CHAPTER 9

AN OVERVIEW OF WOODY VEGETATION UTILISATION IN THE MANQAKULANE RURAL COMMUNITY, KWAZULU-NATAL, SOUTH AFRICA

Abstract

A survey of woody species utilisation by small browsers, insects, man and natural damage, was conducted in six woodland vegetation units found in the village area of the land of the Manqakulane rural community, Maputaland, KwaZulu-Natal, South Africa. The study was conducted primarily to assess vegetation use by people in rural areas of this part of the Maputaland – Pondoland – Albany hotspot of biodiversity. Canopy removal was evaluated for two age ranges, (a) recent, 12 months prior to the study and (b) old, more than 12 months prior to the study. Overall utilisation was also evaluated but without age ranges. The results showed that utilisation levels by people were high, with canopy removal concentrated around the village area where woodlands are cleared for agriculture and the construction of households. Intense use of edible fruit-bearing woody species was also documented, and could be unsustainable. Insect herbivory affected up to 60% of woody species and canopy removal by defoliation appeared the most likely utilisation. Insects also completely removed more than 9% of height classes in a sparse woodland unit and proved a significant agent of woody species utilisation. Finally there appeared to be a link between natural damage and human utilisation of the area, as it appeared doubtful that all utilisation documented as natural damage could be explained by natural causes

Keywords

Browsers, insects, Maputaland, people, rural communities, woody species utilisation

Introduction

Woodlands and forests are important sources of free natural products that support the livelihoods of rural communities in Africa (Hillring 2006; Shackleton *et al.* 2007). In South Africa, the importance of these products, also called non-timber forest products (NTFP) is primarily the liberation of scarce cash resources for the purchase of products and services that cannot be obtained from the environment, such as education and health benefits (Shackleton and Shackleton 2006; Shackleton *et al.* 2007). The use of NTFP resources by rural and poor communities was initially thought to be a solution for introducing the concept of sustainable utilisation to rural people.

This belief was based on that fact that rural people are aware of the resources and know that when all resources are harvested life becomes increasingly difficult, and that by guiding them through the steps of utilising the resource base in a more sustainable manner, rural people would be agreeable to the restrictions imposed. It was hoped that associated to the development of a sustainable utilisation conscience among rural people, the greater goal of conservation would benefit by default (Arnold and Pérez 2001; Ickowitz 2006). However, poor planning of the resource use has led to problems of resource regeneration and therefore sustainability was threatened (Gram 2001; Janse and Ottitsch 2003; Ticktin 2004). In some cases where utilisation provided the expected financial benefits, people suddenly had the financial means to purchase tools for timber harvesting and thereby threatened the woodland and forest conservation altogether, because the value of timber products and the ease of harvesting proved superior to any potential returns from NTFP (Christensen 2004; Ticktin 2004; Ickowitz 2006).

Maputaland is a region shared by Mozambique and South Africa, and is comprised of a coastal plain that spreads from Maputo in Mozambique, southwards to the St-Lucia estuary in South Africa, and is wedged between the Indian Ocean to the east and the Lebombo Mountain Range to the west (Matthews 2006; Smith *et al.* 2006). The region is considered as possibly the second richest in biodiversity in South Africa (Eeley *et al.* 2001; Matthews 2006; Smith *et al.* 2006), and as such Maputaland has been included in the Maputaland – Pondoland – Albany hotspot of biodiversity (Smith *et al.* 2006). Areas are declared hotspots because they harbour exceptional biodiversity that is under threat from human activities and a growing human population (Brooks *et al.* 2002; Jha and Bawa 2006). The population of Maputaland has indeed grown significantly over the past 20 years (Browning 2000) and recently has been boosted by immigration towards the region fast becoming a tourism centre (Matthews 2006; Peteers 2005).

Because the levels of human population growth and associated vegetation utilisation are threatening the ecology of Maputaland, it is important to evaluate the extent and potential effects as soon as possible. In the present study, the levels of woody species utilisation in a rural community are evaluated for four main agents, i.e. small browsers, insects, people and natural damage. The number of woody species and height classed used by each agent by vegetation unit is evaluated to present a preliminary overview of utilisation in the northern Maputaland region.

Study area

The study area is situated in northern Maputaland, KwaZulu-Natal, South Africa (-26.85º to -27.15º South and 32.35º to 32.60º East). Six kilometres south of the southern fence of Tembe Elephant Park lies the land of the rural community of Manqakulane, which is composed of two sections: a community village (Manqakulane) and its commons to the east and the Tshanini Community Conservation Area (Tshanini) to the west (Gaugris 2004). The village and its associated communal land is spread over approximately half of the tribal land, *ca*. 2 500 ha, of the community of Manqakulane (Gaugris *et al.* 2007), while Tshanini represents the other half at 2 420 ha. A complete description of the community of Manqakulane and Tshanini is presented in Gaugris (2004). Tshanini will not be evaluated further in this chapter.

The overlying geology of the study site is the result of a succession of marine transgressions during the Miocene and Pleistocene eras and the dune cordons that cross the Maputaland Coastal Plain along a north – south axis are ancient littoral dunes (Matthews 2006). This predominantly sandy substratum is covered by an Open to Closed Woodland, with patches of Short and Tall Sand Forest, while clay cells have developed in low-lying areas and hold semi-permanent water bodies such as the Muzi Swamp running along the eastern boundary of the Tembe Elephant Park and Manqakulane (Matthews *et al.* 2001). Maputaland represents the southern limit of the tropical zone, and summers are hot, wet, and humid, and winters are cool to warm and dry. The mean annual rainfall for the region as measured at the Sihangwane weather station in the Tembe Elephant Park is 721 mm in the period from 1981 to 2003 (Matthews 2006).

In 1992, the Manqakulane community people moved from their previous settlement, centrally located within their tribal land, on the eastern boundary of Tshanini, and resettled further east along the Muzi Swamp area where the government installed a safe water supply, and where soils lend themselves to agriculture (Gaugris 2004). This is where the village area of the community is now situated, spread along a north-south axis. A total of 778 people were living permanently in that area in 2004 while the total number of community people consisted of an additional 120 people currently working elsewhere in South Africa (Peteers 2005). The utilisation of hardwood species by people for house construction is documented in Gaugris *et al.* (2007).

Methods

The methodology used is identical to that of the previous chapter and is therefore not repeated in its entirety. Only the relevant aspects are presented below.

Fieldwork

Only woody species were evaluated and no other plant forms were recorded. Woody plants in the present study are defined as all plants with an erect to scrambling growth form and with a ligneous trunk. The methodology was designed to evaluate the vegetation structure and the utilisation of vegetation by a range of agents. Both aspects were evaluated in 42 plots. Plot dimensions were density-dependent and varied from a minimum of 15 m by 2 m to a maximum length of 45 m by 19 m. Extremely dense vegetation such as Closed Woodland Thicket called for shorter and narrower lines than the less dense Open Woodlands. By following this approach a similar amount of information was gathered for most plots.

Data analysis

The canopy removal and overall utilisation of woody species by agents analyses were conducted independently for the following agents (see Table 1 for details):

- undetermined small browsers (such as: suni *Neotragus moschatus* (Von Dueben), red duiker *Cephalophus natalensis* (A. Smith), common duiker *Sylvicapra grimmia* (Linnaeus), nyala *Tragelaphus angasii* (Gray), impala *Aepyceros melampus* (Lichtenstein), bushbuck *Tragelaphus scriptus* (Pallas))
- insects (utilisation by insects was recorded with the help of local assistants able to differentiate utilisation patterns by such agents from small browsing mammals)
- man
- natural damage (all cases where the above agent categories could not be identified positively or where a natural cause such as wind, drought, fire, lightning, light conditions, was deemed the most likely reason for the observed damage).

Tree species selection by agent

For practical reasons only the first ten most utilised woody species by agent were presented in this manuscript. However, the complete list of woody species height classes utilised by agent by vegetation unit is available from the author on request.

Table 1: Codes used for evaluating the utilisation of vegetation by browsers, man and natural damage in Manqakulane community, the coding is derived from a co database used for other studies in KwaZulu-Natal, Northern Maputaland, South Africa, and only the codes relevant to the present study are displayed

State of the woody plant as encountered

1	Normal growth
2	Normal with branch regrowth from breakage
3	Pollarded (main stem snapped off, height reduced) – tree living, resprouting
4	Pollarded (main stem snapped off, height reduced) – tree living, coppicing
5	Pollarded (main stem snapped off, height reduced) – tree living, no growth response
6	Pushed over, stem intact, still partially rooted - living
7	Pushed over, stem partially broken - living
8	Mostly normal growth with some hedge growth
9	Hedge growth from continuous, regular browsing
10	Coppice growth from larger (older) dead stem
11	Coppice growth from accumulated browsing of young plant
12	Coppice growth from repeated fire
13	Coppice growth from repeated moisture stress
20	Senescent
30	Tree dead - main stem partially broken
31	Tree dead - main stem completely broken (pollarded)
32	Tree dead - main stem pushed over (partially uprooted)
33	Tree dead - main stem debarked
34	Tree dead - main stem intact, accumulated branch removal
35	Tree dead - debarking and branches / stems removed
50	Tree dead - intact - cause of death unknown
51	Tree dead - intact - killed by moisture stress
52	Tree dead - intact - dead from shading
53	Tree dead - intact - dead from high light
54	Tree dead - killed by combination of moisture stress and branch removal
55	Tree dead - killed from combination of shading and branch removal
56	Tree dead - killed by fire
60	Tree dead - totally uprooted
72	Top kill - dieback from debarking
80	Windfall
90	Live – deciduous leaf loss
91	Dying some branches still alive
92	Hedge growth from human utilisation
93	Tree dead, pushed over and broken, not uprooted

Agent (Agt.) of utilisation

1	Elephant
2	Giraffe
3	Kudu
4	Eland
5	Black rhinoceros
6	Nyala
7	Impala
8	Bushbuck
9	Grey duiker
10	Red duiker
11	Suni
12	Unidentifiable mega browsers (elephant, giraffe)
13	Unidentifiable large/medium size browsers (kudu, nyala, eland, etc)
14	Unidentifiable medium/small size browsers (impala, bushbuck, duiker etc)
15	Moisture stress
16	Flooding
17	Shading
18	High light intensity
19	Fire
20	Frost
21	Wind
22	Accidental
23	Unknown
24	Human
25	Insects
26	Cane rat
27	Lightning
28	Cattle
29	Porcupine
30	Goats

Type of utilisation observed

1	Whole plant (canopy and roots) utilized
2	Whole canopy utilized (roots still intact in ground)
3	Leaves and small twigs removed
4	Leaves, twigs, small branches, and large branches removed
5	Branch ends bitten off
6	Leaves plucked off
7	Leaves stripped
8	Parts of leaves removed
9	Only young leaves and leaf buds removed
10	Only mature leaves removed
11	Only senescent leaves removed
12	Bark removed
13	Roots removed
14	Flowers removed
15	Fruit / seeds removed
16	Dieback of main vertical branches/stems from top down
17	Dieback of horizontal branches/branch ends
18	Main stem/s cut
20	Accidental damage
21	No use / not damaged
22	Fire
23	Lightning
24	Pushed over and main stem broken
25	Pushed over and main stem intact

Growth responses (G.R.) to branch removal, stem breaking and debarking

1	Coppice growth
2	Wound regrowth
3	Main stem resprouting
4	No coppice or regrowth - vigour appears unaffected
5	No coppice or regrowth - vigour appears reduced (tree dying)
6	Hedge growth
7	Mostly hedge growth with some normal growth
8	Mostly normal growth with some hedge growth
9	Tree dead

Age of utilization (Age)

1	< 1 month
2	> 1 – 2 months
3	> 2 – 4 months
4	> 4 – 6 months
5	> 6 – 12 months
6	> 12 – 24 months
7	> 24 months
8	Continuous Regular Use

Canopy volume removal

1	1 % - 10 %
2	11 % - 25 %
3	26 % - 50 %
4	51 % - 75 %
5	76 % - 90 %
6	91 % - 99 %
7	100%

Debarking – circumference (Brk.)

1	1 % - 10 %	of the circumfer
2	11 % - 25 %	of the stem rem
3	26 % - 50 %	
4	51 % - 75 %	
5	76 % - 90 %	
6	91 % - 99 %	
7	100%	

Debarking - stem height (Brk.)

	Percentage of Stem Height	
0.1	1 % - 10 %	of the height of s
0.2	11 % - 25 %	removed
0.3	26 % - 50 %	
0.4	51 % - 75 %	
0.5	76 % - 90 %	
0.6	91 % - 100 %	
0.7	Whole stem plus branches	

Results

A new woodland unit was described in Manqakulane, the Open Woodland on Abandoned Household Sites. This unit on old household sites and old fields was markedly different form the surrounding natural vegetation and has not previously been described by Gaugris (2004) or Matthews *et al.* (2001). A total of 3 632 trees and shrubs were evaluated in the surveys, with a total of 80 woody species sampled.

Number of tree species utilised

As expected, there were no signs of utilisation from medium or large browsers, or African elephants *Loxodonta africana* (Blumenbach 1797). However, small browsers were present in Manqakulane as evidenced by some utilisation observed on some woody species. Recent signs of utilisation were only observed in the Open Woodland on Abandoned Household Sites (Table 2). Old signs of utilisation were observed in the latter and also in the Closed Woodland Thicket. Some of the survey sites in these two vegetation types were placed the furthest away from the community village in the direction of Tshanini. Overall, the number of species found to be utilised by small browsers was low.

In terms of canopy removal, people from the community utilised 4.55% to 16.39% of the available woody species within the 12 months prior to the fieldwork (Table 2). The most utilised vegetation units were the Closed Woodland Thicket, the Closed Woodland on Sand and the Sparse Woodland on Sand. The older utilisation values showed that the most utilised vegetation units in terms of number of woody species were the Closed Woodland on Sand, Open Woodland on Abandoned Household Sites, and Closed Woodland on Clay. In terms of overall utilisation, the Open Woodland on Abandoned Household Sites, the Closed Woodland Thicket, and the Closed Woodland on Sand were the most utilised vegetation units, with values in excess of 50% of the woody species utilised.

The overall occurrence of natural damage was exceptionally high in the Closed Woodland Thicket, while the Open Woodland on Abandoned Household Sites, the Sparse Woodland and Closed Woodland on Sand also showed signs of intensive utilisation. Natural damage appeared mostly in the form of canopy removal more than 12 months prior to the fieldwork (Table 2).

An interesting feature observed in the Manqakulane site was insect herbivory. Due to the extremely low numbers of small mammals in Manqakulane, it proved possible and feasible in time as well as sampling effort to actually distinguish between small browser herbivory and insect herbivory. However, insect herbivory was only

Table 2: The number of species utilised by various agents in the Woodland association of Manqakulane Rural Community, Maputaland, northern KwaZulu-Natal, South Africa. Values are given for canopy removal (number of species where a percentage of canopy volume (CV) was removed) for the two periods evaluated (Recent: within 12 months prior to the study and Old: > 12 months prior to the study) and for the overall utilisation (O U), including all utilisation events, but time was undetermined

Vegetation unit →			**Closed Woodland Thicket (VT 02.1.0)**		**Closed Woodland on Clay (VT 02.2.0)**		**Closed Woodland on Sand (VT 02.3.0)**		**Open Woodland on Sand (VT 03.1.0)**		**Open Woodland on Abandoned Household Sites (VT 03.2.0)**		**Sparse Woodland on Sand (VT 04.1.0)**	
No of Species sampled →			61		37		53		22		60		19	
No of Species used by	Age	Type	Number	(%)	Number	(%)	Number	(%)	Number	(%)	Number	(%)	Number	(%)
Small Browsers	Recent	CV	0	0.00	0	0.00	0	0.00	0	0.00	2	3.33	0	0.00
	Old	CV	2	3.28	0	0.00	0	0.00	0	0.00	1	1.67	0	0.00
	All ages	O U	2	3.28	0	0.00	0	0.00	0	0.00	2	3.33	0	0.00
Insects	Recent	CV	37	60.66	9	24.32	32	60.38	4	18.18	30	50.00	6	31.58
	Old	CV	na	na	na	na	na	na	na	na	na	na	na	na
	All ages	O U	45	73.77	9	24.32	35	66.04	6	27.27	35	58.33	8	42.11
Man	Recent	CV	10	16.39	3	8.11	8	15.09	1	4.55	5	8.33	2	10.53
	Old	CV	21	34.43	16	43.24	26	49.06	8	36.36	27	45.00	8	42.11
	All ages	O U	32	52.46	18	48.65	28	52.83	8	36.36	32	53.33	8	42.11
Natural Damage	Recent	CV	15	24.59	0	0.00	17	32.08	1	4.55	19	31.67	0	0.00
	Old	CV	42	68.85	13	35.14	25	47.17	5	22.73	28	46.67	11	57.89
	All ages	O U	46	75.41	13	35.14	28	52.83	6	27.27	36	60.00	11	57.89

na: not applicable

distinguishable as a recent feature, and therefore no data were available for old canopy removal by this agent. In terms of number of woody species utilised, insect herbivory proved remarkably high in the Closed Woodland Thicket, Closed Woodland on Sand, and Open Woodland on Abandoned Household Sites (Table 2) with up to 60.66% of the woody species affected in the former (Table 2).

Number of height classes utilised

Small browsers were scarce, and recent utilisation marks were only found within the Open Woodland on Abandoned Household Sites. In that unit they utilised the canopy in 1.31% of the height classes available to them within the past 12 months and utilisation by small animals confined to canopy removal (Table 3). Old signs of utilisation by small browsers were observed in the Closed Woodland Thicket.

The people in the Manqakulane had a noteworthy effect on the vegetation. In the 12 months preceding the study, people utilised the canopy in 2.94% to 6.25% of the available height classes (Table 3). However, the older marks bore testimony of a greater use in the past with 15.46% (Closed Woodland Thicket) to 40.63% (Sparse Woodland on Sand) of height classes where canopy was removed in the past (Table 3). Overall utilisation values reveal that canopy removal was possibly the only form of utilisation in the Open and Sparse Woodland on Sand, but that all woody plant individuals in more than 10.00% and up to 21.88% of available height classes bore utilisation marks from people in four of the woodland units (Table 3).

Recent canopy removal through natural damage was absent in the Closed Woodland on Clay and Sparse Woodland on Sand, while visible but low (<10% of height classes utilised) in the Closed Woodland Thicket and Open Woodland on Sand, and in excess of 10.00% of height classes utilised in the remaining two units (Table 3). For older utilisation signs, canopy removal was observed in 17.14% (Open Woodland on Sand) to 51.52% (Sparse Woodland on Sand) of height classes, and was generally high (Table 3). The overall utilisation values mirrored the above but were slightly higher. However, the percentage of height classes that showed utilisation of all woody individuals was considerable and exceeded 10.00% of the available height classes for four units (Table 3).

Insect herbivory signs where observed in >10.00% of height classes in all vegetation units with a high of 33.73% of height classes being used in the Open Woodland on Abandoned Household Sites (Table 3). The overall utilisation of height classes showed that insect herbivory affected all woody individuals in a range of height

Table 3: The number and percentage of height classes (HC) utilised by the various agents in the Woodland association of Manqakulane Rural Community, Maputaland, northern KwaZulu-Natal, South Africa. The number of height classes utilised is represented in three ways, a total number of height classes utilised within the range utilised by the agent, the number of height classes in that range where utilisation of at least 50% of the height class was observed for at least one species, and the number of height classes where 100% of individuals in one height class were utilised for at least one species. Values are given for canopy removal utilisation events (CV) for the two periods evaluated (Recent: within 12 months prior to the study and Old: > 12 months prior to the study) and for the overall utilisation (O U), including all utilisation events, but time was undetermined

Agent	Range of height classes used	Age	Type	Vegetation Units: Closed Woodland Thicket (VT 02.1.0)						Closed Woodland on Clay (VT 02.2.0)						Closed Woodland on Sand (VT 02.3.0)					
				NHCS*	Total HC utilisation		HC use where > 50 % of HC used		HC use where 100% of HC used		NHCS*	Total HC utilisation		HC use where > 50 % of HC used		HC use where 100% of HC used		NHCS*	Total HC utilisation		HC use where > 50 % of HC used		HC use where 100% of HC used	
					(No)	(%)	(No)	(%)	(No)	(%)		(No)	(%)	(No)	(%)	(No)	(%)		(No)	(%)	(No)	(%)	(No)	(%)
Small Browsers	**01 - 05**	Recent	CV	203	0	0.00	0	0.00	0	0.00	74	0	0.00	0	0.00	0	0.00	166	0	0.00	0	0.00	0	0.00
		Old	CV	203	2	0.96	0	0.00	0	0.00	74	0	0.00	0	0.00	0	0.00	166	0	0.00	0	0.00	0	0.00
		All ages	O U	203	2	0.96	0	0.00	0	0.00	74	0	0.00	0	0.00	0	0.00	166	0	0.00	0	0.00	0	0.00
insects	**01 - 07**	Recent	CV	223	72	31.58	1	0.44	0	0.00	79	9	11.39	0	0.00	0	0.00	177	62	35.03	1	0.56	0	0.00
		Old	CV	223	na	na	na	na	na	na	79	na	na	na	na	na	na	177	na	na	na	na	na	na
		All ages	O U	223	94	41.23	39	17.11	14	6.14	79	11	13.92	7	8.86	4	5.06	177	69	38.98	20	11.30	6	3.39
Man	**02 - 07**	Recent	CV	207	11	5.31	2	0.97	0	0.00	78	3	3.85	0	0.00	0	0.00	164	9	5.49	1	0.61	1	0.61
		Old	CV	207	32	15.46	2	0.97	0	0.00	78	19	24.36	4	5.13	1	1.28	164	52	31.71	3	1.83	0	0.00
		All ages	O U	207	47	22.71	20	9.66	10	4.83	78	22	28.21	21	26.92	17	21.79	164	56	34.15	25	15.24	14	8.54
Natural Damage	**01 - 08**	Recent	CV	223	20	8.77	0	0.00	0	0.00	79	0	0.00	0	0.00	0	0.00	178	23	12.92	4	2.25	4	2.25
		Old	CV	223	81	36.53	9	3.95	5	2.19	79	15	18.99	0	0.00	0	0.00	178	51	28.65	7	3.93	4	2.25
		All ages	O U	223	95	41.67	54	23.68	29	12.72	79	15	18.99	12	15.19	10	12.66	178	56	31.46	26	14.61	12	6.74

Agent	Range of height classes used	Age	Type	Vegetation Units: Open Woodland on Sand (VT 03.1.0)						Open Woodland on Abandoned Household Sites (VT 03.2.0)						Sparse Woodland on Sand (VT 04.1.0)					
				NHCS*	Total HC utilisation		HC use where > 50 % of HC used		HC use where 100% of HC used		NHCS*	Total HC utilisation		HC use where > 50 % of HC used		HC use where 100% of HC used		NHCS*	Total HC utilisation		HC use where > 50 % of HC used		HC use where 100% of HC used	
					(No)	(%)	(No)	(%)	(No)	(%)		(No)	(%)	(No)	(%)	(No)	(%)		(No)	(%)	(No)	(%)	(No)	(%)
Small Browsers	**01 - 05**	Recent	CV	34	0	0.00	0	0.00	0	0.00	153	2	1.31	0	0.00	0	0.00	33	0	0.00	0	0.00	0	0.00
		Old	CV	34	0	0.00	0	0.00	0	0.00	153	1	0.65	0	0.00	0	0.00	33	0	0.00	0	0.00	0	0.00
		All ages	O U	34	0	0.00	0	0.00	0	0.00	153	2	1.31	0	0.00	0	0.00	33	0	0.00	0	0.00	0	0.00
insects	**01 - 07**	Recent	CV	35	4	11.43	0	0.00	0	0.00	166	56	33.73	0	0.00	0	0.00	33	6	18.18	0	0.00	0	0.00
		Old	CV	35	na	na	na	na	na	na	166	na	na	na	na	na	na	33	na	na	na	na	na	na
		All ages	O U	35	6	17.14	3	8.57	0	0.00	166	65	39.16	16	9.64	10	6.02	33	9	27.27	5	15.15	3	9.09
Man	**02 - 07**	Recent	CV	34	1	2.94	0	0.00	0	0.00	150	5	3.33	0	0.00	0	0.00	32	2	6.25	0	0.00	0	0.00
		Old	CV	34	10	29.41	2	5.88	0	0.00	150	53	35.33	5	3.33	2	1.33	32	13	40.63	3	9.38	1	3.13
		All ages	O U	34	10	29.41	8	23.53	5	14.71	150	64	42.67	40	26.67	27	18.00	32	13	40.63	8	25.00	7	21.88
Natural Damage	**01 - 08**	Recent	CV	35	1	2.86	0	0.00	0	0.00	166	38	22.89	10	6.02	5	3.01	33	0	0.00	0	0.00	0	0.00
		Old	CV	35	6	17.14	3	8.57	0	0.00	166	60	36.14	11	6.63	6	3.61	33	17	51.52	6	18.18	0	0.00
		All ages	O U	35	7	20.00	6	17.14	5	14.29	166	72	43.37	32	19.28	16	9.64	33	17	51.52	14	42.42	6	18.18

NHCS* = Number of height classes sampled in the range used by the agent
HC = Height Classes
No = Number

classes in all units but the Open Woodland on Sand, with a high of 9.09% of height classes fully utilised in the Sparse Woodland on Sand (Table 3).

Tree species selection by agent

Small browser utilisation in Manqakulane was diagnosed in only four woody species (Table 4). These tree species showed utilisation signs, but there were no indications that height classes were excessively utilised.

Human utilisation of a selection of woody species was expectedly high. *Dialium schlechteri*, a good firewood species (Gaugris 2004), was one of the most utilised plants in three vegetation units (Closed Woodland Thicket, Closed Woodland on Clay, Open Woodland on Abandoned Household Sites, Table 5), where one to three height classes were removed. The edible fruit bearing species *Strychnos madagascariensis, Strychnos spinosa* and *Sclerocarya birrea* were heavily utilised, especially the former species, where signs of full height classes utilisation or at least 50% use of a height class were found in all vegetation units (Table 6). *Hyphaene coriacea* is a species of predilection for the production of palm wine (ubusulu), and in all three vegetation units where utilisation was documented, all individuals were utilised.

An interesting feature was the intensity at which *Sclerocarya birrea* appeared to be damaged through natural events in the Closed Woodland on Sand, Open Woodland on Abandoned Household Sites, and Sparse Woodland on Sand (see Table 6). As this is a species preferred by people, a question is raised whether human use of the species engenders a premature and aggravated damage and possibly death of trees of this species. The effect appeared particularly striking in the Closed Woodland on Sand where canopy removal-like events, recent and old, have affected 50% to 100% of individuals in at least four height classes.

Insect utilisation preferences appeared for the following species: *Zanthoxylum capense* and *Deinbollia oblongifolia* in the three Closed Woodland units, *Strychnos madagascariensis* and *Sclerocarya birrea* in the Closed Woodland on Sand, Open Woodland on Abandoned Household Sites, and Sparse Woodland on Sand (Table 7).

Discussion

An obvious deduction from this study is the low or lack of impact of small to large mammals outside formally conserved areas in northern Maputaland. The reasons are most likely linked to human hunting pressure over the past 20 years (Kloppers 2001; Gaugris 2004). The only signs of small mammal presence were observed in the areas furthest away form the community village, close to the eastern boundary of

Table 4: *The 10 woody species most utilised by small browsers in Manqakulane Rural Community, by vegetation unit and age of damage (for canopy volume removal only). Values given reflect the number of height classes (HC) where utilisation was reported (HC 01), as well as the number of height classes where utilisation was > 50% (HC 02) and 100% (HC 03) of canopy removed or number of individuals utilised within a height class, and the highest height class where damage was observed (HC 04). Species highlighted in red represent situations where at least one height class was completely utilised. Maputaland, northern KwaZulu-Natal, South Africa*

Number	Vegetation unit	Taxa	Canopy Volume removal < 12 months				Taxa	Canopy Volume removal > 12 months				Taxa	Overall Utilisation			
			HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*
1	VT 02.1.0	-	-	-	-	-	*Dovyalis longispina*	1	0	0	02	*Dovyalis longispina*	1	0	0	02
2	VT 02.1.0	-	-	-	-	-	*Strychnos spinosa*	1	0	0	04	*Strychnos spinosa*	1	0	0	04
1	VT03.2.0	*Acacia burkei*	1	0	0	02	*Terminalia sericea*	1	0	0	02	*Acacia burkei*	1	0	0	02
2	VT03.2.0	*Terminalia sericea*	1	0	0	02	-	-	-	-	-	*Terminalia sericea*	1	0	0	02

VT 02.1.0 = Closed Woodland Thicket

VT 03.2.0 = Open Woodland on Abandoned Household Sites

Table 5: *The 10 woody species most utilised by man in Manqakulane Rural Community, by vegetation unit and age of damage (for canopy volume removal only). Values given reflect the number of height classes (HC) where utilisation was reported (HC 01), as well as the number of height classes where utilisation was > 50% (HC 02) and 100% (HC 03) of canopy removed or number of individuals utilised within a height class, and the highest height class where damage was observed (HC 04). Species highlighted in red represent situations where at least one height class was completely utilised. Maputaland, northern KwaZulu-Natal, South Africa*

Number	Vegetation unit	Taxa	Canopy Volume removal < 12 months				Taxa	Canopy Volume removal > 12 months				Taxa	Overall Utilisation			
			HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*
1	VT 02.1.0	*Zanthoxylum capense*	2	0	0	04	*Dialium schlechteri*	3	0	0	07	*Strychnos madagascariensis*	3	2	1	05
2	VT 02.1.0	*Canthium setiflorum*	1	1	0	04	*Strychnos spinosa*	3	0	0	05	*Dialium schlechteri*	3	2	0	07
3	VT 02.1.0	*Ptaeroxylon obliquum*	1	1	0	03	*Terminalia sericea*	2	1	0	06	*Strychnos spinosa*	3	1	1	05
4	VT 02.1.0	*Carissa tetramera*	1	0	0	04	*Acacia burkei*	2	0	0	06	*Terminalia sericea*	3	0	0	06
5	VT 02.1.0	*Clausena anisata*	1	0	0	02	*Bridelia cathartica*	2	0	0	05	*Zanthoxylum capense*	3	0	0	06
6	VT 02.1.0	*Monanthotaxis caffra*	1	0	0	02	*Dichrostachys cinerea*	2	0	0	05	*Bridelia cathartica*	2	1	0	05
7	VT 02.1.0	*Strychnos madagascariensis*	1	0	0	05	*Euclea natalensis*	2	0	0	06	*Euclea natalensis*	2	1	0	06
8	VT 02.1.0	*Terminalia sericea*	1	0	0	05	*Strychnos madagascariensis*	2	0	0	05	*Strychnos gerrardii*	2	1	0	06
9	VT 02.1.0	*Tricalysia capensis*	1	0	0	03	*Zanthoxylum capense*	2	0	0	06	*Acacia burkei*	2	0	0	06
10	VT 02.1.0	*Xylotheca kraussiana*	1	0	0	03	*Lagynias lasiantha*	1	1	0	04	*Dichrostachys cinerea*	2	0	0	05
1	VT 02.2.0	*Dialium schlechteri*	1	0	0	06	*Dialium schlechteri*	2	0	0	05	*Dialium schlechteri*	3	3	2	06
2	VT 02.2.0	*Hyphaene coriacea*	1	0	0	04	*Ehretia obtusiflora*	2	0	0	03	*Ehretia obtusiflora*	2	2	1	03
3	VT 02.2.0	*Margaritaria discoidea*	1	0	0	03	*Euclea natalensis*	2	0	0	06	*Euclea natalensis*	2	2	1	06
4	VT 02.2.0	-	-	-	-	-	*Acacia burkei*	1	1	1	06	*Acacia burkei*	1	1	1	06
5	VT 02.2.0	-	-	-	-	-	*Psydrax locuples*	1	1	0	03	*Balanites maughamii*	1	1	1	07
6	VT 02.2.0	-	-	-	-	-	*Rhus gueinzii*	1	1	0	05	*Canthium setiflorum*	1	1	1	03
7	VT 02.2.0	-	-	-	-	-	*Strychnos madagascariensis*	1	1	0	05	*Hyphaene coriacea*	1	1	1	04
8	VT 02.2.0	-	-	-	-	-	*Balanites maughamii*	1	0	0	07	*Psydrax locuples*	1	1	1	03
9	VT 02.2.0	-	-	-	-	-	*Canthium setiflorum*	1	0	0	03	*Pteleopsis myrtifolia*	1	1	1	05
10	VT 02.2.0	-	-	-	-	-	*Dalbergia obovata*	1	0	0	03	*Rhus gueinzii*	1	1	1	05
1	VT 02.3.0	*Dichrostachys cinerea*	2	0	0	04	*Sclerocarya birrea*	4	0	0	07	*Sclerocarya birrea*	4	4	2	07
2	VT 02.3.0	*Rhus gueinzii*	1	1	1	05	*Strychnos spinosa*	4	0	0	05	*Catunaregam taylori*	4	1	0	05
3	VT 02.3.0	*Brachylaena discolor*	1	0	0	04	*Catunaregam taylori*	3	1	0	05	*Strychnos spinosa*	4	1	0	05
4	VT 02.3.0	*Catunaregam taylori*	1	0	0	02	*Erythroxylum delagoense*	3	1	0	05	*Trichilia emetica*	3	3	3	06
5	VT 02.3.0	*Deinbollia oblongifolia*	1	0	0	03	*Terminalia sericea*	3	1	0	06	*Terminalia sericea*	3	2	1	06
6	VT 02.3.0	*Dialium schlechteri*	1	0	0	03	*Dichrostachys cinerea*	3	0	0	05	*Strychnos madagascariensis*	3	1	1	06
7	VT 02.3.0	*Sclerocarya birrea*	1	0	0	04	*Strychnos madagascariensis*	3	0	0	06	*Erythroxylum delagoense*	3	1	0	05
8	VT 02.3.0	*Spirostachys africana*	1	0	0	05	*Trichilia emetica*	3	0	0	06	*Dichrostachys cinerea*	3	0	0	05
9	VT 02.3.0						*Acacia burkei*	2	0	0	05	*Lagynias lasiantha*	2	1	1	05
10	VT 02.3.0						*Bridelia cathartica*	2	0	0	04	*Spirostachys africana*	2	1	1	06

Table 5 continued

1	VT 03.1.0	*Strychnos madagascariensis*	1	0	0	03	*Brachylaena discolor*	2	1	0	04	*Hyphaene coriacea*	2	2	2	04
2	VT 03.1.0	-	-	-	-	-	*Hyphaene coriacea*	2	0	0	04	*Brachylaena discolor*	2	2	0	04
3	VT 03.1.0	-	-	-	-	-	*Strychnos madagascariensis*	1	1	0	03	*Balanites maughamii*	1	1	1	03
4	VT 03.1.0	-	-	-	-	-	*Balanites maughamii*	1	0	0	03	*Combretum molle*	1	1	1	05
5	VT 03.1.0	-	-	-	-	-	*Combretum molle*	1	0	0	05	*Euclea natalensis*	1	1	1	04
6	VT 03.1.0	-	-	-	-	-	*Euclea natalensis*	1	0	0	04	*Grewia microthyrsa*	1	1	0	04
7	VT 03.1.0	-	-	-	-	-	*Grewia microthyrsa*	1	0	0	04	*Strychnos madagascariensis*	1	0	0	03
8	VT 03.1.0	-	-	-	-	-	*Xylotheca kraussiana*	1	0	0	03	*Xylotheca kraussiana*	1	0	0	03
1	VT 03.2.0	*Acacia robusta*	1	0	0	04	*Strychnos spinosa*	4	0	0	06	*Dialium schlechteri*	5	5	3	07
2	VT 03.2.0	*Margaritaria discoidea*	1	0	0	03	*Terminalia sericea*	4	0	0	07	*Terminalia sericea*	5	3	3	07
3	VT 03.2.0	*Tricalysia delagoensis*	1	0	0	04	*Trichilia emetica*	4	0	0	07	*Trichilia emetica*	4	4	1	07
4	VT 03.2.0	*Trichilia emetica*	1	0	0	07	*Dichrostachys cinerea*	3	0	0	05	*Sclerocarya birrea*	4	3	1	07
5	VT 03.2.0	*Xylotheca kraussiana*	1	0	0	02	*Euclea natalensis*	3	0	0	05	*Strychnos spinosa*	4	1	1	06
6	VT 03.2.0	-	-	-	-	-	*Gymnosporia senegalensis*	3	0	0	05	*Strychnos madagascariensis*	3	3	1	06
7	VT 03.2.0	-	-	-	-	-	*Sclerocarya birrea*	3	0	0	06	*Euclea natalensis*	3	1	1	05
8	VT 03.2.0	-	-	-	-	-	*Strychnos madagascariensis*	3	0	0	06	*Gymnosporia senegalensis*	3	1	1	05
9	VT 03.2.0	-	-	-	-	-	*Dialium schlechteri*	2	1	1	07	*Dichrostachys cinerea*	3	1	0	05
10	VT 03.2.0	-	-	-	-	-	*Spirostachys africana*	2	1	0	07	*Spirostachys africana*	2	2	2	07
1	VT 04.1.0	*Acacia gerrardii*	1	0	0	03	*Acacia gerrardii*	2	2	1	04	*Hyphaene coriacea*	2	2	2	03
2	VT 04.1.0	*Strychnos madagascariensis*	1	0	0	03	*Strychnos madagascariensis*	2	1	0	05	*Acacia gerrardii*	2	2	1	04
3	VT 04.1.0	-	-	-	-	-	*Dichrostachys cinerea*	2	0	0	03	*Sclerocarya birrea*	2	1	1	05
4	VT 04.1.0	-	-	-	-	-	*Hyphaene coriacea*	2	0	0	03	*Strychnos madagascariensis*	2	1	1	05
5	VT 04.1.0	-	-	-	-	-	*Sclerocarya birrea*	2	0	0	05	*Dichrostachys cinerea*	2	0	0	03
6	VT 04.1.0	-	-	-	-	-	*Gymnosporia senegalensis*	1	0	0	02	*Phoenix reclinata*	1	1	1	04
7	VT 04.1.0	-	-	-	-	-	*Phoenix reclinata*	1	0	0	04	*Ziziphus mucronata*	1	1	1	04
8	VT 04.1.0	-	-	-	-	-	*Ziziphus mucronata*	1	0	0	04	*Gymnosporia senegalensis*	1	0	0	02

VT 02.1.0 = Closed Woodland Thicket
VT 02.2.0 = Closed Woodland on Clay
VT 02.3.0 = Closed Woodland on Sand
VT 03.1.0 = Open Woodland on Sand
VT 03.2.0 = Open Woodland on Abandoned Household Sites
VT 04.1.0 = Sparse Woodland on Sand

Table 6: *The 10 woody species most damaged through natural damage in Manqakulane Rural Community, by vegetation unit and age of damage (for canopy volume removal only). Values given reflect the number of height classes (HC) where utilisation was reported (HC 01), as well as the number of height classes where utilisation was > 50% (HC 02) and 100% (HC 03) of canopy removed or number of individuals utilised within a height class, and the highest height class where damage was observed (HC 04). Species highlighted in red represent situations where at least one height class was completely utilised. Maputaland, northern KwaZulu-Natal, South Africa*

Number	Vegetation unit	Taxa	Canopy Volume removal < 12 months				Taxa	Canopy Volume removal > 12 months				Taxa	Overall Utilisation			
			HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*
1	VT 02.1.0	*Euclea natalensis*	3	0	0	05	*Dialium schlechteri*	4	1	0	07	*Euclea natalensis*	5	2	0	06
2	VT 02.1.0	*Zanthoxylum capense*	3	0	0	05	*Acacia burkei*	4	0	0	05	*Acacia burkei*	4	4	1	07
3	VT 02.1.0	*Grewia caffra*	2	0	0	05	*Bridelia cathartica*	4	0	0	06	*Commiphora neglecta*	4	3	0	06
4	VT 02.1.0	*Acacia burkei*	1	0	0	05	*Commiphora neglecta*	4	0	0	07	*Dialium schlechteri*	4	2	1	07
5	VT 02.1.0	*Carissa tetramera*	1	0	0	00	*Dichrostachys cinerea*	3	2	1	05	*Zanthoxylum capense*	4	2	0	06
6	VT 02.1.0	*Catunaregam taylori*	1	0	0	04	*Catunaregam taylori*	3	0	0	04	*Bridelia cathartica*	4	0	0	05
7	VT 02.1.0	*Clausena anisata*	1	0	0	04	*Clausena anisata*	3	0	0	06	*Dichrostachys cinerea*	3	3	1	06
8	VT 02.1.0	*Coddia rudis*	1	0	0	05	*Euclea natalensis*	3	0	0	06	*Strychnos gerrardii*	3	2	2	06
9	VT 02.1.0	*Combretum molle*	1	0	0	05	*Strychnos gerrardii*	3	0	0	06	*Catunaregam taylori*	3	2	1	05
10	VT 02.1.0	*Deinbollia oblongifolia*	1	0	0	03	*Xylotheca kraussiana*	3	0	0	04	*Coddia rudis*	3	1	1	05
1	VT 02.2.0	-	-	-	-	-	*Dialium schlechteri*	2	0	0	06	*Rhus rhemanianna*	2	2	2	05
2	VT 02.2.0	-	-	-	-	-	*Rhus rhemanianna*	2	0	0	05	*Dialium schlechteri*	2	2	1	06
3	VT 02.2.0	-	-	-	-	-	*Acacia gerrardii*	1	0	0	05	*Balanites maughamii*	1	1	1	07
4	VT 02.2.0	-	-	-	-	-	*Balanites maughamii*	1	0	0	07	*Pteleopsis myrtifolia*	1	1	1	05
5	VT 02.2.0	-	-	-	-	-	*Bridelia cathartica*	1	0	0	02	*Rhus gueinzii*	1	1	1	05
6	VT 02.2.0	-	-	-	-	-	*Carissa bispinosa*	1	0	0	03	*Strychnos madagascariensis*	1	1	1	05
7	VT 02.2.0	-	-	-	-	-	*Deinbollia oblongifolia*	1	0	0	03	*Strychnos spinosa*	1	1	1	05
8	VT 02.2.0	-	-	-	-	-	*Pteleopsis myrtifolia*	1	0	0	05	*Tabernaemontana elegans*	1	1	1	04
9	VT 02.2.0	-	-	-	-	-	*Rhus gueinzii*	1	0	0	05	*Trichilia emetica*	1	1	1	06
10	VT 02.2.0	-	-	-	-	-	*Strychnos madagascariensis*	1	0	0	05	*Carisse bispinosa*	1	1	0	03
1	VT 02.3.0	*Sclerocarya birrea*	4	4	4	05	*Sclerocarya birrea*	6	4	4	07	*Acacia burkei*	4	2	1	07
2	VT 02.3.0	*Bridelia cathartica*	2	0	0	05	*Strychnos madagascariensis*	4	1	0	06	*Strychnos madagascariensis*	4	2	1	06
3	VT 02.3.0	*Erythroxylum delagoense*	2	0	0	03	*Acacia burkei*	4	0	0	07	*Sclerocarya birrea*	3	2	2	07
4	VT 02.3.0	*Zanthoxylum capense*	2	0	0	04	*Bridelia cathartica*	3	0	0	05	*Bridelia cathartica*	3	2	0	05
5	VT 02.3.0	*Acacia burkei*	1	0	0	02	*Catunaregam taylori*	3	0	0	05	*Dichrostachys cinerea*	3	2	0	05
6	VT 02.3.0	*Acacia robusta*	1	0	0	03	*Dichrostachys cinerea*	3	0	0	05	*Terminalia sericea*	3	2	0	06
7	VT 02.3.0	*Carissa bispinosa*	1	0	0	03	*Strychnos spinosa*	3	0	0	05	*Strychnos spinosa*	3	1	1	05
8	VT 02.3.0	*Dalbergia obovata*	1	0	0	04	*Terminalia sericea*	3	0	0	06	*Catunaregam taylori*	3	1	0	05
9	VT 02.3.0	*Deinbollia oblongifolia*	1	0	0	03	*Combretum molle*	2	1	0	05	*Erythroxylum delagoense*	3	1	0	05
10	VT 02.3.0	*Dichrostachys cinerea*	1	0	0	04	*Acacia robusta*	2	0	0	08	*Trichilia emetica*	2	2	1	06

Table 6 continued

1	VT 03.1.0	*Brachylaena discolor*	6	4	2	07	*Euclea natalensis*	2	0	0	04	*Euclea natalensis*	2	1	1	04
2	VT 03.1.0	-	-	-	-	-	*Acacia burkei*	1	1	0	06	*Acacia burkei*	1	1	1	06
3	VT 03.1.0	-	-	-	-	-	*Combretum molle*	1	1	0	03	*Combretum molle*	1	1	1	03
4	VT 03.1.0	-	-	-	-	-	*Vangueria infausta*	1	1	0	03	*Tabernaemontana elegans*	1	1	1	05
5	VT 03.1.0	-	-	-	-	-	*Tabernaemontana elegans*	1	0	0	05	*Vangueria infausta*	1	1	1	03
6	VT 03.1.0	-	-	-	-	-						*Brachylaena discolor*	1	1	0	03
7	VT 03.1.0	-	-	-	-	-										
1	VT 03.2.0	*Trichilia emetica*	6	4	3	07	*Trichilia emetica*	6	4	3	07	*Sclerocarya birrea*	7	4	2	07
2	VT 03.2.0	*Sclerocarya birrea*	6	4	2	07	*Sclerocarya birrea*	6	3	2	07	*Trichilia emetica*	6	4	2	07
3	VT 03.2.0	*Dichrostachys cinerea*	4	0	0	04	*Acacia burkei*	4	0	0	05	*Acacia burkei*	5	1	0	05
4	VT 03.2.0	*Canthium armatum*	3	0	0	04	*Dichrostachys cinerea*	4	0	0	05	*Dichrostachys cinerea*	5	1	0	05
5	VT 03.2.0	*Acacia burkei*	2	0	0	04	*Strychnos spinosa*	4	0	0	05	*Strychnos spinosa*	4	2	0	05
6	VT 03.2.0	*Gymnosporia senegalensis*	2	0	0	04	*Tabernaemontana elegans*	4	0	0	05	*Tabernaemontana elegans*	4	1	1	05
7	VT 03.2.0	*Margaritaria discoidea*	2	0	0	04	*Terminalia sericea*	4	0	0	07	*Terminalia sericea*	3	2	0	04
8	VT 03.2.0	*Strychnos spinosa*	2	0	0	03	*Gymnosporia senegalensis*	3	0	0	05	*Gymnosporia senegalensis*	3	1	0	05
9	VT 03.2.0	*Tecoma capense*	1	1	0	04	*Canthium armatum*	2	1	0	04	*Canthium armatum*	3	0	0	04
10	VT 03.2.0	*Ziziphus mucronata*	1	1	0	04	*Brachylaena discolor*	2	0	0	05	*Brachylaena discolor*	2	2	1	05
1	VT 04.1.0	-	-	-	-	-	*Dichrostachys cinerea*	3	1	0	04	*Sclerocarya birrea*	3	3	0	05
2	VT 04.1.0	-	-	-	-	-	*Sclerocarya birrea*	3	1	0	05	*Dichrostachys cinerea*	3	2	1	04
3	VT 04.1.0	-	-	-	-	-	*Acacia gerrardii*	2	0	0	04	*Acacia gerrardii*	2	2	0	04
4	VT 04.1.0	-	-	-	-	-	*Gymnosporia senegalensis*	2	0	0	03	*Gymnosporia senegalensis*	2	1	1	03
5	VT 04.1.0	-	-	-	-	-	*Acacia burkei*	1	1	0	03	*Acacia burkei*	1	1	1	03
6	VT 04.1.0	-	-	-	-	-	*Phoenix reclinata*	1	1	0	04	*Phoenix reclinata*	1	1	1	04
7	VT 04.1.0	-	-	-	-	-	*Tabernaemontana elegans*	1	1	0	03	*Strychnos madagascariensis*	1	1	1	05
8	VT 04.1.0	-	-	-	-	-	*Vangueria infausta*	1	1	0	04	*Vangueria infausta*	1	1	1	04
9	VT 04.1.0	-	-	-	-	-	*Euclea natalensis*	1	0	0	03	*Euclea natalensis*	1	1	0	03
10	VT 04.1.0	-	-	-	-	-	*Garcinia livingstonei*	1	0	0	03	*Tabernaemontana elegans*	1	1	0	03

VT 02.1.0 = Closed Woodland Thicket
VT 02.2.0 = Closed Woodland on Clay
VT 02.3.0 = Closed Woodland on Sand
VT 03.1.0 = Open Woodland on Sand
VT 03.2.0 = Open Woodland on Abandoned Household Sites
VT 04.1.0 = Sparse Woodland on Sand

Table 7. *The 10 woody species most utilised by insects in Manqakulane Rural Community, by vegetation unit and age of damage (for canopy volume removal only). Values given reflect the number of height classes (HC) where utilisation was reported (HC 01), as well as the number of height classes where utilisation was > 50% (HC 02) and 100% (HC 03) of canopy removed or number of individuals utilised within a height class, and the highest height class where damage was observed (HC 04). Species highlighted in red represent situations where at least one height class was completely utilised. Maputaland, northern KwaZulu-Natal, South Africa*

Number	Vegetation unit	Taxa	Canopy Volume removal < 12 months				Taxa	Overall Utilisation			
			HC 01*	HC 02*	HC 03*	HC 04*		HC 01*	HC 02*	HC 03*	HC 04*
1	VT 02.1.0	*Zanthoxylum capense*	5	0	0	06	*Acacia burkei*	5	2	1	07
2	VT 02.1.0	*Acacia burkei*	4	0	0	07	*Zanthoxylum capense*	5	1	0	06
3	VT 02.1.0	*Bridelia cathartica*	4	0	0	05	*Terminalia sericea*	4	4	1	06
4	VT 02.1.0	*Euclea natalensis*	4	0	0	06	*Bridelia cathartica*	4	2	0	05
5	VT 02.1.0	*Canthium armatum*	3	1	0	04	*Commiphora neglecta*	4	1	0	05
6	VT 02.1.0	*Carissa bispinosa*	3	0	0	04	*Euclea natalensis*	4	1	0	06
7	VT 02.1.0	*Clausena anisata*	3	0	0	03	*Clausena anisata*	4	0	0	04
8	VT 02.1.0	*Psydrax locuples*	3	0	0	04	*Brachylaena discolor*	3	2	0	05
9	VT 02.1.0	*Albizia adianthifolia*	2	0	0	05	*Carissa bispinosa*	3	2	0	04
10	VT 02.1.0	*Brachylaena discolor*	2	0	0	04	*Deinbollia oblongifolia*	3	1	0	04
1	VT 02.2.0	*Canthium setiflorum*	1	0	0	03	*Grewia caffra*	2	2	2	05
2	VT 02.2.0	*Dalbergia obovata*	1	0	0	03	*Dialium schlechteri*	2	1	1	06
3	VT 02.2.0	*Deinbollia oblongifolia*	1	0	0	03	*Canthium setiflorum*	1	1	1	03
4	VT 02.2.0	*Dialium schlechteri*	1	0	0	02	*Dalbergia obovata*	1	1	0	03
5	VT 02.2.0	*Ehretia obtusiflora*	1	0	0	00	*Ehretia obtusiflora*	1	1	0	03
6	VT 02.2.0	*Grewia caffra*	1	0	0	03	*Rhus gueinzii*	1	1	0	03
7	VT 02.2.0	*Kraussia floribunda*	1	0	0	03	*Deinbollia oblongifolia*	1	0	0	03
8	VT 02.2.0	*Rhus gueinzii*	1	0	0	03	*Kraussia floribunda*	1	0	0	03
9	VT 02.2.0	*Zanthoxylum capense*	1	0	0	03	*Zanthoxylum capense*	1	0	0	03
1	VT 02.3.0	*Acacia burkei*	4	0	0	05	*Strychnos madagascariensis*	5	2	1	06
2	VT 02.3.0	*Bridelia cathartica*	4	0	0	05	*Bridelia cathartica*	4	2	0	05
3	VT 02.3.0	*Dichrostachys cinerea*	4	0	0	05	*Zanthoxylum capense*	4	2	0	05
4	VT 02.3.0	*Zanthoxylum capense*	4	0	0	05	*Acacia burkei*	4	0	0	05
5	VT 02.3.0	*Coddia rudis*	3	0	0	04	*Dichrostachys cinerea*	4	0	0	05
6	VT 02.3.0	*Euclea natalensis*	3	0	0	04	*Sclerocarya birrea*	3	2	0	07
7	VT 02.3.0	*Psydrax locuples*	3	0	0	04	*Spirostachys africana*	3	1	0	06
8	VT 02.3.0	*Strychnos madagascariensis*	3	0	0	05	*Coddia rudis*	3	0	0	04
9	VT 02.3.0	*Deinbollia oblongifolia*	2	0	0	03	*Euclea natalensis*	3	0	0	04
10	VT 02.3.0	*Dialium schlechteri*	2	0	0	04	*Psydrax locuples*	3	0	0	04

Table 7 continued

1	VT 03.1.0	*Brachylaena discolor*	1	0	0	04	*Brachylaena discolor*	1	1	0	04
2	VT 03.1.0	*Combretum molle*	1	0	0	05	*Combretum molle*	1	1	0	05
3	VT 03.1.0	*Dalbergia obovata*	1	0	0	03	*Dalbergia obovata*	1	1	0	03
4	VT 03.1.0	*Grewia microthyrsa*	1	0	0	04	*Grewia microthyrsa*	1	0	0	04
5	VT 03.1.0	-	-	-	-	-	*Hymenocardia ulmoides*	1	0	0	03
6	VT 03.1.0	-	-	-	-	-	*Xylotheca kraussiana*	1	0	0	03
1	VT 03.2.0	*Dichrostachys cinerea*	4	0	0	04	*Terminalia sericea*	4	1	1	07
2	VT 03.2.0	*Strychnos madagascariensis*	4	0	0	05	*Dichrostachys cinerea*	4	0	0	04
3	VT 03.2.0	*Strychnos spinosa*	4	0	0	05	*Strychnos madagascariensis*	4	0	0	05
4	VT 03.2.0	*Euclea natalensis*	3	0	0	04	*Strychnos spinosa*	4	0	0	05
5	VT 03.2.0	*Ochna natalitia*	3	0	0	07	*Ochna natalitia*	3	1	1	07
6	VT 03.2.0	*Sclerocarya birrea*	3	0	0	04	*Sclerocarya birrea*	3	1	0	04
7	VT 03.2.0	*Terminalia sericea*	3	0	0	04	*Euclea natalensis*	3	0	0	04
8	VT 03.2.0	*Albizia adianthifolia*	2	0	0	03	*Trichilia emetica*	3	0	0	07
9	VT 03.2.0	*Commiphora neglecta*	2	0	0	04	*Commiphora neglecta*	2	2	1	04
10	VT 03.2.0	*Deinbollia oblongifolia*	2	0	0	03	*Albizia adianthifolia*	2	1	1	03
1	VT 04.1.0	*Garcinia livingstonei*	1	0	0	03	*Sclerocarya birrea*	2	1	0	05
2	VT 04.1.0	*Sclerocarya birrea*	1	0	0	02	*Trichilia emetica*	1	1	1	02
3	VT 04.1.0	*Strychnos madagascariensis*	1	0	0	03	*Xylotheca kraussiana*	1	1	1	02
4	VT 04.1.0	*Trichilia emetica*	1	0	0	02	*Ziziphus mucronata*	1	1	1	04
5	VT 04.1.0	*Xylotheca kraussiana*	1	0	0	02	*Garcinia livingstonei*	1	1	0	03
6	VT 04.1.0	*Ziziphus mucronata*	1	0	0	04	*Acacia gerrardii*	1	0	0	03
7	VT 04.1.0	-	-	-	-	-	*Dichrostachys cinerea*	1	0	0	03
8	VT 04.1.0	-	-	-	-	-	*Strychnos madagascariensis*	1	0	0	03

VT 02.1.0 = Closed Woodland Thicket
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Tshanini. It would seem that the local people have hunted all small mammals within a 2 km zone around the core community village. The Closed Woodland Thicket and Open Woodland on Abandoned Household Sites have a dense undergrowth and these conditions are the most favourable for these small mammals, by providing cover and abundant food (van Eeden 2005). Van Eeden (2005) evaluated small mammals' occurrence in Tshanini and established that only suni and red duiker occurred in the area.

Human utilisation of the area is remarkably high and appears destructive. The number of height classes fully utilised is alarming, and it seems that canopy removal by humans tend to have a cumulative effect on the vegetation. As expected, the units where most of the older signs of utilisation are found were the Open Woodland on Abandoned Household Sites but also the Sparse Woodland on Sand and the Closed Woodland on Clay. The former, as indicated by its name is an open woodland vegetation phase, where the vegetation is recovering from a range of man-induced utilisation (Gaugris 2004; Peteers 2005). The latter two occupy the area where most of the local people relocated after 1992, when the government installed a safe water supply along the western side of the Muzi Swamp (Gaugris 2004; Peteers 2005).

The Closed Woodland on Clay is found along the eastern and western sides of the Muzi Swamp and in addition to being close to the safe water supply, the tall trees provide much-needed shade in summer (Gaugris 2004). Most households are therefore settled within this woodland type, but also on the first dune cordon in a westerly direction, where a mixture of Open and Sparse Woodland on Sand occurs (Gaugris 2004). However, due to the nature of the latter vegetation unit the need to remove trees to settle a household is lower and could therefore explain the reduced impact observed there. Moreover, the Open Woodland on Sand is rich in fruit bearing trees and it is possible that the extensive use of this unit is linked to such a form of utilisation.

The recent signs of utilisation identified in the Closed Woodland Thicket go against statements that people rarely travel further than 2 km to harvest building material (Brookes 2004; Gaugris *et al.* 2007). This observation could be associated with either of two events or both. Tshanini was fenced at the end of 2005, and during most of the year prior to that event, teams of workers from the community were sent to clear the fence lines. It appears highly likely that some of the recent utilisation observed is linked to that event, as the people would have been equipped with harvesting equipment and would have used the access roads to the reserve. The fence line clearing most likely brought the people further away than they would normally do, and

they have used the opportunity to harvest trees in that vegetation unit for firewood or the building of households. The alternative option is that tree species used for the construction of households have been so depleted in the vicinity of the village that the people are actually forced to walk the extra distance to reach this vegetation unit. Such a pattern of utilisation has been observed in several places in South Africa (Banda *et al.* 2006; Shackleton *et al.* 2007). However, the actual tree species utilisation values in Table 5 do not support this hypothesis fully. The most utilised species in the Closed Woodland Thicket are the fruit bearing *Strychnos* species, and *Dialium schlechteri*, which is utilised more for firewood or non-habitation buildings such as maize stores (Gaugris *et al.* 2007). The straight poles of smaller *Terminalia sericea*, and medium sized *Euclea natalensis* are currently used for house building although their short durability is not a preferred feature (Gaugris *et al.* 2007), while the thorny branches of *Acacia burkei* and *Dichrostachys cinerea* are used for firewood or as cattle-proof fences around cultivated fields.

The tree species utilisation analysis (Table 5) reveals that people do indeed use fruit bearing trees extensively, although it was not unexpected (Emanuel *et al.* 2005; Shackleton *et al.* 2007). The values also show that the utilisation could potentially be unsustainable in the long-term, especially for the species where utilisation exceeds the 50% of a height class utilisation mark in more than one height class. Several studies that evaluated non-timber forest product utilisation established that in most instances the use was not sustainable, as the removal of parts of the plants, and sometimes the reproductive systems led to much reduced flowering and fruiting and regeneration (Fredericksen *et al.* 1999; Ticktin 2004; Shackleton *et al.* 2005). The utilisation of *Hyphaene coriacea* for the production of palm wine appears particularly destructive. The stems of the trees are cut at approximately breast height, thereby removing the whole canopy. While the latter explains the noticeably high utilisation level for that species, it also highlights a major problem with the sustainable utilisation of this species. Every time a tree is cut for producing palm wine, the flowering part of the plant is removed, and there is no further potential for sexual reproduction and genetic mixing.

The utilisation due to natural damage is a puzzling issue. Natural damage appears to affect a large percentage of woody species, and greatly affects a large percentage of height classes as well. Furthermore, the natural damage appears to have an accumulative nature, whereby plants seem to have insufficient time to recover between utilisation events. The latter is most uncharacteristic of natural disturbance damage (Whitmore and Burslem 1996; Burslem and Whitmore 1999). One option could be the human-induced burning of the bush, especially in Open and Sparse Woodland

units (Gaugris *et al.* 2004). The local people burn the vegetation to induce fresh grass growth towards the end of the dry season, in order to feed the cattle. The author observed numerous fires, left uncontrolled. The practice is regular and annual burning of the same vegetation units was observed. Due to the human utilisation of these vegetation units, some of the tree canopy is removed and conditions are favourable for the development of a dense herbaceous layer, thus generating high fuel loads and hot, intense fires. The latter has been documented in east Africa and elsewhere (Franklin *et al.* 2000; Kauffman *et al.* 2003; Schwartz and Caro 2003) and could potentially be the one important reason for the high level of natural damage observed. Another option could be linked to the opening of the vegetation for fields and households (Colón and Lugo 2006), which changes conditions at all levels of the woody species' canopies (Gerwing 2002; Okuda *et al.* 2003; Schwartz and Caro 2003; Paul *et al.* 2004). The changes include increased light and temperature, which could have a bearing on the ability of some species to survive especially when such changes are extensive and lead to constant absence of vegetation at several levels.

The level of insect herbivory observed is an interesting aspect in the present study. The number of woody species used by insects is high (>60% in three vegetation units) and damage consists mostly of defoliation, but also the removal of some height classes. In a study in east Africa, it was established that insects caused the greatest damage to the seedlings of *Acacia* species, but also that insect herbivory was greater in areas where mammals larger than rodents were absent (Shaw *et al.* 2002), while another study measured the effect of arthropods at 20.00% removal of the net primary productivity (Chapman *et al.* 2006). Insects are an often overlooked agent, but the utilisation levels observed proves that it must be included in the larger picture when considering the sustainable utilisation of the vegetation in a region. It appears possible that insect herbivory is exacerbated in the Manqakulane area due to the lack of small browsers (Shaw *et al.* 2002).

Conclusion

An overview of the utilisation of woodland vegetation outside protected areas and in a remote part of northern Maputaland is presented. The levels of utilisation observed indicated that rural people were utilising the vegetation at an alarmingly high rate, especially around settled areas. Insect herbivory was observed and evaluated as a non-negligible agent in the utilisation of vegetation, while natural damage was

believed to be largely aggravated by the human utilisation methods. The conservation of natural vegetation of northern Maputaland outside conserved areas appears a difficult task as modernisation of the rural society has led to the opening of clearings for new households characterised by smaller families. This society change is taking a remarkable toll on the surrounding vegetation and it appears judicious to focus future conservation efforts on enticing people to set aside non-farmed land such as Tshanini and to evaluate the potential of agro-forestry to provide building material in a sustainable manner.

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