The potential influence of elephants on Southern Ground Hornbill nesting sites

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Elephants are quite clearly ecosystem engineers, and although they are only one of many species that have the capacity to modify their environment, the impact of elephants is frequently obvious to man and so they are typically considered to be a keystone species. It has been proposed that elephants could have an influence on the number of nesting sites available to Southern Ground Hornbills (*Bucorvus leadbeateri*).

Vegetation monitoring results during the dry season (Greyling 2004)

Fifty of the 92 woody species recorded in the 250 food- and 90 control plots within the APNR were not utilised by elephants. A narrow range of 6-8 plant species made up 70-80% of the diet of elephants. *Grewia* species were the principal food to both family units and bull groups as this set of species made up 41% of the diet utilised by family units and 38% of the diet utilised by bull groups (Figure 1).

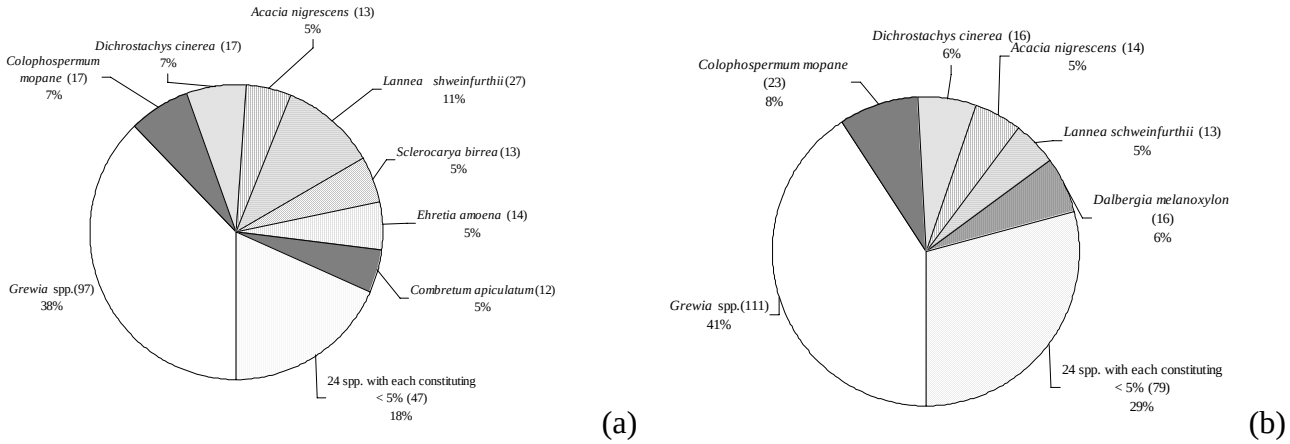

Figure 1 Relative dietary contributions of woody plant species that were utilised by (a) bull groups and (b) family units of elephants during the dry season. The number of individual plants of each species is given in brackets.

Results show that both bull groups and family units utilised only 9% of the 5 780 individual woody plants that were available to them in the study plots. Six woody plant species i.e. *Albizia harveyi*, *Colophospermun mopane*, *Dalbergia melanoxylon*, *Dichrostachys cinerea*, *Grewia* species and *Lannea schweinfurthii* were identified as plants favoured by both types of social unit. In addition, bull groups favoured *Sclerocarya birrea*. These seven woody species were utilised during 72% and 70% of all feeding events by bull groups and family units respectively. *Grewia* species, aesthetically an unimportant species but with high availability, proved to be the staple food plant for both bull groups and family units.

An estimated phytomass removal of more than 50% was found in 36% and 22% of the woody species utilised by bulls and breeding herds respectively. Bull groups had a greater impact on the structure of the vegetation as they removed larger proportions of phytomass per plant and engaged in activities such as uprooting, felling and branch breaking, more frequently than family units. Bull groups felled trees more often than family units (Table 1). Trees were defined as perennial woody plants with a single main stem and a distinct upper crown (Van Wyk & Van Wyk 1997). Single stemmed plants with basal measures > 6 cm were used to distinguish trees from shrubs according to the guidelines given by Walker (1976). Trees were felled by either bull groups or family units to access smaller plant parts such as twigs, bark, heartwood or the roots. As all uprooting events by family units included only shrubs (*Grewia* spp.), these were excluded from the analysis. Bull groups also selected for taller trees compared to family units. All the above indicate that bulls groups have a greater potential for alteration of vegetation structure within the APNR.

Table1 The number of individual trees felled or uprooted by family units or bull groups of elephant.

Family units			Bull groups		
Tree species	Feeding mode	Number felled	Tree species	Feeding mode	Number felled
Albizia harveyi	MBA[1]	1	*Acacia exuvialis*	MBA	1
Acacia robusta	MBA	1	*Acacia nigrescens*	MBA	3
			Colophospermum mopane	MBA	1
			Combretum apiculatum	UR[2]	2
			Lannea schweinfurthii	MBA	6
			Lannea schweinfurthii	UR[2]	4
			Pappea capensis	MBA	1
			Sclerocarya birrea	MBA	3
			Ziziphus mucronata	UR	1
Total number of trees felled		2	Total number of trees felled		22
Total number of trees utilised		80	Total number of trees utilised		93

[1]MBA = Main stem breakage to access smaller canopy parts
[2]UR = Uprooting to consume the roots

Information required in relation to ground hornbill nesting sites

From the above mentioned it becomes clear that the following information would be required **before** a relationship between the impact of elephants on mature trees and the number of nesting sites available to ground hornbills can be determined:

1) All tree species used by ground hornbills as nesting sites need to be ranked according to their frequency of use. According to our knowledge, mature woody species **felled** by elephants do not overlap with preferred ground hornbill nesting sites.
2) Feeding modes in which bulls break large branches to gain access to smaller plant parts (refer to Table 2) may be important when considering woody species such as *Acacia nigrescens*, *Diospyros mespiliformis*, *Lonchocarpus capassa* and *Schotia brachypetala*. Such feeding activities by elephants may be beneficial to creating nesting cavities for ground hornbills. These feeding events by elephants need to be documented and followed over time to determine whether they do result in suitable nesting cavities for ground hornbills.

3) Long-term studies need to be launched to determine at what rate mature trees are being lost to the system and what are possible causes (i.e. elephants, fire, climatic changes, episodic flooding along rivers etc.).
4) Factors influencing the regeneration of trees favoured both by elephants for browsing and by ground hornbills for nesting sites should be investigated. If we do not understand what is preventing the recruitment of these species into the mature canopy phase, then low densities of elephants will not alleviate the perceived problem. For example, if frequent fires are keeping young trees in a 'fire-trap' or if seedlings are heavily browsed by impala, then low elephant densities will not affect the replacement of mature species to the system in the long run.
5) Preliminary results from our elephant movement study within the APNR suggest that bulls occupy a non-musth range outside the range of breeding herds. The patterns of bull impact upon tall trees relative to their musth status needs to be evaluated and the implications of this in terms of the spatial arrangement of elephants and ground hornbills (elephants are unlikely to have a consistent impact across the landscape).
6) The interaction between fire and elephants on ground hornbill nesting trees. Bark stripping may increase the vulnerability of individual trees to fire. Alternatively trampling around the base of a tree by elephants may reduce the intensity of fires around the tree stem.

<u>Suggestions:</u>

1) If mature tree mortality is primarily caused through bark stripping by elephants, then wire netting can be place around the stem of trees that have ground hornbill nesting sites in them. Bird wire (13mm mesh, 1.8m tall) is wrapped around the tree trunk about 50cm off the ground to a height of approximately 230cm. On average 1.25m of wire is used per tree. The ends of the netting are stapled on the tree trunk with 25mm wire fencing staples. The wire is inconspicuous and the costs are low (R20 per tree, excluding labour). This technique has been applied by Save the Elephants and has successfully prevented the bark-stripping of *Acacia* spp. in East Africa. The same technique is currently being investigated on an experimental plot in the Timbavati Private Nature Reserve and has thus far yielded positive results as no bark-stripping has occurred on 'treated' trees.
2) Artificial nesting sites could be strategically placed in trees not favoured by elephants and which may prove to be too challenging to fell such as *Combretum imberbe*.
3) All trees with nesting sites could become important indicators of elephant impact and could be monitored specifically for elephant damage whilst monitoring ground hornbill nests. This could become an important source of information and could provide operational guidelines in future. The following guidelines are given below when recording elephant impact:

> The tree with the ground hornbill nest should be recorded by species and height category. We assume that the GPS co-ordinate will be documented. The following eight height classes of woody species can be distinguished: 0 to <0.5m, 0.5 to <1m, 1 to <1.5m, 1.5 to <2m, 2 to <2.5m, 2.5 to <3m, 3 to <5m and >5m. The basal circumference measurement should be taken whether multi- or single stemmed. A combined circumference measurement can be taken for all the stems of a multi-stemmed species that are closer than 5 cm apart. Where the stems of a multi-stemmed species are further than 5cm apart they should be measured individually. A single circumference measurement for a multi- stemmed species can then calculated as the mean of the stem measurements.
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> All breakage events can be categorised according to the feeding modes in which they occurred (Table 2). Estimates of damage by elephants, which refers to the percentage of stems that were removed, can be made according to Anderson & Walker's (1974) categories: 0%, 1-10%, 11-

25%, 26-50%, 51-75%, 76-90%, 91-99% and 100%. When different types of feeding events occur on an individual plant, an overall estimate of the damage should be given. Feeding modes in which the main stem is pushed over or broken should be considered to represent 100% damage. Uprooting events in which all the stems are first removed or flattened can also be classified as 100% damage. If the plant is left intact and only a proportion of the roots are utilised at a distance away from the main stem, damage can be estimated as with the bite and breakage events of branches. For all leaf-stripping feeding modes the damage can be estimated as being no more than 10%. A distinction should be made between new and old damage (*i.e.* damage incurred prior to the most recent feeding bout).

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Table 2 Categorisation and description of the different feeding modes of elephants.

Feeding mode	Plant part consumed	Description	Data collected
Uprooting	The whole root, the pith of a root or the bark of a root	Roots are utilised after either uprooting the whole plant or pushing the main stem over.	- Number of roots removed per plant
Main stem breakage	These events refer to breakage without consumption	Main stem snapped off or pushed over at the base.	- One main stem breakage event is recorded per plant
Large branch breakage	These events refer to breakage without consumption as only smaller branches, which are then broken off these larger branches, are utilised in some way	Large branch breaking is distinguished from main stem breaking when the stem forks into two or more branches below the breaking point (Gadd 1997).	- Breakage height (if possible). - Number of large branches broken per plant
Branch breakage	Heartwood or bark	Heartwood/bark is removed on the proximal end of the broken branch. These branch breakage events involve smaller branches than those mentioned previously.	- Number of branches broken per plant
Branch biting	Twigs with or without leaves	Utilised twigs are consumed after direct bites to the larger broken branches or by twigs that are severed with the trunk and then consumed. All whole bites are thus recorded as twig usage.	- Number of branches bit or broken per plant
Leaf-stripping	Leaves	Leaf-stripping usually occurs when branchlets are very flexible and often include new growth.	- One leaf-stripping event can be recorded per plant, as the possible number of leaf-stripping events that could have occurred per individual plant can not be distinguished