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Permit requirements, associated challenges and recommendations for biodiversity collections and research in South Africa

South Africa is frequently cited as being a megadiverse country, with high numbers of species, ecosystems and biomes, and high levels of endemism or uniqueness of species and habitats. A number of globally recognised products such as a detailed national vegetation map[1], a comprehensive strategy for protected areas expansion[2], Red List assessments of plant species[3], mammals, birds, reptiles[4] and butterflies[5]. A comprehensive scientific National Biodiversity Assessment is carried out every 6 or 7 years.[6,7] A large number of books on South African plants, animals and fungi have been published and these books present information not only for scientists but also for the public, environmental impact practitioners, conservationists, the tourism industry, bioprospectors, biotraders and decision-makers. All these biodiversity-related products rely on sound scientific knowledge of species, gathered over decades through expeditions and surveys and research in fields that include taxonomy and biogeography. Material collected and researched is housed in museums and herbaria across the country, and the specimens and associated data are used by scientists and postgraduate students globally on an ongoing basis. Despite the vast amount of knowledge and data, many gaps in the knowledge of South Africa's biodiversity still exist. Over 200 new South African species are described each year, and the application of molecular phylogenetic approaches is revealing a large amount of cryptic diversity in taxa that were considered well known.[8-10] The continued expansion of collections and knowledge is critical for the conservation and sustainable use of species and ecosystems, as well as for understanding the impacts of climate change and other forms of global change on biodiversity.[11,12]

Collection of plants and animals by scientists in South Africa has been regulated through a permitting system for decades. In the last 10 to 15 years, however, the permitting requirements have become increasingly complex and, for most biodiversity scientists, determining what permits are required is daunting. This has a significant impact on the research, capacity development and natural science collection community's mandated work.

Two recent projects have been established through the South African Department of Science and Innovation as part of their South African Research Infrastructure Roadmap (SARIR). The Natural Science Collections Facility is a network of museums, science councils and university herbaria that hold preserved biodiversity specimens and materials. The Biodiversity Biobanks South Africa includes institutions that hold mostly cryopreserved materials such as frozen tissues (e.g. reproductive, blood, muscle), DNA extracts and cultures of microbial organisms. In line with global initiatives for large research infrastructure, the purpose of these SARIR projects is to serve researchers both nationally and internationally through acting as a repository and providing access to materials and data for research and development projects, especially where these are of societal and economic benefit. The challenges faced by participating institutions in terms of permits to collect, accept donations, and house and share materials is a major constraint to the achievement of the objectives of the SARIR initiatives.

In this Commentary, we summarise the current legal requirements for the collection and use of biodiversity material for non-commercial research purposes in South Africa, highlight the main challenges from the perspective of researchers and natural science collection curators and managers, and make recommendations for addressing the challenges identified.

The global context for permits relating to biodiversity

South Africa is a signatory to the Convention on Biological Diversity (CBD), the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation, a supplementary agreement to the CBD, and to the Convention on International Trade in Endangered Species (CITES), which is a multinational treaty that aims to ensure that international trade in wild species of plants and animals does not lead to their extinction. The CBD acknowledges that there are significant gaps in knowledge, and that these need to be addressed in order for the Convention's objectives to be met. The Nagoya Protocol states that signatory countries should establish mechanisms to 'create conditions to promote and encourage research contributing to biodiversity conservation and sustainable use'[13], and CITES makes allowances for preserved material, DNA extracts and tissue samples for analysis of CITES-listed species that is exchanged for scientific research purposes. It is clear that the need to enable research on biodiversity was recognised when these three conventions were developed, but in many countries this intention has not been adequately addressed.

National legislation

Biodiversity samples, specimens and collections can be considered as research infrastructures, biological or genetic resources, agents of disease or heritage assets, depending on which legislation is being considered. The national legislation that gives effect to the CBD, CITES and the Nagoya Protocol is the *National Environmental Management: Biodiversity Act* (NEMBA) and its associated Regulations. In terms of biodiversity research and permits, NEMBA only legislates for those species that are listed on CITES, or on the national Threatened or Protected Species (ToPS) list, or where material will be used or potentially used for commercial projects or where it will be exported from the country for any type of research purpose.

The Threatened or Protected Species Regulations of NEMBA were first published in 2007 but have undergone several amendments. The ToPS list that is currently in use is still the original one published in 2007 and covers

30 mammal, 32 bird, 13 reptile, 2 amphibian, 21 fish, 66 plant and 14 invertebrate species and 10 invertebrate genera. The Regulations and list have been under review for more than a decade.

The challenges for scientific institutions and researchers working on ToPS is the number of different processes that must be followed, and confusion around the authority for these. Registration as a scientific institution and a standing permit are required for institutions, and application forms are available on the South African Department of Forestry, Fisheries and Environment (DFFE)'s website, but the responsible authority is unclear. The issuing authority for ToPS permits and for registration as a scientific institution was originally the provincial authority but this has been amended several times. According to the 2011 amendments, the Minister is the issuing authority for permits for all organs of state and for restricted activities relating to marine ToPS, and in the 2012 amendments, restricted activities in a national protected area were added. According to the Constitution of South Africa, organs of state include institutions 'exercising a public power or performing a public duty in terms of any legislation'. This would cover all national, provincial and municipal museums as well as universities. This suggests that the national Department, and not the provincial authorities, should issue ToPS permits to these institutions, but currently some of the provincial authorities are issuing these permits while others are not. Registration of scientific institutions appears to currently be through DFFE, although this is delegated to the provinces in the Regulations.

ToPS permits cannot be issued retrospectively, but listed species may be inadvertently collected, especially in the case of plants or invertebrates which are difficult to identify in the field. Without the ToPS permit, such specimens cannot legally be deposited in a collection institution and the collector is at risk of prosecution. Experts carrying out surveys also often unexpectedly come across a suspected ToPS, but without a permit, they cannot collect it to confirm the record. The time and expense of returning to a site after a permit has been accessed and the challenges of finding plants that emerge or flower for short periods or are short-lived or small invertebrates mean that this is often not feasible, so valuable new records are lost.

In line with the international Convention, Section 15 of the CITES Regulations deals with 'Scientific exchange', which is intended to facilitate research by not requiring the same application process as commercial traders and hunters. A recent Conference of the Parties (CoP18) notification extended the exemption from normal permitting requirements to DNA extracts or frozen or preserved tissues used for forensics or research. However, scientific institutions need to be registered for CITES, and they need to have what is referred to as a 'label', which is an official form with the CITES acronym, issued by the relevant authority, which accompanies materials being sent out of the country or imported, and which declares the nature of the contents of a parcel and that it is for scientific exchange. Most of the South African collection institutions are CITES registered, but whether they meet the criteria specified internationally (see Supplementary table 1) is uncertain. The process for additional institutions to register is unclear and does not currently seem possible. None of the permit issuing authorities are currently providing CITES 'labels', which means that for scientific exchange, the normal CITES permitting application route has to be followed. For import of materials, the Regulations are unclear, stating that for import of materials of species on Appendix II and III 'prior presentation of either an export permit or a re-export certificate' is required. What is meant by 'presentation' and to whom this refers is unclear.

The Bioprospecting, Access and Benefit Sharing (BABS) Regulations were first gazetted in 2008 but these were extensively amended in 2015. A permit from the relevant provincial department where the material was collected is required to export any biological material from South Africa. This includes specimens and tissue samples or DNA samples that are being donated or supplied to international researchers or institutions, or being sent for analysis, even if the intention is not bioprospecting. While export permits are issued by some of the provincial authorities for research purposes, it appears that these are being issued in terms of the provincial ordinances rather than the national Regulations, and it is uncertain whether the provincial export permits comply with the BABS Regulations and with the Nagoya Protocol requirements.

The Nagoya Protocol states that parties (countries) should issue a permit as evidence that access to genetic resources was based on prior informed consent (e.g. collecting permit, written landowner consent, export permit) and mutually agreed terms (e.g. specified benefits such as access to research results, collaboration with local researcher or student, and material transfer agreement). The recipient of the material (importer) will need an import permit, and this may not be issued by authorities, especially those under the European Union, if the provincial export permit is not explicit about it being issued in terms of the national legislation. An export permit that does not provide evidence of complying with the BABS Regulations may result in the import permit for the recipient being denied, or the material being blocked at a port of entry, or a manuscript resulting from research on the material not being accepted for publication in a European journal.[14]

The Nagoya Protocol also requires that signatories must make information on permits available to the Access and Benefit Sharing Clearing-House, in the form of an 'Internationally Recognised Certificate of Compliance' or IRCC. For South Africa there are 33 IRCCs, but only 4 of these are for non-commercial use. It appears that for most export permits there are no IRCCs issued by provinces, and so international authorities cannot check whether the material for which an import permit has been applied meets the Nagoya Protocol requirements.

A further challenge relates to specimens collected under standard collecting permits or without permits. According to the Nagoya Protocol, prior informed consent to access the materials is required. A collecting permit or written landowner consent and an export permit issued under the BABS Regulations from the relevant authority could be considered as prior informed consent. Without this, specimens or materials cannot be exported for research purposes or for sequencing or other analysis. While there are more stringent requirements for materials collected after the Nagoya Protocol came into effect, i.e. October 2014, this is not addressed in the Regulations.

Specimens or samples in collections cannot be used for any type of research that may be linked in any way to bioprospecting or commercialisation, even if this is in the future and/or downstream (e.g. the specimen may in future be used for chemical analysis for any compound that may have a pharmaceutical potential) because this requires an Exploration Permit, and change in use from the original intent of collection is not allowed, even though the Nagoya Protocol promotes accommodating change of intent.[13] There have been examples in which specimens were collected on an ordinary provincial research permit, and these were later used for biocompound extraction in a study investigating potential for pharmaceuticals. This is illegal according to the BABS Regulations.

The *National Forests Act (No. 84 of 1998)* regulates activities involving protected trees and in state forests, including research. Application forms for licences for such activities are available on the DFFE website, but there are no details about submission of the application forms except on the actual form where it is stated that these must be sent or delivered to the nearest Forestry Office of the DFFE. The website does not include a list of the state forests nor any contact information for queries or for submitting the application form. The application forms do state that the licence does not exempt the applicant from complying with other legislation, which suggests that any activities regulated under NEMBA or provincial ordinances will still require those permits.

The *Animal Diseases Act (No 35 of 1984. Section 20)* is critically important for protecting livestock and people from disease. The South African Department of Agriculture, Land Reform and Rural Development (DALRRD) provides guidelines for the application of a permit under Section 20 of the Act[15], but the permitting process is still opaque and complex (Supplementary tables 1 and 2). Because new diseases emerge, a set list of taxa cannot be provided, and so any animal or microbe may require a Section 20 permit. Handling, storage facilities and protocols at the institution, transport and waste management are

considered in the assessment of applications, especially if there is a perceived risk of disease. If any biobanked materials are held and these do not have permits, detailed records or data, they could be incinerated by DALRRD.

Collection institutions often receive dead animals from the public, for example, birds or small mammals that have been killed by domestic cats or dogs, or animals killed on the road. According to the Act, the institution would need to be certified and meet the requirements above, but, even then, such specimens should probably not be accepted because they were collected without a Section 20 permit.

While the Act has been in force for almost 40 years, it appears that only in the last few years has there been an effort to expand its application to research on all inland taxa, many of which are highly unlikely to be flagged by the State Veterinarians as being associated with the spread of diseases of concern. There is limited knowledge and understanding of the Act amongst researchers, and little understanding of the scope and scale of work that is done by biodiversity researchers by the Animal Disease Control unit of DALRRD. If Section 20 permits are applied as required, it is unlikely that the State Veterinarians and the permitting office will be able to service permit requests within the 3-month period they suggest is required for applications to be processed.

The *Agricultural Pests Act* is relevant for controlling the import or export of pests which pose a risk to South Africa or other countries' agriculture. Import and export permits are required for agricultural products (fruit, vegetables, ornamental plants) and associated packaging, but no permits appear to be required for other biological specimens. While this may be a relief to collection institutions, if herbaria or museums do not have phytosanitary certificates for export or import of preserved herbarium or dried animal material, it is possible that donations and loans of specimens may be stopped by customs and biosecurity officials. A recent article[16] gave two examples of consignments of historical herbarium specimens that were incinerated by Australian biosecurity officials. Some institutions in the USA are also concerned about sending out loans because their own biosecurity agencies may prevent their re-entry into the country because of the risk of importing pests.

In addition to CITES, ToPS and BABS export permits, some specimens may also need export permits if they are considered to be significant South African heritage objects. In terms of the *National Heritage Resources Act (No. 25 of 1999)* and a notice published in April 2019, natural history 'type specimens' require an export permit, whether they are being sent permanently or on loan. There are many forms of types (e.g. syntypes, paratypes, topotypes) and not all of these have the same value in terms of heritage. It is also unclear whether specimens collected outside South Africa but housed in collections here should also be considered as national heritage.

Provincial ordinances for nature conservation

Each province has its own legislation controlling the collection, import and export of plants and animals. This legislation is extremely complex to navigate for collections staff and researchers. For some provinces, the ordinances predate the political transition of 1994 democracy and are applicable to the former homelands. For example, the Eastern Cape currently operates under three outdated ordinances (Transkei, Ciskei and Cape Province), and how these are interpreted is unclear. The North West Province has a similar challenge with its ordinances coming from Bophuthatswana, the Transvaal and the Cape Province. Some provinces have drafted new biodiversity legislation in the form of an Act but these are not yet in force (e.g. KwaZulu-Natal and North West Province).

At the time of writing, most of the provinces do not provide guidelines for permits or contact details for the permitting office or access to the application forms online (Supplementary table 3). The provincial legislation and lists of protected species are also not provided. An exception is CapeNature, which has a webpage providing all relevant information.

Each province has different categories, and lists of protected species and activities relating to these require specific permits. The categories and definitions vary between provinces, and the species included in these differ from the national lists and from each other. In many cases, the names and classifications are outdated and are not standardised across provinces, and the criteria and rationale for species included is unclear. In most cases, the sections of the ordinances relating to animals are in the context of hunting, game ranching and poaching or recreational or commercial fishing, and in the case of plants, commercial harvesting, propagation and sales. In general, provincial permitting therefore does not specifically cover the collection of specimens or samples for scientific purposes, and researchers are subject to the same rules and regulations as hunters and commercial ventures.

In general, provinces require registration of a research project and a collecting permit for protected areas, and a permit to collect listed species outside protected areas and to export these out of the province. Collecting along roads is prohibited in provinces except the Northern Cape and Western Cape, where this can be included in permits. Landowner permission is required for collecting outside of the protected areas under the control of the issuing authority, and this may be a private landowner or a state entity such as SANParks, iSimangaliso Wetland Park Authority, the South African National Biodiversity Institute, a municipality or a state forest. In the case of SANParks, the project must be registered with them and a licence to collect must be issued, but the provincial permit is still required. Possession, donation, accepting a donation, transporting, importing into or exporting from the province of any of the listed species also requires permits.

Discussion

Originally, we intended developing guidelines on permitting for collection institutions, but after studying 25 pieces of legislation, including amendments, covering over 1500 pages and 15 different lists of species, and trying to interpret these in the context of collection institutions and research activities, it became clear that this was an impossible task. The complexity of the current requirements (Supplementary tables 1–3), the lack of access to useful information (Supplementary table 3), unclear or irrational legislation, a series of amendments that require checking back to the original document to try follow changes, published but not promulgated legislation, together with delayed or no response from some authorities to permit requests or queries, leaves institutions struggling to carry out their mandated responsibilities while complying with all legislation. The threat of institutions receiving fines of up to ZAR5 million or individuals being imprisoned for up to 5 years could result in a decline in the expansion of collections and in provision of specimens or samples for research and development. The permitting requirements also affect researchers from outside collection institutions and environmental impact assessment practitioners who collect material that they need identified or deposited in a collection institution. Large quantities of important material may be discarded or destroyed because the material cannot be legally deposited in a collection institution. International collaboration – which results in accelerated knowledge generation, capacity development, access to new technologies and increased research investment – is also on the decline due to these impediments. These impacts are not the intended consequence of any of the legislation, the CBD, CITES or the Nagoya Protocol, which all recognise the need for finding ways of streamlining regulation processes for research.

Recommendations

Globally, the challenges with permits, especially related to the Nagoya Protocol, for natural science collections have been raised[17], but it has been recognised that country-based solutions are needed. Amendment of legislation is usually a lengthy and costly process, and so while changes may be needed, this is not a short-term solution for urgently addressing the permitting challenges.

The national legislation relating to permitting serves several important functions, including meeting the requirements of global conventions that allow South Africa to trade internationally, protecting our economy, protecting populations of rare species, and ensuring that special specimens sent out of the country can be legally retrieved if necessary.

The BABS legislation is becoming critical to protect the interests of local researchers, not only in terms of preventing loss of access to specimens, but also the ability to publish in international journals that are increasingly checking Nagoya Protocol compliance.[14,18] This means that it is not reasonable to expect research or collection institution activities to simply be exempt from all permits. However, it is reasonable to expect that the permitting requirements and processes will be transparent, accessible, responsive and rational. Supplementary table 2 illustrates the level of uncertainty and the complexity associated with permits that confront collection institutions and researchers.

Streamlining processes for permits for research and the other activities of collection institutions could have a significant positive impact. At a provincial level, permitting offices deal with thousands of permit applications each year, mostly related to hunting, trade and harvesting. Their expertise and priority may not be academic research on obscure taxa, and so mechanisms are required to reduce the burden, not only on researchers but also on the issuing authorities. Annual collecting permits issued to institutions and integrated permits that cover a range of activities and taxa would reduce the burden. Annual reports and data sets from field trips can still be submitted for the permits to be renewed and the need to notify managers of protected areas of proposed research is also a reasonable expectation.

The research and collection institutions need to ensure that they play their part in being credible, professional, accountable and ethical, which will increase levels of trust by the issuing authorities. There have been cases of international 'biopiracy' by scientists[18,19], and this can undermine efforts to work with the authorities to streamline permitting processes. The loss of potential revenue through biological samples being sent outside the country without a Material Transfer Agreement that restricts its use for commercialisation, or where material is exported and deposited in overseas institutions, inaccessible to South African researchers, are valid concerns, but this type of activity is not effectively regulated by the current complex permit environment, which may actually inadvertently drive non-compliance.

While reduced activity in biodiversity surveys, collections and research may not seem like a high priority outside of those affected, there are impacts for capacity development, knowledge generation, land-use decision-making and the bioeconomy and so initiatives like the Natural Science Collections Facility and the Biodiversity Biobanks South Africa, as well as professional societies and associations should facilitate engagement with the authorities and actively participate in any opportunity that arises for input into reviews of legislation.

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Competing interests

We have no competing interests to declare.

References

1. Rutherford MC, Mucina L, Powrie LW. The South African National Vegetation Database: History, development, applications, problems and future. S Afr J Sci. 2012;108(1–2), Art. #269. http://dx.doi.org/10.4102/sajs.v108i1/2.629
2. South African Department of Environmental Affairs (DEA). National Protected Areas Expansion Strategy for South Africa. Pretoria: DEA; 2016.
3. Raimondo D, Von Staden L, Foden W, Victor JE, Helme NA, Turner RC, et al., editors. Red List of South African plants. Strelitzia. Volume 25. Pretoria: South African National Biodiversity Institute; 2009.
4. Bates MF, Branch WR, Bauer AM, Burger M, Marais J, Alexander GJ, et al. Atlas and red list of the reptiles of South Africa, Lesotho and Swaziland. Pretoria: South African National Biodiversity Institute; 2014.
5. Mecenero S, Ball JB, Edge DA, Hamer ML, Henning GA, Krüger M, et al., editors. Conservation assessment of butterflies of South Africa, Lesotho and Swaziland: Red list and atlas. Johannesburg / Cape Town: Saftronics / Animal Demography Unit; 2013.
6. Skowno AL, Poole CJ, Raimondo DC, Sink KJ, Van Deventer H, Van Niekerk L, et al. National biodiversity assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis report. Pretoria South African National Biodiversity Institute and Department of Environment, Forestry and Fisheries; 2019.
7. Driver A, Sink KJ, Nel JN, Holness S, Van Niekerk L, Daniels F, et al. National biodiversity assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis report. Pretoria: South African National Biodiversity Institute and Department of Environmental Affairs; 2012.
8. Goodier SA, Cotterill FP, O'Ryan C, Skelton PH, De Wit MJ. Cryptic diversity of African tigerfish (Genus *Hydrocynus*) reveals palaeogeographic signatures of linked Neogene geotectonic events. PLoS ONE. 2011;6(12), e28775. http://dx.doi.org/10.1371/journal.pone.0028775
9. Tolley KA, Conradie W, Harvey J, Measey J, Blackburn DC. Molecular phylogenetics reveals a complex history underlying cryptic diversity in the bush squeaker frog (*Arthroleptis wahlbergii*) in southern Africa. Afr Zool. 2018;53(3):83–97. http://dx.doi.org/10.1080/15627020.2018.1517608
10. Taylor PJ, Kearney TC, Kerbis Peterhans JC, Baxter RM, Willows-Munro S. Cryptic diversity in forest shrews of the genus *Myosorex* from southern Africa, with the description of a new species and comments on *Myosorex tenuis*. Zool J Linn Soc. 2013;169(4):881–902. http://dx.doi.org/10.1007/s13364-016-0291-z
11. Kharouba HM, Lewthwaite JM, Guralnick R, Kerr JT, Vellend M. Using insect natural history collections to study global change impacts: Challenges and opportunities. Phil Trans Roy Soc B. 2019;374(1763), Art. #20170405. https://doi.org/10.1098/rstb.2017.0405
12. Bradley RD, Bradley LC, Garner HJ, Baker RJ. Assessing the value of natural history collections and addressing issues regarding long-term growth and care. BioScience. 2014;64(12):1150–1158. http://dx.doi.org/10.1093/biosci/biu166
13. Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the Convention on Biological Diversity: Text and annex. Montreal: Secretariat of the Convention on Biological Diversity; 2011.
14. Marden E, Abbott RJ, Austerlitz F, Ortiz-Barrientos D, Baucom RS, Bongaerts P, et al. Sharing and reporting benefits from biodiversity research. Mol Ecol. 2021;30(5):1103–1107. http://dx.doi.org/10.1111/mec.15702
15. South African Department of Agriculture, Forestry and Fisheries (DAFF). Guidelines for application for a permit under Section 20 of the Animal Diseases Act (Act No. 35 of 86) [document on the Internet]. c2017 [cited 2020 Dec 12]. Available from: https://www.nda.agric.za/vetweb/Epidemiology/Section20/Guidelines%20Section%2020%20Applicants%20V171%2014%20February%202017.docx.pdf
16. Stokstad E. Botanists fear research slowdown after priceless specimens destroyed at Australian border. Science News. 2017 May 11 [cited 2020 Dec 12]. https://doi.org/10.1126/science.aal1175
17. Watanabe ME. The Nagoya Protocol: Big steps, new problems. BioScience. 2017;67(4):400. https://doi.org/10.1093/biosci/bix019
18. Law Y-H. Illicit centipede raises thorny question: Should journals have refused to publish a paper about it? Science Insider. 2021 February 10. Available from: https://www.sciencemag.org/news/2021/02/illicit-centipede-raises-thorny-question-should-journals-have-refused-publish-paper
19. Fukushima C, West R, Pape T, Penev L, Schulman L, Cardoso P. Wildlife collection for scientific purposes. Conserv Biol. 2021; 35:5–11. https://doi.org/10.1111/cobi.13572