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Naming South African frogs and reptiles in nine Indigenous languages

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ABSTRACT

Scientific taxonomy, as a standardised means of communicating about wildlife, might have limited use or relevance for wildlife conservation stakeholders with minimal understanding of scientific names. Indigenous language names can improve species-specific communication with non-expert conservation stakeholders due to their familiarity. Indigenous names for wildlife are, however, not specific to all scientifically described species and are seldom documented for wider use. To have a folk-formal taxonomy that is familiar to non-expert stakeholders in herptile (amphibians and reptiles) conservation and useable by experts, we conducted the first comprehensive analysis of nine South African Indigenous cultures' naming and classification of herptiles based on Indigenous language names recorded from an online questionnaire and existing literature. Etic and emic analyses of the collected names revealed the underlying guidelines of folk taxonomy and its comparability to scientific taxonomy respectively. Furthermore, taxonomic correspondence analysis provided an understanding of the correspondence between scientific species and Indigenous language delineation of herptile diversity. Multiple scientific species are generally grouped together into a single folk taxon based on observed similarities and only a few Indigenous language names are specific to scientific species. The underlying guidelines of folk taxonomy and their comparability and correspondence to scientific taxonomy were the basis for extending the generalised Indigenous names of herptiles into a comprehensive list of names for South Africa's 543 scientifically described herptile species (136 frog and 407 reptile species) in the nine official South African Indigenous languages.

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Introduction

Science (i.e., studying the physical world through verifiable observations and experimentations) is a relatively recent development in the history of human civilization. The roots of science, however, run deep and stretch back to ancient times. These roots were nested in two primary sources, namely technical experience and spiritual tradition (Strickberger 1996). To facilitate communication in science and other spheres of life, the process of name-giving is essential. According to Mason (1956) we must distinguish between the taxonomy or name-giving and classification, both of which are artificial. The purpose for taxonomy or name-giving is purely for communication.

Scientific taxonomy or the biological classification of species has provided a standardised means of communicating about wildlife and classifying organisms (Ebach et al. 2011). The International Code for Zoological Nomenclature (ICZN) outlines guidelines and recommendations for assigning specific scientific names to animal taxa thus promoting standardised names with universal applicability (International Commission on Zoological Nomenclature 1999). This universal applicability of scientific names has resulted in them being unambiguously used in different communication contexts from scientific to agricultural, legislative, and social (Remsen 2016). Universally applicable, however, does not mean universally understood. Scientific names of animals may have limited relevance for stakeholders without formal science education (Wehi et al. 2019). Folk taxonomy, the nomenclature and classification of wildlife based on cultural perspectives using Indigenous language names, is important for communicating with Indigenous communities about species of interest (Raven et al. 1971; Mkize et al. 2003; Loko et al. 2018) when community members only know/use local names of species. This folk or Indigenous taxonomy is poorly recorded (Cheng et al. 2020; Phaka and Ovid 2022) and is thus mostly unavailable for those interested in using names that are familiar to local community members in collaborative biodiversity conservation projects. Such consideration for local collaborators can improve effectiveness of conservation planning (Bennett et al. 2017).

Through studying folk taxonomies, we obtain an understanding of how people observe discontinuities or different components of nature (Atran 1998). Folk taxonomy investigations also provide an understanding of previously undocumented local perceptions of biodiversity and can inform the communication of conservation science and policy (Beaudreau et al. 2011). In addition to informing effective communication of policy to stakeholders, an increased understanding of how people name and classify organisms can also improve conservation practitioners' understanding of wildlife utilisation (Boster 1986). Further value in investigating folk taxonomy was demonstrated by a study showing examples of taxa having specific Indigenous names prior to being assigned scientific names (Ulicsni et al. 2016), and folk taxonomies contributing to the clarification of taxonomic uncertainties among scientists (Cheng et al. 2020). Conversely, disregarding folk taxonomy can lead to confusion for local stakeholders and *Pan paniscus* is an example of one such incident. *Pan paniscus* is locally known as Elya in a place called Bolobo where first specimens of this primate were reportedly exported (Maniacky 2006). Throughout most of the world *P. paniscus* is commonly called Bonobo which is a misspelling of the place name Bolobo. There is potential for confusion when collaborating with local stakeholders that know *P. paniscus* as Elya and for whom Bonobo might sound like a place name rather the animal they are familiar with.

Besides being poorly recorded, another limitation of folk taxonomy is that it often groups together different species and many Indigenous language names are not specific to every species described in science (Medeiros et al. 2022). With these generalised folk names (generalised groupings of species using Indigenous language names) there is a chance that stakeholders who are not familiar with scientific names could be referring to several scientific species in conservation planning aimed at only one species. Another conservation issue posed by generalised folk names is that they can lead to persecution of all scientific species included in a particular folk generalised taxon; grouping multiple snake species under one Indigenous language name does not enable Xhosa and Zulu community members to communicate differences between venomous and non-venomous snakes thus leading to apprehension towards all snakes (Simelane and Kerley 1997). Scientific names remain the main means of communication about species, but other names can have a supplementary role in this communication provided they are clearly linked to the scientific names (Murray and Stackebrandt 1995). The possibility of establishing an unambiguous link between scientific names and Indigenous names was demonstrated through a pilot study of IsiZulu folk taxonomy for frogs in South Africa's Zululand region which documented generalised Indigenous names for frogs and extended them into a list of specific Indigenous names corresponding to each scientific species described from Zululand. This extension based on the underlying guidelines of folk taxonomy was achieved by adding descriptive words to generalised folk names to formulate names that are specific to individual species and recognisable to Indigenous language speakers (Phaka et al. 2019) and updating the Indigenous language names published by Tarrant (2015). Additionally, such research into creating a comprehensive list of species names in Indigenous languages contributes to social inclusion in wildlife matters and the development of African languages (Mkize et al. 2003; Phaka and Ovid 2022). This research ensures that Indigenous names can supplement scientific names without confusion and thus improve communication of conservation planning with people that are less familiar with scientific names.

Given the conservation and social benefits that can be derived from researching folk taxonomy, the current study seeks to conduct the first comprehensive analysis of the folk taxonomy of South African herptiles and compile a comprehensive list of Indigenous names for South Africa's herptile species in the country's nine official Indigenous languages (i.e., languages of African origin or Bantu languages). A comprehensive list of names in South Africa's two official languages of Indo-European origin (Afrikaans and English) already exists. South Africa has a total 12 official languages (11 spoken and one sign language). Further justification for such a comprehensive list is that the extended Indigenous names for frogs by Phaka et al. (2019) are only specific to 58 of 136 scientifically described South African frog species (Frost 2024) which occur in an area within one of nine South African provinces and are relevant to only one of the country's nine officialised Indigenous languages. Prior to consideration of non-scientific names for South African herptiles by Phaka et al. (2019), local names of southern African herptiles received sustained research attention between the 1960s and 1970s by herpetologists (such as Vesey-FitzGerald 1960; Broadley 1961; Jacobsen 1978; and van Dijk 1978) who discussed local language names as a supplement to scientific names. In subsequent decades, English and Afrikaans names became regularly included in South African herptile guides (books), although it is unclear whether their inclusion was inspired by those earlier

discussions of local names. It is thus necessary to spotlight local names for herptiles once again and expand on the Phaka et al. (2019) pilot study by investigating the folk taxonomy of herptile species according to all the official South African Indigenous languages which are currently underrepresented in reading materials about herptiles.

Methods

Figure 1 provides an overview of methods used for this study from 2020 to 2024. The South African Indigenous language names of herptile species that naturally occur in the country were documented using an online questionnaire in the respondents' preferred language between 09 May 2020 and 09 May 2022. The questionnaire was used to collect data for an ethnographic analysis of herptile-based cultural practices for multiple topics in a doctoral research project including folk taxonomy (Phaka 2022). Respondents were requested to provide names for the most common representatives of South African herptile taxa shown in photographs embedded in the questionnaire and additionally provide the etymology of those names where applicable (Figure 2). Paid advertisements were used to promote this questionnaire to South Africans who use Indigenous languages and have shown interest in wildlife based on their social media activity as determined by the respective social media networks; (announced from www.facebook.com/wildvernac/), Instagram (announced from www.instagram.com/wild_vernac/), and

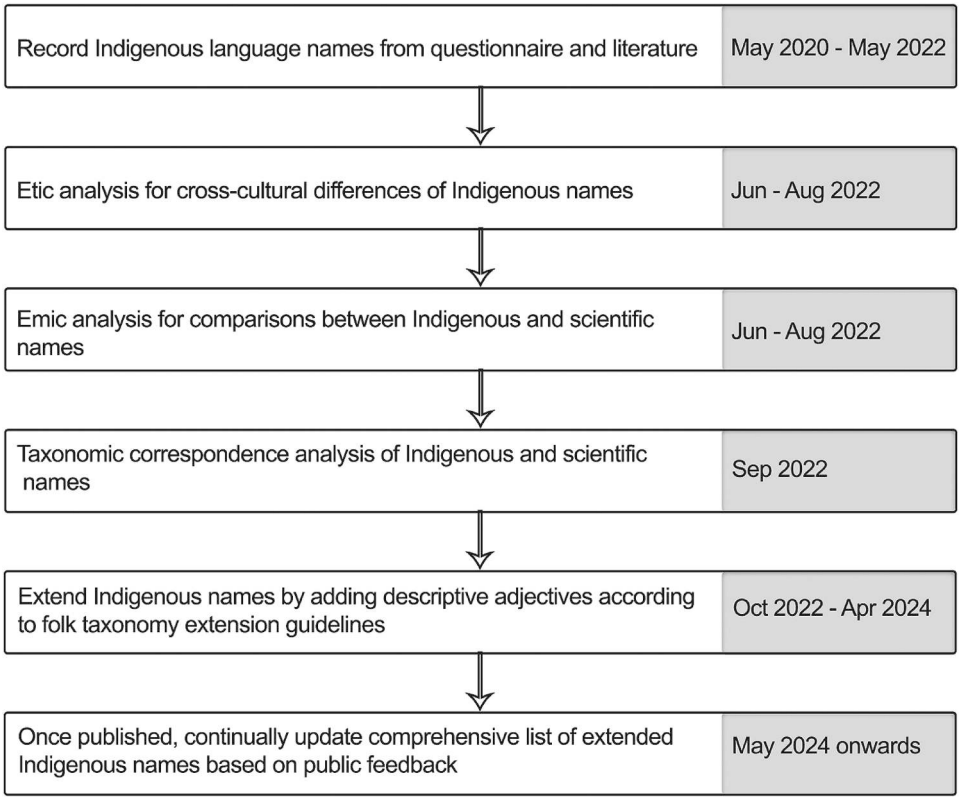

Figure 1: Process of compiling a comprehensive list of Indigenous language names for herptiles.

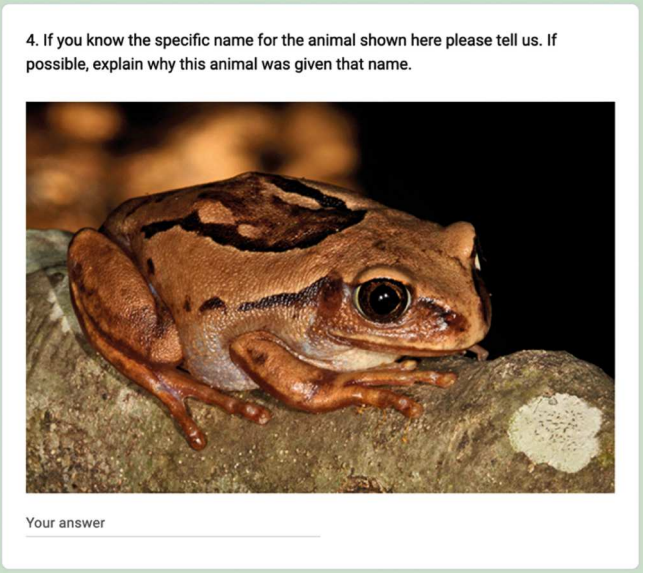

Figure 2: English version of a multilingual online questionnaire used to document folk taxonomy of South Africa's herptile species.

Twitter (announced from www.twitter.com/wild_vernac). The landing page of the online questionnaire provided full details of the study (including potential benefits and anonymisation of participation) and participants could only proceed after confirming they had read these details (i.e., giving informed consent). Additional names were collected through in-person interviews carried out between 16 to 18 November 2024 in the village of Moletji (Limpopo province, South Africa).

Indigenous language names for South African herptile species were also recorded from postgraduate dissertations, books, and scientific articles (Supplementary Material 1) using snowball sampling that started with two search queries on the Google Scholar web search engine (https://scholar.google.com/); 'Frog Indigenous names South Africa' and 'Reptile Indigenous names South Africa'. The returned results were screened by searching for Indigenous names of herpetofauna in their text and other suitable sources were identified from the references of the screened publications. These Indigenous names were mentioned in the text of 18 dissertations, books and scientific articles (Supplementary Material 1).

The Indigenous language names obtained from the questionnaire and published sources were analysed under the emic/etic research strategies for studying cultural phenomena (Van de Vijver 2010). With the etic approach, cross-cultural differences of the Indigenous language names are analysed to understand commonalities in inherent/underlying folk nomenclature and classification guidelines across the different South African Indigenous cultures and their languages. Furthermore, the emic approach focused on Indigenous language names as equivalents for scientific names to investigate how folk classifications are comparable to the different scientific classification ranks. In addition to investigating the comparability between folk and scientific classification

through the emic approach, taxonomic correspondence analysis using scientific species and folk taxa (expressed in Indigenous language names of herptiles) as the basic unit of comparison (Berlin 1973) was conducted. A taxonomic correspondence analysis from the work of Berlin (1973) was used to analyse whether folk taxonomy and scientific taxonomy had one-to-one correspondence (one folk taxon corresponds with one scientific species), over-differentiation (two or more folk taxa correspond with one scientific species), Type I under-differentiation (one folk taxon corresponds with more than one scientific species from the same genus), and Type II under-differentiation (one folk taxon corresponds with more than one scientific species from different genera).

Understanding the underlying guidelines of folk taxonomy and how it compares to scientific taxonomy informed the compilation of a comprehensive list of Indigenous names for the 136 frog species (Frost 2024) and 407 reptile species (Tolley et al. 2023; Uetz et al. 2023) naturally occurring in South Africa by extension of the existing generalised Indigenous names. The folk taxonomy extension guidelines piloted by Phaka et al. (2019) that were used to ensure that the extended Indigenous names remain relevant to Indigenous language speakers while also being cognisant of biological classification guidelines are as follows:

- priority is given to extending existing Indigenous language names by adding descriptive adjectives,
- distinctive, commonly observed traits should preferably be used as descriptive adjectives when extending the existing generalised names,
- extended Indigenous language names should bear a similar meaning to scientific names or published common/popular names in other local languages, provided those existing names are descriptive of the species in question,
- and avoid coining completely new names wherever possible.

Additionally, this research applied the majority principle of language planning to give preference to the most widely used alternative of an Indigenous language name when that name has several dialectical spelling variations (Vikør 1993) and more than one name is used for several scientific taxa. The extension of generalised Indigenous languages names to ones that are specific to each scientific species of South African herptile took place from October 2022 to November 2024. The first and third authors reviewed all the extended names as biologists with an understanding of South Africa's official Indigenous languages, in addition to extending the SePedi and TshiVendˆa names respectively as native speakers of these two languages. The services of language experts/consultants were used for the extensions of Indigenous language names in the remaining seven languages (namely IsiNdebele, IsiXhosa, IsiZulu, SeSotho, SeTswana, SiSwati and XiTsonga). Language experts also added names that were known to them but not collected during sampling. The comprehensive list of 4887 Indigenous language names for South African herptile species (across nine languages) that resulted from this research is publicly shared and constantly updated by the first author to improve naming accuracy according to changes in herptile scientific taxonomy and comments from the public (Figure 1).

Profile of the Respondents

The online questionnaire respondents were aged between 25 and 57 years, with 82 respondents identifying as female and 193 identifying as male. These 275 respondents indicated their home languages as follows: IsiNdebele ($n = 16$), IsiXhosa ($n = 39$), IsiZulu ($n = 55$), SePedi ($n = 32$), SeSotho ($n = 28$), SeTswana ($n = 49$), SiSwati ($n = 13$), XiTsonga ($n = 27$) and TshiVenḓa ($n = 16$). The in-person interviews had 12 SePedi-speaking respondents (3 female and 9 male) aged between 26 and 52. Language classifications are according to the South African government, each language tends to be more prevalent in a respective province (Statistics South Africa 2018), and each of these languages has dialects.

Results

Classification in Folk Taxonomy

This study collected Indigenous language names used for South African herptile taxa and these names representing folk taxa are shown in Figures 3 and 4. The etic analysis shows that folk taxonomy across all South African Indigenous cultures broadly distinguishes between frogs (anurans) and reptiles (non-avian reptiles), and these two groupings have sub-divisions. Through the emic approach to studying folk taxonomy, it became apparent that classifications in South African folk taxonomy are mostly comparable with higher scientific classification (Figures 3 and 4). For example, non-avian reptiles, the order Anura, and suborder Serpentes are respectively assigned a unique folk taxon (i.e., have a specific Indigenous language name), across all cultures under consideration here. Overall, the Indigenous language names recorded from the questionnaire and existing literature in this study are comparable (i.e., match) with 2–9% of scientific classification (Figure 5). However, there were unique instances where generalised folk names are not comparable with any scientific classification, but those generalised folk names have Type 2 under-differentiation; the IsiZulu and IsiXhosa names Ixoxo and Isele (short for Iselesele) are used for generally grouping warty and smooth-skinned frog species respectively which is a delineation that is not comparable to any scientific classification of anurans (Du Preez et al. 2017), but the classification of frogs based on skin appearance also groups multiple scientific species from numerous genera into one generalised folk taxon (i.e., Type 2 under-differentiation). Ixoxo and isele also serve as the respective IsiZulu and IsiXhosa equivalents for Anura and are often used interchangeably in both languages (Figure 3).

Taxonomic correspondence analysis found under-differentiation to be the most common correspondence between generalised folk taxa and scientific species (Figures 3 and 4). Type 1 under-differentiation was found in the classification of aquatic frog species (*Xenopus* spp.) collectively called Idwi in IsiZulu or Lesele in SePedi, and Grass frogs (*Ptychadena* spp.) which are collectively called Uvete or Umjamu in IsiZulu and Ntlampya in XiTsonga (Figure 3). The questionnaire respondents explained that ntlampya is based on the ability of Grass frogs to jump further compared to other ground-dwelling frogs they encountered but did not explain the meaning of this word. Brevicipitidae spp. (Rain frogs) and another fossorial frog family, Hemisotidae (Shovel-nosed frogs), are grouped together under one generalised folk taxon (across all cultures under

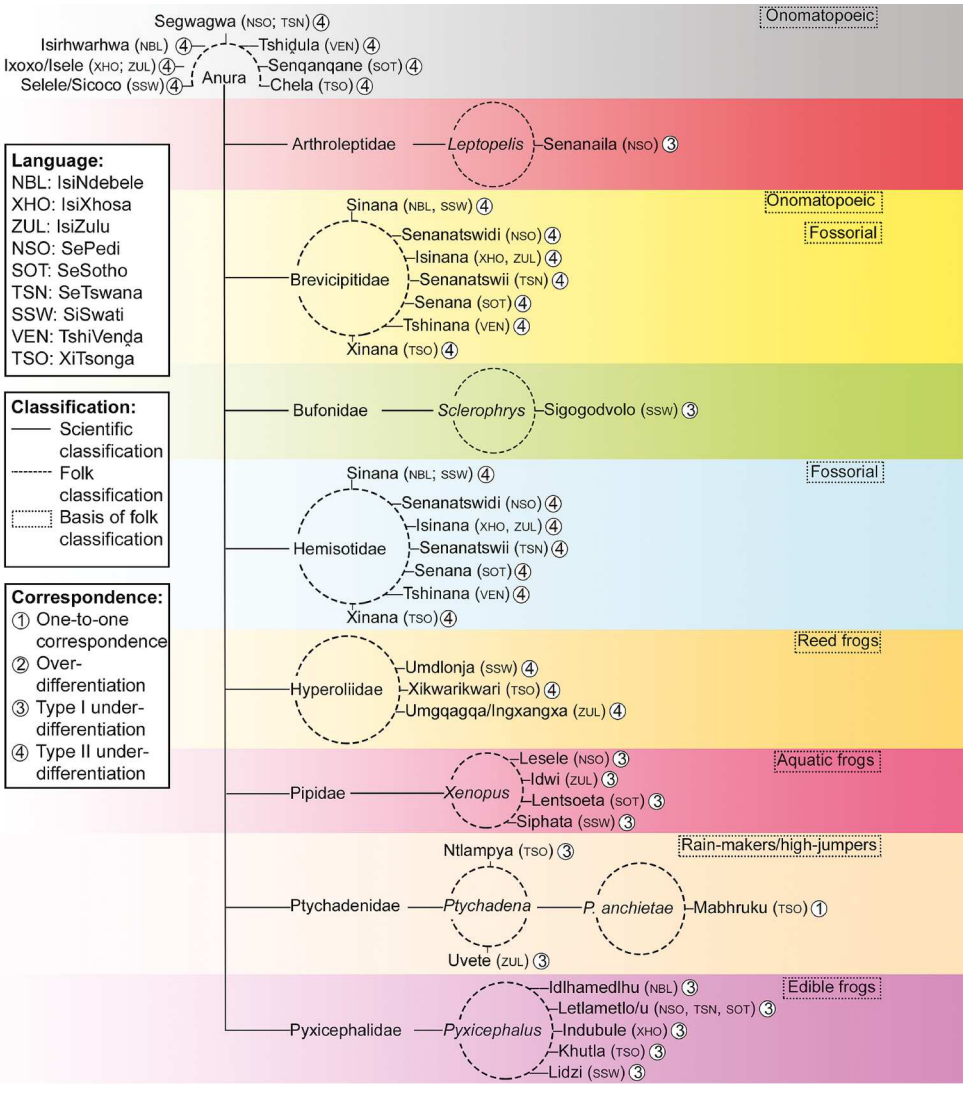

Figure 3: Correspondence of collected Indigenous language names with scientific names of South African frog species.

consideration here), thus representing a Type 2 under-differentiation (Figure 3). There is one-to-one correspondence between *Ptychadena anchietae* (Plain Grass Frog) and its folk taxon in XiTsonga, Mabhruku.

In reptile taxonomy, the Indigenous language names for Varanids (Monitor Lizards) show both type I under-differentiation and one-to-one correspondence with scientific names as a single Indigenous name in some languages refers to two species, while in other languages each scientific species has its individual Indigenous names (Figure 4). Type 2 under-differentiation is found in the classification of Chameleons, Geckos, Tortoises, Lacertids, Psammophids, Scincids and Typhlopids among other scientific families that have one Indigenous name for several scientific species in different genera across most languages under consideration here (Figure 4). One-to-one correspondence in

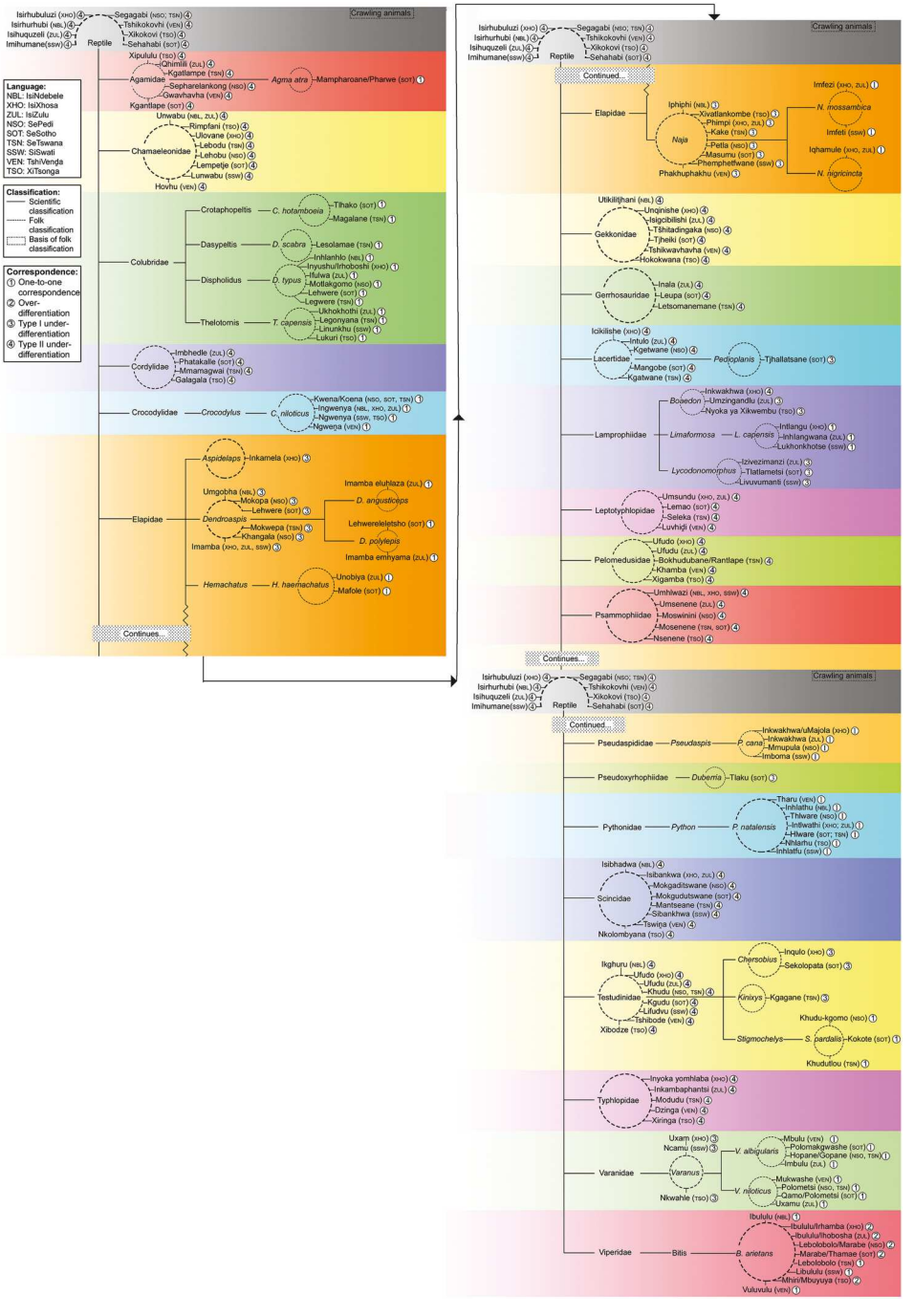

Figure 4: Correspondence of collected Indigenous language names with scientific names of South African reptile species.

folk and scientific classification of reptiles were also found in a few other instances; *Bitis arietans* (Puff Adder), *Crocodylus niloticus* (Nile Crocodile) and *Python natalensis* (Southern African Python) have a unique Indigenous language name or were each assigned to a

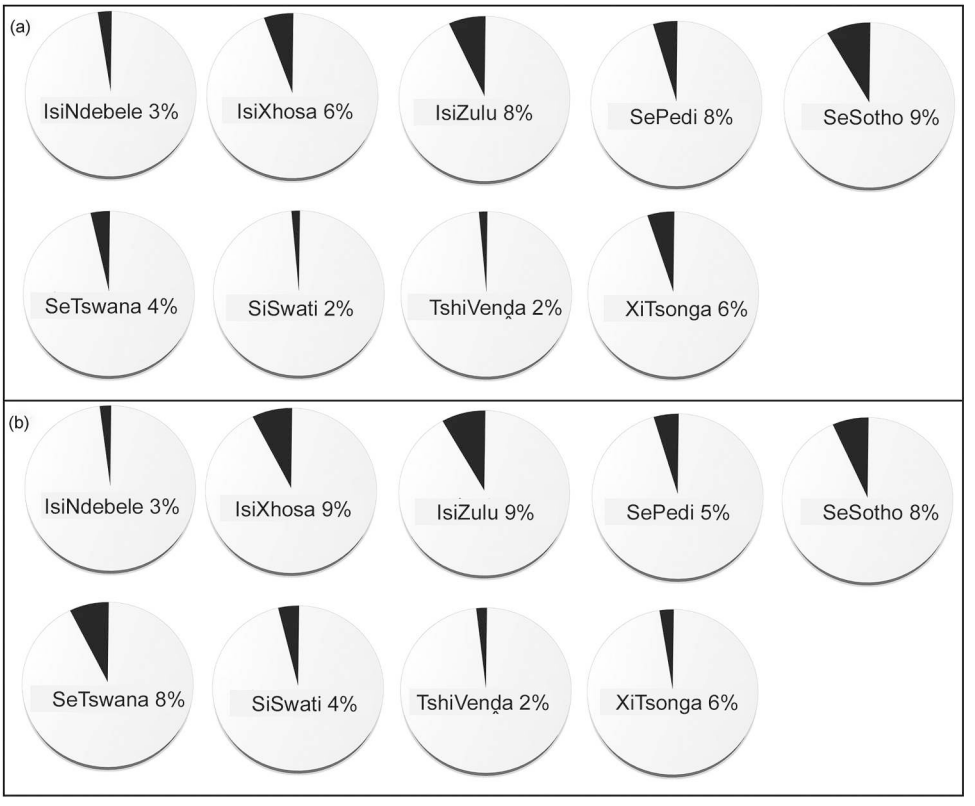

Figure 5: Taxonomic rank comparability between South African herptile scientific taxa and folk taxa recorded from published literature and a questionnaire. 5a) Percentage of folk taxa comparable with scientific taxa for frogs. 5b) Percentage of folk taxa comparable with scientific taxa for reptiles.

unique folk taxon across all nine Indigenous languages. Further one-to-one correspondence in reptile folk taxonomy was found with *Agama atra* (Southern African Rock Agama) called Mampharoane (alternative form: Pharwe) as its unique folk taxon in SeSotho, *Pseudaspis cana* (Mole Snake) which has the unique name Majola in IsiXhosa and *Naja mossambica* (Mozambique Spitting Cobra) with the unique name Mfezi in IsiZulu (Figure 4). Instances of over-differentiation were also found with one scientific species being assigned different Indigenous language names; XiTsonga folk taxonomy uses the names Mhiri and Mbuyuya for *B. arietans*.

Etymology of Indigenous Language Names for South African Herptiles

The name for the non-avian reptiles in the respective Indigenous languages describes animals that crawl, creep or drag their abdomen along the ground as they walk/move (Figure 4). The Indigenous language names for frogs (Anura) in IsiNdebele, SePedi, and SeTswana are onomatopoeic words describing animals that make a 'gwa-gwa' sound (Figure 3). The SePedi name Senanatswidi which joins Brevicipitidae and Hemisotidae together, is an onomatopoeic word based on the whistle-like 'tswi' sound characteristic of the calls made by frogs of these two families. *Ptychadena anchietae* (Plain Grass

Frog) is named Mabhruku in XiTsonga in reference to their long hind legs and ability to jump further than many other frog species it shares habitats with. Mabhruku is derived from the Afrikaans word broek, the name for pants or the lower part of an animal's body.

Cognates in Indigenous Language Names of Herptiles

Some of the Indigenous language names recorded through this study's questionnaire and from previous literature are cognates; words from different languages with the same linguistic derivation and similarities in spelling and pronunciation (Figures 3 and 4). The collective name for Hemisotidae and Brevicipitidae in the respective South African Indigenous languages have "nana" as their root word (Figure 3). *Crocodylus niloticus'* Indigenous name is also a cognate across all languages and is based on the similar sounding "Ngwenya" or "Kwena" (Figure 4); Ingwenya (in IsiNdebele, IsiXhosa, and IsiZulu), Ngwenya (in SiSwati and XiTsonga), Kwena (in SePedi, SeSotho and SeTswana), and Ngweṇa (in TshiVenḓa). The Indigenous language names of *P. natalensis* also have similarities in pronunciation across the different official Indigenous languages; Inhlatfu (in SiSwati), Tharu (in TshiVenḓa), Nhlarhu (in Xitsonga), Inhlathu (in IsiNdebele), Intlwathi/Inhlwathi (in IsiZulu and IsiXhosa) while the Sotho group languages of South Africa (SePedi, SeSotho and SeTswana) refer to it as Hlware/Thlware (Figure 4). Other Indigenous language names of herptile taxa with similarities in spelling and pronunciation across different languages include *B. arietans*, *Pyxicephalus* (Bullfrogs), and Chamaeleonidae (Figures 3 and 4).

Underlying Principles of Folk Taxonomy

Analysis of the recorded Indigenous language names revealed the following principles underlying the folk taxonomy of South African herptiles which are similar to a previous study by Phaka et al. (2019): (1) a uninomial name (single word or term) is often used to group multiple species, (2) grouping of species is based on observed similarities in traits, and (3) names are sometimes descriptive of species' observed traits. These underlying guidelines supplemented the folk taxonomy standardisation guidelines piloted by Phaka et al. (2019) which are used here in the compilation of a comprehensive list of names in the nine official South African Indigenous languages for the 543 herptile species naturally occurring in the country (Supplementary Material 2 – https://dx.doi.org/10.6084/m9.figshare.25768995).

Discussion

This analysis of South African folk taxonomy has shown how different Indigenous peoples' cultures assign names to frog and reptile species based on their traits. Folk taxonomy is in some instances, comparable to scientific taxonomy. Furthermore, there is correspondence between folk taxa and scientific taxa. Most of this correspondence is under-differentiation where one folk taxon either corresponds with multiple scientific species from the same genus or corresponds with multiple scientific species from different genera. Only a few Indigenous language names are specific to individual scientific species. Based on guidelines that underlie folk taxonomy along with the comparability and correspondence

between scientific taxonomy and folk taxonomy, the generalised Indigenous language names were extended into a comprehensive list of names where each folk taxon has a one-to-one correspondence with a scientific species.

This study is a contribution to South African herpetology with strides towards having standardised common names alongside scientific names. It is a continuation of discussions about common names (i.e., non-scientific names) for herptiles of the southern African region which took place in the 1960s and 1970s by Vesey-FitzGerald (1960), Broadley (1961), Jacobsen (1978) and van Dijk (1978) among others. Interestingly, this is the time that North American (i.e., America north of Mexico) herpetologists were deliberating the common names of the herptiles they study (Collins et al. 1978). Unlike their southern African counterparts, North American herpetologists continued their deliberations, formed a committee for common and scientific names, and formulated guidelines for common English names (Crother 2017). Efforts to rekindle interest in common names for southern African herptiles with a study on IsiZulu common names by Phaka et al. (2019) yielded similar results to the current study where some names on the newly compiled comprehensive list are not binomial as per scientific taxonomy guidelines. Simon et al. (2022) demonstrated that it is possible to compile a comprehensive list of Afrikaans and English common binomial names with a study on polychaetes. Formulating binomial common names, in any language, depends on whether a language has the vocabulary to concisely communicate the uniqueness of species especially if species are cryptic. South Africa has many herptiles whose uniqueness is sufficiently communicated with common names that have at least three words.

The reason behind folk taxonomy having more generalised than specific Indigenous names, or low one-to-one correspondence between folk and scientific taxonomy, could not be ascertained from the responses, but other researchers have speculated on the likely causes. Species that receive high cultural interest are likely to have names specific to them (Raven et al. 1971). The utilitarian value of species for Indigenous communities is also said to drive their naming. Thus, species that people do not use are less likely to be named (Berlin 1991). Species that are not readily observable due to their size, behaviour and significance to culture are not expected to have specific names under folk classification (Berlin 1973). In the South African context, it seems that utilitarian value is a major factor in assigning specific Indigenous language names to herptile species but this is a topic that requires further research. We speculate that another reason scientific taxonomy has delineated a higher number of species in comparison to folk taxonomy is due to biodiversity surveys and monitoring (from visual observations to molecular techniques) by external scientists when Indigenous communities might not have dedicated monitoring activities thus making them less likely to encounter the same number of species or differentiate as many cryptic species as scientists do.

The structure of folk taxonomy provides clues about how people perceive patterns in nature (López et al. 1997). Folk taxonomies provide information on the Indigenous knowledge and perception of biodiversity (Pinto et al. 2013; Medeiros et al. 2022). Based on this study's sample of respondents and existing literature, South African Indigenous cultures' perception of herptile diversity is lower than what is delineated through scientific taxonomy as seen in folk taxa being comparable to 2–9% of scientific taxa. Based on the assertion by López et al. (1997) and Atran (1998) that folk taxonomy provides clues on perceptions of patterns or discontinuities, the higher prevalence of under-differentiation

(i.e., higher numbers of generalised folk names) in the correspondence between folk and scientific taxonomy suggests that South African Indigenous communities can better distinguish herptile diversity at higher taxonomic ranks (e.g., genus rank or higher) while their perception of species level discontinuities is still unclear. Without the biodiversity surveys and monitoring that are associated with scientific taxonomy, it would not be possible to take note of the sometimes-subtle diagnostic traits that are used to tell species apart.

Mourão et al. (2006) mentioned that the names used in folk taxonomies contain information on species' biology. In the current study, examples of the knowledge of some species' traits is shown in the Indigenous naming of Brevicipitidae and Hemisotidae using onomatopoeic words based on these families' advertisement calls, and the Indigenous name of *P. anchitae* being descriptive of the frog's jumping ability (Figure 3). This knowledge of species' traits contained in folk taxonomy demonstrates previously overlooked field-observation-based knowledge of wildlife by Indigenous community members. These Indigenous interpretations of nature (contained in Indigenous language names for wildlife) and local wildlife perspectives are part of complex cultural systems that include nomenclature and classification, language and natural resource use (International Council for Science 2002). Such local interpretations and perspectives of wildlife are often overlooked in conservation. Inclusive conservation planning can be informed by previously ignored local perspectives contained in local taxonomies (Beaudreau et al. 2011).

The folk taxonomies of the various South Africa's Indigenous languages have the same underlying principles as the folk taxonomies of other countries including Tanzania (Tibuhwa 2012), Pakistan (Altaf et al. 2017) and Hungary (Ulicsni et al. 2016). Folk taxonomies worldwide are known to have some similarities among themselves (Berlin 1973). There are further similarities between folk taxonomies and scientific taxonomies as they are systematic (Ross 2014) and organise species according to similarities in their traits (Phaka et al. 2019). Berlin (1973) hypothesised that over-differentiation, where at least two folk taxa correspond with one scientific species, would generally have low occurrence across all folk taxonomies. The current study also shows low over-differentiation between folk and scientific taxonomy of South African herptiles (Figures 3 and 4). A similarity between folk taxonomies which is not sufficiently reported in previous research is instances where certain Indigenous language names for wildlife have the same meaning or sounds across different languages such as the cognates for the Nile Crocodile or Puff Adder reported here. This similarity of names across different languages opens areas of research into similarities of how cultures in different geographical settings perceive wildlife and subsequently name wildlife based on that perception.

Incorporating Indigenous language names into threatened species' lists is recommended for more effective conservation planning (Medeiros et al. 2022). Extending Indigenous language names so that each herptile known to be distributed in South Africa has its unique name ensures there is a one-to-one correspondence between folk and scientific taxonomy when including Indigenous names in conservation planning. One-to-one correspondence between folk and scientific taxonomy thus would ensure that communication and subsequent planning are directed at the correct species in conservation collaborations between stakeholders of varying expertise/exposure to scientific taxonomy. This type of folk-formal taxonomy can be helpful in resource management

considering inherent weaknesses in both folk and scientific taxonomy (Mekbib 2007). A practical example of the conservation value of Indigenous names for species was demonstrated through a compilation of a checklist of insect names in English and IsiXhosa to be used by scientists, farmers and other stakeholders whenever they needed to communicate and to also inform an English-IsiXhosa bilingual dictionary (Mkize et al. 2003). Indigenous language names of animals contributing to a species checklist and a bilingual dictionary demonstrates the social inclusion value of folk taxonomy investigations in addition to their conservation value.

Indigenous language names (and Indigenous languages in general) are underrepresented in South African wildlife literature, and thus need to be made available to those seeking to learn about wildlife in a country with low English literacy (Phaka et al. 2023). Scientific, English and sometimes Afrikaans names with the occasional inclusion of a few Indigenous language variants are listed on the species' description pages of some of the popular wildlife guides for the country's frog and reptile diversity (see Minter et al. 2004; Marais 2011; Bates et al. 2014; Du Preez et al. 2017). Of South Africa's 11 official spoken languages, most wildlife guides are available in English, while comparatively fewer have been published in Afrikaans. The remaining nine Indigenous languages are either excluded or have even fewer wildlife guides than the already low number of guides published in Afrikaans (Phaka et al. 2023). The compilation of a comprehensive list of names for South African herptiles in the country's official Indigenous spoken languages thus makes the overlooked names available for inclusion in future publications and their potential for use in conservation planning. Investigation of folk taxonomy additionally results in its preservation as an element of culture (Feely 2009), while also highlighting previously overlooked wildlife perspectives and contributing to the development of African languages (Phaka and Ovid 2022). Continued development of African languages into languages of teaching and learning will likely lead to more wildlife guides being published in Indigenous languages or Indigenous language names, both of which are still rare occurrences in the country.

Conclusion

This research contributes to improving the understanding of how Indigenous communities name and classify herptiles and how elements of people's culture (in this case language) relate to herptile diversity. The comprehensive list of herptile names in nine official Indigenous South African languages for the 543 scientific species currently known to occur in South Africa makes it possible for people to find names of herptiles in any of the country's 11 official spoken languages. Furthermore, Indigenous language names that are specific to herptile species are now available for use in herptile conservation while also contributing to inclusion of previously marginalised languages (and their cultures). However, further research is required to understand why the folk taxonomies analysed here have specific names for only a few species as there is currently more than one hypothesis about the likely causes.

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No potential conflict of interest was reported by the author(s).

Ethical Considerations

The first page of this study's questionnaire explained the purpose and potential benefits of this research to prospective respondents in their preferred South African language and stated they were under no obligation to participate and could withdraw their participation at any time they choose. Before proceeding to respond, respondents gave consent for participation and acknowledged that they have read and understood the explanation of the study provided to them. Ethics approval for this study was obtained from the North-West University Animal Care, Health and Safety Research Ethics Committee (Ethics number: NWU-00185-18-S5) and Hasselt University Social-Societal Ethics Committee (Reference: REC/SMEC/VRAI/189/127). The research conducted complies with the Nagoya Protocol on Access and Benefit-sharing (UID: ABSCH-IRCC-ZA-257320-1)

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