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Screening key browse species in a semi-arid rangeland

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Abstract: Rangeland productivity in semi-arid areas is adversely affected by increased variability in precipitation and frequency of droughts, coupled by increased livestock numbers. Knowledge on key rangeland resources that have capacity to increase resilience of livestock based rural livelihoods is critical for ensuring their sustainability. In this study, we identified key browse species used by livestock during the dry season, and determined their multiple uses in a semi-arid rangeland of Zimbabwe. Random sampling was used to select 138 respondents for participating in individual qualitative questionnaires, and seven key informants for a focus group discussion. The Cultural Significance Index was calculated to determine the importance of the key browse species identified. An index to determine risk associated with competitive use of key browse species based on individual species uses and relative abundance as an indicator for species sustainability was also introduced. Twenty-eight key species used as browse by livestock and wildlife, and for ethnoveterinary and human medicines were identified. Species that were common to all uses constituted 25% (n = 7) of the total. No species (n = 0) had a single purpose only or, were used for both medicines and firewood/timber. Therefore, screening key browse species facilitates their sustainability.

Clarice P. Mudzengi

ABOUT THE AUTHOR

Clarice P. Mudzengi is a PhD Student at the University of Zimbabwe (www.uz.ac.zw). She holds a BSc Degree in Natural Resource Management and Agriculture, and an MSc Degree in Tropical Resource Ecology. She also heads the Rangeland and Pastures Research Unit at Grasslands Research Institute (Zimbabwe). Clarice is part of a research project working on sustainable use of indigenous browse species in addressing animal nutrition and health in livestock based rural livelihoods of semi-arid areas. This work, conducted within the framework of the Research Platform “Production and Conservation in Partnership”, RP-PCP (RenCare) could improve focus on management and conservation of culturally important rangeland resources, for sustainable rural livelihoods. The collective interest of the research group is therefore on resilience and adaptation of communities to climate change and vulnerability through development of smart-technologies and strategies of conflict resolution at livestock-wildlife interfaces around Transfrontier Conservation Areas (TFCAs) in Southern Africa.

PUBLIC INTEREST STATEMENT

Indigenous browse species normally have competing uses at livestock-wildlife interfaces of Southern Africa. This study established *Salvadora persica*, *Xanthocercis zambesiaca*, *Boscia albitrunca*, *Lonchocarpus capassa*, *Hippocratea crenata*, *Colophospermum mopane* and *Dichrostachys cinerea* as the key browse species of the South East Lowveld of Zimbabwe. They are used in human and animal nutrition and health, firewood and timber. However, this multiple use renders browse species vulnerable to mismanagement and unsustainable utilization. Coupled with climate change and vulnerability, mismanagement adversely affects rangeland productivity, and consequently livestock based livelihoods. This study also introduced an index to determine risk associated with competitive use of key browse species. It is asserted that determination of key rangeland resources that could increase resilience of the livestock based rural livelihoods especially in the semi-arid regions is critical in order to ensure sustainability in these systems.

Subjects: Environment & Agriculture; Bioscience; Environmental Studies & Management

Keywords: Browse species; livestock production; rangeland productivity; sustainability; rural livelihoods

1. Introduction

Rangeland productivity, i.e. the amount of available grazing and browse per square area per unit time, is an important measure of sustainability of livestock based rural livelihoods of Southern Africa, as rangelands are the major source of livestock feed. However, in recent years, rangeland productivity has been deteriorating as a result of the increased frequency of droughts (Intergovernmental Panel on Climate Change [IPCC], 2007). The effect of the increased frequency in droughts is exacerbated by anthropogenic factors that include deliberate increases in livestock numbers by farmers, as a strategy to hedge against losses during drought (Murungweni, Andersson, Van Wijk, Gwitira, & Giller, 2012). In the face of deteriorating rangeland productivity, it can be asserted that the determination of key rangeland resources that could increase resilience of the livestock based rural livelihoods especially in the semi-arid regions is critical in order to ensure sustainability in these systems.

Indigenous browse species in semi-arid rangelands tend to be generally abundant as they are heat resistant, thus have the ability to persist during droughts. In this regard, it is reasonable to hypothesise that indigenous browse species could provide the key to the sustainability of livestock-based livelihood systems in semi-arid rangelands faced by increased frequencies of drought. However, predominant browse species in an area normally attract multiple uses as the locals tend to be more accustomed to them, thus posing further challenges to their use for sustaining livestock livelihoods in semi-arid rangelands. In fact these browse species are normally culturally important in the livelihoods of resource poor rural people in conformity with the ecological apparency hypothesis which predicts that the most visible, most dominant, and most frequent plants tend to have a higher cultural importance than less apparent plants (de Lucena, de Lima Araújo, & de Albuquerque, 2007). Several studies have shown the increasing role of browse species in firewood, timber, and food provision for humans in forms of fruits, edible roots, bark and leaves (Gondo, Frost, Kozanayi, Stack, & Mushongahande, 2010; Rusinga & Maposa, 2010). Thus, understanding the multiple uses of browse species in addition to their role as fodder for livestock is critical for the sustainability of semi-arid rangelands.

Although the importance of browse species in livestock production has been generally identified (Kumara Mahipala, Krebs, McCafferty, & Gunaratne, 2009; Larbi et al., 2005; Sanon, Kaboré-Zoungrana, & Ledin, 2007), in most cases the specific or key browse species are less known. As a result, most conclusions on the role of browse species in livestock production have been drawn upon nutritional value of these species only (Mlambo et al., 2004; Yayneshet, Eik, & Moe, 2008). Additionally, the methods used to determine key browse species in a given area have also been underdeveloped. For instance, the traditional use of the free listing method intended to produce exhaustive lists of plant species for a particular use is criticized for having the risk of only reflecting biased perspectives based on the respondent's active vocabulary. There is also the risk that respondents may deliberately omit certain information. Thus, there is need to improve on the free listing method by combining it with other techniques, for example, focus group discussions in order to maximize its effectiveness in identifying key browse species. It is asserted that tapping into the indigenous knowledge of the locals through participatory approaches such as focus group discussions (FGDs) also allows better comprehension of the role of these species.

In this study we sought to explore and identify key browse species in a semi-arid rangeland of the South-eastern Lowveld (SEL) of Zimbabwe using an improved approach that combined the free listing method with other data from individual questionnaires and a FGD. We also used the ethnographic, qualitative approach of the anthropological Cultural Significance Index (CSI) method to calculate the cultural importance of the key browse species. Next, we established overlaps in the use of browse species between humans and animals using an innovative risk index that we developed to determine vulnerability of key browse species due to competing uses in a given area.

2. Materials and methods

2.1. Study area

The study was carried out in Malipati communal land adjacent to Gonarezhou National Park (GNP) in the SEL of Zimbabwe (Figure 1). Malipati is located between 22°5′23.50″ S and 31°22′3.16″ E to the West and 22°2′57.66″ S and 31°26′58.81″ E to the East at an altitude of 300–600 m above sea level. A communal land is a land category characterised by collective or community land ownership (Murwira, 2003). The area experiences mean maximum and minimum temperatures of 21.8°C in October, and 13.3°C in June, respectively. Rainfall is unpredictable and mainly falls between November and March. The highest monthly rainfall of 158 mm is often recorded in December. The area is dominated by *Colophospermum mopane* and *Combretum* woodland/shrub, *Acacia* dominated shrub and riparian woodland (Zengeya, Murwira, & de Garine-Wichatitsky, 2011). Cattle based rural livelihoods dominate the area.

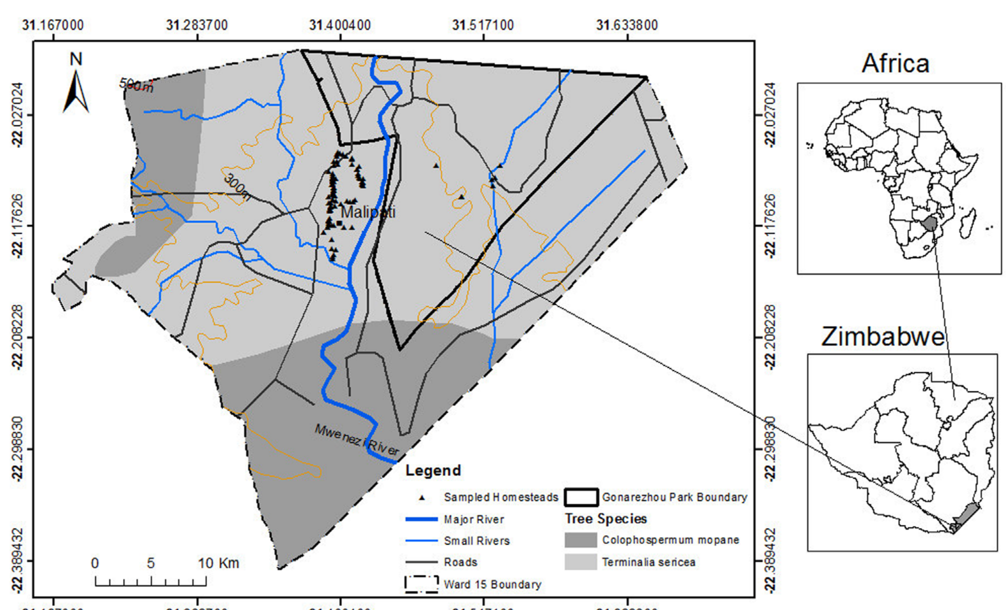
2.2. Data collection

Malipati communal land consists of nine villages within which random sampling was used to select 12% of the households. Next, individual qualitative questionnaires were administered to 138 respondents. Pre-testing of the questionnaire was done to identify aspects of the questionnaire that needed further clarification.

The questionnaire was divided into four sections: (1) socio-demography, (2) livestock production characteristics including livestock ownership and feed resources, (3) trees of economic importance and their uses, and (4) management of wildlife-livestock interactions. Based on the data from the respondents, 28 tree species were identified from the individual interviews as browse species.

Next, a FGD with seven key informants was conducted to identify seven key browse species basing on the list identified from the household survey, but with room to include any other omitted species. The participants included livestock farmers, traditional leaders and seasoned herders. Gender representation was considered as both men and women in the area are active livestock keepers. In the FGD, we used an elementary approach of using small stones to allow the group members to rank the species according to importance, with the most important species being reflected by a higher number of stones. Thus, 21 stones were availed to the group members to be distributed across each of the identified key browse species according to importance of the particular species under each of the following

Figure 1. Location of the study area in the South-East Lowveld of Zimbabwe.



criteria: most abundant, most persistent (continually availing browse across seasons), highly preferred by livestock, most nutritious as perceived by the herder (basing on observations of animal performance feeding on a particular species), and proximity to homesteads where species found within a 500 m distance from the homesteads were considered near, while those found beyond 7 km were the furthest. Ranking was also done across criteria, to identify the order of importance of the criteria for livestock production during the dry season. Apart from livestock nutrition, data collected also included the various uses of these species for livestock health, human food and medicines, wildlife feed, firewood and timber. The plant part(s) for each of the stated use was recorded.

2.3. Species identification

The plant species were identified with the help of the locals in addition to using field identification guides (Carruthers, 1997; Palgrave, 1983; Plower & Drummond, 1990; van Wyk & van Wyk, 1997). Growth habit, canopy, bark, leaf, and other tree structures were used to differentiate closely related trees. Samples of the species not identified in the field, as well as all the other species were collected for verification at the National Herbarium in Harare, Zimbabwe.

2.4. Data analysis

The key browse species were ranked according to order of importance during the FGD. The Cultural Significance Index (CSI) (Da Silva, Andrade, & Albuquerque, 2006) was also calculated using data from individual questionnaires using the formula:

$$\text{CSI} = \sum_{i=1}^{n} (i*e*c)*\text{CF} \tag{1}$$

where i represents species management, e is the preference of use and c is the use frequency. To reduce subjectivity, for each of the specific uses considered in this study (ethnoveterinary, human medicine, livestock feed, wildlife feed, human food, firewood and timber) for the key browse species identified in this study, a two-point scale was adopted following Da Silva et al. (2006). Thus, the variable i was represented by two categories where 2 = managed and 1 = not managed. Preference of use (e) was categorized into 2 = preferred and 1 = not preferred and use frequency (c) into 2 = species effectively used and 1 = species rarely cited. CF is a correction factor used to reduce sensitivity of the index to sampling (Hoffman & Gallaher, 2007) and is calculated as follows:

$$\text{CF} = \frac{\text{number of citations for a given species}}{\text{number of citations for the most mentioned species}}$$

The CSI is a measure of the importance of species through researcher determined weighted ranking of multiple factors (Hoffman & Gallaher, 2007). The higher the value, the more important the species. It was selected as we deemed it appropriate in determining importance of the key browse species for our particular cultural group under study.

A four way Venn diagram generator (www.pangloss.com) was used to plot a Venn diagram illustrating species uses and the overlap in use of the identified browse species combined into four lists as: (1) ethnoveterinary/human medicine, (2) livestock/wildlife feed, (3) human food and (4) firewood/timber.

2.5. Risk index

We developed a species vulnerability index which considers the intensity of use and species availability/abundance in the landscape. To quantify the intensity of use, we first determined the number of people using the species for a particular purpose that has a detrimental effect on species persistence in the landscape which in our case includes: human medicine, ethnoveterinary medicines, firewood and timber. We considered this approach as it is often difficult to have actual values of what is harvested. Thus the index is calculated as follows:

$$\frac{I_i}{A_i} = (x_1 * X_2 * \dots x_n)A_i \tag{2}$$

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where I_i is the intensity of use of a particular species and is determined as the product of the proportion of people (x) using species i for 1, 2 ... n purposes. A_i is the proportion of abundance of a particular species i in the landscape. For example, to determine relative abundance, the area covered by species i is expressed as a fraction of the total area under study or total area covered by browse species.

Table 1. List of browse species in the south east lowveld of Zimbabwe

Scientific name	Family name	English name	Vernacular name	1	2	3	4	5	6	7
Acacia albida	*Fabaceae*	Winter thorn	Shokoshoko			x	x			
Acacia karroo	*Fabaceae*	Sweet thorn	Muunga		x	x	x		x	
Acacia tortilis	*Fabaceae*	Umbrella thorn	Sesani/umsasane			x	x	x	x	x
Acacia xanthophloea	*Fabaceae*	Fever tree	Kelenga		x	x	x			
Adansonia digitata	*Bombacaceae*	Baobab	Mabuwu/muwu			x	x	x	x	x
Aloe cameronii	*Aloaceae*	Aloe	Mhangani	x	x	x				
Berchemia discolor	*Rhamnaceae*	Bird plum	Munyii		x	x	x	x		
Boscia albitrunca	*Capparaceae*	Shepherd`s Tree	Shukutsu	x		x	x	x	x	x
Brachystegia spiciformis	*Fabaceae*	Zebrawood/Msasa	Musasa			x	x		x	
Cassia abbreviata	*Fabaceae*	Longtail cassia	Murumanyama	x	x	x	x			
Cissus quadrangularis	*Vitaceae*	Devil's backbone	Chiololo/ muvengahonye	x		x				
Colophospermum mopane	*Fabaceae*	Turpentine tree	Mopane/xanatsi	x	x	x	x	x	x	x
Combretum apiculatum	*Combretaceae*	Red bush willow	Chikukutsi	x	x	x	x		x	x
Combretum imberbe	*Combretaceae*	Leadwood	Mutsviri/mondo/ monzo	x	x	x	x	x	x	x
Dichrostachys cinerea	*Fabaceae*	Sickle bush	Mupangara/ndenge	x	x	x	x		x	x
Diospyros mespiliformis	*Ebenaceae*	Jackal berry	Musuma/tithoma		x	x	x	x	x	x
Ficus sycomorus	*Moraceae*	Sycomore fig	Muonde/mikuwa		x	x		x		
Hippocratea crenata	*Celastracea*	Valley paddle pod	Sengeti			x	x			
Hyphaene petersiana	*Aracaceae*	Real fan palm	Makwangwala/ilala			x	x	x		
Julbernadia globiflora	*Caesalpinioideae*	Mnondo	Mutondo			x	x		x	x
Kigelia africana	*Bignoniaceae*	Sausage tree	Pfungu/mumvewa			x	x			
Lonchocarpus capassa	*Fabaceae*	Rain tree	Mupanda/ umchitamuzi		x	x	x		x	x
Mimusops zeyheri	*Sapotaceae*	Red milkwood	Hlatsva/chechete			x	x	x		
Neorautanenia brachypus	*Fabaceae*	-	Zhombwe	x		x	x			
Phragmites mauritianus	*Poaceae*	Reed grass	Shanga	x	x	x	x	x		
Salvadora persica	*Salvadoraceae*	Mustard tree	Dhungulu pokwe	x	x	x	x	x		
Sclerocarya birrea	*Anacardiaceae*	Marula/Jelly plum	Mupfura/mufura	x	x	x	x	x		x
Xanthocercis zambesiaca	*Fabaceae*	Nyala berry	Muhlaru/musharo	x	x	x	x	x	x	x

Notes: 1 = veterinary medicine, 2 = Human medicine, 3 = livestock feed, 4 = wildlife feed, 5 = human food, 6 = firewood, 7 = timber.
Use of a species is denoted by "x".

Table 2. Summary of the numbers of species and their names for the competing uses

Uses	Number of species	Set	Plant species
1 (Veterinary and human medicine)	20	1	*Acacia karroo, Acacia xanthophloea, Adansonia digitata, Aloe cameronii, Berchemia discolor, Boscia albitrunca, Cassia abbreviata, Cissus quadrangularis, Colophospermum mopane, Combretum apiculatum, Combretum imberbe, Dichrostachys cinerea, Diospyros mespiliformis, Ficus sycomorus, Lonchocarpus capassa, Neorautanenia brachypus, Phragmites mauritianus, Salvadora persica, Sclerocarya birrea, Xanthocercis zambesiaca*
2 (Livestock and wildlife feed)	28	2	*Acacia albida, A. karroo, Acacia tortilis, A. xanthophloea, A. digitata, A. cameronii, B. discolor, B. albitrunca, Brachystegia spiciformis, C. abbreviata, C. quadrangularis, C. mopane, C. apiculatum, C. imberbe, D. cinerea, D. mespiliformis, F. sycomorus, Hippocratea_crenata, Hyphaene_petersiana, Julbernadia_globiflora, Kigelia_africana, L. capassa, Mimusops_zeyheri, N. brachypus, P. mauritianus, S. persica, S. birrea, X. zambesiaca*
3 (Human food)	14	3	*A. tortilis, A. digitata, B. discolor, B. albitrunca, C. mopane, C. imberbe, P. mauritianus, S. persica, S. birrea, X. zambesiaca, H. petersiana, M. zeyheri, D. mespiliformis, F. sycomorus*
4 (Firewood and timber)	14	4	*A. karroo, A. tortilis, A. digitata, B. albitrunca, B. spiciformis, C. mopane, C. apiculatum, C. imberbe, D. cinerea, D. mespiliformis, J. globiflora, L. capassa, S. birrea, X. zambesiaca*
1 only	0	a	
2 only	4	b	*A. albida, H. crenata, K. africana, P. mauritianus*
3 only	0	c	
4 only	0	d	
1, 2	5	e	*A. xanthophloea, A. cameronii, C. abbreviata, C. quadrangularis, N. brachypus*
1, 3	1	f	*P. mauritianus*
2, 3	2	g	*H. petersiana, M. zeyheri*
1, 4	0	h	
2, 4	2	i	*B. spiciformis, J. globiflora*
3, 4	0	j	
1, 2, 3	3	k	*B. discolor, F. sycomorus, S. persica*
1, 2, 4	4	l	*A. karroo, C. apiculatum, D. cinerea, L. capassa*
1, 3, 4	0	m	
2, 3, 4	1	n	*A. tortilis*
1, 2, 3, 4	7	o	*A. digitata, B. albitrunca, C. mopane, C. imberbe, D. mespiliformis, S. birrea, X. zambesiaca*

A limitation in our study is the availability of data on the abundance/availability of the different browse species in the landscape. We however used a land cover map produced by Zengeya, Murwira, and De Garine-Wichatitsky (2014) which encompassed three of the species *C. mopane*, *Lonchocarpus capassa* (classified as riparian vegetation) and *D. cinerea* (included in the acacia class) and this covered our study site. We therefore determined the proportion of available *C. mopane*, *L. capassa* and *D. cinerea* within a buffer distance of 5,000 m which coincides with the maximum distance GPS collared cattle were found to range in the communal area (unpublished data). The total area covered by *C. mopane*, *L. capassa* and *D. cinerea* was 50 226 484.45, 8 487 129.826 and 8 677 641.615 km^2 respectively. Their corresponding proportions of available area were 0.423, 0.0714 and 0.073. We then used Equation (2) to determine the vulnerability of these three browse species.

3. Results

A total of 28 browse species belonging to 17 families were identified from free listing of dry season browse species from respondents (Table 1). We observe that the *Fabaceaea* family of species are the most commonly used for livestock feeding (11 species).

We observe overlaps, as well as non-overlaps in use of some species (Table 2). No overlaps were detected between firewood/timber and human food, neither were there overlaps between human/ethnoveterinary medicines and firewood/timber. Species common to all the uses constituted 25% (n = 7) of the total species (Figure 2). A total of 4 (14.3%) of the species are used for livestock feed while there were no species for human/ethnoveterinary medicines only or human food only. Similar results are observed for firewood/timber only. Table 2 specifies the numbers and names of the plant species for all the uses indicated in Figure 2. It was also observed that the root, bark and tuber were the commonly used plant parts for both ethnoveterinary and human medicine while leaves pods and twigs were mostly eaten by animals. Firewood, carpentry and timber mostly used branches while human food was mostly fruits.

From the initial list of 28 species identified as livestock feed, the FGD established 7 of these browse species as key in livestock production during the dry season. Identified species included *Salvadora persica*, *Xanthocercis zambesiaca*, *Boscia albitrunca*, *L. capassa*, *Hippocratea crenata*, *C. mopane* and *D. cinerea*. It can be observed that *C. mopane* is the most preferred species having been rated first in the FGD (Table 3).

From the FGD it can also be observed that species abundance is the most important criterion to livestock keepers followed by preference by cattle, and perceptions of the herders about the nutritive value of the browse species (Table 4).

Based on the cultural significance index, *C. mopane* is the most important species with a CSI of 26, followed by *X. zambesiaca* at 17.04 (Table 5). The one listed to be of least importance among the browse species is *H. crenata* with the lowest CSI of 7.20.

Using data collected in this study it can be observed that the intensity of use of six of the key browse species is variable (Table 6). For the three species with abundance data, it can be observed that *L. capassa* (0.069) is more at risk compared with *C. mopane* (0.047) and *D. cinerea* (0.019).

Figure 2. Degree of overlap in use of browse species in the South-East Lowveld of Zimbabwe.

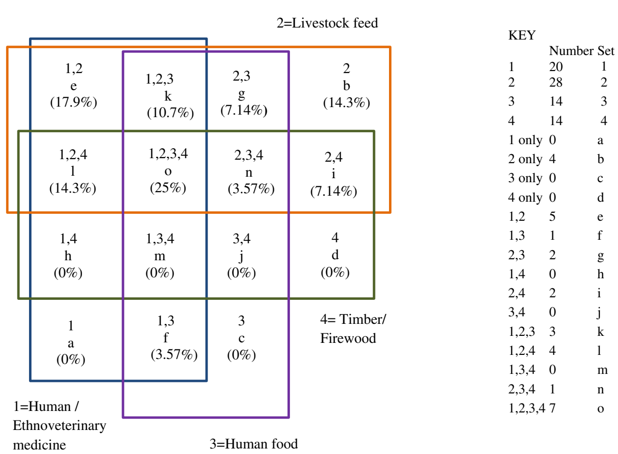

Table 3. Ranking by criteria of species from the focus group discussion

Tree	Highly preferred by cattle	Most nutritious as perceived by herders	Most abundant	Most persistent	Close proximity	Rank
Salvadora persica	4	5	6	5	3	5
Xanthocercis zambesiaca	3	3	5	4	1	3
Boscia albitrunca	6	4	4	6	6	6
Lonchocarpus capassa	5	6	3	3	2	4
Hippocratea crenata	2	1	2	2	5	2
Colophospermum mopane	1	2	1	1	4	1
Dichrostachys cinerea	7	7	7	7	7	7

Table 4. Ranking of criteria from the focus group discussion (FGD)

Criterion	FGD ranking
Most liked by cattle	2
Most nutritious as perceived by herders	5
Most abundant	1
Most persistent	3
Close proximity	4

Table 5. Cultural Significance Indices (CSI) of the key browse species in the south east lowveld of Zimbabwe

Species	i*e*c									CF	CSI	Rank
	No. of citations	A	B	C	D	E	F	G	Sum (i*e*c)			
Salvadora persica	107	1	2	4	4	4	1	1	17	0.78	13.18	4
Xanthocercis zambesiaca	112	4	2	4	4	4	1	2	21	0.81	17.04	2
Boscia albitrunca	98	2	1	4	4	4	1	2	18	0.71	12.78	5
Lonchocarpus capassa	64	2	4	4	4	1	4	4	23	0.46	10.67	6
Hippocratea crenata	71	1	1	4	4	1	2	1	14	0.51	7.20	7
Colophospermum mopane	138	4	4	4	4	2	4	4	26	1	26	1
Dichrostachys cinerea	102	4	4	4	4	1	1	2	20	0.74	14.78	3

Notes: A = veterinary medicine, B = Human medicine, C = livestock feed, D = wildlife feed, E = human food, F = firewood, G = timber; CSI = ∑ (i*e*c) * CF. i = species management [non-managed (1) or managed (2)] e = Use Preference [not preferred (1) or preferred (2)] c = Use Frequency [rarely used (1) or used frequently (2)] CF = Correction factor [number of citations for a given species divided by the number of citations for the most-mentioned species].

Table 6. Risk indices of key browse species

Species	1	2	3	4	Intensity of use (*Ii*)	Proportion available (*Ai*)	Risk index (*Ii/Ai*)
Lonchocarpus capassa		0.096	0.376	0.136	0.00571	0.0714	0.069
Colophospermum mopane	0.2	0.48	1	0.208	0.023	0.423	0.0473
Dichrostachys cinerea	0.08	0.216	0.528	0.152	0.00153	0.073	0.019
Salvadora persica	0.072	0.104	0.144		0.00127		
Xanthocercis zambesiaca	0.144	0.12	0.28	0.08	0.000786		
Boscia albitrunca	0.04		0.176	0.064	0.000959		

Notes: 1 = veterinary medicine, 2 = human medicine, 3 = firewood, 4 = timber.

4. Discussion

Contrary to previous studies that generalize the type and extent in use of dry season browse species of the SEL (Gandiwa, Magwati, Zisadza, Chinuwo, & Tafangenyasha, 2011; Sebata & Ndlovu, 2012; Smith et al., 2005), this study classified seven key browse species for the area. Using factors that affect browsing behaviour of cattle such as preference of certain plant species (Winnie, Cross, & Getz, 2008; Zengeya et al., 2014), we preset criteria that we used to rank and classify these species. Tapping into the indigenous knowledge of the locals through participatory approaches such as FGDs allowed better comprehension of the role of these species at the wildlife-livestock interface. Basing on the questionnaires, we also established overlaps and non-overlaps in species use by livestock and humans. We deduce that this information is critical for the management and conservation of biodiversity.

Moreover, results of this study indicate the importance of browse species in both livestock and wildlife nutrition. Consistent with the ecological apparency hypothesis, the most commonly occurring species, i.e. *C. mopane* and *Acacia* species are important dry season browse species (Badar, Iqbal, Khan, & Akhtar, 2011; Gandiwa et al., 2011; Zengeya et al., 2014). The fact that *Fabaceaea* is the most commonly occurring plant family in the study area also makes our results less surprising. Elsewhere in Zimbabwe, separate studies by Maroyi (2012a, 2012b) also found *Fabaceaea* to be the most frequently used where it occurs as the dominant family of plants. In fact, although some of the key browse species such as *S. persica*, *B. albitrunca* and *X. zambesiaca* may be found occurring in other areas, they are mainly endemic to the SEL. Thus, we deduce that these results could improve our focus on the investigations of species that are significant to community livelihoods.

Browse species identified in this study are mostly used for ethnoveterinary purposes. This can possibly be explained by the availability of the plants and also as a cost effective alternative to expensive veterinary drugs. Browse species have been reported to possess anthelminthic, antibacterial and antidiarrheal properties (Banso & Adeyemo, 2007). In Zimbabwe, Ethiopia and Botswana, it is generally known that plants are the most commonly utilized ingredients in the preparation of ethnoveterinary medicine (Kidane, van der Maesen, van Andel, & Asfaw, 2014; Moreki, 2012; Mushi, Binta, Chabo, Ndebele, & Ramathodi, 2000; Ndhlovu & Masika, 2013). Thus, we assert that browse species are a sustainable alternative to expensive orthodox medicines.

From our results, we speculate that similarity in plant species used for both ethnoveterinary and human medicine such as *Aloe cameronii*, *Cassia abbreviata*, *C. mopane*, *D. cinerea*, *Terminalia sericea* and *S. persica* in this study could be due to the fact that the natural woodland is the main source of livelihoods for the local people. Ethnomedicinal properties of such predominant locally available species are therefore exploited for both humans and livestock. In fact and as mentioned earlier, high *C. mopane* and *X. zambesiaca* CSI values from this study conform to the ecological apparency hypothesis which claims that apparent plants (the most visible, most dominant, and most frequent) have a higher cultural importance than less apparent plants, not because they are essentially more valuable, but merely because they are more available or visible to human communities (de Lucena et al., 2007). However, differences in species use for firewood/timber and the rest of the uses cited in this study could be due to that firewood and timber uses involve selective harvesting of tree species as not all species can be used for firewood or hardwood.These findings could improve management and conservation of the culturally important species of the SEL.

Browse species abundance was ranked as the most important factor in the use of browse species. This result is consistent with the findings of Cumming (2005), who reported that low rangeland resource as a result of climate change and variability has a significant effect on livestock production in the SEL. Additionally, increases in human populations have also resulted in rangeland fragmentation. Given the high cattle densities in the study area, 30.9 km^2 (Murwira et al., 2013), feed abundance thus becomes an important aspect of livestock production. Higher ranking for proximity to homesteads could possibly be explained by low risk of cattle to theft and also for the animals not to be physiologically stressed as a result of looking for forage.

Results of this study indicate that based on a simple risk index we proposed in this study, abundance and intensity of use of browse species are key to determining the species of conservation concern. For example, *C. mopane* with high intensity of use and high abundance is less at risk than *L. capassa* which is low in abundance and intensively used. Thus, low availability in the rangeland accompanied by high intensity of use would significantly affect the persistence of species in the rangeland. Thus, identifying species that are at risk due to multi-use is important for developing strategies aimed at sustainable utilization. The index however, captures relative use, since it is often challenging to quantify actual amounts of the species that are extracted for the various uses. Nonetheless, the risk index helps conservation efforts in targeting the species that are actually vulnerable due to high frequency of use, yet are not abundant enough to meet demand.

Although the CSI used in this study is a subjective allocation method that uses researcher weighted-ranking of multiple factors, thereby increasing the probability of researcher bias, results from a combination of a large sample of the population and a FGD in this study allowed for meaningful conclusions to be made with particular reference to the SEL. Regarding the criteria used to classify the key browse species, we acknowledge that other factors apart from our chosen criteria influence significance of browse species. Also, the nutritive value of the key browse species was based on the perceptions of the herders. There is, therefore, need to scientifically validate these findings through proximate analyses to determine the actual chemical composition of the key browse species. It would also be interesting to scientifically validate their ethnoveterinary effects. Furthermore, although species abundance emerged as the most important factor affecting livestock production in the dry season, to our knowledge, the spatio-temporal distribution of most of the key browse species has not been mapped. We therefore recommend this as necessary future work.

5. Conclusion

In this study seven browse species have been classified as key for livestock production during the dry season in the SEL of Zimbabwe. We also identified their uses in rural livelihoods. The *Fabaceaea* were the commonly used species. It can be concluded that besides their nutritive value, the key browse species are also important in addressing livestock health through their ethnoveterinary contribution. Other uses identified included human food, livestock and wildlife feed, ethnomedicines, firewood and timber. Overlaps were established in these uses between humans and animals where six of the total number of species were common to all uses. Basing on the FGD, abundance was considered the most important factor of rangeland species. Both the CSI and ranking from the FGD rated *C. mopane* as the most important species.

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Competing Interests
The authors declare no competing interests.

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