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Environmental science investigations of folk taxonomy and other forms of indigenous knowledge

The strides made in standardising English and Afrikaans frog names created a gap to achieve the same for the other South African languages spoken by the majority of the country's population. This gap hints at an exclusion of indigenous languages and associated cultures from wildlife-related matters. Frog names in indigenous languages are part of mostly undocumented cultural/indigenous knowledge systems and they are subject to indigenous naming and classification guidelines. Indigenous names often have localised use due to cultural specificity.

Indigenous taxonomy is part of a pre-scientific knowledge system which is often considered a pseudoscience. However, a recent study was able to show that indigenous amphibian taxonomy from the Zululand region of South Africa's KwaZulu-Natal Province has scientific merit.[1] Furthermore, the investigated indigenous naming and classification guidelines have similarities to those used when formulating Afrikaans, English and scientific names. A comparison with other indigenous taxonomy research shows that similarities also exist between Zululand's taxonomy and indigenous taxonomies of other parts of the world. Researchers also found indigenous names to be condensed forms of knowledge rather than abstract words.[2] Information about species' behaviour and ecology is often contained within indigenous names.[3] Linnaean taxonomy's basic structure is inspired by indigenous taxonomy's fundamental organising principles.[4]

Other investigations have shown that some traditional medicinal and gastronomic uses of organisms purported in South African indigenous knowledge systems have scientific validity.[5,6] Conversely, overexploitation of natural resources under the guise of indigenous knowledge systems has also been reported.[7,8] Cross-disciplinary research that investigates the scientific merit of indigenous knowledge systems is not meant to justify culturally motivated overexploitation. This research seeks to explore an under-investigated knowledge base while also increasing social inclusion in environmental matters. Studies of this nature are spurred on by the recent research focus on the interactions between biological and cultural biodiversity[9], and the environmental science sector's acknowledgement of the coupling of ecological and social systems[10]. Zululand's rural setting is steeped in culture and high in amphibian diversity, and thus presented the region as an ideal area to pilot a study investigating interactions between South Africa's herpetofaunal and cultural diversity.

This pilot was completed with two major outcomes. Firstly, there is merit in researching how South African cultures interact with local biodiversity (in this case herpetofauna). Secondly, it is possible to standardise the indigenous names of South Africa's amphibians and bridge the gap left by the standardisation of names in two of the country's 11 official languages. The outcomes fulfil scientific curiosity (as this is a relatively novel research field) and also contribute to social inclusion. The social inclusion begins before the actual research takes place as one has to sufficiently integrate into the community whose culture they are researching in order to understand their ways and also introduce them to the type of wildlife research being undertaken. This integration helps with being welcomed into the community and enables discussions about potential benefits to be obtained in return for allowing the survey of elements of their culture that interact with biodiversity. Social inclusion is a clear benefit from the researcher's point of view, but for the community it may be perceived as being intangible. More tangible benefits are likely to appeal to research participants. For the Zululand community, a tangible benefit was an educational publication (a handbook) based on their knowledge of amphibians in their area. The publication was translated to their own language (isiZulu) and thus presented the additional benefit of an indigenous language being developed. Indigenous knowledge relating to amphibians has also been preserved in the process.

Employing purposive sampling to collect cultural data has a greater chance of yielding results when there is minimal negativity towards the research project. The purposive sampling of 13 Zululand community members using a semi-structured questionnaire technique allowed documentation of naming and classification guidelines used for amphibians in the area. The study's sample consisted of 3 female and 10 male native isiZulu speakers whose socio-economic status varied from unemployed to full-time students and the permanently employed. The participants were from five different parts of Zululand with similar environmental conditions. Analysis of the documented guidelines revealed that Zululand's indigenous taxonomy groups amphibian species according to their habits, habitats or appearance. Scientific taxonomy conventions also group species in a similar way. Species with similar traits are placed under uninomial isiZulu names. These single word isiZulu names correspond to either scientific genera or families (Figure 1) that are also represented by uninomial names. Zululand taxonomy's use of single word names to group species based on their biology is in line with the International Code of Zoological Nomenclature.[12]

The similarities between indigenous and scientific taxonomy have enabled supplementation of indigenous taxonomy guidelines with their modern knowledge counterparts. These supplemented guidelines were then used to assign individual isiZulu names to Zululand's amphibian species (Table 1). The newly formulated isiZulu species names have a meaning that is similar to English and/or scientific names and they also retain their relevance to isiZulu speakers as they are modified from existing indigenous names. When the newly formulated names are subjected to the rigour of the International Code of Zoological Nomenclature[12], 55% conform to the principles of binomial nomenclature as each name is composed of two words with the first word being a generic name. Due to the isiZulu language's descriptive nature, the remaining 45% of names could not conform to the principles of binomial nomenclature without their meaning being altered.

[a]*IsiZulu names modified from Tarrant[11] with the assistance of Mr Bongani Mkhize.*

[b]*Name borrowed from existing English generic and common name.*

Figure 1: Zululand's indigenous amphibian taxa and their corresponding scientific taxonomy equivalents.[1]

The semi-structured interview technique fostered discussions among participants of the pilot study. Those discussions presented an opportunity to document folkloric elements of the cultural knowledge system in addition to indigenous taxonomy. There is an indication that some folklore is more than mere mythical beliefs and may constitute observations of amphibian behaviour coupled with attempts to explain the observed behaviour using available knowledge. For instance, members of the Zululand community believe that grass frogs (Ptychadenidae) bring rain as they are often seen moments before a rain event. Without knowledge of amphibian biology, the repeated observation of rainfall being preceded by the presence of grass frogs may reinforce this idea of them bringing rain. With an understanding of amphibian biology, increased activity of the grass frogs would be attributed to the humid and moderate conditions associated with rain. These favourable conditions precede rainfall and thus prompt frog activity to also precede rainfall. The indigenous taxonomy and folklore investigated in the pilot study represent a few of the many elements in the relationship between biological and cultural diversity.

Table 1: A comprehensive list of isiZulu names for frogs that occur in KwaZulu-Natal's Zululand region[1]

Isizulu name	Scientific name
Umanswininiza Onyawo Zingamafosholo	*Arthroleptis stenodactylus*
Umanswininiza Wasehlathini[a]	*Arthroleptis walhbergii*
Isele Lasezihlahleni Elinsundu[a]	*Leptopelis mossambicus*
Isele Lasezihlahleni LaseNatali	*Leptopelis natalensis*
Isinana Sasehlathini[a]	*Breviceps adspersus*
Isinana SikaBilbo[a]	*Breviceps bagginsi*
Isinana SakwaPhinda	*Breviceps carruthersi*
Isinana SaseMozambique	*Breviceps mossambicus*
Isinana SakwaNdumo	*Breviceps passmorei*
Isinana Sekhwela/Somtshingo	*Breviceps sopranus*
Ixoxo Elifishane	*Poyntonophrynus fenoulheti*
Ixoxo Elibomvu[a]	*Schismaderma carens*
Ixoxo Eliklabalasayo[a]	*Sclerophrys capensis*
Ixoxo Eliluhlaza Okotshani	*Sclerophrys garmani*
Ixoxo Lembodlomane[a]	*Sclerophrys gutturalis*
Ixoxo Lomhlane Oyisicaba	*Sclerophrys pusilla*
Isele Lasempophomeni	*Hadromophryne natalensis*
Isinana Esimabhadubhadu[a]	*Hemisus guttatus*
Isinana Esipendiwe	*Hemisus Marmoratus*
Umgqagqa Oyigolide	*Afrixalus aureus*
Umgqagqa Othambile	*Afrixalus delicatus*
Umgqagqa Omkhulu[a]	*Afrixalus fornasinii*
Umgqagqa i-Argus[a]	*Hyperolius argus*
Umgqagqa Opendiwe[a]	*Hyperolius marmoratus*
Umgqagqa Ka-Pickersgill	*Hyperolius pickersgilli*
Umgqagqa Omude	*Hyperolius poweri*
Umgqagqa Weminduze[a]	*Hyperolius pusillus*
Umgqagqa Wemigqa Ephuzi	*Hyperolius semidiscus*
Umgqagqa Oluhlaza Okotshani[a]	*Hyperolius tuberilinguis*
UKassina Wemilenze Ebomvu	*Phlyctimantis maculatus*
UKassina Obhadlayo[a]	*Kassina senegalensis*
Isele Elisanjoloba Elinemigqa[a]	*Phrynomantis bifasciatus*
Isele Lechibi Lasempumalanga Afrika	*Phrynobatrachus acridoides*
Isele Lechibi Elifishane[a]	*Phrynobatrachus mababiensis*
Isele Lechibi Elihonayo[a]	*Phrynobatrachus natalensis*
Ixoxo Elihlotshisiwe[a]	*Hildebrandtia ornata*
Uvete Olujwayelekile	*Ptychadena anchietae*
Uvete Olunomugqa Obanzi	*Ptychadena mossambica*
Uvete LwaseNile[c]	*Ptychadena nilotica*
Uvete Olunempumulo Ecijile[a]	*Ptychadena oxyrhynchus*
Uvete Olunemigqa[a]	*Ptychadena porosissima*
Uvete Olufishane	*Ptychadena taenioscelis*
Idwi Elijwayelekile[a]	*Xenopus laevis*
Idwi Lika-Müller	*Xenopus muelleri*
Isele Elithambile Elijwayelekile	*Cacosternum boettgeri*
Isele Elithambile LaKwaZulu	*Cacosternum nanogularum*
Isele Elithambile Elisathusi[a]	*Cacosternum nanum*
Isele Elithambile Elinemigqa	*Cacosternum striatum*
Isele Lase-Kloof	*Natalobatrachus bonebergi*
Isele Lasemfuleni Elijwayelekile[a]	*Amietia delalandii*
Inkunzi Yexoxo	*Pyxicephalus edulis*
Isele Lasemfuleni Elinemidwa[a]	*Strongylopus fasciatus*
Isele Lasemfuleni Eligqafazayo[a]	*Strongylopus grayii*
Isele Lasesihlabathini Elinemigqa	*Tomopterna cryptotis*
Isele Lasesihlabathini Elingqongqozayo[a]	*Tomopterna krugerensis*
Isele Lasesihlabathini LaseNatali[a]	*Tomopterna natalensis*
Isele Lasesihlabathini LikaTandy	*Tomopterna tandyi*
Usomagwebu Waseningizimu[a]	*Chiromantis xerampelina*

[a]*IsiZulu names modified from Tarrant[11] with the assistance of Mr Bongani Mkhize.*
[c]*This name was changed from uvete lwaseMaskarina to uvete lwaseNile to correspond with the scientific name change of this species in South Africa.[13]*

Other aspects of this relationship include medicinal usage, gastronomy, and traditional ecological knowledge. As a continuation from the pilot, investigations of the relationship between cultural and herpetofaunal diversity have been broadened to cover the entire country and also include reptiles. Upon conclusion of this research project it will be possible to make inferences about the state of the relationship between South African cultures and herpetofaunal diversity, and how this relationship can inform environmental policy that embraces the coupling of social and environmental systems.

Indigenous knowledge's place in science

The interaction of traditional knowledge with nature has generally been viewed to have negative environmental consequences. This view is justified by reports of environmental abuses informed by traditional knowledge.[7,8] Furthermore, the view was pervasive in environmental science as evidence of less destructive interactions was limited, but it started changing when research into the relationship between biological and cultural diversity started generating evidence to the contrary. Research solely focused on understanding the relationship between the two diversities started gaining prominence in the 1990s as a concept called biocultural diversity.[9] A systematic review of scientific literature on South Africa's biocultural diversity research shows that focus over a period of 28 years has collectively transcended more than 10 disciplines or fields of study. Some of this literature presents evidence of indigenous knowledge's applicability in human health science[5], veterinary science[14] and ecology[15]. The research presented is transdisciplinary as questions stemming from one discipline are answered using methods from another field of study. Transdisciplinarity is a critical, self-reflexive research approach relating societal with scientific problems and producing new knowledge through integration of different scientific and extra-scientific insights with the aim of contributing to both societal and scientific progress.[16] The consideration of extra-scientific insights translates to inclusion of indigenous knowledge practitioners as well as their perspectives. This inclusion is especially vital for conservation planning which often focuses on intrinsic value of wildlife protection while disregarding people who are the ultimate beneficiaries of conservation initiatives. People's perspectives have become integral to conservation planning, and failing to integrate people lessens the effectiveness of this planning.[17] In a culturally rich country such as South Africa, people's perspectives are often linked to their culture. Biodiversity is especially important to the culture of many South Africans as it features in their names, praises, folklore, art and traditional medicine. The country has a rich heritage of nature-based cultural traditions and this reiterates the importance of wildlife to the country's cultures.[18] Conservation planning that embraces the complex link between biological and cultural diversity is more likely to succeed in reducing biological and cultural diversity loss, and could potentially provide effective and just conservation outcomes across different socio-ecological contexts.[19] Socio-ecologically just conservation planning requires the knowledge pool from which it draws evidence to also embrace the link between biological and cultural diversity. The pilot study and its follow-up project as mentioned above aim to contribute to this knowledge pool through focusing on languages/cultures and taxa that are often marginalised from environmental science research.

Studying the relationship between South African biological and cultural diversity

The research required to inform appropriate environmental planning for the unique South African biological and cultural landscape should adequately embrace local contexts. A systematic review of 263 peer-reviewed articles shows this required research is succeeding in providing a greater understanding of the South African culture and biodiversity relationship, but the local context is not fully embraced due to knowledge gaps that still exist. Research focus is biased towards four of the country's nine provinces. Within provinces, research tends to concentrate on certain localities (Figure 2).

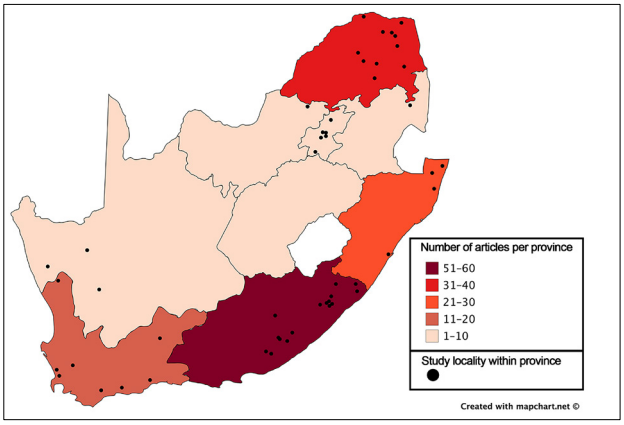

Figure 2: Distribution of biocultural diversity research within South Africa. The map plots spatial research focus (grouped by province) of 142 of 263 peer-reviewed articles published between 1990 and 2018. The remaining 121 articles have a national research focus.

Investigations of South African biocultural diversity have steadily increased from 1990, when the biocultural diversity concept gained prominence, to 2018, when the follow-up project commenced (Figure 3). Ethical consideration or the reporting thereof was only present in 74 of the 263 articles in the review sample. Without this ethical consideration

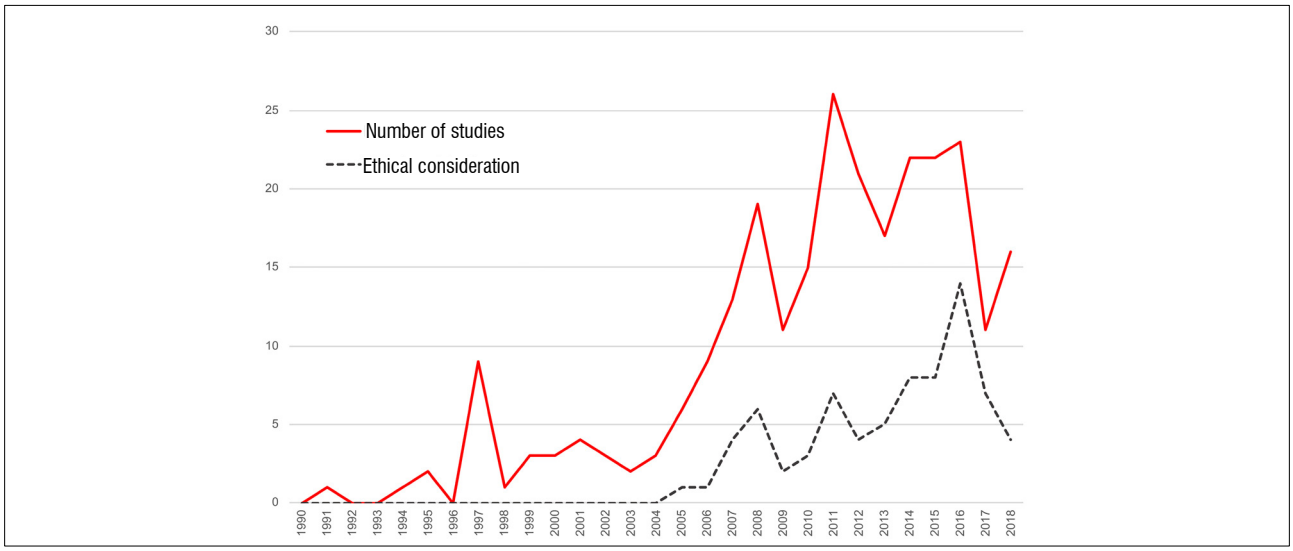

Figure 3: South African biocultural diversity literature published in 1990–2018 and the ethical considerations of these studies. The studies were searched on the Scopus database and the ethical consideration data were extracted using a pre-determined review protocol.

there is no assurance that researchers did not exploit human participants or subject non-human organisms to undue stress. The consideration of ethics began in 2005, the year before adoption of the International Society of Ethnobiology's code of ethics following deliberations that began in 1996.[20] Ethical consideration is not extended to plants which feature prominently in this research niche as they have a weaker moral standing than humans and non-human animal research subjects. Plants dominate the focus of South African biocultural diversity investigations (Figure 4). This taxonomic bias misrepresents the proportion of taxa which interact with culture. The dominance of plants is due to their importance in traditional medicine, and this results in a bias in the field of study within which investigations are carried out. Of the 14 fields of study explored in the review sample, human health science was explored in 84% of the articles. The taxonomic bias provides motivation to increase representation of herpetofauna (along with other non-plant taxa) in research so as to make the South African biocultural diversity knowledge pool more contextually appropriate and suited to informing socio-ecologically just environmental policy.

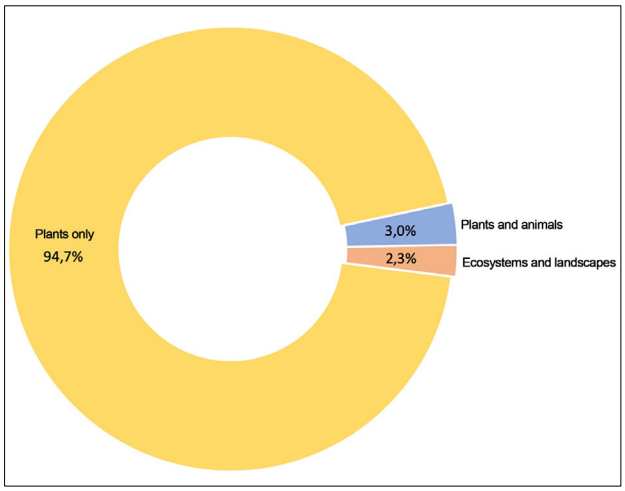

Figure 4: Taxonomic focus of South African biocultural diversity research from 1990 to 2018.

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