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A picture of health? Animal use and the Faraday traditional medicine market, South Africa

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ABSTRACT

Ethnopharmacological relevance: The use of animals and plants as traditional remedies for both medical afflictions and social or cultural issues (symbolism) has a long history in South Africa and a reasonably large proportion of the population will consult a traditional healer during their life-time. Compared to plants, the use of animal parts in traditional medicine and folklore is poorly documented.
Methods: We interviewed 32 traders from South Africa's largest traditional medicine market, the Faraday Street market in Johannesburg, of which only 20 consented to supplying some species use information. Traders are particularly protective of the medicinal properties of their wares. Given the sensitive nature of this information (12 traders declined to be interviewed), we were only able to gather data on their perceived uses and no data on dosages, efficacy, or individual turn-over of products. We assessed the trade of animal parts from the perspective of consumer needs by analysing use-categories (e.g. headaches, strokes, skin problems, bad luck, etc.) and the degree of informant consensus in the selection of fauna to treat certain conditions.
Results: We documented 301 uses for animal parts from 52 species and 18 'morphospecies' that we allocated to 122 broad-use categories. Overall, reptiles and mammals were the most frequently used taxa in traditional medicine and some species had multiple uses (i.e., appeared in multiple use-categories) including crocodiles, lizards generally, chameleons, striped polecats, elephants and jackals. Animals were mostly used for 'strength' (physical or overcoming fear), but also as love charms, warding off bad luck or bad spirits or improving one's luck. Only 36% of our categories were medicinal (e.g., headaches, skin problems, swollen feet, etc.). We also found a high rate of non-disclosure of uses per species (a mean 86% of traders did not reveal information on the use of a species), and a variable degree of consensus between the traders on what particular species are actually used for.
Conclusions: We suggest that traditional medicine markets provide a unique opportunity to gauge the health and symbolic or personal issues representative of a large sector of society. What's more, we recommend that researchers be more mindful in the way that use information is reported. We also highlight the potentially serious threat of traditional medicine to species that may be particularly vulnerable by virtue of their restricted distribution or predictable behaviour.

1. Introduction

Animal derivatives have constituted an important component of folk medicines and rituals in numerous cultures (Anyinam, 1995; Lev, 2002; Betlu, 2013). They are also important ingredients in the preparation of curative, protective and preventative medicines for such purposes as immunity from disease, protection against bad luck and witches, aphrodisiacs and potency, and to bring good health to local people and their communities (Anyinam, 1995). The use of animals and plants as traditional remedies for both medical conditions and symbolic social or cultural issues has a long history in South Africa, and a reasonably large proportion of the population will consult a traditional healer during their life-time. Compared to plant ethnomedicines however, traditional healing with animals (zootherapy) comprises a smaller proportion of the documented ethnomedicinal species and practices, and research in this area has been sporadic and largely neglected (Betlu, 2013).

In South Africa, the majority of traditional medicines (*umuthi*) are of botanical origin (> 2062 species, Williams et al., 2013) whereas only 232 animal species (excluding invertebrates and marine species) have been similarly inventoried (Whiting et al.,

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2011). Furthermore, while studies on the use and trade of traditional medicinal plants have been routinely conducted for more than two centuries, ethnozoological studies in South Africa have mostly occurred since the 1980s amid growing concerns that the hunting, and commercial trade, of animals, are exploitative and unsustainable – for example: vertebrates and invertebrates (Cunningham and Zondi, 1991; Marshall, 1998; Ngwenya, 2001; Whiting et al., 2011), vertebrates (Simelane 1996; Simelane and Kerley, 1998), birds (Derwent and Mander, 1997; Williams et al., 2014), vultures (Cunningham, 1990; Mander et al., 2007), reptiles (Simelane and Kerley, 1997), and invertebrates (Herbert et al., 2003).

The importance of animal-derived ethnomedicines in southern Africa was acknowledged in 1950 by Watt and Breyer-Brandwijk, the authors of the classic works on medicinal and poisonous plants of East and southern Africa (Watt and Breyer-Brandwijk, 1932, 1962). Twelve years before the second edition of their book they wrote: "…*the medicines, charms and poisons derived from animal… sources. Many of these are of great interest and are worth putting on record…We often laugh at the bizarre nature of the animal products which are sometimes used….Two live lice thrice daily by the mouth in the treatment of measles is palpably absurd, yet the use of hyraceum (klipsweet or dassiepis) the inspissated urine the rock rabbit (Procavia capensis), as a remedy for hysteria and epilepsy, is not so far removed from the present-day use of mare's urine as the source of a hormone remedy. We now have quite an imposing array of medicines, chiefly hormones, derived from animal sources and we seem to be still very much at the beginning of a new phase of therapeutics*" (Watt and Breyer-Brandwijk, 1950). The strongly aromatic concretions of rock hyrax (*Procavia capensis*) urine is a well-known Khoikhoi medicine, often used as a post-natal medicine for mothers and babies (Van Wyk et al., 2008). Another ethnomedicine with active ingredients, this time dangerous and potentially fatal, is the blister beetle (*Mylabris* sp.); the complex terpenoids in the genus are a severe irritant that are used to treat skin diseases and have been included in strong enema mixtures (Cunningham and Zondi, 1991; Dzerefos et al., 2013; Hewat, 1906). But, despite Watt and Breyer-Brandwijk's call nearly 70 years ago to investigate animal remedies in southern Africa, very little has been published in the intervening years. Historically, the most meticulously researched account from South Africa is Godfrey's book on bird-lore and *"native proverbs"* inspired by the symbolic use of birds in the Eastern Cape Province (Godfrey, 1941).

That animals are generally a small component of the *Materia Medica* of indigenous cultures is one reason for the paucity of research and published information (Betlu, 2013). However, animal parts are, with a few exceptions such as the blister beetle, typically used for "*symbolic 'magical' purposes*" (Cunningham and Zondi, 1991) and the general association of animal uses with practices of 'witchcraft', especially in Africa, has also deprived zootherapeutics of credibility within ethnopharmacological research, and especially bioprospecting for new medicines, since the spiritual/ancestral and often sacred guidance given to a healer when selecting animals to treat various conditions cannot readily be translated into scientifically screened and medically approved patent medicines. Furthermore, the selection of animals by zootherapeutic practitioners seems to be mostly allied with the Doctrine of Signatures, or what Hutchings (1989) refers to as 'suggestive forms' since their appearance suggests the use.

While the Doctrine is usually associated with plants, it is also based upon the complete or partial resemblance of an animal or its behaviour to a specific part of the human body, organ, bodily function, bodily reaction or attribute that signifies its utility relative to the attribute and which it is allegedly capable of treating (De Conconi and Moreno, 1988; Voeks, 1993; Lev, 2002; Douwes et al., 2008). The users of animal medicines also see fauna as *"complex biological systems that undergo mysterious transmutations, e.g. caterpillars turning into moths"* (Pujol, 1990), and for this reason they are used in related treatments to *"strengthen medicines and provide cures"*. In Korean traditional medicine for example, centipedes with numerous legs, feet and articulated body segments are used for leg, foot and joint problems (Pemberton, 1999). In parts of South Africa, the perceived agility of baboons is a reason why their bones may be used to treat arthritis (Pujol, 1990). But despite the wealth of indigenous knowledge and the importance of animals to indigenous communities and consumers around the world (which is especially well documented in Latin America, e.g. Alves and Alves, 2011; Alves and Rosa, 2007), inventories of animal use are sometimes presented in the context of superstition and amusing anecdotes instead of indicators of social health and well-being.

Nevertheless, the reasons behind the selection of animals offers a glimpse into the remedial needs of prospective consumers and the conditions which trouble the sector of society that uses these faunal resources. Furthermore, one can examine the reasons for animal selection by moving beyond the classic 'species and their uses' inventories and indices and the commonly accompanying question *"what is this animal and what is it specifically used for?"*. In so doing, a general picture of the health needs of consumers can be constructed by considering the uses that are most frequently reported and, the species of conservation concern can be examined by considering the animals that are most frequently sought after independent of the specific reason for their use. It is from this perspective that an intention of our paper is to examine species utilisation as indicators of social health and well-being. Hence, we have intentionally 'uncoupled' alleged use from the actual species and explored each aspect separately in order to portray a 'picture of health' of the community of users. Thus, through this process, the specific indigenous knowledge of the research participants is purposefully safeguarded.

In 2004/2005 we conducted an investigation at the large urban Faraday traditional medicine ('*muthi')* market in Johannesburg, South Africa, primarily to quantify the richness and diversity of the taxa sold by traders and to assess the trade in species of conservation concern (Whiting et al., 2011). A subsidiary component of that study included recording the uses for the animals on sale. Thus, since this paper considers ethnozoological medicines only, the indigenous knowledge is biased towards ailments that can only (or partially) be treated with animals in a more symbolic rather than strictly medically therapeutic context. Hence, these uses may not necessarily be indicative of the entire suite of conditions and concerns treated by traditional healers, nor the spectrum of the health requirements and priorities of urban consumers as would generally be treated by the more dominant plant-based therapeutic sector of the market. Nevertheless, these uses do illuminate one facet of the public's health needs and the taxa that are mostly illegally acquired and traded to service these needs.

2. Survey area

The Faraday traditional medicine (*umuthi*) market is in Johannesburg, the largest city in South Africa and located in the wealthiest province (Gauteng) (Statistics South Africa, 2011). Over the last decade, Faraday has grown to be the biggest market for traditional medicine in South Africa, if not southern Africa and Africa. The market ultimately services the urban population from the city and the province of Gauteng, as well as rural and urban healers and consumers from neighbouring provinces seeking to purchase products they are unable to source from where they live. There are currently (as of October 2015) about 220 dedicated *umuthi* traders in Faraday (which is down from > 300 traders counted in October 2014), of which ±42% sell animal parts (19 traders sold animals only; 74 sold animal and plant parts; 117 sold plants only; not determined for 10 traders). The throughput and turn-over is usually low compared to plants (parts of some species remain at stalls for years with only small pieces being sold at irregular intervals).

There were approximately 185 traders in the market at the time of our 2004/2005 survey, of which about 34 (18%) sold animal products (either exclusively or in addition to plants). Like other *umuthi* markets in the country, animal products are a lesser component of the total biotic richness being offered to consumers. In Faraday in 2001, for example, there were 166 sellers of plant and animal parts, and of these 5% sold animal products only, 10% sold both plants and animals, and 85% sold plant products only (Williams, 2003), i.e. 15% of traders sold animals parts. Cunningham and Zondi (1991) similarly documented that between 17% and 22% of traders sold animal products in an urban and rural market respectively in the province of KwaZulu-Natal (KZN), South Africa (a source for many of the species sold in Faraday), but Herbert et al. (2003) only documented 10% of traders selling animal parts in the urban KZN market that they surveyed.

3. Methodology

A semi-quantitative survey of the Faraday Street *umuthi* market was conducted between June 2004 and November 2005 with 32 of the 34 *umuthi* traders that sold animal products. Details of the survey methodology and a complete list of the identified species (including body parts and their prevalence in the market) are published in Whiting et al. (2011) and we encourage readers to consult this paper for information not republished here. Ethics clearance was obtained from the Human Research Ethics Committee (Medical) at the University of the Witwatersrand before the study commenced (Protocol M0500945). The interviews were conducted in the home language of the traders in most cases (typically in isiZulu), and consent to conduct the survey was obtained from the Chairman of the market and from the individual respondents.

Animals were mostly identified at the market, however photographs of the stalls were also taken so that some species could be identified later with the aid of field guides and/or experts for the major taxonomic groups (Whiting et al., 2011). The selection of the common names to refer to species in this paper was taken from Stuart and Stuart (2015), with the exception of 'Dassie' where we have used the name 'Hyrax' instead, and 'Bushbaby' instead of 'Galago'.

Of the 32 traders interviewed, 32 sold mammals, 31 sold reptiles, 22 sold birds, and 13 traders sold invertebrates (terrestrial and marine) and marine vertebrates (Whiting et al., 2011) although none were exclusive to any particular group. In addition to inventorying the species sold by the trader, we (Whiting et al., 2011) also recorded the uses of the animals they sold. However, use information was only captured from 20 consenting traders (63% of traders), of which 19 were men. Of the 20 traders that consented to supply some use information, eight were traditional healers (three diviners or 'sangomas'; five 'herbalists' or inyangas') and 12 were regular traders and not traditional healers. A further 12 traders (38%; all simply traders and not traditional healers) would not consent to providing any use information. What's more, at least one interview was cut short when a trader was discouraged from disclosing use information by his neighbour.

Like Herbert et al. (2003) and Cunningham and Zondi (1991), who reported that survey respondents were frequently reluctant or resistant to discussing and imparting the uses of species when questioned about them (especially species used for magico-medicinal purposes and sorcery), we experienced a similar reluctance among consenting traders. In addition to the 38% of traders who did not consent to revealing use information for any of the species they sold, the remaining 62% of respondents usually did not impart use information for all of the species at their stalls. Hence, in order to quantify the degree to which respondents disclosed use information, we calculated 'no answer' response rates: (a) per species (i.e. for a specific species, the percentage of traders that disclosed no answers as to its use), and (b) per trader (i.e. for a specific trader, the percentage of species they sold for which they disclosed no answers as to their use). A 'no answer' indicates that traders either did not know the use, or declined to impart the information. We also examined the 'no answer' response rate in relation to (a) the size of the stall (i.e. the number of species a trader sold) in order to assess whether stall size influenced the proportion of species that traders would disclose use information for, and (b) the prevalence/frequency of the species across the market (i.e. the number of $n=20$ traders that sold the species) in order to assess whether uses for frequently or infrequently traded species were more likely to be disclosed.

Since the primary focus of the 2004/2005 survey was to inventory and document the trade in animals and to quantify the richness and diversity of the taxa sold, we did not document the corresponding methods of remedy preparation, dosage, side effects, efficacy, price, frequency of sale, etc. or the localities from which the animals were harvested from. This was also because of the sensitive nature of some of this information, from the perspective of the trader, and the challenges of obtaining reliable responses.

The uses for animals communicated by the traders were simplified, summarised and then categorised into short word strings. The words in the strings were hyphenated to keep them together to generate a word cloud produced by WordItOut (http://worditout.com) in which the sizes of the words are proportional to the frequency with which the words (i.e. uses) recurred (i.e. were mentioned by traders). The maximum number of citations for a use was 19 for the word 'strength' (Appendix 1). A word cloud was also generated for the number of times an animal name (relating to a species/morphospecies) was associated with a use, thereby indicating the animals with the most number of uses mentioned by the traders (Appendix 2). The maximum number of citations for the use of a specific animal was 20 for 'Southern African Python'. We did not analyse or correlate uses with animal body parts since the specific parts used were not always recorded. All taxonomic classifications for the English names for the animals listed in the paper and associated tables and figures are itemised in Appendix 2.

To analyse the degree of heterogeneity in the selection of animals to treat certain conditions, we calculated the 'informant consensus factor' (ICF). The method was originally developed by Trotter and Logan (1986) for identifying consensus and variation in the use of plants in folk pharmacopoeias. Their hypothesis was that the greater the degree of group consensus regarding the use of plants for plant-based therapies (i.e. ICF values closer to 1), the greater the likelihood that the remedy in question was physiologically active or effective (Trotter and Logan, 1986). The method was adapted for plants by Heinrich et al. (1998) and animals used for zootherapeutic practices by Alves and Rosa (2006). Thus, according to this method, ICF values close to one (1) indicate a higher degree of informant consensus regarding which animals are effective in treating certain conditions, whereas values closer to zero (0) indicate a higher degree of variation in the number of different animals used to treat the condition. The ICF formula obtained from Alves and Rosa (2006) is: $ICF=(n_{ur}-n_t)/(n_{ur}-1)$, where n_{ur} equals the number of use citations in each use category, and n_t equals the number of species used per use category. ICF values were only calculated for use categories with five or more citations.

4. Results and discussion

4.1. Diversity of species and their uses

Excluding marine organisms, uses for 52 species and 18 'morphospecies' (i.e. a typological species that could only be identified as genet sp., eagle sp., snake sp., etc.) of terrestrial vertebrates were recorded in Faraday during the survey (Table 1). Because of the difficulty in identifying individual species from the highly diverse marine classes (e.g. molluscs, echinoderms, fishes) (Whiting et al., 2011), these organisms were only identified to 13 different morphospecies (Table 1). Most of the uses recorded during the survey were for mammals (42%) and reptiles (29%), and to a lesser extent birds and marine invertebrates (8% each) (Fig. 1).

In contrast to the 147 vertebrate species and 40 morphospecies that were originally identified in the market during the survey (published in Whiting et al., 2011), uses were only documented for 37% of the vertebrate taxa and excluded information for 117 species/morphospecies (Table 1). In part this reflected the sensitivities of the traders towards discussing use information, which is demonstrated in the high proportion of 'no answers' discussed later. The survey was thus only able to capture uses for 54% of the total number of mammal taxa present in the market at the time of the survey, for 41% of the reptiles and 17% of the birds (Table 1). Uses were unfortunately not captured for species such as Temminck's Ground Pangolin (*Smutsia temminckii*), Honey Badger (*Mellivora capensis*), African Wild Dog (*Lycaon pictus*), Serval (*Leptailurus serval*), Southern Ground-hornbill (*Bucorvus leadbeateri*), rhinoceroses and most of the ungulates, snakes, raptors and perching birds (passerines). This was largely due to the reluctance of the respondents to reveal their uses specifically, but also their rarity in the market (see Appendix 1 of Whiting et al., 2011). However, uses for some of these species have been reported in other publications should readers wish to learn more (e.g. Godfrey, 1941; Brautigam et al., 1994; Cunningham and Zondi, 1991; Marshall, 1998; Simelane (1996)). In Appendix 3 we list examples of some of the uses that have been published for the taxa documented in our survey; this is not an exhaustive literature search, and only compares the uses we documented in Faraday with the uses published in four references. Also in Appendix 3 we tally the combined number of uses from our survey and the literature, and indicate the percentage of uses per taxon that were not published in the four references (mean ± S.D. = 54 ± 35%). This percentage of previously unpublished uses will drop if a broader literature base is consulted.

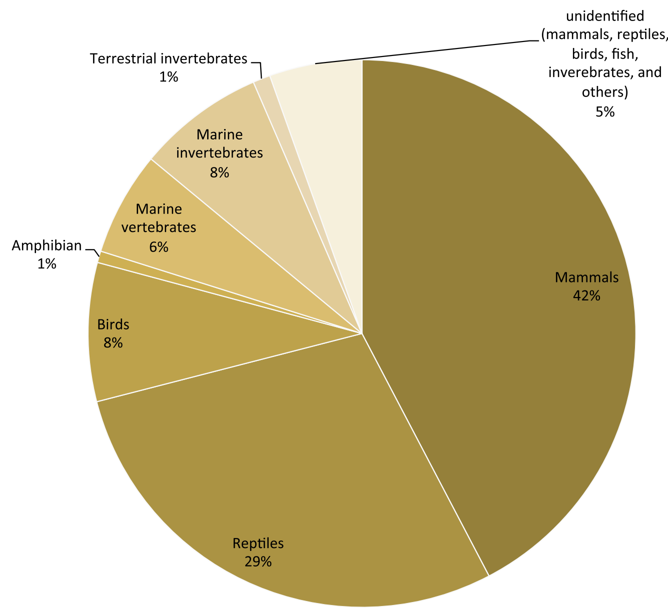

Fig. 1. Proportion of the overall recorded uses attributed to the different groups of vertebrates and invertebrates.

Of the identified individual species, uses attributed to the Southern African Python (*Python natalensis*), Cape Porcupine (*Hystrix africaeaustralis*), Chacma Baboon (*Papio ursinus*), Nile Crocodile (*Crocodylus niloticus*) and African Elephant (*Loxodonta africana*) were most frequently mentioned (Fig. 2). Furthermore, uses attributed to the morphospecies 'lizard' (including species of *Cordylus, Smaug* and *Agama*), 'jackal' (*Canis* sp.), 'tortoise' (including species of *Kinixys*, *Stigmochelys* and *Chersina*) and 'monitor' (*Varanus albigularis* and *Varanus niloticus*) were also very frequently reported (Fig. 3). Six of the top 10 species/morphospecies with the most number of reported uses are reptiles (Fig. 3), thus making the associated species vulnerable to unsustainable harvesting by virtue of the diversity of their uses.

Since the survey respondents were only asked what the species are used for and not the frequency with which species are purchased for these uses, it was not possible to resolve whether frequently cited use categories and the corresponding species are positively correlated with customer demand. However, species for

Table 1
The number of species and morphospecies identified per group during the 2004/2005 survey of the Faraday market, and the corresponding number and proportion of taxa that uses were attributed to during the same survey. The table excludes figures for taxa that could only be identified to class.

Group	(a) No. of taxa recorded during the Faraday market survey (*n* = 32 traders)[a]			(b) No. of taxa in the market during the same survey that uses were recorded for (*n* = 20 traders)			% of species/morphospecies per group that uses (a) were recorded for relative to the total number recorded during the survey (b)
	Species	Morphospecies	Total taxa	Species	Morphospecies	Total taxa	
Mammal	60	12	72	29	10	39	54%
Reptile	33	11	44	13	5	18	41%
Bird	53	16	69	9	3	12	17%
Amphibian	1	1	2	1	–	1	50%
Subtotal	*147*	*40*	*187*	*52*	*18*	*70*	*37%*
Terrestrial invertebrates	Difficult to identify and not comprehensively documented			1	2	3	?
Marine vertebrates					> 5[b]	> 5[b]	?
Marine invertebrates					> 8[c]	> 8[c]	?

[a] Derived from Whiting et al. (2011).
[b] Identified broadly as pufferfish, eel, 'fish', flounder, sole.
[c] Identified broadly as octopus, cuttlebone, crab, starfish, urchins, shells (including cowries), sea slug.

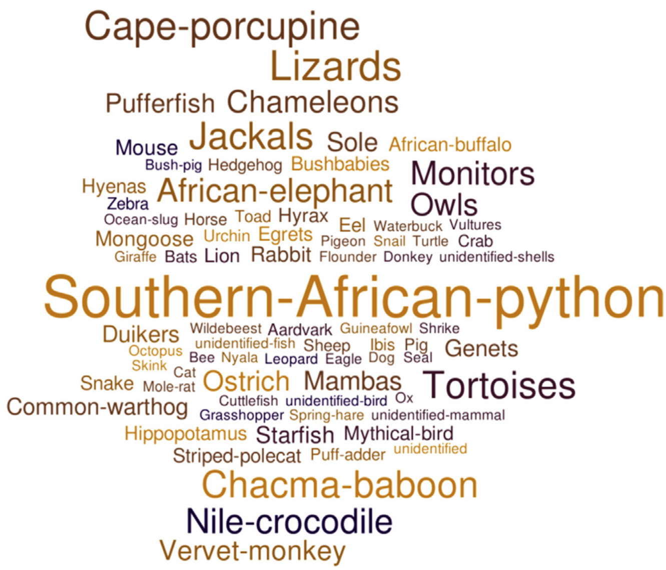

Fig. 2. Word cloud of the vertebrate and invertebrate species and morphospecies mentioned by traders in the Faraday market as being used for traditional medicine. The size of the words is proportional to the number of times that uses were attributed to each animal. Maximum mentions are 20 for Southern African Python.

which uses were more frequently mentioned tend to be more prevalent in the market and sold by more traders (Fig. 4, $n=20$ traders). The top cited species indicated in Figs. 3 and 4 were also typically more common throughout the entire Faraday market ($n=32$, compare with Fig. 5 in Whiting et al., 2011). Furthermore, irrespective of their uses, some of these frequently used species (especially the threatened ones) tend to be most at risk for population decline resulting from frequent selective harvesting events.

Three-hundred-and-one records of uses for animals were distilled into 122 broad-use categories (Fig. 5) (Appendix 1). These categories of uses reported by the traders probably paint a picture of the health needs of the urban consumers in the greater Johannesburg metropolitan area and beyond. The animals were mostly used for 'strength' (e.g. home strength, imbuing physical strength and overcoming fear), or for protection to ward off evil spirits from within a person or from their residence (Fig. 6). Also important were medicines for treating skin problems, strokes, bad luck and making a member of the opposite sex fall in love with you ('love charms') (Figs. 5 and 6). Only 36% of the use classes in Fig. 6 are for medically recognised conditions (skin problems, strokes, headaches, swollen feet and stomach problems). Hence, the uses portrayed in Figs. 5 and 6 reinforce the observations by Cunningham and Zondi (1991) and Herbert et al. (2003) that animal product usage centres on magico-medicinal properties considered inherent in the animal, and that use tends to be more ritualistic and symbolic than for treating *"somatic symptoms"* (Herbert et al., 2003) and medically described diseases/conditions such as thrombosis, asthma, rheumatism or high blood pressure. The rationale behind the uses of most species documented here is thus aligned with the Doctrine of Signatures.

'Signatures' indicative of the disorders that animals can treat have been gleaned from observations of their morphological traits, habits, and social behaviours, such as diurnal/nocturnal movements and feeding habits, manner of feeding and prey capture, distinctive calls, nesting and burrowing patterns, skin texture, and more. Sometimes with some lateral thinking, uses can be predicted by associating the physical and behavioural traits of animals with traits suggestive of what one would wish to possess or treat. For example, women that worry about their male partner philandering will make use of the suckers from an octopus/squids' tentacles because that will keep him close. Likewise, the physical strength displayed by pythons, elephants, crocodiles, lions and buffalos are traits believed to be transferable to humans to impart comparable strength to overcome adversity. Similarly, a hedgehog's spines offer protection to those threatened with bodily harm or make them untouchable to the law. Common Fiscals (*Lanius collaris*, previously the Fiscal Shrike) are used to make school children intelligent might stem from observations that the birds 'cleverly' impale and cache prey items on thorns or on the barbs of wire fences. Jackals and rabbits are similarly believed to make one clever, possibly because their opposing methods and tactics of seeking out prey and avoiding predators, respectively. Beliefs that a Puff Adder (*Bitis arietans*) will stop livestock from straying might stem from the observation that, as ambush predators, they can remain without moving in one place for long periods of time while waiting for prey to come within striking distance. Slow-moving tortoises are similarly used to make livestock graze near to the owners land and stop them from straying. However, tortoises are also reportedly used by women to stop their husbands from cheating because the extension and retraction of the head and neck are seen as comparable to a penis and an erection. But whereas a worried woman will use tortoise derivatives to constrain her partner's erection (via the retraction of the head) and thereby stop him from philandering, a man might use it to

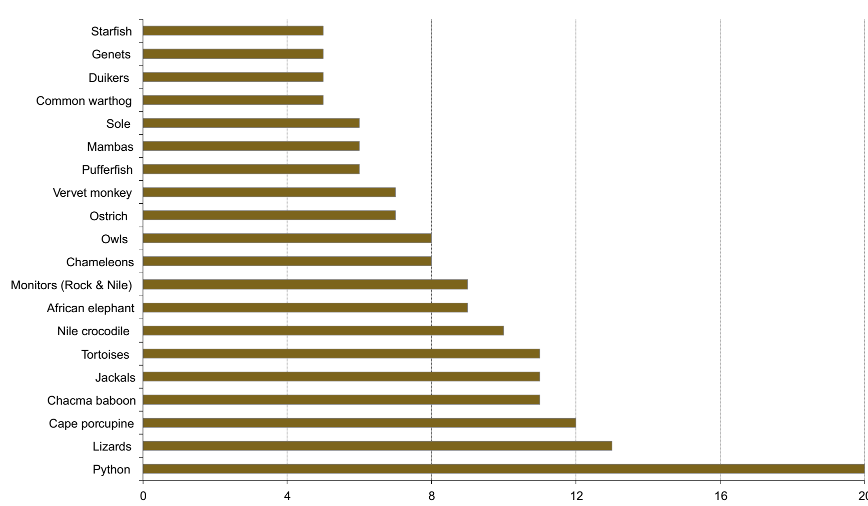

Fig. 3. The number of different use categories attributed to frequently mentioned species and morphospecies (shown for animals with >5 use categories).

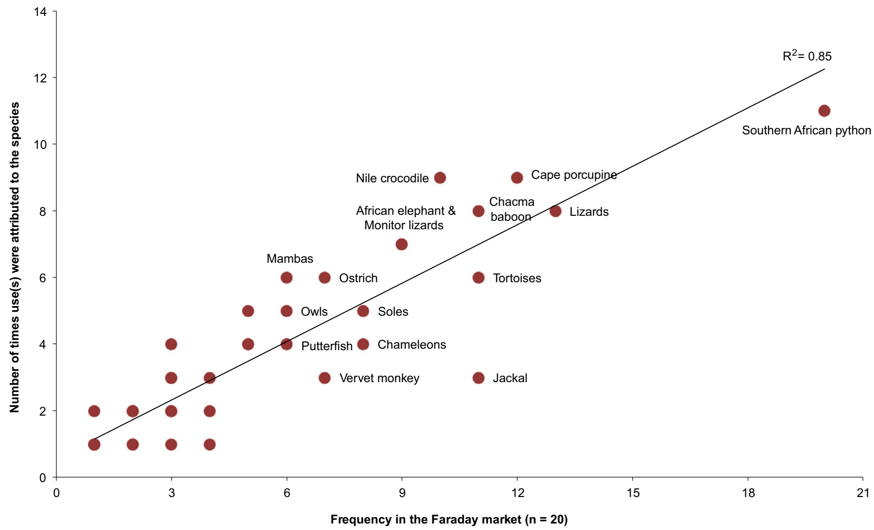

Fig. 4. The frequency with which taxa were present at the stalls of traders in the Faraday market relative to the number of times these traders attributed a use to the animal. Only taxa recorded at the stalls of ≥6 traders are labelled. (n=73 species or morphospecies).

Fig. 5. A picture of health. Word cloud of the uses categories derived from 52 species and 18 morphospecies cited by 20 traders in the Faraday market as being used traditionally. The size of the words is proportional to the number of times the uses were mentioned. Maximum mentions are 'strength' (19 times).

strengthen and elongate his manhood (via the extension of the neck).

The prevailing use of fauna and their parts is also aligned with four other beliefs about animals, namely that they "*are considered to be the agents of witchdoctors, … add power to the muti prepared for a specific purpose, … represent ancestors and … serve as sources of spirits possessed by some traditional healers*" (Simelane, 1996). Traditional healers (especially the diviners or '*sangomas*') are thus important agents in the delivery of allied zootherapeutic treatments.

4.2. Rate of use disclosure

The respondents' sensitivities towards imparting and disclosing information on animal usage and/or their lack of knowledge of the use, are illustrated in their 'no answer' response rates. On average per trader, the percentage of 'no answers' for the species they sold was 55 ± 24% (S.D.; n=20, 0–91%). In other words, traders did not disclose use information for an average of 55% of the species at their stalls. This 'no answer' rate was highest for the *sangomas* (mean=64 ± 4%, n=3), followed by non-healers (mean=61 ± 24%, n=12) and *inyangas* (mean=35 ± 20%, n=5). For traditional healers combined, the mean 'no answer' rate was 46 ± 22% (n=8). There was also a positive linear relationship (r^2=0.40) between the size of the stall and the percentage of 'no answers'; the more species a trader sold, the less likely they were to disclose use information on all the species present and the traders with the largest stalls were generally not traditional healers (Fig. 7). For non-healers, the 'no answers' are most likely because they did not know the uses for all of the species they sold, whereas traditional healers would have been making a deliberate choice not to reveal the information.

At the species level, the 'no answer' rates were higher. On average per species (terrestrial vertebrates only), the percentage of 'no answers' was 86 ± 12% (n=59 species) and ranged from 45% for pythons to 95% for species such as Giraffe and Nyala; in other words, for an individual species an average of 86% of traders did not disclose an answer as to its use. There was also a strong inverse linear relationship (r^2=0.84) between the frequencies of the species in the market (i.e. the number of traders that sold it) and the 'no answer' rate – in other words, the rarer the species was in the market, the greater the proportion of 'no answers' (Fig. 8). Hence, use information was more likely to be documented for commonly sold species. Cunningham and Zondi (1991) also calculated the percentage of no answers per species and found comparably high proportions of traditional medical practitioners who were not prepared to give information on uses for species (mean: 62 ± 25%; sample size: 50 species and 48 respondents)

The lack of responses for species that were uncommon in the market is related to at least two factors: (a) the inherent rarity of the species in the wild, and (b) opportunistically acquired (e.g. road kills) species that are not commonly used and sold. First, there are rare and/or threatened species (such as pangolins and vultures) that are widely known and popular (i.e. quickly sold relative to other species), and for those reasons are not always present in the market and for which few traders divulged information. Second, there were a large number of birds in the market that were only sold by one trader and are likely to be acquired opportunistically rather than deliberately harvested (Whiting et al., 2011); it is unlikely that uses for some of these species are widely known, hence the average non-healer trader is unlikely to hold indigenous knowledge on such species. In the case of rare and highly sought after species, traders are particularly

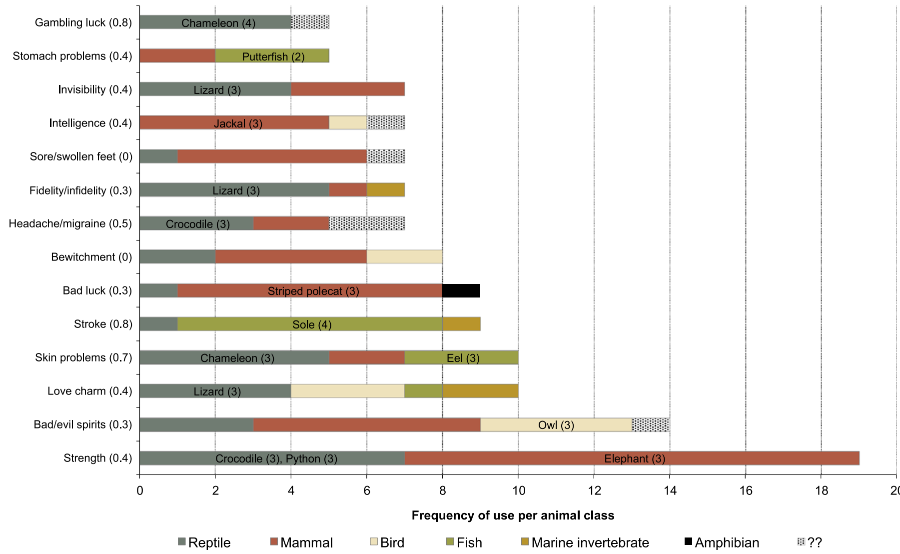

Fig. 6. Number of times animal classes were mentioned for a use category. Species and/or morphospecies mentioned more than three times are labelled in the bars with their frequency of mention. Series with no labelled species or morphospecies had no animal dominant for that use. The Informant Consensus Factor (ICF) values are given in parentheses after each use category on the *y*-axis.

reluctant to discuss their value and use perhaps in part because they know they are protected and illegal to own. There may also be a taboo associated with discussing the uses of particular highly valued species.

The average percentage of 'no answers' for the uses of particular classes of terrestrial vertebrates was lowest for reptiles (74 ± 17%; $n = 11$), yet highest for birds (89 ± 9%; $n = 9$) and mammals (86 ± 38%; $n = 9$). Hence, traders were most likely to divulge the uses of reptiles (such as pythons and crocodiles), but less likely to discuss uses for birds (with the exception of ostriches) and mammals (with the exception of porcupines and baboons). Cunningham and Zondi (1991) also found the proportion of no answers to be highest in birds (74 ± 18%), but lowest for reptiles (62 ± 26%) and mammals (60 ± 25%). One reason that uses for birds are highly likely to result in a 'non answer' is because they are often opportunistically acquired species and a high proportion of them occur infrequently in the market (with the exception of ostriches, owls and a broad spectrum of Falconiformes), hence it is unlikely to find the same species being sold by more than one trader (Whiting et al., 2011) and uses for these uncommon species are not necessarily known by the traders.

4.3. Informant consensus

The degree of heterogeneity and homogeneity in the selection of different animals to treat certain conditions is evident in Fig. 6. The highest degree of informant consensus (i.e. low variation in the number of animals used relative to the number of citations of use) were for strokes, gambling luck and skin problems (ICF values equal to 0.8, 0.8 and 0.7 respectively) (Fig. 6). Thus, there was greater consensus among informants that strokes were best treated using soles (fish), that chameleons were most effective in gambling luck, and that skin problems were best treated with eels and/or chameleons. The lowest degree of informant consensus was for which animals are best used in the treatment of bewitchment and sore/swollen feet (ICF = 0 each); in other words, every species mentioned by an informant for these use categories was different. Consensus was also low for species most effective

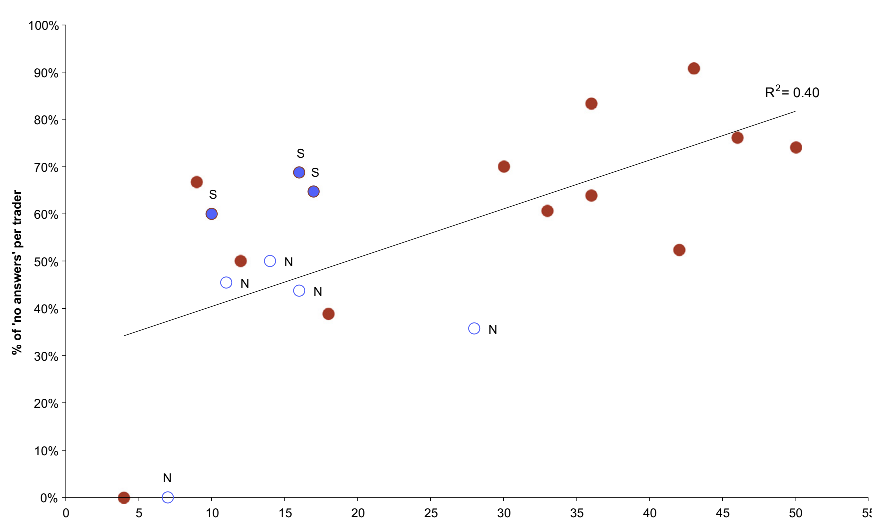

Fig. 7. The number of species sold per trader relative to the percentage per trader that provided 'no answer' as the use. Data points labelled 'S' indicate that the trader was a '*sangoma*' (a traditional healer equivalent to a diviner), whereas data points labelled 'N' indicate that the trader was an '*inyanga*' (a traditional healer equivalent to a herbalist). All other non-labelled data points indicate that the trader was not a traditional healer.

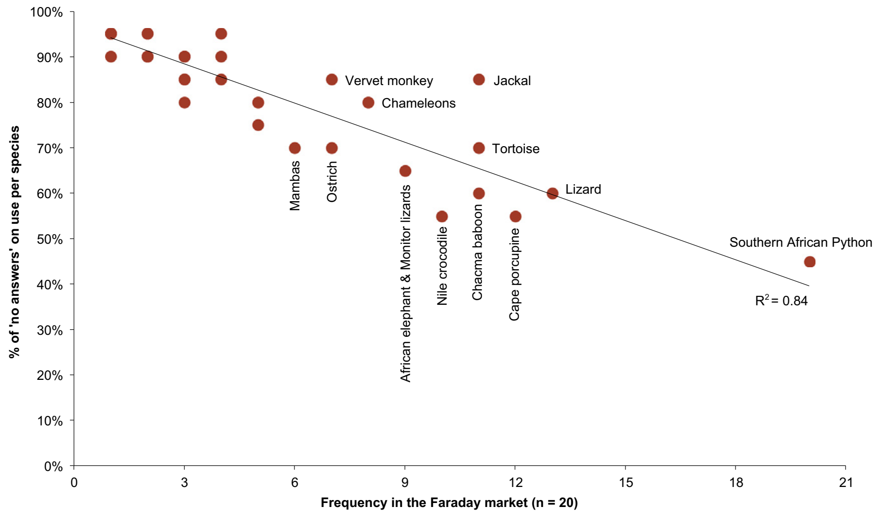

Fig. 8. The frequency with which taxa were present at the stalls of traders in the Faraday market relative to the percentage of traders that provided 'no answer' for the uses of the species they sold. Only taxa recorded at the stalls of ≥6 traders are labelled. (n=59 species or morphospecies).

for treating bad luck, warding off evil spirits, and for curing infidelity in one's partner (ICF=0.3 each).

4.4. General

Zoothereapeutic practitioners are, it seems, open to adapting old treatments for new circumstances and adopting new treatments and signatures to address new and perhaps not-so-traditional needs by consumers. Examples include the use of the Common Warthog (*Phacochoerus africanus*) to create fame and be liked by people, which might stem from the worldwide fame of the highly likeable character *Pumbaa* in the animated film the *Lion King* (one of the highest-grossing animated films of all time). Or, the use of Giraffe (*Giraffa camelopardalis*) parts to obtain a high-up corporate position (in a traditional setting, however, this could be related to obtaining a higher-up position within the tribal authority). Or, the reported use of marine sole fish wiped on the legs of soccer players to help them slip past the opposition.

These remedies are used or applied by the consumer in a number of ways. Animal parts are only sometimes ingested (e.g. octopus tentacles), but more often they are rubbed or wiped on to the skin, burned, sniffed/inhaled, sprinkled, applied topically, sprinkled around the home, worn (e.g. animal skin worn as a wrist band for strength), or wiped inside a cooking pot (e.g. giant land snails to get people to reveal their secrets – akin to emerging from hiding). These modes of treatment therefore do not always explicitly endanger consumers if the animals that are used are harvested through poisoning events (such as raptors, especially vultures, e.g. Williams et al., 2014).

5. Conclusion

"*Animals and traditional healing are inseparable*" (Simelane, 1996), and the selection of species involves layers of anthropological, ecological, behavioural and phenotypic complexity (Williams et al., 2014). And, whatever reasons are behind the selective use of animals, and no matter how trivial or ridiculous these remedies may sound to some, the zootherapeutics trade has led to the targeted harvesting and exploitation of species that puts their long-term population survival prospects into jeopardy. For fauna that are especially popular, threatened, range-restricted, habitat-specific and/or have small population sizes, the risks are high for localised or regional extirpations and thus appropriate conservation interventions are advised. It seems that reptiles are a group most at risk – however, large avifauna such vultures (not frequently mentioned in this study) are also under threat (Williams et al., 2014). For the sector of South African society for whom animal-based traditional medicines are acceptable, these risks need to be viewed in light of what ails/troubles the community and thus what therapeutic approaches they may seek to treat these conditions.

Our study indicates that there is value to analysing uses irrespective of the species, and similarly analysing the species irrespective of their uses, in order to focus on and assess aspects of social health and well-being and the species most likely to be threatened by constant trade. Furthermore, uncoupling the use from the species also makes one mindful of the way in which indigenous use information is reported and shared. We are cognisant of the value of documenting and preserving important indigenous knowledge and presenting uses in conjunction with the species (e.g. for the purposes of exploring inter-cultural differences in indigenous knowledge). However, we also have an ethical responsibility to respect and safeguard the wishes of the indigenous knowledge holders who do not unanimously wish for this information to be lodged in the public domain and who have, in our experience, become progressively averse to sharing this sensitive cultural, and often sacred, information (which is also illustrated by the high percentage of 'no answers' in this study). Herbert et al. (2003) wrote about this sensitivity when, in describing their survey of a *umuthi* market in KwaZulu-Natal, they acknowledged that questions relating to the medicinal use of animal products were purposely omitted because the committee members of the market "*considered that this was a controversial issue, which traders might view as compromising their livelihoods and intellectual property rights*". What's more, the market committee members "*felt that knowledge regarding the use of such products ought to be kept, as far as possible, in the hands of trained practitioners only*". We therefore see our decision to present the uses separately from the species as an equally valuable (albeit alternative) perspective and compromise which, while still putting some information in the public domain, does not detract from its worth. Furthermore, this data sharing compromise still recognises the position and intellectual property rights afforded to the holders of the indigenous knowledge.

In our survey, the most frequently cited benefit of using animals was to acquire 'strength'. It is especially pertinent to ask if this is because people are feeling socially powerless, insecure and impotent in some way and that they have no way of addressing these weaknesses and gaining control except via symbolic medicines? Likewise, are traditional medicines aimed at predicting lottery numbers a sign of a gambling problem, or pervading household privation? Similar questions should be asked of the other uses identified in the 'picture of health'. Our study in no way addresses these important social issues but it does highlight the need to take a multifaceted approach to understanding the reasons people use traditional medicine for symbolic purposes. We need to know the relative contributions of simple cultural transmission versus socio-economic and societal pressures. Future studies of this nature will go a long way in helping understand key health and social issues, and ameliorating any negative impacts on the consumers and the animals that are being exploited.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jep.2015.12.024.

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