



Natural Science Collections Facility

SOUTH AFRICA

Report to the Department of Science & Innovation

1 April - 30 September 2023



science & innovation

Department:
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REPUBLIC OF SOUTH AFRICA

SANBI

Biodiversity for Life

South African National Biodiversity Institute



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1. Rationale and Scope

- Research collections are essential for all countries with scientific enterprises, and they should be considered as large scale, global research infrastructure. South Africa has an estimated 20 million objects or specimens representing over 100,000 different species in natural science collections.
- Natural science collections and the data associated with these are a crucial resource for a wide range of society both nationally and globally, including researchers, environmental assessment consultants, land use managers and planners, farmers, bioprospectors, students, learners and decision-makers.
- South Africa's natural science collections are managed in a highly fragmented and largely isolated environment and there is no common strategy or approach to research which means that their full potential as a national research infrastructure is not being realised. In addition, the specimen data are largely inaccessible, which causes delays in decision-making or poor decision-making relating to sustainable development and sustainable harvesting of natural resources, both of which have considerable economic impacts. Inaccessible data also limits their use in large scale, multi- and trans-disciplinary studies.
- The NSCF aims to address this situation, which will have positive impacts on research in numerous fields, on the economy through providing critical information for agriculture, fisheries, pest control, alien invasive management, natural products, and on society which benefits from biodiversity in virtually all aspects of life.
- The NSCF is a distributed network of institutions that hold natural science collections, with a Central Co-ordinating Hub hosted at SANBI in Pretoria. SANBI is responsible for the overall implementation of the project plan and management of the budget allocation for the NSCF from the DSI. The individual institutions continue to be supported by their existing structures, and continue to report to these but will collaborate to meet the objectives of the NSCF, and will receive support in order to enable this.
- The NSCF' scope is limited to preserved plant, animal, fungi, palaeontology and geology collections, and during this phase only those institutions that have such collections that are actively managed for research purposes and that are accessible to the global research community in terms of both material and data are included. This is in line with the requirements to be considered as national research infrastructure. Four national museums, under the national Department of Arts & Culture, five provincial museums under the Eastern and Northern Cape Department of Sports, Recreation, Arts & Culture, one municipal museum, three science councils, and three universities are involved in the NSCF for the 2016/17 to 2018/19 period. For the herbaria, the participating institutions were limited to the "big 6 collections" as identified in the NRF report of 2011. This limit was required because of the large number of small herbaria scattered across South Africa (over 80 of these), and the extent to which they meet the requirements for qualifying as research collections at this stage is limited. In order to be able to establish the NSCF and to achieve outputs and outcomes in the short term, a phased approach is essential, with the major institutions participating initially, and in future, a broader approach can be considered.

Expected deliverables, outputs, outcomes and impacts

Deliverables specified in the Addendum to the Agreement between the Department of Science & Innovation and SANBI for the NSCF from 2021/22 to 2023/24.

Deliverables	Outputs	Outcomes	Impact
<p>Report on the status of natural science collections, including risks and required resources and interventions, based on assessment using the system developed, and using the 2009/10 assessment as the baseline.</p> <p>Rescue of three to six orphan and at risk collections and movement into secure environments, based on the assessment report.</p>	<p>Well managed, accessible and secured collections of biological specimens</p>	<p>Increased research and education outputs in a range of fields, by national and international scientists</p>	<p>Increased knowledge of South Africa's past and present biodiversity for the benefit of all of society, including future generations;</p> <p>International recognition for SA collections</p>
<p>Implementation of courses and workshops for staff and postgraduate students</p> <p>Training in collection data management</p> <p>Exposure to international trends in collection management, curation and data management through attendance and participation in virtual conferences and workshops</p> <p>NSCF Forum to bring all staff together to strengthen the network and share knowledge and experience.</p>	<p>Collection based staff and postgraduate students upskilled</p>	<p>Upskilled and qualified collections-based staff; greater effectiveness and efficiency in curation and management of collections</p>	<p>Skilled and qualified staff; motivated staff; secured collections used globally by scientists to address critical issues related to biodiversity</p>

<p>Virtual museum includes type specimen images (6000 total), specimen data (1.2 million records total) and archival documents (600 total) for plant, animal, fungi and fossil groups</p> <p>Monitoring figures on the use of the collections nationally and globally (number of visitors, loans, data use) with input into Annual Reports</p>	<p>Integrated and openly accessible specimen data sets, including images of specimens used by researchers, postgraduate students, undergraduates and learners globally, and nationally by EIA practitioners, threatened species experts, and conservation authorities.</p> <p>Provision of data for Red Listing of priority groups of organisms (freshwater invertebrates, pollinators, dung beetles in next three years) to assess threat of species extinctions</p>	<p>Increased research and education outputs in a range of fields</p> <p>Inclusion of wide range of species in impact assessments and decision-making in development applications</p> <p>Information provided for National Biodiversity Assessment</p>	<p>Sustainable development, protection and use of biodiversity;</p> <p>Involvement of broader society in decision-making</p>
<p>Collections used as a reference for the identification of biological materials: 500 agriculturally relevant species and 1000 illegally harvested and traded species DNA barcoded and added to Barcode of Life reference database</p>	<p>DNA barcode reference library expanded for use by a range of stakeholders</p>	<p>Improved decision-making related to pest and disease control for crops (which pest management strategy to implement or pesticide to use), which impacts on farmers at all scales (subsistence to large scale commercial), and the Department of Agriculture in the case of national risks.</p> <p>This service also supports biosecurity agents making decisions about imports and exports – whether to authorize, or to request quarantine, or other treatment, (fruit, vegetable, horticultural products) which impacts on</p>	<p>Increased food security and economic benefits from trade in agricultural products; reduced loss of biodiversity and revenue from legal trade in biodiversity</p>

		<p>food security and the economy.</p> <p>Trade in indigenous species: investigations and prosecutions need accurate identifications for illegally harvested and traded plants and animals. Illegal trade poses a risk to South Africa's unique biodiversity, and results in loss in revenue for legal breeders and traders.</p>	
<p>Report on use and impacts of collections, data and research</p> <p>Assessment of iconic specimens in collections to highlight heritage value of natural science collections</p> <p>Development and distribution of a range of materials for various audiences that highlight the value and use of the collections for addressing challenges in society</p> <p>Report on perceptions of researchers and decision-makers of the natural science collections and data</p>	<p>Material / curriculum guidelines based on outcome of research into collection value for the public displays at museums, and for museum education programmes</p> <p>Material to illustrate how scientists use the collections to solve societal and economic problems, and to highlight iconic specimens</p> <p>Improved understanding of needs of users of the collections, data and services to improve service delivery</p>	<p>Improved public understanding of biodiversity, its importance for human well-being and for national and cultural identity</p> <p>Society participates in and contributes to collection and biodiversity related activities</p> <p>Cross cultural appreciation for varied values for species</p> <p>Collections and data used increasingly for solving societal challenges at national and international level</p> <p>Policy decisions that recognise the value of collections so that they are protected for future generations</p> <p>Improved understanding of biodiversity and related research and discovery by school learners; inspired learners</p>	<p>Biodiversity and collections viewed as national assets and treasures of value for science and decision-making; social cohesion; increased interest in life sciences by learners</p>
<p>Transformation process to strengthen leadership and the network and to recontextualise the collections and associated science: report on transformation journey</p>	<p>Increased leadership capacity and capability in collection institutions</p> <p>Increased buy-in and support for NSCF</p>	<p>Secured collections with increased efficiencies and productivity</p> <p>Novel science and interpretation / displays based</p>	<p>Sustainable institutions and network; accessibility of information from collections to a wide</p>

produced to assist other programmes	amongst staff at collection institutions	on indigenous knowledge systems	range of South Africa's population
Regular and effective communication between the NSCF Hub, institutions, and governance structures to strengthen the network and increase sharing of knowledge and experience. Eg. Website, Facebook page, webinars.	Increased appreciation for diversity, inclusivity and the African context of the collections and associated science Increased collaboration and sharing of resources across institutions	Other initiatives involving the development of networks of institutions able to learn from the experience of the NSCF	

Duration of the contract

The NSCF falls within the South African Research Infrastructure Roadmap (SARIR) programme of the Department of Science & Innovation. The South African National Biodiversity Institute (SANBI) has been contracted by the DSI to co-ordinate the implementation of the NSCF. The initial contract between SANBI and the DSI was from 24 February 2017 to 31 March 2020, but this was extended to July 2021 to accommodate SANBI's co-ordination of a second SARIR project, the Biodiversity Biobanks. The next three-year contract was signed in March 2020, with an allocated budget of R59 million. This amount has been reduced in response to government's request that budgets are revised and all possible funds are directed to the Solidarity Fund to fight Covid-19 in South Africa. This has impacted on the 2020/21 allocation only which has been reduced from the original amount of R19 980 012 to R6 439 157. This reduction is possible through cutting travel funds and the costs of the NSCF Forum. A new three-year contract between SANBI and the DSI was signed in March 2022, with a termination date of February 2025, and an additional two years of funding (2022/23 and 2023/24).

2. Aim and objectives

The overall aim of the NSCF is to ensure that ***collections and associated data are used for high quality research and decision-making to address issues of socio-economic importance***

In order to realise this aim, the NSCF has the following overall goals:

1. Estimated 18-20 million preserved plant, animal, fungi and fossil specimens collected over the last 200 years, well curated, and accessible either virtually or physically to the global research community for research in biological, environmental and palaeo-sciences, for contributing to **documenting past and present biodiversity, understanding global change impacts on species and biological communities, and possible mitigation and adaptation mechanisms.**

The NSCF Collection Management & Curation Manual which includes policy and procedure guidelines and standards was published in early 2021. A training course was run from May 2021 to January 2023 and the series of virtual webinars and discussion forums that cover the Manual topics serve not only those staff registered for the course, but all staff at institutions requiring guidance for implementation of the Manual.

The next three years will focus on providing additional guidance to institutions for implementing the Manual, assessing the collections at participating institutions to determine the extent to which they have implemented the Manual, producing a report on the collection assessment, and putting in place interventions for at-risk collections identified in the assessment.

2. The data from the specimens (what it is, where it was collected, when it was collected as a basic minimum) assembled into **databases that are openly accessible in an integrated way for researchers, practitioners involved in monitoring and assessing the status of biodiversity (eg. threatened species assessments, alien invasive species risk assessments, environmental impact assessments for various forms of land use change and development), and decision-makers involved in authorisations for land use change (eg. mining, agriculture), development, and harvesting quotas (eg. medicinal plants, fish)**. The data are currently incomplete, with a large number of specimens for which data have not been captured and gaps in the data for which there are digital records.

The first five years of the NSCF focussed on developing guidelines for institutional data policies, workflows and procedures and set standards for data quality. All this information was included in the NSCF Collection Management and Curation Manual. There was also migration of data sets to common software and training and support to institutions for using Specify software, mobilisation of plant specimen data, as well as upgrading of some animal collection data.

The need to first address curational backlogs for the collections before the data could be upgraded was recognised for the animal collections and because of capacity constraints in many institutions, two curation assistants with experience in herpetology (reptiles and amphibians) were appointed to work across institutions.

A large amount of work remains in terms of data mobilisation and upgrading of existing specimen data sets, as well as making data accessible on an integrated platform. Ways of increasing the rate of data capture from specimen labels will be investigated because this is currently labour intensive and slow, and there are approximately 600 000 records still to capture. A move towards specimen imaging and initially capturing only the key identifier for the specimen in a data set was initiated in 2022.

3. **Establishment of a Virtual Museum that provides online access to images of specimens from the collections of all participating institutions, specimen data sets and archival documents** such as field notes of historic collectors. Researchers, postgraduate students, EIA practitioners, threatened species and alien invasive species assessors, conservation authorities, and learners will be able to access the virtual museum for a range of projects.

Focussed efforts to image type specimens (the specimens on which species descriptions are based) was initiated in mid-2019. The standards and workflows were developed and included in the NSCF Collection Management and Curation Manual, and two professional photographers were appointed to work in the institutions imaging types for fossils and vertebrates. This work will continue over the next three years.

The NSCF has also supported various herbarium collections to digitise / image the plant specimens over the past three years. This has allowed centralised data capture from the specimen labels, but the value of having digital versions of the specimens has become evident through the Covid pandemic because travel to visit collections and posting of specimens on loan has been difficult, and as a result of the fire at UCT, where the potential for loss of entire collections through disasters was seen.

In addition to the imaging of specimens, there will also be a focus on digitisation of archival documents linked to the collections and of relevance to research. This includes the original accession registers, collectors' field notes and research notes.

4. Provision of **services and development and application of tools for the accurate identification of biological specimens and materials for a range of stakeholders** including the research community,

enforcement agencies investigating illegal trade in wildlife, agencies dealing with biosecurity and eradication programmes, veterinary and medical practitioners, EIA consultants, farmers, and bioprospectors. Accurate identification of species is often challenging, especially for groups with very high levels of diversity (eg. 18 000 beetle species, 24 000 plant species in South Africa), or where only partial samples are available (eg. blood, bone, horn, bark, dried powders, meat), or where the specimen is an immature stage (eg. seeds, bulbs, bird, insect or parasite eggs, larval stages of fish or insects). Export and import of agricultural products can be blocked if there are doubts about the identity of any infestations or infections which impacts the economy and jobs. The need for increased accuracy and speed of identifications and for addressing gaps in expertise for many groups requires the application of DNA barcoding. The reference library for DNA barcodes needs to be expanded to represent important species, and the technology adopted especially where there is potential economic or societal impact (eg. identification of material for biosecurity, illegal trade, parasite infestations for diagnostics).

Over the last year the NSCF has identified target species (agricultural pests and disease vectors, illegally traded species), and we will be carrying out the sequencing and loading the data into the international Barcode of Life Database over the next eight months. Over the next three years we will continue with this work to expand the DNA barcode reference library for species of importance for the economy and conservation.

5. Increase understanding of the value of natural science collections to society to (i) inform policy influencing their long term sustainability, (ii) stimulate new ways of including the collections and data in research in the fields of climate change, sustainability, biodiversity conservation (iii) communicate how the collections contribute to sustainable development and understanding of climate change to learners and the public, and (iv) promote social cohesion. **The unique and valuable national assets in the form of the natural science collections have not been promoted nationally, and there is little awareness or understanding of their significance, which means that they are often at risk of being neglected or discarded.**

During 2021 and 2022 the NSCF has started documenting case studies of use of the collections to solve problems of national and global relevance, and documenting some of the iconic specimens held in the collections. Showcase documents have been produced and a webinar series run on the material. Over the next three years this work will continue, expanding the case studies and iconic specimen documentation, and the number of platforms used to communicate the information. The information presented must be audience specific, relevant to the African context, promote indigenous knowledge systems and contribute to public understanding of science and social cohesion. The outcome of this goal will have relevance beyond South Africa because many countries face similar challenges related to the sustainability of natural science collections, and they run museum education programmes.

The NSCF investigated and documented the perceptions of researchers based outside of the collection institutions and other relevant stakeholders / decision-makers regarding the value of the collections, associated data and the services offered. Increasing understanding of the science – policy – decision-making interface in the context of the collections is critical to address any obstacles to access and use for societal benefit. The research paper for this study was published in the African Biodiversity and Conservation journal in July 2023.

A project investigating the societal impact of the publications generated through use of collections and data will also be initiated.

Enabling strategies

In order to achieve the goals the following enabling strategies will be critical:

- Transforming the current fragmented natural science collections landscape to one with participatory planning, and collaborative implementation, monitoring and reporting processes and systems, and one that reflects its African and South African context.

We have run a facilitated transformation and organisational development process since 2018. Given the complexity of establishing and sustaining a distributed research infrastructure, with 17 institutions, the challenges need to be addressed on an ongoing basis and so this work will continue. A new contract with organisational development facilitators was entered into in 2022 and will run until 2024.

- o Ensuring that appropriate capacity to curate collections, manage data and research the collections is available and well qualified staff are retained.

The NSCF has run training in the use of Specify software for managing collections and data, and there is a higher level mentorship programme for staff as well. The NSCF sponsored 17 staff to attend a customised Data Management course presented by the University of Pretoria. This work will continue.

The NSCF ran a virtual training course in collection management and curation based on the Manual. This course had 74 staff registered. There will be more focussed shorter courses offered or sponsored over the next three years.

The Covid-19 pandemic has provided many opportunities for staff at all institutions to participate in virtual international conferences and workshops at no or minimal cost and hopefully this will continue.

- o Contributing to the identification of strategies and models that will ensure financial sustainability of the natural science collections.

As allocations from government and higher education institutions continue to decline, pressure to increase efficiencies is increasing. There are limited opportunities for commercial activities associated with the collections, but sharing knowledge and resources across institutions, and potentially rationalising some collections will be investigated over the next three years.

3. Progress: 1 April - 30 September 2023

STRATEGIC OBJECTIVE	3 YEAR DELIVERABLES (2021/22 to 2023/24)	PROGRESS APRIL TO SEPTEMBER 2023
1. Securing collections – ensuring collections meet global standards	<p><u>2021/22</u></p> <ul style="list-style-type: none"> Assessing the implementation of the NSCF Manual standards and impact of the NSCF on the collections: criteria and assessment checklist developed; circulated to participating institutions <p><u>2022/23</u></p> <ul style="list-style-type: none"> Assessment of the extent to which the standards and procedures developed and included in the NSCF Manual have been implemented in the participating institutions (depending on Covid Regulations). Production of report on status of the collections for governance structures. <p><u>2023/24</u></p> <ul style="list-style-type: none"> Actions to address risks to collections in terms of 	<ul style="list-style-type: none"> Process for the facilitated self-assessments of collections initiated, assessment checklist developed and institutions completed self-assessments in April 2023, which were moderated and verified from May to June 2023. Analyses of the assessments are underway and reports are planned to be released in early December 2023. Orphan collections incorporated: Buffelskloof Herbarium to Moss Herbarium, Wits University underway, East London Museum Marine Invertebrate Collection was moved to the Iziko Museum and incorporation is underway. Private cicada collection moved to Iziko Museum in July 2023, incorporation is underway. Funding round for institutions to apply for funding to move and incorporate orphan and at risk collections initiated in September 2023.

	<p>collection management and curation as identified in the assessment</p> <ul style="list-style-type: none"> • Integration of orphaned collections identified through assessment (x3) 	
<p>2. Upgrading and expanding collection specimen databases, and making these openly accessible in an integrated way for research, biodiversity assessment and decision-making</p>	<p><u>2021/22</u></p> <ul style="list-style-type: none"> • 40 000 specimen records captured or upgraded (vertebrates, plants) • Membership of international consortium for Specify software. This promotes collaborative research into data management for collections • Migration of 70% of animal and paleontology collections to Specify software, which contributes to meeting GRAP 103 standards for heritage collections accounting <p><u>2022/23</u></p> <ul style="list-style-type: none"> • 100 000 specimen records captured or upgraded (vertebrates, selected invertebrates, plants) • Migration of 90% of animal and paleontology collections to Specify software <p><u>2023/24</u></p> <ul style="list-style-type: none"> • 200 000 specimen records captured / upgraded (selected invertebrates – for Threatened Species Assessment; plants; vertebrates) • Data submitted to and made accessible through GBIF and NSCF Virtual Museum. 	<ul style="list-style-type: none"> • 6,962 herbarium specimen records georeferenced, • Data cleaning of Ditsong herpetology database 99% complete (~75 000 records) • Migration of NICD mosquitoes and ESI stalled; ARC PHP spiders near complete (ARC staff are georeferencing ~ 6000 records which had problematic coordinates, now 30% complete) • Data cleaning of ca. 60 000 records for UP Herbarium completed, included duplicate removals, removal of old database codes, correction of several hundred records manually, and reconciliation of taxonomy with the SANBI taxon backbone. • Some data cleaning, corrections and reconciliation done for Skukuza Herbarium during visit there, but not undertaken fully as the purpose was primarily to create a database for the barcoding.
<p>3. Developing an online and accessible Virtual Museum, with images of the type specimens, specimen data and archival documents that can be used by researchers, postgraduate students, undergraduates and learners globally, and nationally by EIA practitioners, threatened species experts, and conservation authorities.</p>	<p><u>2021/22</u></p> <ul style="list-style-type: none"> • Online virtual museum architecture set up • Specimen imaging: type specimens: 400 vertebrates, fossils; plant specimens: 20 000 • Digitisation plan for archival documents related to collections developed <p><u>2022/23</u></p> <ul style="list-style-type: none"> • Specimen imaging: type specimens: 500 vertebrates, fossils; plant specimens: 120 000 • 100 archival documents related to collections digitized • Uploading of all new images and data and archival documents onto virtual museum 	<ul style="list-style-type: none"> • Imaging of Ditsong mammal types is now complete and final edits are being done. • 10 000 plant specimens imaged at UP, another 7 000 at Wits Moss Herbarium. • Institutions reported a further 87,695 specimens imaged from April to September 2023. • Archival document imaging coordinator appointed and training underway. • Procurement of Virtual Museum server stalled again (but finally delivered in early October).

	<p><u>2023/24</u></p> <ul style="list-style-type: none"> • Specimen imaging: type specimens: 500 vertebrates, fossils; plant specimens: 360 000 • 200 archival documents related to collections digitized • Uploading of all new images and data and archival documents onto virtual museum 	
<p>4. Global use of collections for research and capacity development</p>	<p><u>2021/22</u></p> <ul style="list-style-type: none"> • 100 publications produced by researchers using collections • 80 new species described from the collections • 100 scientists visiting the collections for research purposes • 3000 specimens used by researchers for various projects • 20 MSc, PhD and Postdocs using collections for their research <p><u>2022/23 & 2023/24</u></p> <ul style="list-style-type: none"> • 100 publications produced by researchers using collections • 100 new species described from the collections • 200 scientists using the collections for research purposes (physical visits or requests for digital images of specimens or for data sets or accessing these resources online through Virtual Museum) • 10 000 specimens used by researchers for various projects sent out on loan to researchers • 25 MSc, PhD and Postdocs using collections for their research 	<p><u>2021/22 (April 2021 to March 2022):</u></p> <ul style="list-style-type: none"> • 189 publications produced • 105 new species described • 668 national visitors and 64 international visitors using the collections • 13 323 specimens sent out on loan • 272 postgraduate students using the collections <p><u>2022/23 (April 2022 to March 2023):</u></p> <ul style="list-style-type: none"> • 148 publications produced of which 87 are open access • 110 new species described • 541 national visitors and 121 international visitors using the collections • 11 856 specimens sent out on loan • 183 postgraduate students using the collections <p><u>2023/24 (April to September 2023):</u></p> <ul style="list-style-type: none"> • 56 publications produced of which 40 are open access • 58 new species described • 338 national visitors and 39 international visitors using the collections • 5 477 specimens sent out on loan • 140 postgraduate students using the collections <p>*the total number of postgraduate students, local and international visitors may be inflated because the same student or visitor may have been counted each year because they used the collections more than once in separate years</p>
<p>5. Translational research / services outputs (societal impacts)</p>	<p>Over 10 000 biological specimens identified per year, including, but not limited to the following sectors:</p> <p><u>2021/22</u> Agriculture:</p> <ul style="list-style-type: none"> • decision-making related to pest and disease control for crops (which pest management strategy to implement or pesticide to use), which impacts on farmers at all scales (subsistence to large scale commercial), and the 	<ul style="list-style-type: none"> • 2021/22: 67,007 specimens identified • 2022/23: 429,026 specimens identified • 2023/24 (Apr to Sep): 1,331,492 specimens identified • Purpose of identifications include: farming diagnostics, commercial crop production, research, biological invasion management, disease management, pest management, law enforcement, regulation, training, conservation management and planning, forensic entomology, stranding responses, and public interest. • Clients include: National Sea Rescue Institute, Stranded Marine Animal Rescue Team, DALRRD, seed companies, Bio-products, Cape Nature Conservation, Two Oceans Aquarium, Dyer Island Conservation Trust, environmental consultants, Birdlife Border, SAPS, SANParks, Sefako

	<p>Department of Agriculture in the case of national risks.</p> <ul style="list-style-type: none"> • This service also supports biosecurity agents making decisions about imports and exports – whether to authorize, or to request quarantine, or other treatment, (fruit, vegetable, horticultural products) which impacts on food security and the economy. <p>Harvesting and trade in indigenous species:</p> <ul style="list-style-type: none"> • Investigations and prosecutions need accurate identifications for illegally harvested and traded plants and animals. Illegal trade poses a risk to South Africa's unique biodiversity, and results in loss in revenue for legal breeders and traders (eg. indigenous plant breeders, wildlife breeders), as well as in tax revenue. <p>Adoption of new technologies for identification of biological material:</p> <ul style="list-style-type: none"> • 300 agriculturally relevant species DNA barcoded and added to Barcode of Life reference database for use by the Agricultural Research Council for diagnostics for farmers and biosecurity agents. • 500 harvested and traded indigenous species added to the DNA barcode reference library (eg. cycads, succulents, fish, reptiles) for use by enforcement and prosecuting agents <p><u>2022/23</u></p> <ul style="list-style-type: none"> • 300 agriculturally relevant species DNA barcoded and added to Barcode of Life reference database for use by the Agricultural Research Council for diagnostics for farmers and biosecurity agents. • 500 harvested / traded indigenous species added to the DNA barcode reference library for use by enforcement and prosecuting agents 	<p>Makgatho University, Nelson Mandela University, FreeMe Rehabilitation Centre, University of South Africa.</p> <ul style="list-style-type: none"> • Plan developed for barcoding of agricultural pests and pathogens, disease vectors and illegally traded species. • List of species compiled, including list of agricultural pests, alien invertebrates with associated data on numbers represented in BOLD, potential source of materials. • Fungal material sent to SANBI's DNA service lab for piloting.
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	<p><u>2023/24</u></p> <ul style="list-style-type: none"> • 500 harvested indigenous species added to the DNA barcode reference library (eg. cycads, fish, reptiles) for use by enforcement and prosecuting agents. • Promotion of adoption of DNA barcoding technology by staff involved in diagnostics and biosecurity, and by enforcement agents for illegal trade and harvesting. 	
	<p>Spatial planning and decision-making for development:</p> <p><u>2021/22</u></p> <ul style="list-style-type: none"> • Research carried out to support decision-making for biodiversity: spatial planning; protected area expansion; environmental impact assessments; Red List assessments; alien invasive species assessments; climate change / global change monitoring. <p><u>2022/23</u></p> <ul style="list-style-type: none"> • Research carried out to support decision-making for biodiversity: spatial planning, protected area expansion; environmental impact assessments; Red List assessments; alien invasive species assessments; climate change / global change monitoring. • Surveys of new national park in Eastern Cape to identify key areas for inclusion <p><u>2023/24</u></p> <ul style="list-style-type: none"> • Promotion of specimen datasets amongst national and provincial conservation authorities, municipalities and consultants for use in impact assessments and decision-making in development applications and in spatial development frameworks. 	<ul style="list-style-type: none"> • Collections and spatial data being expanded and museum staff involved in two large projects funded through the Foundational Biodiversity Information Programme (FBIP) (one marine co-ordinated by SAEON and one freshwater co-ordinated by SAIAB / SANBI) • Project on fly (Diptera) pollinators underway, contributing to museum collections and data for Red List assessments. Funded by Belgian government, involving researchers from KZN and Albany Museums.
	<p><u>2021/22</u></p> <ul style="list-style-type: none"> • Production of a report on use and impacts of collections, data and research that will be provided to national (Environment, Arts & Culture, Agriculture, DSI) and provincial departments and higher 	<ul style="list-style-type: none"> • Survey on broader research community perceptions of natural science collections was completed and paper published in African Biodiversity and Conservation journal in July 2023. Available at: https://www.abcjournal.org/index.php/BothaliaABC/article/view/420

	<p>education institutions that govern the collections to help guide decision-making about this infrastructure.</p> <ul style="list-style-type: none"> • Material / curriculum guidelines based on outcome of research into collection value for the public displays at museums, and for museum education programmes. <p>2022/23</p> <ul style="list-style-type: none"> • Expansion of knowledge base on use of collections for addressing societal problems and of iconic specimens in the collections. • Expansion of platforms where material on value of collections presented, targeting different audiences. • Investigation into perceptions of researchers and decision-makers at different levels of government of the natural science collections, data and services provided to identify needs and obstacles to expand use of collections for research and decision-making purposes. <p>2023/24</p> <ul style="list-style-type: none"> • Report and publication on researcher and decision-maker perceptions of collections and data and recommendations for increasing use of these for societal impact. • Investigation into the impact of collection-based publications on society. 	
<p>6. Human resources management and capacity development</p>	<p>2021/22</p> <ul style="list-style-type: none"> • Hub and project-related staff: 24 staff (NSCF Lead, Project Manager, Administrative Officer, Science Communication Officer Data Co-ordinator, Data Quality Specialists (2), Collection Management and Curation Co-ordinator, 5x Data Technicians, 2x photographers, document archivist; Curation Technicians (2), Management as well as development in various skills and capabilities. 	<ul style="list-style-type: none"> • Current Staffing: NSCF Lead, Project Manager, Data Management Co-ordinator, Collection Management Co-ordinator (Vacant post advertised); Science Communication Officer, two Specimen Photographers, two Scientific Curation Technicians, Admin Officer, one Data Quality Specialist and five Data Technicians, HR Officer (as well as 2 curation technicians appointed at partner institutions to incorporate orphan collections and image backlog plant specimens), two Data Coordinators for the Virtual Museum and Specify database support posts advertised. 6 Research Assistants appointed on 6 month contracts to assist with imaging specimens and data capture. • One hub staff member attended an international online Transmitting Science course in care and management of natural history collections from 28 August to 8 September. • Hub staff attended the annual BioDigiCon virtual conference on 18 and 19 September. • Training in data management: Several months of training of NSCF staff in herbarium specimen management and imaging, as well as image editing and management.

- Participating institutions: Approx. 20 short term contracts (up to 6 months) and internships for recent graduates / to develop capacity and assist with curation activities / data capture and digitisation; 4 Curation Technicians to assist with integration of and 1 Curation Assistant orphan collections; imaging of type specimens, imaging of plant specimens, digitisation of documents.
- International and national conferences relating to natural science collection and data management, collection-based research: participation by staff from participating institutions and Hub, presentations on the work of the NSCF
- Training course in collection management and curation for institution staff, postgraduate and undergraduate students

2022/23

- Hub and institution staff management and development.
- Training courses in collection management and curation for institution staff, postgraduate and undergraduate students
- International and national conferences relating to natural science collection and data management, collection-based research: participation by staff from participating institutions and Hub, presentations on the work of the NSCF

2023/24

- Hub and institution staff management and development
- Training courses in collection management and curation for institution staff, postgraduate and undergraduate students
- International and national conferences relating to natural science collection

	and data management, collection-based research: participation by staff from participating institutions and Hub, presentations on the work of the NSCF	
7. Organisational development & support – strengthening the internal structures of the NSCF to enable the long-term sustainability of the collections and associated research to benefit society	<p><u>2021/22, 2022/23 and 2023/24</u></p> <ul style="list-style-type: none"> • 25-35 participants in 2 workshops for development and transformation to ensure long term sustainability of collections and NSCF. • NSCF Forum for staff from 16 participating institutions (140 staff). • Communication platforms for the NSCF network – website, Facebook page, WhatsApp group. • Promotion of the NSCF and collections at professional society conferences to increase use of collections and data for research (minimum of 3 / year). 	<ul style="list-style-type: none"> • A third phase of leadership and organisational development commenced in February 2022 for a further 2 year period through the appointment of organisational development facilitators and an evaluator. Sessions with hub members were held in May and July 2023. • Website, Facebook page and group, Instagram and Twitter accounts operational, news circulated via mailing list regularly, on an adhoc basis. • Website hits from April 2023 to September 2023: Visits: 19,092; visitors: 11,162. Facebook page likes: 976. Facebook group members: 438. Instagram followers: 251. Twitter followers: 233. YouTube subscribers: 125. • Collection Management and Curation Course completed, with 52 successful participants. • Limpopo outreach, 2-5 May 2023, 699 learners reached. Exhibited at National Science Week Launch, University of Venda, Limpopo, 21-22 July 2023, approximately 300 people reached. Sci-Bono National Science Week Talk, 1 August 2023, approximately 300 learners reached.
8. Governance	<p><u>2021/22, 2022/23 and 2023/24</u></p> <ul style="list-style-type: none"> • Meetings of Advisory Committee (twice a year); Co-ordinating Committee (3 times a year), and Task Teams (6 meetings annually) • Develop new Collaboration Agreements with partner institutions. • Six monthly and final report to DSI; quarterly report to SANBI EXCO / Board. 	<ul style="list-style-type: none"> • Advisory Committee meeting scheduled for October 2023. • Coordinating Committee meets quarterly. • Herbarium and animal data working groups meet on an ad hoc basis as needed. • Collaboration agreements were developed for the existing 16 partner institutions and two new partners – The National Institute for Communicable Diseases, Vector Control Laboratory, and the University of Pretoria. The National Museum Bloemfontein has not signed a new agreement and communication attempts with the institute have failed. Funding for the 2022/23 financial year was allocated to 9 institutions (ARC, Bayworld Museum, Ditsong Museum, Iziko Museum, McGregor Museum, SAIAB, Bolus Herbarium UCT, NICD, Wits University Evolutionary Studies Institute) and a new funding round has been initiated in September 2023. • Six monthly reports submitted to DSI, and quarterly reports submitted to SANBI (EXCO/Board).

4. Financial analysis

Income:

The grant for the 2023/24 financial year was transferred to SANBI's bank account in June 2023. The **total project income to date is R124,204,289.**

Expenditure to date is R114,023,049:

- Human Resources and support services costs amounted to R46,178,320.
- Non HR Operational Costs totalled R36,937,747.

- Capital Expenditure amounted to R30,906,981 which included payments to collaboration partners for the purchase of freezers, microscopes, x-ray machine, ethanol recycler, dehumidifiers, cabinets, compactor shelving and small items for curation of collections and research. This also included procurement of imaging equipment for specimen photography and archival document digitisation.

The committed amount for the project period is R5,486,333.

Collaboration agreements were developed for the existing 16 partner institutions and two new partners – The National Institute for Communicable Diseases, Vector Control Laboratory, and the University of Pretoria. Funding for the 2022/23 financial year was allocated to 9 institutions for storage, collections consumables, dehumidifiers, and staff for incorporating backlogs and orphan collections. Funding committed in collaboration agreements amount to R396,682.

The balance of staff contracts including twenty-two Coordinating Hub posts, one HR Officer and short term data technicians and curation assistants for incorporation of orphan collections and specimen imaging amount to R4,472,112.

The contract towards the change management process amounts to R511,597, and R105,942 is committed towards the contract for website maintenance and technical support.

We have accrued R5,959,883 in interest to date.

5. Financial information

A detailed financial report for the third phase of the project (provided by SANBI's Finance Division and approved by the Director, Finance), is provided. This report forms the basis of the financial information presented below on income, expenditure and commitments for the 2021/22, 2022/23 and 2023/24 (up to 30 September 2023) financial year:

Budget vs Expenditure:

Period: April - September 2023

Description	Budget Allocation				Actual		
	2021/22	2022/2023	2023/2024	TOTAL	2021/22	2022/2023	2023/2024 as at 30.09.2023
Opening Balance				-	10 442 626	13 624 648	6 574 310
Opening Balance					10 954 433	13 611 316	6 619 185
Prior period adjusted					-511 807	13 332	-44 875
Income	18 971 020	19 065 285	18 215 100	56 251 405	19 461 402	10 597 974	18 777 647
Grant	18 971 020	19 065 285	18 215 100	56 251 405	18 971 020	10 000 000	18 215 100
Interest earned					490 382	597 974	562 547
Expenditure	18 971 020	19 065 285	18 215 100	56 251 405	16 292 712	17 603 438	9 210 833
Human Resources and Support Services	10 177 850	11 834 252	12 473 363	34 485 465	9 721 849	9 979 051	4 568 575
Operational Expenditure	5 171 789	5 331 033	5 041 737	15 544 559	3 297 371	5 105 937	4 154 286
Training & research support (including workshops)	1 348 320	1 400 000	1 326 610	4 074 930	34 456	79 810	36 512
Fixed annual operational cost	50 000	690 000	1 037 140	1 777 140	702 160	1 477 577	750 568
Travel & accommodation	760 000	471 769	590 000	1 821 769	208 238	1 108 689	774 346
Consumables for office, collections upgrades	1 116 449	862 736	266 477	2 245 662	455 416	1 439 861	771 349
SANBI overheads charge (10%)	1 897 020	1 906 528	1 821 510	5 625 058	1 897 102	1 000 000	1 821 510
Capital Investments	3 621 381	1 900 000	700 000	6 221 381	3 273 492	2 518 449	487 972
Webservers & networking	3 470 070	1 300 000	500 000	5 270 070	3 273 492	2 518 449	487 972
Equipment				-			
Workstations	151 311	600 000	200 000	951 311			-
Closing balance					13 611 316	6 619 185	16 141 124
Less total interest accumulated to dated							-5 959 883
Total balance as at 30.09.2023							10 181 240

With a project balance of R10,181,240, 56% of the R18,215,100 grant has been spent.

Details of financial commitments:

There are several commitments at various stages of finalisation, and with various actions that are required before payments can be transferred from SANBI's accounts. These are commitments against signed staff contracts, and service provider contracts for which the project is obliged by SANBI to keep the committed funds in the project cost centre. Commitments against actual signed contracts are detailed in the table below.

Salary costs (committed through staffing contracts, and required to be retained in cost centre by SANBI)

Item	Expected date of finalisation	Amount
Hub staff and short term contract staff at institutions	October 2024	R4,414,512
Incorporation of orphan collections; data cleaning projects – research assistants	January 2023	R57,600
TOTAL		R4,472,112

Contract commitments

Item	Expected date of finalisation	Amount
Change management evaluator and consultants contract	February 2024	R511,597

Website maintenance and technical support	May 2026	R105,942
TOTAL		R617,539

Partner funding (committed in signed collaboration agreements)

Item	Expected date of finalisation	Amount
Iziko Museums of South Africa	October 2023	R87,843.61
National Institute for Communicable Diseases	October 2023	R45,074.50
South African Institute for Aquatic Biodiversity	October 2023	R250,000.00
University of the Witwatersrand, Evolutionary Studies Institute	October 2023	R13,764.22
TOTAL		R396,682

Financial summary:

Total Project Income	-R124,204,289
Total Project Expenditure	R114,023,049
Commitments	R5,486,333
Balance	R4,694,907

*R5,959,883 interest earned not included in the table above

6. Summary and assessment

Achievements April to September 2023:

1. Integrated monitoring of outputs from the use of the collections has been carried out, and illustrates the value of the collections as research infrastructure: figures for April to September 2023: 112 requests for data serviced, with 46,336 specimen records provided; 338 national visitors and 39 international visitors using the collections; 58 new species described using the collections; 56 peer-reviewed papers published where the collections were used; the number of postgraduate students who used the collection was 140 (note that the same student may be counted more than once if they used more than one institution's collections). Seventeen institutions submitted reports through the online monitoring system. Institutions reported the following outputs for the first half of the 2023/24 financial year:

Indicator	Q1	Q2	Year Total
Orphan collections: no. of specimens incorporated	850	1470	2320
New specimens accessioned	3305	5750	9055
Number of DNA samples added	13	36	49
Number of tissue samples added	1071	319	1390
Number of DNA samples supplied for research purposes	1056	38	1094
Data provided to external users: no. of requests	63	49	112
Data provided to external users: no. of records	13088	33248	46336
Number of new specimen records added to Brahm's/Specify	13892	15170	29062
Number of specimens imaged	63520	24175	87695
Number of specimens sent out on loan for research	4146	1331	5477
Number of visitors using collection (national)	138	200	338
Number of visitors using collection (international)	22	17	39
Number of new species described	32	26	58
Number of papers published based on collection	37	19	56
Number of papers open access	23	17	40
Number of specimens identified: external stakeholders	1261010	70482	1331492
Number of outreach activities held	34	60	94
Number of learners/attendees exposed to the activity	11444	6046	17490
Number of postgrad students using the collection	95	45	140
Number of students trained in the collections	26	35	61
Number of students graduated from using the collections	7	1	8

These figures illustrate the extensive use of the collections and associated services, and the high number of outputs.

2. Translational outputs: the collections are used as a reference for the identification of materials in agriculture (crop pests, livestock disease vectors and parasites, weed biocontrol agents, phytosanitary diagnostics for import and export of produce), **health** (eg. outbreak of head lice at a school), **environmental impact assessments** for development applications, postgraduate studies and for researchers in a number of different disciplines, and for the general public: 1,331,492 specimens have been identified from April to September 2023. The impacts of not having the correct identification include the loss of crops and livestock, or a global ban on export of produce, and delays in approvals for development applications or the loss of biodiversity through development.

3. Outreach activities were held as follows:

The NSCF was invited by UNIVEN and NMU to the annual science awareness outreach event in the Vhembe East and West education districts of Limpopo Province, from 2-5 May 2023. The outreach was aimed at grade 10-12 learners to inform them about careers in Science. Short talks were shared with the learners, with some specimens on the table, to make the information more understandable and relatable. A total of 699 learners were reached.

We also exhibited at National Science Week Launch, at the University of Venda, Limpopo, from 21-22 July 2023, with approximately 300 people reached, and presented a talk at the Sci-Bono National Science Week on 1 August 2023, with approximately 300 learners reached.



NSCF Exhibition stall at National Science Week Launch

4. National Collections Assessments/Iqoqwana Initiative:



Natural Science Collections Facility

Iqoqwana Initiative

Saving our Past, Securing our Future

Over the last five years funds have been allocated to partner institutions to upgrade research and curation infrastructure and practice, and support has been provided for various collection activities including data capture and management, imaging of specimens, and movement and integration of orphan collections. The Collection Management and Conservation Manual was published and disseminated in early 2021, an outcome of a collaborative effort bringing

together collection institutions. This Manual serves as a guide, providing standards, procedures and templates that align with best professional practice as well as audit principles. A Collections Management Course was developed based on the Manual to build capacity and provide further guidance and support for implementation. With over R100 million of investment in the NSCF by the Department of Science & Innovation over the past five years, an assessment of the state of our natural science collections is now required.

Working with developmental and transformation facilitators a process of facilitated self-assessment, self-reflection on what is revealed by the assessment, and collaborative learning and support across the network through the process and into the future was proposed. The facilitated self-assessment concept received support from the NSCF Advisory Committee and from the Co-ordinating Committee, as well as from the Directors of the partner institutions.

The facilitated self-assessment process is aimed at providing support for the future of natural science collections in South Africa, but also for transformation, building staff capacity, and creating a collaborative learning and vibrant environment that will ensure sustainability. Several engagements have been held with the community in order for the assessments to be based on collaborative planning, organisational learning and principles of inclusivity, participation and capacity building. As mentioned, engagements were held with the Advisory and Coordinating Committees of the NSCF, as well as the Directors of the institutions. The annual NSCF Forum which is open to the entire community was designed around onboarding all levels of staff at institutions to the assessment process, and collaborative design of the assessments. The forum was held online from 25 to 28 October and attended by between 60 and 120 participants for various sessions. Regional orientation sessions were held during March 2023.

Partner institutions conducted self-assessments of their collections in April and early May 2023. These assessments were moderated on-site by the NSCF hub team and observers from other partner institutions during site visits in May, June and July 2023. A total of 78 collections were moderated by the hub team. The collation of the assessment data and the production of individual collections reports as well as a national report is currently underway and is expected to be completed in early December 2023. Sense-making workshops will be held with institutions to discuss the findings of the assessments and work on plans for improvement and future support.



NSCF Hub staff and collections staff conducting collections assessments

Challenges:

1. National Museum Bloemfontein continued participation in the NSCF is uncertain: The museum did not sign the new collaboration agreement with the NSCF which would run until 28 February 2025, the previous agreement ended on 31 March 2022. The CEO resigned from the NSCF Advisory Committee and also removed the museum representative from the Coordinating Committee. The NSCF Lead has written to the CEO enquiring whether the museum will continue to be part of the NSCF network and whether they will participate in the upcoming national collections assessments, but we have received no response and the museum did not participate in the assessments.

2. Operational Challenges. Recruitment of staff, procurement, signing of collaboration and other agreements are all through SANBI systems and getting the required authorisations and support has resulted in significant delays with many activities.

The NSCF is considered as a project within a Division of SANBI, which means that authorisation for agreements, procurement and staffing is often through between four and six signatories above the level of the NSCF Lead. Procurement processes are often very long, with even small items taking up to six months to procure and there have been long periods when computer hardware could not be procured because supplier contracting was problematic. There is one opportunity per annum to include items over R1 million on the procurement plan. Recruitment processes can take as long as a year, and the minimum requirements and post level are specified by SANBI and not by the NSCF. All these challenges mean that significant efforts are required from most activities and there are delays in implementation of some activities.

Three key staff resigned during the first half of 2022/23 and filling the positions was delayed which has meant that achievement of certain targets has not been possible. One of the reasons for the delay in filling the positions is that only 1-year contracts were offered, which is in line with SANBI's policy that staff contracts cannot extend beyond the SANBI contract with the DSI. This is especially challenging for more senior level posts that require scarce skills, six

years of experience as well as leadership capacity. This matter was escalated to the SANBI Board and the NSCF Lead was requested to obtain a written confirmation from the DSI that the SARIR projects are intended to be long-term and that staff contracts should be for 5 years. The DSI have supplied the letter, however the NSCF Lead has not received a way forward from SANBI.

There have also been considerable delays from SANBI HR to conduct job evaluations on the posts of key staff members of the project. These staff members' jobs have changed considerably over the past 5 years with considerably more responsibility. The NSCF Lead engaged with SANBI HR regarding this matter, and job evaluations were finally conducted in July 2023, with no feedback received so far.

3. Cash flow challenges: We are required to retain sufficient funds in the cost centre to cover the full cost of all contracts, including collaboration agreements for institutions and staffing. This results in funds being tied up in two to three year contracts, but we are required by DSI to spend 90% of funds before the next allocation can be drawn.

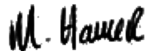
4. Fostering a culture of serving society and accountability in institutions and staff, many of who have previously had a predominantly inward looking and self-serving approach to the collections and research.

5. Status of the NSCF as a short term project within SANBI, which limits decision-making, with authority delegated to senior management who have limited involvement in the NSCF.

6. Development of an online virtual museum, Initially integration with SANBI's National Biodiversity Information System was planned. However delays with the implementation meant that an alternative arrangement was required. Living Atlas software (open source) will be used and we have advertised a post for virtual museum setup and coordination.

Approval

Submitted by:



Prof Michelle Hamer

DSI-SARIR Projects Lead

Date: 30 October 2023

Approved by:



Prof Ramagwai Sebola

Chief Director, Foundational Biodiversity Science

Date: 30/10/2023