Importance value of landscapes, flora and fauna to Tsonga communities in the rural areas of Limpopo province, South Africa

Brandon P. Anthony[a*] and Edward G. Bellinger[b]

Many parts of the former homeland areas of South Africa are believed to be experiencing environmental scarcity, and are increasingly vulnerable to resource over-exploitation. Frequently, these areas are adjacent to formally protected areas and present unique challenges in integrating biodiversity conservation and sustaining livelihoods, especially for resource-dependent rural communities. Although studies have been undertaken on the use of various plants by Tsonga communities, and the economic value of specific taxa, no investigation on the relative importance value that considers both wild flora and fauna, together with landscapes, has been carried out previously in the former Gazankulu homeland. We used a weighted ranking exercise for nine focus groups within three rural villages bordering the Kruger National Park, which are largely dependent on wild resources, to assess the relative importance of landscape units and species-level biodiversity. Landscape units, particularly forest/bush and river/stream, were found to be extensively used in meeting community needs, across a range of resource use categories including maintaining socio-cultural norms. Moreover, landscape units vary among villages and age/gender regarding how they contribute to sustaining livelihoods. In total, 162 taxa were identified, with two taxa (*Sclerocarya birrea* subsp. *caffra*; *Ficus* spp.) exploited in up to seven use categories. *Sclerocarya birrea, Combretum imberbe* and *Colophospermum mopane* were the most highly valued species among those surveyed, contributing 22% to the overall value of wild flora and fauna in the area. Of those identified, 28 faunal (60%) and 10 floral (8.7%) taxa are listed in either IUCN, national or provincial protected species schedules. Based on combined Local Users Value scores, over 20% of all biodiversity value for local communities comes from protected tree species. Similarly, faunal taxa with enhanced protection constitute almost 12% of all local biodiversity value. In developing strategies for resource conservation, it is necessary to recognize this widespread use of the natural environment and the wild products, including those under formal protection, exploited by local people.

Introduction

It has been postulated that many parts of the former homeland areas of South Africa experience environmental scarcity,[1] and are increasingly vulnerable to resource over-exploitation, driven largely by socio-economic and demographic factors.[2,3] This exploitation of resources is to satisfy both subsistence and commercial demands for a myriad of purposes including as food, drink, fuelwood, and medicine.[4–8] Many of the former homeland areas in South Africa border formally protected areas[2] and it is believed that conserving biodiversity in these parts supports wildlife populations within them.[9–11] Thus, land use adjacent to protected areas, including the Kruger National Park (KNP), is of concern to biodiversity conservation objectives, particularly where new activities, including community-based initiatives, are planned.

Apart from understanding the pressures on resources, there is also a growing literature on the cultural and spiritual values of biodiversity and landscapes[12,13] and the links between cultural and biological diversity.[14,15] Thus, understanding local perceptions of the use and value of both biodiversity and landscapes, and what variables affect these perceptions, can be important in shaping environmental management schemes.[16] More comprehensive and participatory local valuations in understanding what species are used for what purposes can help in identifying conservation targets in community-based initiatives, and can inform planners about specific resource needs.

Both national and provincial legislation has recently been promulgated, in part to address excessive resource exploitation. Knowledge of this legislation, however, especially in rural communal areas, is uncertain and enforcement is hampered by difficulties associated with a transitional democracy and limited capacity.[17,18]

Although studies have been undertaken on the use of various plants by Tsonga communities,[19–22] and of the economic value of specific taxa in rural South Africa,[3,8,23–27] no investigation of their use and relative importance that compares both wild flora and fauna, nor in terms of landscape units, has been carried out previously in the former Gazankulu homeland. Moreover, although there is some information on how gender or age may influence perceptions of the importance of natural resources,[28] this aspect has not been investigated in the study area. Our purpose was to address this research gap and assess the relative importance of landscape units and species-level biodiversity to communities bordering the KNP, who are largely dependent on wild resources.

Methods

Study area

Fieldwork was conducted in three rural Tsonga villages within the former Gazankulu homeland, adjacent to the western border of the KNP in the Greater Giyani and Thulamela municipalities of Limpopo province (Maphophe: 22°48′59″S; 30°54′36″E; 465 m a.s.l.; Peninghotsa: 23°01′15"S; 30°50′14″E; 451 m a.s.l.; Ndindani: 23°23′14″S; 30°57′39″E; 404 m a.s.l.). Peninghotsa lies approximately 12 km south of Maphophe and 37 km north of Ndindani. The study area is located within the Shingwedzi and Letaba river catchments, experiences a mean annual precipitation of 440–560 mm, and is characterized by slightly undulating plains containing villages with built-up land, surrounded by areas for subsistence farming.[29] However, there remain relatively sizeable vacant, bushland areas with biodiversity largely intact, especially between the Shingwedzi and Klein Letaba rivers.[30] Vegetation consists primarily of *Colophospermum mopane* and *Combretum* spp. woodlands.[31]

The communities in the study area experience high unemployment, poor infrastructure, and a slightly lower proportion of

[a]Environmental Sciences and Policy Department, Central European University, Nádor u. 9, Budapest, Hungary.
[b]School of Biological Sciences, University of Manchester, Oxford Rd, Manchester, M13 9PL, U.K.
*Author for correspondence. E-mail: anthonyb@ceu.hu

males to females in the population, especially in age classes >30.[18] Livelihoods are primarily land-based and consist of arable agriculture, animal husbandry, and harvesting of natural resources.

Pebble Distribution Method

To gain an understanding of the importance of landscape units and biodiversity, which captures local priorities and avoids complex quantification, the Pebble Distribution Method (PDM) was employed, which is a weighted ranking exercise used within focus groups.[32] Although focus group results cannot be generalized to larger populations, they are useful in understanding how particular social groups interact with and perceive natural resources.[33] Like other forms of focus groups, PDMs have the advantage that they i) are socially orientated and so inhibitions can be relaxed in a group format, ii) are flexible in that they allow the moderator to probe unexpected issues, iii) have high face validity, especially to participants, and iv) are relatively low-cost and quick.[34] Quantitative results obtained through PDMs are useful in that they can be used to identify patterns and, perhaps more importantly, are particularly valuable in stimulating dialogue among participants regarding their perceptions of the importance of local biodiversity. Moreover, the relatively structured process whereby participants are led step-by-step through the exercise minimized potential disadvantages of employing focus groups, namely the loss of control by the researcher, and encountering lethargic and unresponsive participants.[34]

To encourage equal participation and to keep the composition of the group as homogeneous as possible, groups ranged from six to 10 members. As we were interested in comparing differences across gender, age, and villages, the focus groups were representative of: (1) high school students (both sexes)/men ≥ 35 years of age/women ≥ 35 years of age; and (2) the villages Maphophe, Peninghotsa, and Ndindani.

In total, nine PDM focus groups were investigated from August to September 2004. The PDMs involved 58 participants including 18 high school students (9 male; 9 female; mean age 17.6 years; range 15–20 years), 22 men ≥ 35 years of age (mean age 52.7 years; range 35–89 years) and 18 women ≥ 35 years old (mean age 43.8 years; range 36–60 years, with two ages unknown). In each case, local traditional authorities were approached for permission to conduct the exercises and in appointing suitable persons to invite participants and assist with the exercise. The assistant served to brief the researcher on cultural norms inherent in small group meetings,[35] help coordinate the discussion and to translate. All PDMs lasted 3–4 hours each and were conducted in a building chosen by the traditional authorities. Plant and animal taxa were identified using field guides,[36–43] species lists[19,20,44,45] and assistants/participants who knew the English common names. Where there were inconsistencies regarding taxon names and field guides could not help with identification, samples were brought in for clarification. If doubt remained, or samples were unavailable, taxa lists included a '?' for doubtful-but-likely names, and corresponding English or Latin nomenclature was left blank if there was no consensus on identification (see Appendix as supplementary material online).

Table 1. Landscape units identified and compared in PDM groups.

English	Tsonga–Shangaan
Village	*muti*
Household/community garden	*xirhapa*
River/stream	*nkova*
Lake/dam	*damu/qhivi*
Swamp/marsh	*xibawa/xibodhlo*
Cultivated fields	*masimu*
Grazing area	*dyelo/mariso/marisweni*
Forest/bush	*xihlahla/nhova/khwati*

In the three stages of the exercise, participants were required to distribute 100 counters (in this case, beans) between labelled cards indicating i) landscape units, ii) resource use categories, and iii) species, in proportion to their 'importance'. It was assumed that importance in this case was expressed not so much in economic terms, but rather as a more holistic rating of relative preferences. In the first stage of the exercise, participants were asked as a group to assess, by distributing the beans among eight cards labelled with specific landscape units (Table 1), the relative importance of these units in meeting their livelihood needs, considering all resource use categories described in Table 2.

Secondly, participants were required to assign a relative weighting to each of the resource use categories according to how important these elements are in sustaining livelihoods. At this stage of the exercise, respondents were reminded to think about not only immediate individual needs, but also those of the entire community and throughout the year. The mean relative importance values of both landscape units and resource categories were then multiplied to provide a weighted landscape unit importance score. Importance values for each landscape unit and use category were compiled for all three age/gender groups across the three villages, and mean scores calculated using SPSS (version 13). One-way ANOVA was employed to test whether there were differences between mean scores of the various landscape units according to a) village and b) age/gender. If significant differences were found, Tukey's HSD post hoc tests were then used to determine which means differed.

After assessing the importance of landscape units, the final stage elicited information about local importance of specific wild taxa through a hierarchical weighting procedure. This form of the PDM assumes that the scores of 'importance' are additive

Table 2. Description of identified resource use categories.

English	Tsonga–Shangaan	Description
A. Food – wild flora & fauna	*swakudya /swihari/swinyenyana/nhlampfi*	Primary and secondary food from wild plants and animals; famine food (incl. wild fruits, honey, wild birds, fish, game, etc.)
B. Drink	*xakunwa*	Drinks/teas/beer/wine made from wild plants
C. Fuelwood	*tihunyi*	Used for fire
D. Medicine	*murhi/timintsu/ntsembyani*	Medicinal and health-related
E. Construction	*swoaka/mhandze*	Plant parts used for building huts, fences, kraals
F. Utensils & tools	*xitirho*	Plant parts used for tools in agriculture, utensils
G. Ornaments/religious	*xiambalo/nguvu/-khavisa/-vugandzeri*	Wild plant and animal parts used in ceremonial, dress, jewelry, musical instruments
H. Recreation	*ku wisa/ku hefemula*	Resources used for recreation, games, fun

and can be subdivided through a hierarchy of increasing resolution, ultimately including species-level information. These assumptions are formalized within the context of decision making and priority theory.[46] Moreover, to keep species lists manageable, they were limited to the 10 most important taxa for each resource use category.[32] This limitation constrains the study results concerning the breadth of resource use by local communities, although it still allows assessment of the most important taxa used. To discern the relative importance of specific floral and faunal species for food, wild flora and fauna were treated separately in this component of the PDM, and thus represented a third level in the hierarchy for this resource use category.

At the lowest level, the importance of a *category of use* (*c*) of a *species* (*s*) is represented as an individual user value U_{sc}. The importance of a species is the sum of all a species' U_{sc} values, and can be calculated with the following Total Combined Local User's Value (LUVct) equation:[32]

$$\text{LUVct} = \sum_{s = \text{species, for all } c} U_{sc} .$$

The direct approach to using PDMs is that each U_{sc} can be weighed directly within a grouped comparison; that is, a comparison is made within each class to weigh each U_{sc} as a series of exercises, and then the classes themselves were compared in one exercise. Ordering in this manner (lower before higher) ensured that the respondents had reflected upon the true composition of each class. It was also important that species were ranked according to the class of value (not their total value), when they had more than one use. U_{sc} values for all species and resource categories were compiled from all three age/gender groups across the three villages, and combined to provide a list of LUVct scores. Linear regression analysis was then used to compare these scores between resource use categories and flora and fauna categories.

At the conclusion of each PDM session, all participants received a free lunch and a small gift for their willingness to participate in the exercise. PDM field assistants also were provided with a free lunch and remunerated. Moreover, after each set of focus groups for each village, the local traditional authority received a copy and brief explanation of the results.

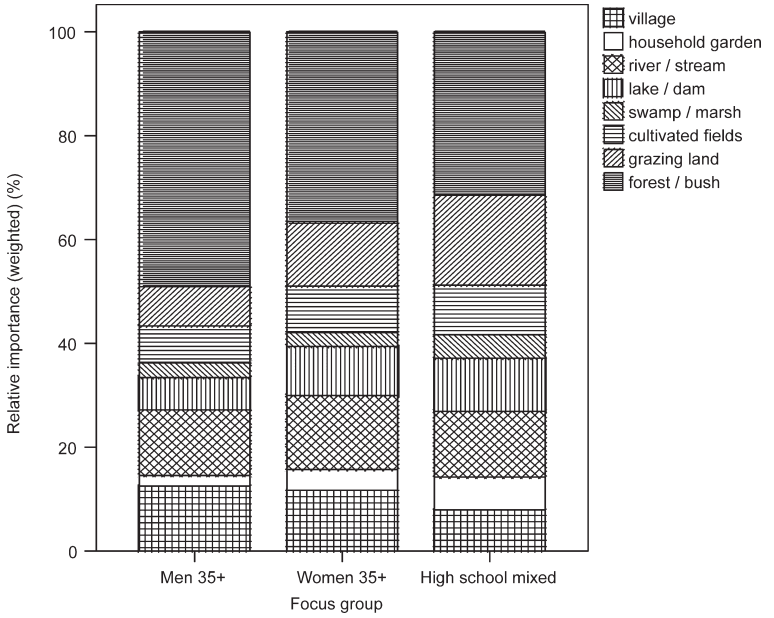

Fig. 1. Weighted relative importance of various landscape units to community livelihood per age/gender group.

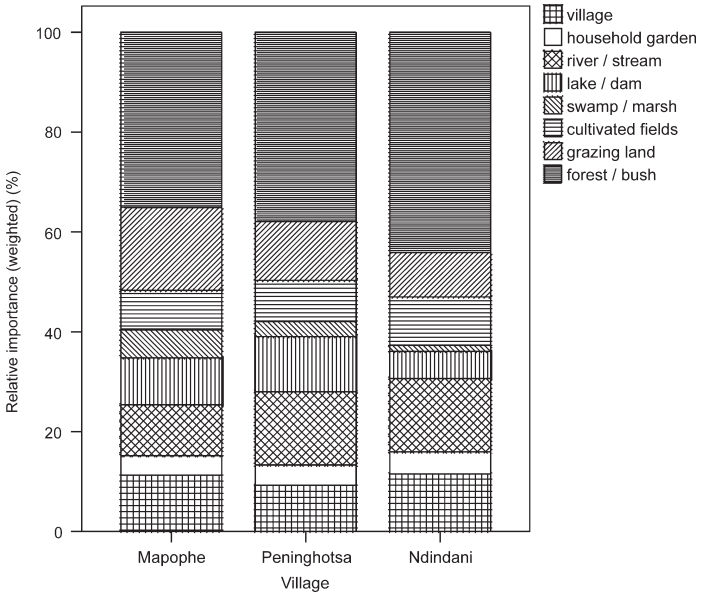

Fig. 2. Weighted relative importance of various landscape units to community livelihood per village.

Results

Landscapes

The two primary factors which this study addressed with respect to importance of landscape unit was the relative role that landscape units play in fulfilling a community's livelihood needs and how importantly each of the resource categories is believed to contribute to a community's overall well-being. The mean relative importance values of both landscape units and resource categories were multiplied to provide weighted landscape unit importance scores for each age/gender group (Fig. 1) and village (Fig. 2).

A significant difference was found between village scores for the swamp/marsh category ($F = 5.05$, $P < 0.01$), and this difference lay between Maphophe and Ndindani (mean difference = 4.51, s.e. = 1.43, $P < 0.01$). This difference is further explained by analysing the mean percentage importance of various use categories towards the swamp/marsh unit, before factoring for the relative weight of resource use categories. Figure 3 shows that Maphophe village uses swamp/marsh significantly more than the other two sites for three categorical uses, namely drink, utensils and tools, and ornamental and religious purposes.

Likewise, a significant difference in means was found between age/gender groups with respect to grazing land ($F = 3.99$, $P < 0.05$), specifically between the men older than 35+ and high school mixed groups (mean difference = 9.73, s.e. = 3.45, $P < 0.05$). To determine the source of this difference in terms of resource use categories, observed mean percentage scores for the high school mixed group were higher than both the men 35+ and women 35+ groups for all but the 'ornamental/religious' use category (Fig. 4).

Finally, to understand the overall relative importance for all landscape units and resource use categories identified in the PDM exercises, mean values for both village and age/

gender groups were combined. Figure 5 summarizes this analysis and, in the last column, also illustrates the total relative importance of each landscape unit to sustaining livelihoods in the three villages studied. The relative importance of forest/bush and river/stream habitats are especially high, as these contribute 39% and 13%, respectively, in terms of importance, in supplying wild natural resources necessary to sustain local communities.

Flora and fauna

The final component of the PDM exercises involved asking participants to list a maximum of 10 most important species/taxa they knew to be used locally for each of the eight resource use categories. They were then instructed to assess the relative importance of each of these species/taxa to the specified resource use. A list was then compiled including LUVct scores of all nine PDM exercises for each species/taxa, across all resource use categories (see Appendix).

In total, 162 taxa were identified, with 94 taxa being used in one use category and two taxa used in up to seven categories (marula, *Sclerocarya birrea* subsp. *caffra;* fig, *Ficus* spp.). Marula, leadwood (*Combretum imberbe*), and mopane (*Colophospermum mopane*) were the most highly valued species among the PDM participants, contributing 22% to the overall value of wild flora and fauna in the area. Indeed, over one half of local biodiversity value is tied up in only 18 taxa, comprising 16 floral and two faunal species (mopane caterpillar, *Imbrasia bellina;* leopard, *Panthera pardus*). Of particular note are mopane caterpillar and blue buffalo grass (*Cenchrus ciliarus*), which, although exploited in only one resource use category, are exceptionally highly valued locally, with LUVct scores of 0.020 and 0.012, respectively.

Correlation between LUVct scores and number of resource categories (ResCat) defined was highly significant ($r = 0.73$, $P < 0.001$, $n = 162$). The relationship between LUVct values and ResCat, grouped by kingdom, and more highly valued species, are shown in Fig. 6.

Although 115 floral and 47 faunal species were identified as being exploited by communities within the study area, the study's limitations (see Methods) imply that this number likely represents only a fraction of the total species used. Of the taxa identified in this study, 28 fauna (60%) and 10 flora (8.7%) are listed in either IUCN, national or provincial protected species schedules (Table 3). Based on LUVct scores, over 20% of all biodiversity value for local communities are derived from protected tree species, including the IUCN endangered pepperbark tree (*Warburgia salutaris*). Similarly, faunal taxa with enhanced protection constitute almost 12% of all local biodiversity value. More noteworthy cases include four mammals classified as vulnerable by the IUCN, namely the cheetah (*Acinonyx jubatus*), African elephant (*Loxodonta africana*), sable antelope (*Hippotragus niger* subsp. *niger*) and lion (*Panthera leo*).

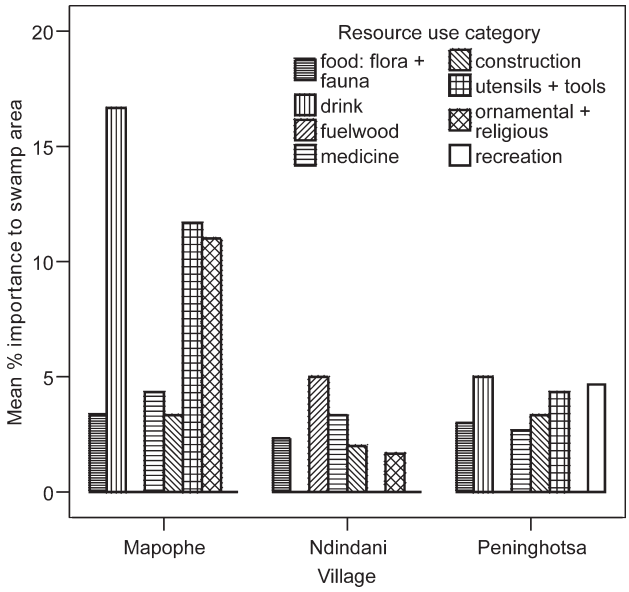

Fig. 3. Mean percentage importance by community of various resource use categories fulfilled by the swamp/marsh landscape unit.

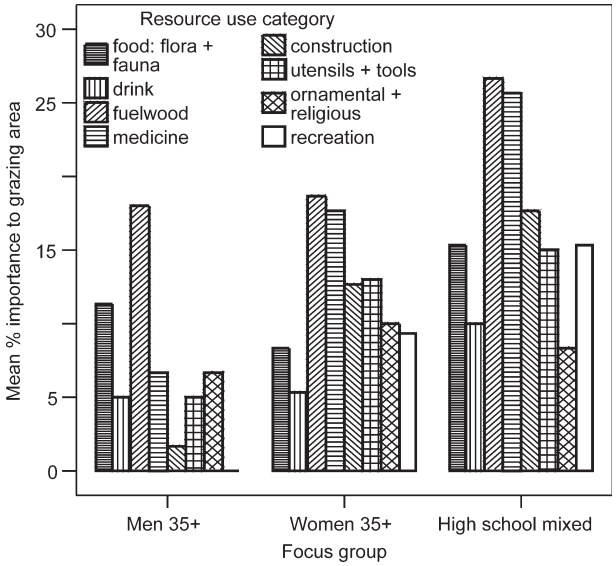

Fig. 4. Mean percentage importance by age/gender group of various resource use categories fulfilled by the grazing area landscape unit.

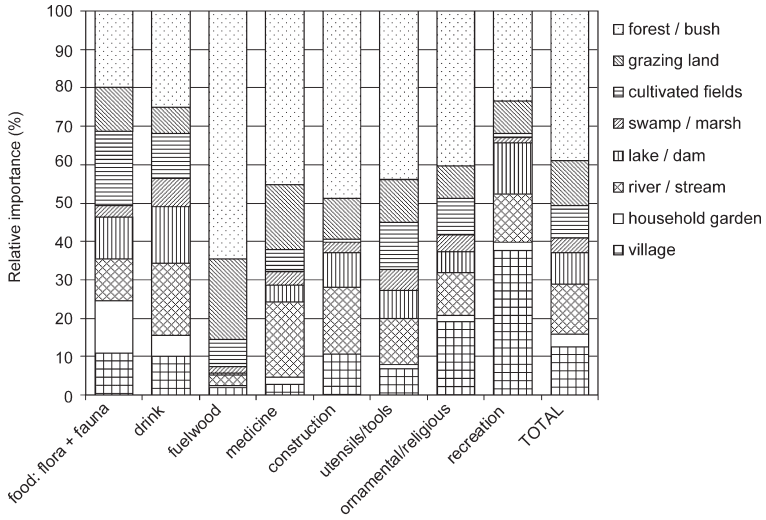

Fig. 5. Combined relative importance assigned to landscape units per resource use category for Maphophe, Peninghotsa and Ndindani villages.

Table 3. Species identified in PDMs as being collected/used by local communities and under enhanced protection according to IUCN and/or national legislation. LUVct scores are provided to indicate relative value to overall livelihood.

Flora						
English	Latin	National Forests Act 1998[a]	IUCN classification[b]	LEMA 2003 Classification[c]	LUVct score	
Baobab	*Adansonia digitata*	protected		protected	0.00102	
Pod mahogany	*Afzelia quanzensis*	protected			0.00640	
Green thorn/torchwood	*Balanites maughamii*	protected			0.00093	
Yellow peeling plane	*Brackenridgea zanguebarica*			protected	0.00480	
Variable bushwillow	*Combretum collinum* subsp. *taborense*			protected	0.00448	
Leadwood	*Combretum imberbe*	protected			0.06836	
Zebra-wood	*Dalbergia melanoxylon*		lower risk; near threatened (1994)		0.01002	
Marula	*Sclerocarya birrea* subsp. *caffra*	protected			0.09591	
Tamboti	*Spirostachys africanus*			protected	0.00531	
Pepper-bark tree	*Warburgia salutaris*	protected	endangered (1994)	protected	0.00280	
Sub-total					0.20003	

Fauna						
English	Latin	IUCN classification[d]	IUCN classification[b]	LEMA 2003 Classification[c]	DEAT 2005 Draft List[e]	LUVct score
Mammalia						
Cheetah	*Acinonyx jubatus*	vulnerable	vulnerable (2001)	protected	vulnerable	0.0010
Impala	*Aepyceros melampus*	least concern	lower risk; conservation dependent (1994)	game		0.0110
Side-striped jackal	*Canis adustus*	near threatened	least concern (2001)	protected		0.0003
Caracal	*Caracal caracal*	least concern	least concern (2001)	game	protected	0.0015
African civet	*Civettictis civetta*	least concern	lower risk; least concern (1994)	protected		0.0003
Spotted hyena	*Crocuta crocuta*	near threatened	lower risk; conservation dependent (1994)	protected	protected	0.0046
Plains zebra	*Equus burchelli*	least concern	least concern (2001)	game		0.0040
African wild cat	*Felis silvestris*	least concern	least concern (2001)	protected		0.0006
Sable antelope	*Hippotragus niger* subsp. *niger*	vulnerable	lower risk; conservation dependent (1994)	protected		0.0032
Serval cat	*Leptailurus serval*	near threatened	least concern (2001)	protected	protected	0.0010
Scrub hare	*Lepus saxatilis*	least concern	lower risk; least concern (1994)	game		0.0056
African elephant	*Loxodonta africana*	least concern	vulnerable (2001)	specially protected		0.0071
Honey badger	*Mellivora capensis*	near threatened	lower risk; least concern (1994)	protected	protected	0.0014
Lion	*Panthera leo*	vulnerable	vulnerable (2001)	protected	vulnerable	0.0033
Leopard	*Panthera pardus*	least concern	least concern (2001)	protected	vulnerable	0.0154
Steenbok	*Raphicerus campestris*	least concern	lower risk; least concern (1994)	protected		0.0110
Common duiker	*Sylvicapra grimmia*	least concern	lower risk; least concern (1994)	game	protected	0.0079
Cape buffalo	*Syncerus caffer*	least concern	lower risk; conservation dependent (1994)	protected		0.0107
Bushbuck	*Tragelaphus scriptus*	least concern	lower risk; least concern (1994)	game		0.0015
Kudu	*Tragelaphus strepsiceros*	least concern	lower risk; conservation dependent (1994)	game		0.0089
Sub-total						0.1002
Aves						
Korhaans	*Eupodotis* spp.			various levels depending on species		0.0009
Falcons/hawks	*Falconidae/Accipitridae*			various levels depending on species		0.0006
Francolins	*Francolinus* spp.			game		0.0016
Helmeted guinea-fowl	*Numida meleagris*		least concern (2001)	game		0.0049
Hornbills	*Tockus* spp.			protected		0.0022
Sub-total						0.0102
Amphibia/Reptilia						
African rock python	*Python sebae*			protected		0.0039
African bull frog	*Pyxicephalus adspersus*		least concern (2001)	protected	protected	0.0011
Leopard tortoise	*Testudo pardalis*			protected		0.0017
Sub-total						0.0067
TOTAL						0.3170

[a] *Government Gazette* Notice 1012 of 27 August 2004, National Forests Act No. 84 of 1998.
[b] IUCN (2004). *IUCN Red List of Threatened Species*. Online: http://www.redlist.org
[c] Limpopo Environmental Management Act No. 7 of 2003.
[d] Friedmann Y. (Ed.)(2004). *Red Data Book of the Mammals of South Africa: a conservation assessment*. Endangered Wildlife Trust and CBSG (IUCN/SSC).
[e] DEAT (2005). Draft lists of threatened and protected species issued in terms of Section 56(1) of National Environmental Management: Biodiversity Act 2004 (publ. 18.02.2005).

Discussion

Landscapes

The following inferences can be drawn from results concerning landscape importance. First, almost exclusively, all eight landscape units identified contribute to each resource use category in some way. The only exception of the possible 64 combinations was that the household garden was not reported by any group to contribute to construction needs. In instances of food and drink derived from wild resources, all landscape units play equally crucial roles. It is essential to recognize this widespread use of the natural environment and the wild products exploited by local people: even seemingly insignificant features of the landscape contribute to sustaining livelihoods. Moreover, by understanding how elements in the landscape contribute to sustaining livelihoods, conservation education can focus on the

importance of these areas and the need to preserve, maintain and extend these landscapes for mutual benefits. For example, efforts targeted at maintaining wetland habitats where *Phragmites* species grow can be based on both environmental services (such as water purification and wildlife habitat) and livelihood needs including construction, utensils and tools, ornamental and religious, and recreation (see Appendix). Policies which recognize the multiple uses and benefits of both landscape units and their species are more likely to be adopted by local collectors and users.

Second, although uniform in many respects, villages and age/gender groups vary regarding the perception of how landscape units contribute to sustaining livelihoods. For example, Maphophe village probably makes use of swamp/marsh habitats more than the two other villages because of the close proximity of the large Makuleke dam and its associated marshes located to the south. Prominent features of the landscape, including large dams, have multiple benefits in not only ensuring water supplies, but also in providing habitats conducive to hydrophytic plants, which can be used for food and medicine. A second example concerns the difference between men older than 35 and mixed high school groups with respect to grazing land. This may be explained by considering distinct divisions of labour among men, women and children. Children of high school age are often employed in livestock herding/caretaking in rural areas and thus will spend on average more time in grazing areas than other groups. This greater time may account for their perception that this landscape unit holds relatively greater importance in fulfilling community needs. Divisions of labour are characteristic of traditional societies and often result in corresponding divisions of space within the cultural landscape and, thus, to its interpretation.[16] These observations underscore the need to acknowledge inter- and intra-village differences with respect to the use of natural resources, and emphasize the fallacy of considering groups of villages, or even individual villages, as single homogeneous units when devising conservation schemes.

Third, the high relative importance of forest/bush and river/stream habitats in supplying wild natural resources necessary to sustain local communities must be appreciated. If ignored, growing threats to these habitats, such as from agricultural and residential expansion, over-extraction of water resources, and unsustainable harvesting of fuelwood,[18] may affect livelihoods adversely.

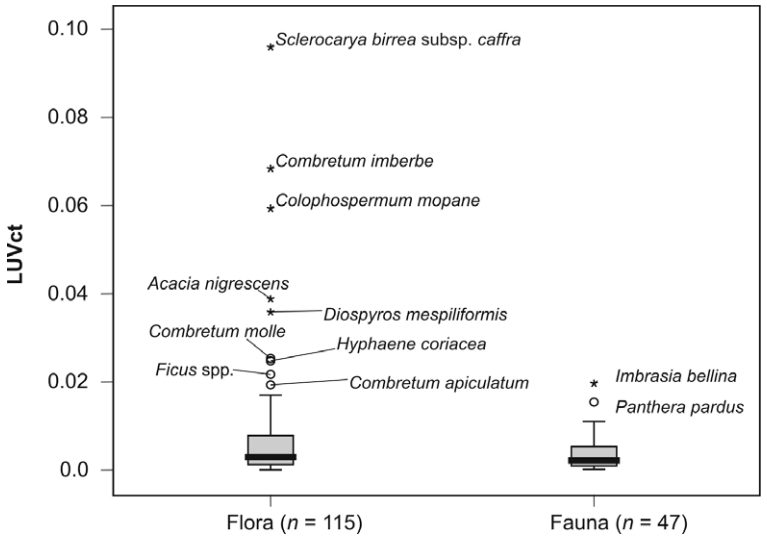

Fig. 6. Boxplot showing relationship between Local User's Value (LUVct) of flora and fauna taxon identified in PDM focus groups.

Flora and fauna

Local realities and externally defined priorities often differ with respect to the way that biological diversity and resources used by local communities are defined and valued. Economic analyses of biodiversity may concentrate on global values and nominal foreign exchange rates[47,48] and little on household uses, resulting in biased conventional resource planning in favour of major food crops and plants of commercial importance.[49] Our results indicate that the local flora, including some highly valued taxa, may be more widely used for more purposes and be more highly valued than local fauna. This may be because of the absence of, or at least the limited availability of, large-bodied mammals, for instance (such as leopards, elephants, lions and buffalo) outside formally protected areas. It also affirms that many species are important for non-conventional purposes, including maintaining socio-cultural norms. The value of species goes far beyond traditional uses such as for food, drink, fuelwood and medicine. Consequently, these values should be appreciated in designing and implementing conservation policies. Moreover, the scoring of resource importance employed in research such as this provides only a static picture of current conditions. Further studies are needed to capture the dynamic nature of resource use, and how it may respond to changes in relative species abundances and economic conditions.

Of all the taxa identified, almost one quarter is listed in international, national or provincial protected species schedules. In addition to acknowledging simply the number of protected species exploited, however, it is essential to understand how important these species are to local users. Our study shows that more than 20% of all local biodiversity value is derived from protected tree species and almost 12% comes from fauna with enhanced protection. This translates into approximately one-third of all local biodiversity value deriving from species with enhanced protection. The levels of formal protection afforded these species are not well understood by local communities, potentially causing conflicts between resource collectors/users and those mandated to ensuring its legal protection. Unsustainable exploitation of these species, where it occurs, represents a grave threat to sustaining viable populations and, consequently, to associated benefits to local livelihoods. Enforcement of species protection is minimal at best, and local knowledge of formal nature protection is poor, so there is a need for expanded research that includes assessing current patterns of harvesting protected species within the study area. The situation also demands that the KNP (SANParks) and other conservation agencies improve efforts to convey the message that specific local biota be afforded formal protection.

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Supplementary material to:

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Appendix: List of all taxa identified through PDMs, including categories of use and Total Combined Local User Value scores (LUVct).

	Tsonga–Shangaan	English	Latin	Food	Drink	Fuelwood	Medicine	Construction	Utensils & tools	Ornaments & religion	Recreation	TOTAL	LUVct
1	*nkanyi*	marula	*Sclerocarya birrea* subsp. *caffra*	1	1	1	1	1	1		1	**7**	0.0959
2	*mondo*	leadwood	*Combretum imberbe*			1	1	1	1	1	1	**6**	0.0684
3	*xanatsi*	mopane	*Colophospermum mopane*			1	1	1	1	1	1	**6**	0.0593
4	*nkaye*	knob thorn	*Acacia nigrescens*			1	1	1	1		1	**5**	0.0388
5	*ntoma*	jackal berry	*Diospyros mespiliformis*	1		1	1	1	1		1	**6**	0.0358
6	*xikukutsi*	velvet bushwillow	*Combretum molle*			1	1	1	1			**4**	0.0253
7	*lala*	lala palm	*Hyphaene coriacea*		1			1			1	**3**	0.0248
8	*makuwa*	fig	*Ficus* spp.	1	1	1	1		1	1	1	**7**	0.0217
9	*matamani*	mopane caterpillar	*Imbrasia bellina*	1								**1**	0.0197
10	*xikhavi*	red bushwillow	*Combretum apiculatum*			1	1	1	1		1	**5**	0.0193
11	*konola*	silver cluster-leaf	*Terminalia sericea*			1	1	1	1	1		**5**	0.0170
12	*tsengele*	sour plum	*Ximenia caffra*	1	1		1					**3**	0.0167
13	*yingwe*	leopard	*Panthera pardus*	1						1	1	**3**	0.0154
14	*nkuhlu*	Natal mahogany	*Trichilia emetica*	1			1	1		1	1	**5**	0.0129
15	*xitsalala*	transvaal gardenia	*Gardenia volkensii* subsp. *spatulifolia*				1		1			**2**	0.0126
16	*nkwakwa*	black monkey orange	*Strychnos madagascariensis*	1	1				1	1	1	**5**	0.0121
17	*papa*	blue buffalo grass	*Cenchrus ciliarus*					1				**1**	0.0116
18	*sihami*	sandpaper raisin	*Grewia flavescens* subsp. *flavescens*	1		1		1	1	1		**5**	0.0114
19	*mhala*	impala	*Aepyceros melampus*	1						1	1	**3**	0.0110
20	*xipene*	steenbok	*Raphicerus campestris*	1						1	1	**3**	0.0110
21	*ndhenga*	sickle bush	*Dichrostachys cinerea*			1					1	**2**	0.0109
22	*nyarhi*	Cape buffalo	*Syncerus caffer*	1						1	1	**3**	0.0107
23	*biligomo*	blue gum tree	*Eucalyptus* spp.					1	1		1	**3**	0.0106
24	*xipalatsi*	zebra-wood	*Dalbergia melanoxylon*			1	1		1		1	**4**	0.0100
25	*mpfilwa*	wild medlar	*Vangueria infausta*	1	1							**2**	0.0097
26	*mhangani*	mountain aloe	*Aloe marlothii* subsp. *marlothii*				1					**1**	0.0094
27	*mirivata*	false marula	*Lannea schweinfurthi* subsp. *stuhlmannii*				1	1	1			**3**	0.0094
28	*mbvume*	red grass	*Themeda triandra*					1				**1**	0.0092
29	*nhongo*	kudu	*Tragelaphus strepsiceros*	1						1	1	**3**	0.0089
30	*xikwenga*	sisal	*Agave sisalana*						1	1	1	**3**	0.0086
31	*deke*	common thatching grass	*Hyparrhenia* spp.					1				**1**	0.0086
32	*tuva*	dove	*Columbidae* family	1								**1**	0.0085
33	*mhlahlu*	reed	*Cyperus textilis*						1	1		**2**	0.0084
34	*nyiya*	brown ivory	*Berchemia discolor*	1								**1**	0.0084
35	*njiya*	grasshopper/locust	*Acrididae* family	1								**1**	0.0083
36	*lumanyama*	Sjambok pod	*Cassia abbreviata* subsp. *beareana*				1					**1**	0.0080
37	*nhlanga*	reed	*Phragmites mauritianus/australis*					1	1	1	1	**4**	0.0079
38	*mhuti*	common duiker	*Sylvicapra grimmia*	1						1	1	**3**	0.0079
39	*khalavatla*	wild watermelon	*Citrillus lanatus*		1						1	**2**	0.0078
40	*ndlopfu*	African elephant	*Loxodonta africana*	1						1	1	**3**	0.0071
41	*majekejeke*	reed	*Cyperus latifolius*					1	1	1		**3**	0.0067
42	*mbulwa*	mobola plum	*Parinari curatellifolia*	1	1							**2**	0.0066
43	*chugulu*	simple-spined/climbing num-num	*Carissa edulis*	1			1					**2**	0.0066
44	*xenhe*	pod mahogany	*Afzelia quanzensis*						1		1	**2**	0.0064
45	*xipapi*		*Cucumis* spp.	1							1	**2**	0.0064
46	*xifata*	common corkwood	*Commiphora pyracanthoides*						1	1	1	**3**	0.0061
47	*simba*	large-spotted genet	*Genetta tigrina*							1	1	**2**	0.0059
48	*dema*		*Coccinia* spp.				1				1	**2**	0.0058
49	*mpfundla*	scrub hare	*Lepus saxatilis*	1								**1**	0.0056
50	*hlangula*	magic guarri	*Euclea divinorum*	1		1	1					**3**	0.0054
51	*ndzopfura*	tamboti	*Spirostachys africanus*				1	1			1	**3**	0.0053
52	*bawuri*	catfish	*Clarias* spp.	1								**1**	0.0052
53	*sasani*	scented thorn	*Acacia nilotica* subsp. *kraussiana*			1	1					**2**	0.0050
54	*mbhandzu*	apple-leaf	*Lonchocarpus capassa*			1			1			**2**	0.0049
55	*mhangele*	guinea fowl	*Numida meleagris*	1						1		**2**	0.0049
56	*mthavatsindi*	yellow peeling plane	*Brackenridgea zanguebarica*				1					**1**	0.0048
57	*chochela mandleni*	weeping boer-bean	*Schotia brachypetala*		1							**1**	0.0047
58	*mhisi*	spotted hyaena	*Crocuta crocuta*							1	1	**2**	0.0046
59	*molele*	common false-thorn	*Albizia harveyi*			1						**1**	0.0046
60	*mvuva*	variable bushwillow	*Combretum collinum*			1						**1**	0.0045
61	*hlampfurha*	castor oil plant	*Ricinus communis*				1					**1**	0.0044
62	*gedlhe*	carp	*Cyprinus carpio*	1								**1**	0.0042
63	*mangwa*	plains zebra	*Equus burchelli*	1						1	1	**3**	0.0041
64	*nhlarhu*	African rock python	*Python sebae*							1		**1**	0.0039
65	*thswukelano*						1					**1**	0.0039
66	*ncindzu*	wild date palm	*Phoenix reclinata*	1	1							**2**	0.0038
67	*mpotso*	russet bushwillow	*Combretum hereroense*			1		1	1			**3**	0.0036
68	*guvazwivi*	jacket plum	*Pappea capensis*				1					**1**	0.0036
69	*xilungwa*	spear grass	*Heteropogon contortus*					1				**1**	0.0035
70	*majenje*	termites	*Macrotermes* spp.	1								**1**	0.0034
71	*nghala*	lion	*Panthera leo*	1						1		**2**	0.0033
72	*ncecenyi*	buffalo thorn	*Ziziphus mucronata*	1		1	1					**3**	0.0033
73	*xihlangwa*	common spike-thorn	*Gymnosporia buxifolia*				1		1			**2**	0.0032
74	*mhalamhala*	sable antelope	*Hippotragus niger* subsp. *niger*	1						1		**2**	0.0032
75	*rhonge*	snuffbox tree	*Oncoba spinosa*							1	1	**2**	0.0031
76	*masala*	green monkey orange	*Strychnos spinosa*	1	1						1	**3**	0.0031
77	*yembe*	wild custard-apple	*Annona senegalensis*	1			1					**2**	0.0031
78	*muobadali*	woolly caper bush	*Capparis tomentosa*				1					**1**	0.0030
79	*nsihani*	silver raisin	*Grewia monticola*			1		1	1		1	**4**	0.0030
80	*miyatahu*	round-leaved teak	*Pterocarpus rotundifolia*			1			1		1	**3**	0.0029
81	*xibaha*	pepper-bark tree	*Warburgia salutaris*				1					**1**	0.0028
82	*mpfimba hongonyi*	tree wisteria	*Bolusanthus speciosus*			1			1			**2**	0.0028
83	*ndhungulu*	tilapia	*Cichlidae* family	1								**1**	0.0027
84	*nwamba*	lowveld milkberry	*Manilkara mochisia*	1								**1**	0.0027
85	*gotsotso*		*Oxytenanthera abyssinica*?								1	**1**	0.0024
86	*xuva*	weeping wattle	*Peltophorum africanum*			1	1					**2**	0.0024
87	*xigalaphasi*						1					**1**	0.0024
88	*yimbho*	ostrich	*Struthio camelus*							1	1	**2**	0.0023
89	*swinyiyani*	red ivory	*Berchemia zeyheri*		1							**1**	0.0023

	Tsonga–Shangaan	English	Latin	Food	Drink	Fuelwood	Medicine	Construction	Utensils & tools	Ornaments & religion	Recreation	TOTAL	LUVct
90	*mponwani*	snot berry	*Cordia ovalis*				1		1			**2**	0.0023
91	*phaphatani*	blue water lily?	*Nymphaea nouchali* subsp. *caerulea*	1								**1**	0.0023
92	*xisasa vafi*	sumach bean?	*Elephantorrhizia burkei*				1					**1**	0.0022
93	*nkorho*	hornbill	*Tockus* spp.	1								**1**	0.0022
94	*xojowa*	kudu berry	*Pseudolachnostylis maprouneifolia*				1					**1**	0.0021
95	*milala*		*Cyperus* spp.						1	1		**2**	0.0021
96	*mkombego*	sand crown-berry	*Crossopteryx febrifugia*						1			**1**	0.0021
97	*mdlheve*	dead-man's tree	*Synadenium cupulare*				1					**1**	0.0020
98	*mahudinga*	shakama plum	*Hexalobus monopetalus*	1								**1**	0.0021
99	*mhungubye*	black-backed jackal	*Canis mesomelas*							1		**1**	0.0018
100	*mbhovhu*	Cape chestnut	*Calodendrum capense*							1	1	**2**	0.0018
101	*muhimbi*	lowveld mangosteen	*Garcinia livingstonei*		1							**1**	0.0017
102	*futsu*	leopard tortoise	*Testudo pardalis*							1		**1**	0.0017
103	*dedeledede*	Zulu round potato	*Solenostemon rotundifolius?*	1								**1**	0.0016
104	*visangasi*	kei-apple	*Dovyalis caffra*	1								**1**	0.0016
105	*nwharhi*	francolin	*Francolinus* spp.	1								**1**	0.0016
106	*nandzani*	caracal	*Caracal caracal*							1		**1**	0.0015
107	*mhuti*	bushbuck	*Tragelaphus scriptus*	1						1		**2**	0.0015
108	*xikwenga nova*	bowstring hemp	*Sansevieria hyacinthoides*				1	1				**2**	0.0014
109	*hlapfu*	knobbly fig	*Ficus sansibarica*	1								**1**	0.0014
110	*xidzidzi*	honey badger	*Mellivora capensis*	1								**1**	0.0014
111	*swidongodi*	sphinx moth caterpillar	*Sphingidae* family	1								**1**	0.0014
112	*xinungumafi*	white resin tree	*Ozoroa engleri*				1			1		**2**	0.0014
113	*mpetso*	feather climber	*Acridocarpus natalitius*				1					**1**	0.0013
114	*ntinta*	large hook-berry	*Artabotrys brachypetalus*		1							**1**	0.0013
115	*tsovoloti*	climbing cactus	*Cissus quadrangularis*				1					**1**	0.0013
116	*xirhungulu*	red spike-thorn	*Gymnosporia senegalensis*				1					**1**	0.0013
117	*xilopye*				1							**1**	0.0013
118	*hunga*	eel	*Anguillidae* family	1								**1**	0.0013
119	*dzimba*	cheetah	*Acinonyx jubatus*							1		**1**	0.0012
120	*tsumbula*	African osage orange	*Maclura africana*				1					**1**	0.0012
121	*nkowankowa*	white thorn	*Acacia polyacantha*						1			**1**	0.0011
122	*khutla*	African bull frog	*Pyxicephalus adspersus*	1								**1**	0.0011
123	*mavungwa*	wild apricot	*Landolphia kirkii*		1							**1**	0.0011
124	*ximuwi*	baobab	*Adansonia digitata*	1								**1**	0.0010
125	*ndloti*	serval cat	*Leptailurus serval*							1		**1**	0.0010
126	*nulu*	green thorn/torchwood	*Balanites maughamii*				1					**1**	0.0009
127	*guxi*		*Corchorus tridens*	1								**1**	0.0009
128	*michikwani*	korhaan	*Eupodotis* spp.	1								**1**	0.0009
129	manghovo	mongoose	Mongoose species							1	1	**2**	0.0009
130	*hleti*	greater cane rat	*Thryonomys swinderianus*	1								**1**	0.0009
131	*thyeke*	common pigweed	*Amaranthus thunbergii*	1								**1**	0.0009
132	*nsuluwani*		*Urginea altissima ?*							1		**1**	0.0009
133	*dokomela*				1							**1**	0.0008
134	*kolokotso*	camel's foot	*Piliostigma thonningii*			1						**1**	0.0008
135	*ndawani*									1		**1**	0.0007
136	*nsimbitsi*	Lebombo ironwood	*Androstachys johnsonii*					1				**1**	0.0007
137	*bangala*	African cabbage	*Cleome gynandra*	1								**1**	0.0007
138	*munga*	umbrella thorn	*Acacia tortilis*						1			**1**	0.0007
139	*njunju*	mountain mahogany	*Entandrophragma caudata*				1					**1**	0.0007
140	*maxinjani*	tree squirrel	*Paraxerus cepapi*							1		**1**	0.0007
141	*mbhela*	evergreen grape	*Rhoicissus tomentosa*		1							**1**	0.0007
142	*kanjwa*				1							**1**	0.0007
143	*ndangula*							1				**1**	0.0007
144	*xotse*		*Cocculus hirsutus*						1			**1**	0.0006
145	*nkwahle*	savanna monitor	*Varanus exanthematicus*								1	**1**	0.0006
146	*hanga/nala*	many-stemmed false-thorn	*Albizia petersiana* subsp. *evansii*	1								**1**	0.0006
147	*xikhozani*	falcons/hawks	*Falconidae* and *Accipitridae*				1					**1**	0.0006
148	*goya*	African wild cat	*Felis sylvestris*							1		**1**	0.0006
149	*dorho*	sweet prickly pear	*Opuntia ficus-indica*				1					**1**	0.0006
150	*kwahlani*	toad tree	*Tabernaemontana elegans*						1			**1**	0.0006
151	*mbamba*	freshwater mussel	*Unionidae* family							1		**1**	0.0006
152	*kovo*							1				**1**	0.0006
153	*nkaka*	gherkin	*Cucumis anguria* subsp. *anguria*	1								**1**	0.0005
154	*xiluvari*	common wild pear	*Dombeya rotundifolia*				1					**1**	0.0004
155	*fungwe*	African civet	*Civettictis civetta*							1		**1**	0.0003
156	*migwiri*	wild cucumber	*Coccinia sessilifolia?*		1							**1**	0.0003
157	*byanyi*	grass (all)							1			**1**	0.0003
158	*xinjengwe*	slender mongoose	*Galerella sanguniea*							1		**1**	0.0003
159	*manghawani*	jackal	*Canis* spp.							1		**1**	0.0003
160	*mikorho*			1			1					**2**	0.0003
161	*maxinjani*	house rat	*Rattus rattus*							1		**1**	0.0002
162	*swifukwa*			1								**1**	0.0001
			∑	**59**	**20**	**24**	**48**	**26**	**35**	**47**	**40**	**299**	**1.0000**
			Mean									**1.9**	**0.0062**
			s.d.									**1.3**	**0.0114**