museums has also declined. The position for palaeosciences would be dire if the NRF did not establish the African Origins Programme, making it possible for museums to employ technical staff.

The research productivity of the CoE is dependent on the accessibility of palaeontological and archaeological collections of natural science museums and the relevant scientific expertise. Museums must employ internationally competitive scientists to maintain and expand these collections by actively researching the palaeoscience record of the country.

A decade ago, the NRF launched an audit into the state of Natural Science Museum Collections. The NRF provided funding to curate museum collections over three years to rectify many of the collections' poor conditions. The Natural Science Collections Facility (NSCF) was launched as part of the Department of Science & Technology's South African Research Infrastructure Roadmap (SARIR). The NSCF supports collections by improving their storage, digitisation, communication, and outreach and providing opportunities for enhancing research. However, the NSCF cannot appoint or employ permanent scientists at these institutions. The museum's research capacity remains risky to initiatives like the NSCF and the CoE.

In recent years, museums' major problem has been the non-competitive salaries paid to highly qualified museum scientists. As a result, highly productive scientists are not attracted to applying for positions at museums. This has had a downward spiral effect, with active research staff leaving museums and not being replaced with the best candidates. Another problem is the increasingly bloated museums' administrative capacity, especially the flagship

museums, with less funding for the natural science departments. The DSAC Central administration, inappropriate Councillors, and Directors of Natural Science Museums of South Africa often have no experience or understanding of natural science research. Thus, they do not appreciate the opportunities and challenges of natural science research. They cannot develop research projects, identify possible research collaborations, and consequently miss opportunities to raise additional funding through local and international research collaborations. The management and encouragement of natural science research require constant nurturing and reassurance by Council and Directorate. Natural science museum researchers spend so much time complying with bureaucratic legislation and policies that very little work is done. A recent advert for a Director (CEO) for one of the country's sizeable natural science museums did not prioritise research. The skills and knowledge required for the position do not include research experience or exposure.

The fact that the country's major natural science museums do not prioritise research as a critical function creates a significant problem for our CoE and the future of palaeosciences in South Africa. The CoE expects each member scientist to produce two to five research publications annually. All museum staff, except two, produce much less. This is due to fewer museums employing scientists and low salaries failing to attract highly productive scientists. Furthermore, there are no incentives to produce publications in high-ranking international journals and little support from management to create an environment conducive to research.

It is globally accepted that biodiversity and climate change are the earth's greatest crises. Earth is experiencing global warming, climatic change and a massive decline in biodiversity, the so-called 6th mass extinction. The future of humanity is dependent on the preservation of biodiversity. The biodiversity of South Africa and all countries is curated by science museums where all the holotype and reference specimens are housed. Accordingly, these collections are essential for biodiversity audits and global climate change.

Now is the time that the natural science museums' precious collections reflecting our country's past and current biodiversity, built up over many decades and even centuries, need to be nurtured and researched. Yet, it appears that research is no longer a priority of Natural Science Museums. The state of Natural Science Museums needs to be addressed urgently. A way to begin is to re-assess the appropriateness of the Department of Sports, Arts and Culture (DSAC) as a governance structure for institutions responsible for scientific research. Additionally, museums must address declining capacity and create a strong research culture.

The Natural Science Museums hold important fossil and archaeological collections of National Heritage and global relevance. Our CoE will continue to improve, assist, and lobby for natural science museums in South Africa.

To improve the museum research environment, we have implemented several initiatives:

- The CoE strategically partnered with South African universities close to natural science museums to build and increase research collaborations and productivity between the institutions. These include the University of the Free State and Pretoria aligned with the National Museum, Bloemfontein, and Ditsong National Museum of Natural Science. In addition, the CoE supplies postdoctoral fellowships specifically for museum partners to enhance their research productivity.
- Natural Science Museums have issues with procurement and spending funds on research, fieldwork, lab work and attending conferences due to the time it takes to access funds. Researchers sometimes had to return their funds because they were not spent in the allocated time. To ensure that research is undertaken timeously, our CoE provides grantees with an option of keeping the funds within the CoE and using the University of the Witwatersrand procurement process.

- Regarding salaries and positions, museums' current situation requires intervention beyond the scope of the CoE. It requires a higher level of engagement between DSAC, DSI, and the DSI NSCF to implement long-lasting changes. However, the CoE has made completeive postdoctoral fellowships available specifically to museums to increase research, collaboration, and publications.
- Continue face-to-face engagements with the CEO, Directors, boards, curators, collection managers, and technicians to understand their needs that will improve the research environment.

5.3 Sustainability Strategy

Laying a Solid Foundation for the Future

The origin and diversification of life inspire us. A moment intertwined with time and our future. From the past into the present, we remain focused on understanding the steady turn of life and measuring the transformative impact of change.

It is where our differences bind us towards a common destiny. We aim to set forth a new era in Palaeosciences where barriers are broken, where the Palaeocommunity thrives, transformation bears fruits and citizens have a role to play in our future.

The Palaeosciences heritage of South Africa gives the country an important geographic advantage. The work of the CoE and its partners resulted in international and local research productivity through numerous publications in top international journals, spreading our research discoveries through a broad network of science communication and establishing palaeo-tourism opportunities for job creation.

The White Paper, the Decadal Plan, and Evaluation of the DSI Palaeoscience Strategy

Through the support of the DSI and NRF, palaeosciences have flourished in South Africa and have created many new opportunities. The new DSI White Paper, the final Decadal Plan, and the final evaluation of the DSI Palaeoscience strategy will guide us through our decision-making process for the next phase of our CoE and National Institute for Palaeosciences.

Built on the achievements and growth of our CoE, we have rebranded to GENUS to show a movement forward while strengthening our global footprint in excellent palaeoscience research and building a stronger community.

5.3.1 The Next Two to Five Years

The CoE has developed a strong network of excellent Palaeosciences research across South Africa and beyond. The CoE, through a strong partnership with the University of the Witwatersrand, remains the network leader of palaeosciences.

Our plan is dedicated to elevating Palaeosciences and creating a thriving environment for researchers and students to contribute to the future by pushing the boundaries of our CoE and creating other five years of the Centre of Excellence in Palaeosciences while at the same time building a future planning document that can be developed into a national institution for palaeoscience for the next 20 years.

To build on the capacity to implement transdisciplinary research

Transdisciplinary research requires cooperation across disciplines, big data, laboratory time and specialised equipment. In the last two decades, Palaeoscience research has required

large teams to answer big questions with a growing crossover between disciplines to support a new generation of Palaeoscientists. The CoE strongly supports this approach.

To expand employment opportunities for more representation in the field and reduce the loss of talent

Every year 15 scientists enter the employment pool with limited opportunities to enter the academic sector and funding to further their research. Our CoE continues to be actively committed to building a diverse, equitable, and inclusive palaeoscience landscape.

To promote South Africa's heritage to a broader audience by integrating Palaeosciences with education, tourism and citizen science

We have rebranded our CoE to broaden our brand appeal and attract new partners to our network. This shift is critical to our growth. It ensures that Palaeosciences is relevant to all those seeking to understand life's origins.

Protecting, promoting and transmitting heritage

Our extensive and rich fossil and archaeological heritage is unmatched in Africa and internationally. We can use it to deepen conversations about our shared humanity and instil pride in all citizens. Museums play a leading role in protecting and curating our past heritage. Curators are active researchers and science communicators. However, they lack access to resources which South African museums cannot currently provide. We suggest that curators establish dual appointments at the CoE and their host museum in the university system. They will have access to all the University's administrative services, research incentive funding (RINC) for publications, and access to external and internal grant opportunities. The outcome will encourage young South Africans to choose palaeoscience as a career and open more opportunities for scientists.

Improve Financial Sustainability

The CoE has developed an annual fundraising strategy for soliciting donations, scheduling events to raise money and targeted communication. Understanding the CoE's past successful fundraising efforts and repeating them is fundamental to the annual planning of the CoE's work.

Succession Planning for Directorship

An Interim Director, Professor Jennifer Botha, has been appointed to bridge the gap until the NRF hires a new CoE Director.

5.3.2 Future Planning Outlook

A National Institution for Palaeosciences

The Centre of Excellence in Palaeosciences has demonstrated the discipline's capacity to catapult South Africa into an essential and significant player in the international scientific arena. Thus, building a transdisciplinary National Institute for Palaeosciences is logical to enhance the high productivity level in a discipline where South Africa has a competitive advantage. This does not require a new building but can operate as a virtual institute using all available palaeoscience and other resources in South Africa.

We have already set up a future planning document to implement a National Institute for Palaeosciences (Appendix 2). The strategic intent of this document is to scale up research programmes by improving economies of scale and thereby maintain and enhance global competitiveness.

Our roadmap builds on the successful aspects of the Centre of Excellence in Palaeosciences. It proposes additional new ways of proceeding in high-impact research, training, and engagement output that entails these seven points:

1. Facilitating ground-breaking research.
2. Establishing a national facility for palaeosciences that optimises collaboration of existing and new partners to stimulate their expertise to develop joint initiatives
3. Providing expertise that can feed into broad national scientific policies and sustainability goals.
4. Supporting inclusive social development in all communities in palaeoscience through capacity building, skills transfer, creating partnerships and facilitating opportunities for previously disadvantaged communities and palaeo-tourism development.
5. Maintaining world-class laboratory facilities to spearhead transdisciplinary research and teaching in modern Palaeosciences.
6. Preserve, curate, and expand the country's collections to represent the fossil heritage of South Africa.
7. Communicating through initiatives facilitating broad public participation in and appreciation of South Africa's Palaeoscience heritage.

6. Conclusion

The geographic advantage offered by the extensive palaeoscience record of South Africa is worthy of a world-class national institute for palaeosciences. The Centre has successfully undertaken diverse research projects where South Africa has good palaeoscience resources and unique geographic advantages. These include the origin of life and multicellularity, invertebrate palaeobiology, palynology, palaeobotany of various ages, taxonomy, life history and palaeobiogeography of fishes, amphibians, parareptiles, therapsids and dinosaurs, origins of mammals and hominins. In addition, hominin morphology and behaviour, the earliest tools of hominins, the emergence of behavioural complexity, faunal analysis, bone taphonomy and the use of isotopes for understanding physiology, ecology, and palaeoenvironment. In ground-breaking broader multidisciplinary studies, palaeosciences are applied to understand climate and biodiversity change, stratigraphy, and basin development.

South African Palaeoscientists are world leaders in palaeoscience research and translating research for public benefit. With available and emerging technologies and sufficient investment, a step change is possible in discovering, understanding, protecting, and utilising our natural assets.

The CoE has been the lifeblood in transforming the palaeosciences heritage asset of South Africa into an international scientific treasure in understanding the origins, the development of life forms, and ecosystems and the effects of climate change on biodiversity calamities and driving extinctions – something which humanity requires right now. This unique heritage can become a significant eco-tourism asset to the country. For a relatively small investment, South Africa is now a global leader in an important area of scientific endeavour. This momentum needs to be nurtured into the foreseeable future as an area of national pride.

The Centre, its partners and its communities are looking forward to the future of palaeosciences and moving toward developing a National Facility that further promotes South African Palaeosciences to the highest international ranking.

In summary, the South African fossil and archaeological record is of great international importance to the extent that it is impossible to write a comprehensive report on the development of life on Earth without referring extensively to the South African fossil record. It is a leading centre for research and training in palaeosciences by international standards, including collaboration with some of the world's leading palaeoscientists. It has access to

world-class research facilities, which palaeoscientists and students from many continents utilise. The CoE has and will continue to play a pivotal role in the palaeoscience output of South Africa, and indeed in Africa, in a wide variety of spheres facilitating research; expansion and custodianship of South African fossil collections; palaeoscience training at various levels (tourism guides, technicians, schools, undergraduate students, postgraduate students, postdoctoral fellows, and emerging researchers); science communication and developing sites for palaeo-tourism.