Mammalian fauna of indigenous forest in the Transkei region of South Africa: an overdue survey

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The Transkei region of the Eastern Cape has received little attention from mammalian ecologists. This paper describes the presence and absence of mammalian species in Afromontane, Pondoland and south coast indigenous forests using variable width transects and explores the causes of observed differences. The region maintains a rich and diverse mammalian fauna, although differences between forest types exist. Ungulates (bushbuck, *Tragelaphus scriptus*; common duiker, *Sylvicapra grimmia*; and blue duiker, *Cephalophus monticola)* and fossorially-foraging (bushpigs, porcupines and moles/molerats) species are relatively more abundant in south coast forests than in Afromontane or Pondoland forest types. This may be explained by the management practices of these nature reserves compared to state forests.

Key words: baseline survey, conservation, forest, mammals, ungulates.

INTRODUCTION

Forest covers less than one per cent of the area of South Africa and is the smallest biome in the country (Low & Rebelo 1996). Broadly, these forests have been classified as Afromontane and coastal indigenous forests. Despite their small size, only 17.6% of Afromontane and 9.5% of coastal forests occur in declared conservation areas (Low & Rebelo 1996) and the various management forms of these areas are considered to provide low conservation efficiency (Castley & Kerley 1996) . The majority of forested area (47.6% of Afromontane and 95.8% of coastal) remaining in South Africa occur as fragments in the Eastern Cape Province (Low & Rebelo 1996) and approximately 61 000 ha remains in the former 'Republic of Transkei' region (von Maltitz & Fleming 2000). Coastal indigenous forest types in this region have been further separated into south coast and Pondoland coastal forest (Cooper & Swart 1992).

Indigenous forest is of high conservation value with 14% of threatened South African vertebrates occurring there despite the small area they cover (Castley & Kerley 1996), yet little is known about it or the fauna inhabiting it, particularly in the Transkei region. Very few historical descriptions of the fauna of the region exist. However, those that do indicate fauna was abundant and diverse in the forests of the Transkei when Europeans arrived (Skead 1987). Today, the ecological integrity of this biome is becoming increasingly threatened due to habitat destruction and modification that often arises with a rapid population expansion (Castley & Kerley 1996; de Villiers & White 2002; White 2001). Uncontrolled hunting occurs in the Transkei's indigenous forests despite the derived meat not being a major source of nutrition in traditional communities (White 2001). Increasing access to forests, hunting by people from outside local communities, use of high technology weapons (guns) and changes in utilization practices by local communities threaten the indigenous fauna that form an integral component of the ecosystem (White 2001; de Villiers & White 2002). Furthermore, the redirection from exclusion policies in the conservation estate to ones of participatory management (*e.g. National Forest Act 1998*) have led to a desire by local communities to harvest resources, including wildlife, in a sustainable fashion. Consequently, managers are seeking information on faunal species richness and diversity to estimate what levels, if any, of hunting are sustainable and which species should be managed. This paper aims to provide an indication of the occurrence of mammalian fauna in the indigenous forests of the Transkei by comparing relative species richness and diversity in the three forest types of the region using indirect census methods.

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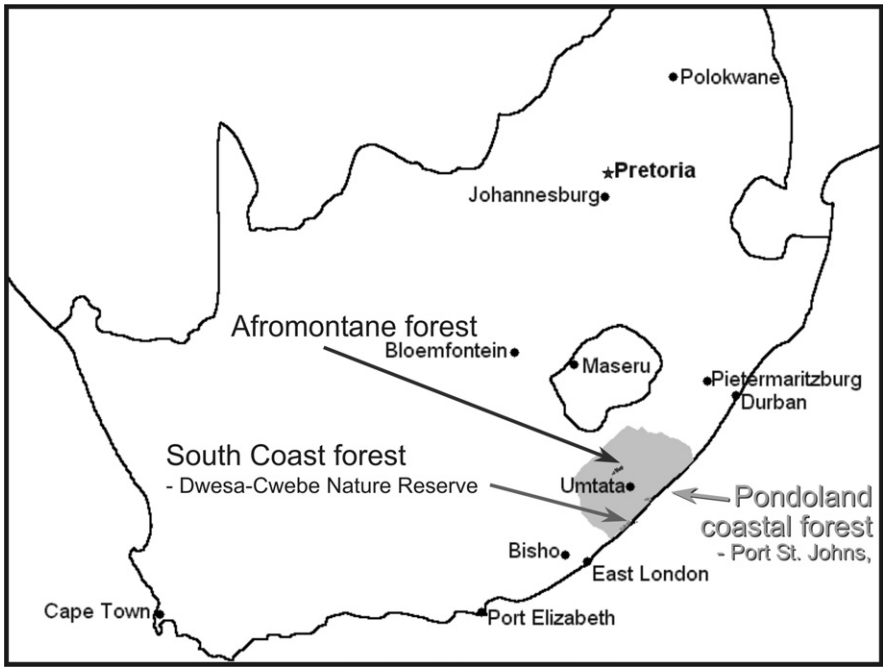

Fig. 1. Location map of the studied forests. The Dwesa and Cwebe Nature Reserves are classified as south coast forests, forests near Port St Johns as Pondoland forests, and the Afromontane forests surveyed were 30 km northwest of Umtata.

STUDY SITES

South coast, Pondoland and Afromontane forests were surveyed throughout the Transkei region. The two adjacent south coast forests surveyed (Cwebe and Dwesa Nature Reserves) lie on the coast approximately 200 km south of Umtata (Fig. 1) between 32°12′and 32°20′S and 28°48′ and 28°58′E and cover an area of 15 254 ha (Timmermans & Naicker 2002). Pondoland coastal indigenous forests were surveyed in the Port St Johns area (31°21′S, 29°30′E), and formed a semi-continous block of coastal forest that includes the Silaka Nature Reserve and Mt Thesiger. The Afromontane forests surveyed were 30 km northwest of Umtata in the Matiwane Range (31° 30′S, 28°30' E). The forest blocks surveyed in this Afromontane forest lie between 1127 m and 1192 m above sea level. The Pondoland and Afromontane forests are categorized as State Forests and hence are largely protected, although limited use of some resources (*e.g.* firewood and medicinal plants) by local people is permitted. Hunting in all these forests is ostensibly illegal but in practice poaching has occurred in all forests. In addition, several species have been introduced to the Dwesa and Cwebe Nature Reserves by the Department of Water Affairs and Forestry.

METHODS

South coast indigenous forest was surveyed between March and July 2003 by 67 transects totalling 80 observer hours. Pondoland coastal forests and Afromontane forests were surveyed between June and August 1999. Pondoland coastal forests were subject to 11 transects totalling 132 observer hours and Afromontane forests to 15 transects totalling 68 observer hours.

Multiple variable-width line transects were walked through all forests by between two and four people on each visit. On each transect, observers walked approximately 5 m apart through the forest on routes perpendicular to tracks recording direct and indirect evidence of all wildlife, such as observations, spoor, dung and diggings, based on published field guides (Stuart & Stuart 1994) and experience. The degree of experience in identifying cryptic sign in the Transkeian forests varied among the surveyors, with R.M.W. having several years experience surveying mammal sign around Transkei villages assisted by the same three technical officers that participated in this study. M.W.H., K.M.M. and P.B. had substantially less experience (up to one year) but were always accompanied by R.M.W. or a technical officer with whom they checked their identification.

Table 1. Orthogonal solution of a principal components factor analysis of habitat variables measured in the three forest types. The explanatory variables in each factor are shown in bold.

Variable	Habitat factor 1	Habitat factor 2	Habitat factor 3
Bare earth cover	0.591	**0.681**	0.209
Rock cover	**0.752**	–0.147	–0.270
Vegetation cover	0.187	–0.633	**0.653**
Leaf litter cover	**–0.807**	0.014	–0.528
Canopy cover	–0.144	**0.894**	0.057
Vegetation density	–0.053	0.129	**0.764**
Variance explained (%)	32.6	28.5	17.9

Bushpigs (*Potamochoerus larvatus*), porcupines (*Hystrix africaeaustralis*) and mole/molerats are grouped together in several analyses. Consequently, we used the phrase 'fossorial species' for them. This is not the strict zoological useage of the term fossorial but we use it here to reflect their foraging strategy.

Human disturbance levels, based on observations of woodcutting, snares or hunting, were recorded in the same manner. An index of relative abundance was then calculated by dividing the number of observations of evidence by the number of observer hours on each transect. A comparative index of evidence per kilometre of each transect was not calculated due to the lack of accurate global positioning system or map locations for the earlier surveys. Habitat attributes measured were subjective estimates of percentage cover of bare earth, rock, vegetation and leaf litter; vegetation density at 1 m above ground (on a scale from 1: visibility to 20 m to 5: visibility <1 m); and percentage canopy cover.

Relative species richness was taken to be the number of mammalian species sign noted per transect. The Shannon-Weiner species diversity index was calculated to take account of the relative abundance of each species. Data were transformed where possible so that parametric statistical tests (ANOVA) could be performed and so that principal components factor analysis could be used to reduce the number of variables and allow easier comparison between forest types. The Kruskal-Wallis non-parametric ANOVA on ranks was used on species relative abundance data as these could not be satisfactorily transformed.

RESULTS

Habitat variables (covering of bare earth, rock, vegetation, leaf litter; canopy cover and vegetation density) were reduced to three principal components factors that explained 79% of the variance (Bartlett's $\chi^2 = 137.2$, d.f. = 20, $P < 0.01$) (Table 1). Habitat factor 1 related to low levels of leaf litter and a high cover of rocks and explained 32.6% of the variance (Table 1). Habitat factor 2 related to a dense canopy cover and a high amount of bare earth while habitat factor 3 related to dense vegetation cover at ground level and 1 m above the ground (Table 1). The last two factors explained 28.5% and 17.9% of the variance in the data, respectively (Table 1).

There was no significant difference in habitat factor 1 (leaf litter and rock cover) between south coast, Pondoland and Afromontane forest types (ANOVA $F_{2,44} = 1.68$, $P = 0.20$). Afromontane forest had significantly denser canopy cover and more areas of bare earth than the two coastal forest types (habitat factor 2 $F_{2,44} = 11.60$, $P < 0.01$; Scheffe's post hoc test $P < 0.05$ for both). There was no difference in vegetation density between the three forest types (habitat factor 3 $f_{2,44} = 2.34$, $P = 0.11$). The differences between the forest types are highlighted in Fig. 2.

A total of 12 mammal species was recorded in Afromontane forests, 13 in Pondoland forests and 18 in south coast forests. However, when introduced species are excluded the number of mammal species drops to 12, 11 and 14, respectively (Table 2). There was no significant difference in relative species richness between the forest types when introduced species were excluded (ANOVA $F_{2,85} = 2.3$, $P = 0.11$); however south coast forest had a significantly greater number of species recorded with these introduced species ($F_{2,85} = 4.99$, $P < 0.01$; Scheffe's post hoc test $P < 0.03$ for both) (Table 2; Fig. 3). Similarly, there was no significant difference in species diversity with introduced species excluded ($F_{2,85} = 1.3$, $P = 0.29$), whereas south coast had a significantly greater relative species diversity than Afromontane

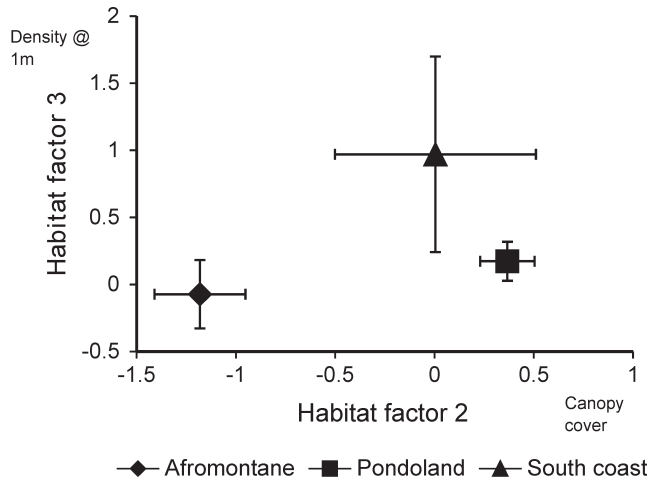

Fig. 2. Plot of mean (±S.E.) habitat factor scores 2 (canopy cover) and 3 (vegetation density at 1 m) for each forest type.

forests when introduced species were included ($F_{2,85}$ = 3.1, P < 0.05; Scheffe's post hoc test P < 0.02) (Table 2; Fig. 4).

Factor analysis was used to reduce the seven most common fauna species to three factor scores which explained 58.5% of the variance in the data (Bartlett's χ^2 = 113.5, d.f. = 35, P < 0.01). Fauna factor 1 related to high abundance of fossorial mammals (bushpig, mole/molerat and Cape porcupine) and explained 30.5% of the variance (Table 3). Fauna factor 2 reflected a high abundance of ungulates (blue duiker, *Cephalophus monticola*; bushbuck, *Tragelaphus scriptus* and common duiker, *Sylvicapra grimmia*) and ex-

Table 2. Mammal species found in the three forest types and their mean relative abundance (evidence per observer hour). Introduced species are denoted with an '‡'. Species that were only recorded once are listed as 'present'. Species richness is shown in bold including and excluding (in brackets) those species introduced to the region.

Common and scientific name	Afromontane	Pondoland	South coast
African buffalo,‡ *Syncerus caffer*			0.1
African wild cat, *Felis lybica*	Present		
Black-backed jackal, *Canis mesomelas*			Present
Blue duiker, *Philantomba monticola*	0.1	0.6	1.0
Blue wildebeest,‡ *Connochaetes taurinus*		Present	0.3
Burchell's zebra,‡ *Equus burchelli*		Present	1.6
Bushbuck, *Tragelaphus scriptus*	0.4	0.3	2.8
Bushpig, *Potamochoerus porcus*	0.1	3.1	0.3
Cape clawless otter, *Aonyx capensis*	Present	0.1	0.1
Cape porcupine, *Hystrix africaeaustralis*	Present	0.2	1.2
Common duiker, *Sylvicapra grimmia*	0.1	0.3	0.7
Mole/Mole-rat[a]	Present	Present	2.7
Eland,‡ *Taurotragus oryx*			Present
Large-spotted genet, *Genetta tigrina*	Present	0.3	0.1
Samango monkey, *Cercopithecus mitis*			0.1
Spotted-necked otter, *Lutra maculicollis*		Present	
Tree hyrax, *Dendrohyrax arboreus*	Present		
Rock hyrax, *Procavia capensis*			Present
Vervet monkey, *Cercopithecus aethiops*	Present	0.2	0.1
Water mongoose, *Atilax paludinosus*	Present	0.1	0.1
White rhinoceros,‡ *Ceratotherium simum*			0.2
Species richness (excluding introd. sp.)	**12 (12)**	**13 (11)**	**18 (14)**

[a]Heaps of moles or molerats were assumed to be Hottentot golden mole (*Amblysomus hottentotus*) or common mole-rat (*Cryptomys hottentotus*), respectively, based on distribution and habitat requirements.

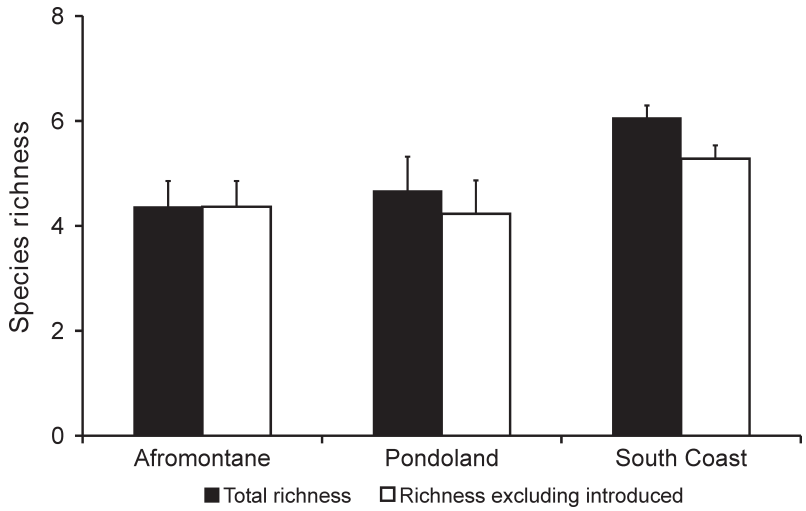

Fig. 3. Plot of mean (±S.E.) relative species richness per transect of the three forest types including and excluding mammal species that have been introduced to the region.

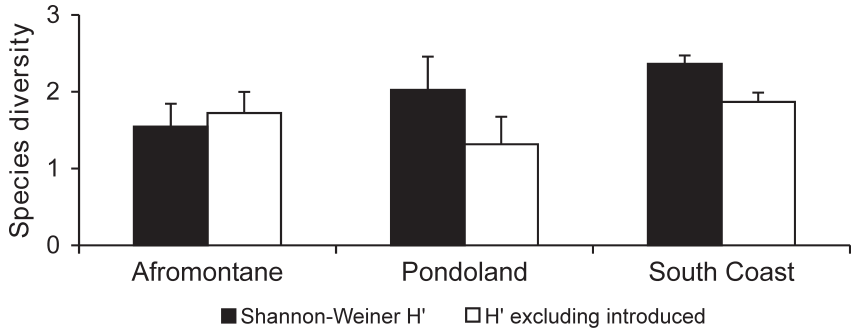

Fig. 4. Plot of mean (±S.E.) Shannon-Weiner species diversity index values (*H'*) per transect of the three forest types including and excluding mammal species that have been introduced to the region.

plained 15.2% of the variance and fauna factor 3 reflects high abundance of vervet monkeys (*Cercopithecus aethiops*) and explained 12.8% of the variance (Table 3).

South coast forest had significantly more evidence of fossorially-foraging mammals than the other two forest types (ANOVA $F_{2,90} = 7.28$, $P < 0.01$; Scheffe's post hoc test $P < 0.03$ for south coast comparisons with Afromontane and Pondoland forest types). South coast forests also had signifi-

Table 3. Orthogonal solution of a principal components factor analysis of the relative abundance (evidence per observer hour) of the seven most abundant fauna species measured at the three forest types. The most important variables in each factor are shown in bold.

Variable	Fauna factor 1	Fauna factor 2	Fauna factor 3
Blue duiker	0.181	**0.570**	0.071
Bushbuck	0.495	**0.516**	0.079
Bushpig	**0.784**	0.166	–0.037
Common duiker	–0.175	**0.831**	–0.096
Mole/Molerat	**0.825**	0.072	0.155
Cape porcupine	**0.828**	–0.070	–0.107
Vervet monkey	0.042	0.006	**0.985**
Variance explained	30.5%	15.2%	12.8%

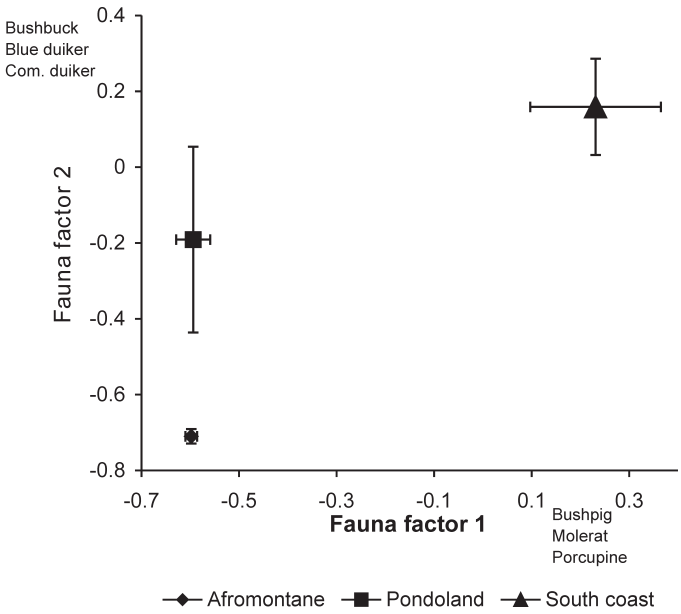

Fig. 5. Plot of mean (±S.E.) fauna factor scores 1 (related to high abundance of bushpig, mole/molerat and Cape porcupine) and 2 (related to a high abundance of blue duiker, bushbuck and common duiker) for each forest type.

Table 4. Kruskal-Wallis ANOVA on ranks test results for mammal species recorded in each of the forest types. *'H'* is the Kruskal-Wallis *H* statistic corrected for ties; and the final three columns are the mean rank for each forest type. Degrees of freedom are two for all comparisons. Significant results are shown in bold.

Species	*H*	Probability	Afromontane	Pondoland	South Coast
Blue duiker	4.28	0.12	33.1	53.6	47.7
Bushbuck	29.59	**<0.01**	27.5	19.4	56.4
Bushpig	22.54	**<0.01**	23.1	28.2	55.1
Common duiker	0.92	0.63	50.6	42.0	47.5
Mole/Molerat	26.27	**<0.01**	23.0	27.1	55.4
Cape porcupine	2.25	0.33	39.8	42.0	49.3
Cape clawless otter	8.75	0.10	45.9	47.1	44.9
Large-spotted genet	14.24	**<0.01**	42.1	63.3	44.2
Vervet monkey	7.71	**0.02**	47.9	57.7	44.4
Water mongoose	4.24	0.12	45.8	54.1	45.6
Human disturbance	16.4	**<0.01**	38.7	25.0	53.3

cantly more abundant ungulates than Afromontane forests ($F_{2,90}$ = 4.17, P < 0.02; Scheffe's post hoc test P < 0.03). These differences are shown visually in Fig. 5. There was no significant difference in factor score three between the three forest types ($F_{2,90}$ = 0.205, P = 0.81).

Kruskal-Wallis ANOVA on ranks were performed to allow straight comparisons between the relative abundances of observations of all mammal species found in each of the forest types. Bushbuck, bushpig and mole/molerat were significantly more abundant in south coast forests, while large-spotted genet (*Genetta tigrina*) and vervet monkey were more abundant in Pondoland forests (Table 4). Evidence of human disturbance (such as woodcutting, snares) was also more common in south coast forest types (Table 4).

DISCUSSION

A high species richness and diversity of mammals persists in the indigenous forests of the Transkei, despite the increased encroachment and poaching (White 2001; de Villiers 2002). The abundance of 'plains' game in forest habitat is undoubtedly due to the refuge afforded from high levels of human disturbance and persecution. It is likely that

they move into the forest during the day to avoid human contact and then move out onto the plains at night to forage.

The species list reported here is not all-inclusive since line transects do not identify all species present and incidental observations have been made of numerous other species. Samango monkeys (*Cercopithecus mitis*) have been incidentally observed in Afromontane and Pondoland forests, tree hyrax have been heard in Pondoland and South Coast forests (R.M.W., unpubl. data) and black-backed jackal spoor has been observed in Afromontane forests (M.W.H., unpubl. data). Additionally, it is expected that African wild cat, spotted-necked otter and, particularly, rock hyrax *Procavia capensis* all occur in appropriate habitats throughout the forests of the Transkei (R.M.W., unpubl. data). There have also been incidental sightings of caracal (*Felis caracal*) and leopard (*Panthera pardus*) in south coast forests (M. Mbete, Dwesa-Cwebe Nature Reserve Manager, pers. comm.). Observations of the latter were confirmed in 2004 (P. Roberts, pers. comm.).

Confusion arises over the original status of several species that have been introduced to the region. These include blue wildebeest, buffalo, Burchell's zebra, eland and white rhinoceros which are thought never to have occurred there but were nevertheless introduced (Feely 1999; de Villiers 2002). Historical reports, however, suggest buffalo and eland were common (Skead 1987). Similarly the extinct quagga was common throughout the Transkei (Skead 1987) and, if we consider it merely a subspecies of Burchell's zebra, then it too originally occurred there.

Several other species have gone extinct in the Transkei since the arrival of settlers. These include elephant (*Loxodonta africana*), warthog (*Phacochoerus aethiopicus*), hippopotamus (*Hippopotamus amphibius*), lion (*Panthera leo*), African wild dog (*Lycaon pictus*) and spotted hyaena (*Crocuta crocuta*) (Skead 1987; de Villiers 2002). Even within the conservation reserves of Dwesa and Cwebe, recent local extinctions have occurred in introduced but extralimital populations of blesbok (*Damaliscus dorcas*) and blue wildebeest, respectively (M. Mbete, pers. comm.).

The greater abundance of ungulates and fossorial species in the south coast forests than Afromontane or Pondoland coastal forests is not attributable to the level of human disturbance or to the habitat features we measured. Signs of hunting parties were never observed on transects but they are less likely to leave evidence of their presence as they enter the forests to hunt rather than to set snares, and thus hunting may be the cause of the observed differences. The south coast forests may have lower levels of hunting because they are managed as nature reserves, whereas the Afromontane and Pondoland forests are managed as state forests. Both forest management types, however, employ guards to prevent poaching. Hunting may explain differences in abundance of ungulates and bushpig; however, soil structural differences probably explain the greater abundance of mole/molerats at the south coast forest sites.

It is unlikely that the greater abundances in south coast forests are due to the slight methodological differences between the three surveys. Transects in Afromontane and Pondoland forests were fewer, but longer and more closely spaced, than those in the south coast. However, the more abundant species in the south coast forests are those species that would be distributed fairly homogeneously and close together throughout the forest, as opposed to predators which may be more widely spaced.

The greater abundance of large-spotted genets and vervet monkeys in Pondoland coastal forests may be attributable to the high floristic diversity there, as the region is known as a centre of endemism. Both species include plant material in their diet (Skinner & Smithers 1990) and a high floristic diversity may provide more invertebrate food than is available in south coast and Afromontane forests.

While this study affords a preliminary look at the larger and more obvious mammalian fauna of the Transkei region, there is much more information to be gathered from this relatively unknown area. Ongoing work is exploring the impacts of hunting and the factors affecting mammalian distribution in more detail.

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REFERENCES

CASTLEY, J.G. & KERLEY, G.I.H. 1996. The paradox of forest conservation in South Africa. *Forest Ecol. Manage.* 85: 35–46.

COOPER, K.H. & SWART, W. 1992. Transkei Forest Survey. Wildlife Society of Southern Africa, Durban.

DE VILLIERS, D.J. 2002. Impacts of human and biological factors on distributions of indigenous mammals in Transkei: with particular emphasis on forest dwelling bushbuck (*Tragelaphus scriptus*), blue duiker (*Philantomba monticola*) and bushpig (*Potamochoerus porcus*). M.Sc. thesis, University of Transkei, Umtata.

DE VILLIERS, D.J. & WHITE, R.M. 2002. Are current conservation practices conserving indigenous forest fauna? In: A.H.W. Seydack, T. Vorster, W.J. Vermeulen & I.J. van der Merwe (Eds), Multiple use management of natural forests and woodlands: policy refinements and scientific progress. Natural Forests and Savanna Woodlands Symposium III (pp. 110–121). Department of Water Affairs and Forestry, Pretoria.

FEELY, J. 1999. Historical distribution of some larger mammals in Transkei. Department of Economic Affairs, Environment and Tourism, Pretoria, South Africa.

LOW, A.B. & REBELO, T.G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

SKEAD, C.J. 1987. Historical mammal incidence in the Cape Province, including the Ciskei, Transkei and east Griqualand. Chief Directorate of Nature and Environmental Conservation of the Provincial Administration of the Cape of Good Hope, Cape Town.

SKINNER, J.D. & SMITHERS, R.H.N. 1990. The mammals of the southern African subregion. University of Pretoria, Pretoria.

STUART, C. & STUART, T. 1994. A field guide to the tracks and signs of southern and east African wildlife. Southern Book Publishers, Halfway House, South Africa.

TIMMERMANS, H. & NAICKER, K. 2002. The land. In R. Palmer, H. Timmermans & D. Fay (Eds), From conflict to negotiation: nature-based development on South Africa's Wild Coast (pp. 2–14). Human Sciences Research Council, Pretoria.

VON MALTITZ, G.P. & FLEMING, G. 2000. Status of conservation of indigenous forests in South Africa. In: A. Seydack, W.J. Vermeulen & C. Vermeulen (Eds), Towards sustainable management based on scientific understanding of natural forests and woodlands, (pp. 93–99). Department of Water Affairs and Forestry, Knysna, South Africa.

WHITE, R. M. 2001. Patterns of utilisation of indigenous fauna and other natural resources by local communities from Transkei forests (94 pp.). Unpublished reportPrepared for the Department of Water Affairs and Forestry, Pretoria, South Africa.