SPECIES

Damage of trees by forest Elephants (*Elephas maximus*) in Cauvery Wildlife Sanctuary, Western Ghats, Karnataka: Are they sustainable?

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ABSTRACT

In the dry deciduous forests along transects for one-month, detailed investigations of indirect observations of forest elephants uprooting and debarking trees were conducted in the Cauvery Wildlife Sanctuary. According to the study, forest elephants generally remove the bark from 6 species of trees and uproot 8 species of trees, with a maximum of 13 trees removed from a deciduous forest and 17 trees destroyed. Compared to other tree species, *Boswellia serrata* and *Hardwickia binnata* experienced significantly higher frequencies of debarking and uprooting, respectively, indicating selective usage. Debarking occurred less frequently than uprooting. The mortality rates of trees might vary depending on how much the trees have been debarked and uprooted.

Keywords: Elephants, debarking, uprooting, dry deciduous forests, Cauvery Wildlife Sanctuary

1. INTRODUCTION

Through trampling, debarking and uprooting, elephants have a significant impact on the dynamics of forest vegetation composition. Elephants use the bark and roots of downed trees to complement their diet of grass, having a bigger impact on woody vegetation (Barnes, 1982; Vanaraj et al., 2022). According to Poorter et al., (2013), a tree's bark is a crucial component for the physiology of woody plants, as well as for protecting the stem against transport and fire. Elephants' debarking of woody plants increases their susceptibility to fire during the dry season, when more harm is done.

Other studies have noted the selection of woody plant species in elephant feeding behaviour (Smallie and O'Connor, 2000; Holdo, 2003). The debarking and tree-uprooting practices of forest elephants in south India are poorly understood. The observations made to identify the tree species that elephants in the Cauvery Wildlife Sanctuary (CWLS) were most likely to uproot and debark are presented in this research.

2. METHODOLOGY

Cauvery Wildlife Sanctuary, which is about 1200 sq. km area is located between 11º 56' 49" to 12º 21' 26" N and 77º 1' 5" to 77º 46' 55 " E of Western Ghats, Karnataka, India (Figure 1). The Sanctuary receives rainfall mainly from Northeast Monsoon and it also receives low rainfall from Southwest Monsoon. The average annual rainfall is about 775 mm. Dry deciduous forests, tropical dry thorn forests and riverine forests are the major forest types within the CWLS, which are dominant forest types (Aranya Work Plan, 2016). Dry forests are more open associated with tree species like *Anogeissus latifolia*, *Hardwickia binata* and *Boswellia serrata*. At the higher altitudes, grasses are seen as understory of deciduous tree species. CWLS is also rich in herbivores such as Elephants, Gaur, Barking Deer and Cheetal.

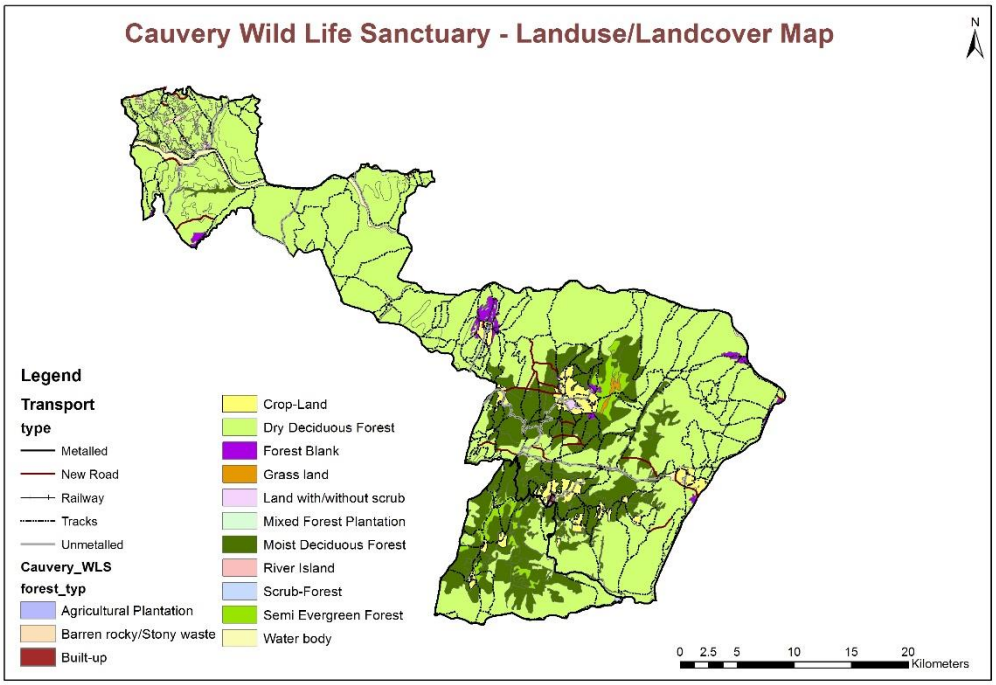

Figure 1 Map of the Cauvery Wildlife Sanctuary study area

According to Kumar, (2014), about 680 elephants inhabit the CWLS. In dry deciduous forest, a forest trail was utilised to catalogue species that forest elephants had uprooted and debarked. At the end of the summer (May 2015), signs of uprooting and debarking by forest elephants were observed on trees with trees ≥ 30 cm girth at breast height. To understand the favoured nature of elephants' feeding patterns, the maximum and minimum variety of woody plant species available in deciduous woods were noted. Elephants can be seen in CWLS in Figure 2 and 3 depict an elephant looking at an uprooted tree. Table 1 lists the species that forest elephants in the dry forests uprooted and debarked.

Figure 2 Elephants (*Elephas maximus*) uprooted trees at Cauvery Wildlife Sanctuary

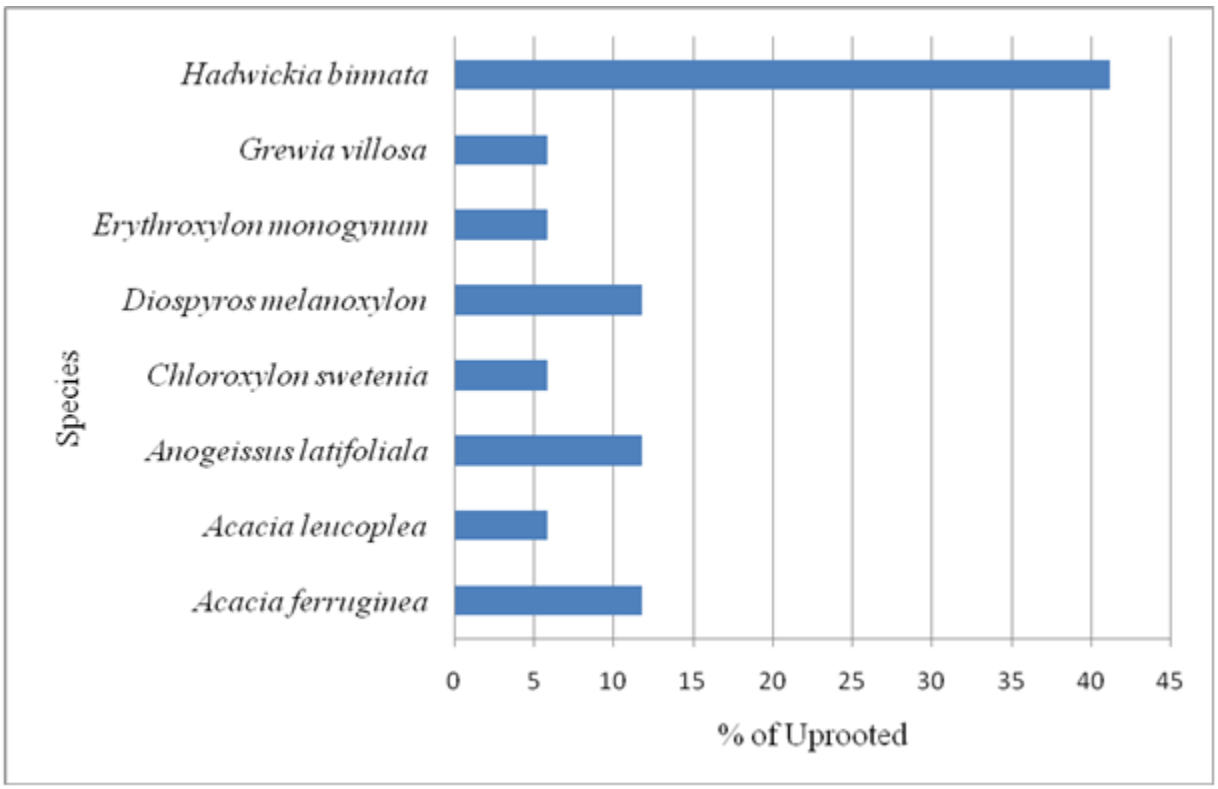

Figure 3 Relative preference among uprooted trees in dry deciduous forests

Table 1 List of Debarked and Uprooted trees encountered in Cauvery Wildlife Sanctuary, Karnataka and number of debarked and uprooted trees in the dry deciduous forest

Species	Family	Debarked	Uprooted
Acacia ferruginea DC	Mimosaceae	0	2
Acacia leucoplea Roxb Wild.	Mimosaceae	0	1
Anogeissus latifoliala Roxb DC	Combretaceae	0	2
Boswellia serrata (Roxb)	Burseraceae	6	0
Bombax ceiba L	Bombacaceae	1	0

Chloroxylon swietenia DC	Flindersiaceae	0	1
Diospyros melanoxylon Roxb	Ebenaceae	0	2
Erythroxylon monogynum Roxb	Erythroxylaceae	0	1
Grewia hirsute	Tiliaceae	1	0
Grewia villosa Willd	Tiliaceae	0	1
Haldeni cordifolia (Roxb) Ridsd	Rubiaceae	1	0
Hadwickia binata Roxb	Fabaceae	0	7
Milliuso tomentosa Roxb Finet & Gagnep	Annonaceae	2	0
Pterocarpus marsupium Roxb	Fabaceae	2	0
Total		13	17

3. RESULTS

13 types of plants were uprooted and 6 woody plant species were debarked in the observation area. Two plant families, Burseraceae and Fabaceae, contained the majority of the woody plant species that were stripped of their bark and uprooted. *Boswellia serrata, Pterocarpus marsupium* and *Milliusa tomentosa* were the species that underwent heavy debarking, while *Bombax ceiba, Haldenia cordifolia* and *Grewia hirsuta* were among the small woody plant species that forest elephants debarked infrequently (Figure 4).

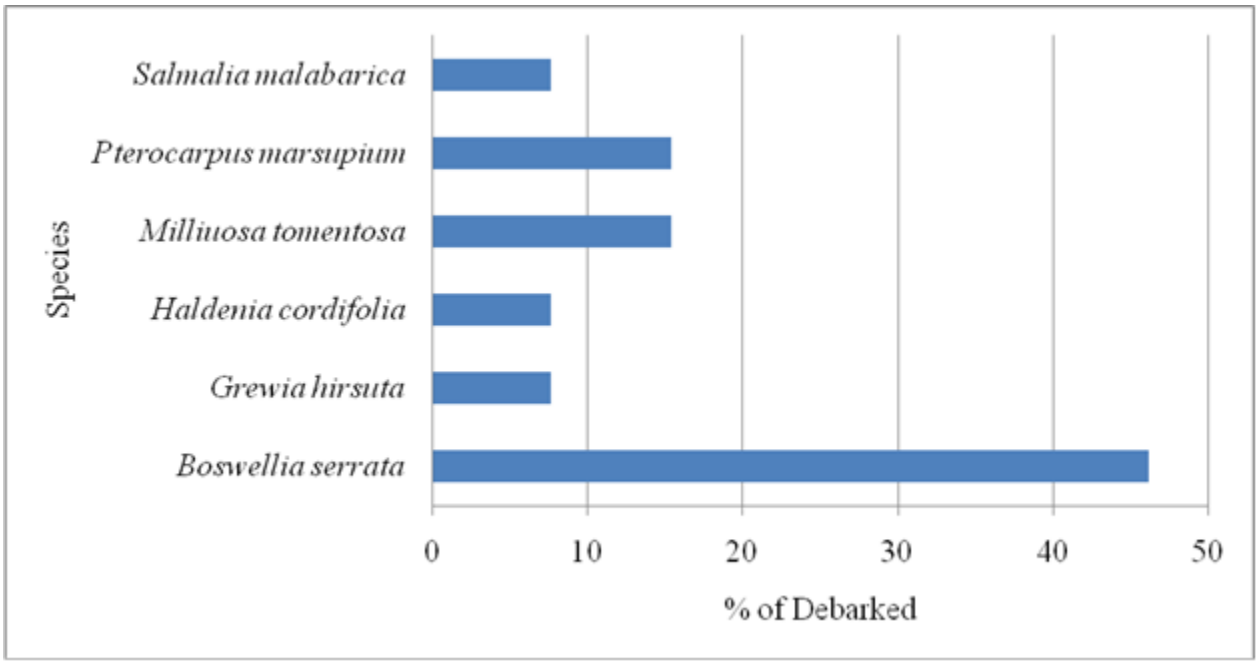

Figure 4 Relative preference among debarked trees species in dry deciduous forests

The dry deciduous forest had a maximum of 6 and 13 woody plants uprooted and debarked, respectively. *Hardwickia binata, Diospyros melanoxylon, Anogeissus latifolia* and *Acacia feruginia* were uprooted in the studied forests. Rarely were large woody trees like *Bombax ceiba* and little woody trees like *Grewia hirsuta* uprooted by forests elephants. *Boswellia serrata, Hardwickia binata* and other dry deciduous trees were more frequently destroyed (e.g., debarked and uprooted). *B. serrata* continued to favour debarking more than other species, nonetheless.

4. DISCUSSION

Previous studies of debarking of trees by elephants have shown that *Boswellia serrata, Hardwickia binata* species did not suffer damage in the forests of Biligiri Rangaswamy temple Tiger Reserve, Western Ghats, India (Vanaraj, 2001) and in the forest of Mudumalai, Western Ghats, India (Sukumar, 1989). Field observation indicates that maximum number of debarked trees was from dry deciduous forests (Vanaraj, 2001). Our field observation indicated that the total numbers of uprooted trees by elephants were much greater than total number of debarked trees by elephants. In the forest of Cauvery Wildlife Sanctuary *Boswellia serrata* was highly debarked and *Hardwickia binnata* was also uprooted compared to other tree species.

A study was also conducted on the debarking behaviour of elephants in southern India, which shows that maximum numbers of debarked trees were from dry deciduous forests (Vanaraj, 2001) and Satkosia Tiger Reserve in Odisha by Pradhan et al., (2011). The current study provides background knowledge on the various debarked trees species options available in BRT Tiger reserve as well as their nutritional value. Further studies are needed to understand this debarking behaviour and the relationship between tree damage and mortality rates. This knowledge is crucial for achieving the long-term conservation of Asian elephants and improved seasonal management. It would be helpful to conduct research on the chemical composition of bark merit investigation explain why elephants consume the bark of particular tree species and not other tree species.

5. CONCLUSION

The consequence of uprooting and debarking can vary. High level of breaking branches of trees and debarking and uprooting may lead to death of the trees. It would be interesting to investigate uprooting, debarking level and mortality rate of trees and also, to investigate the regeneration potential of the selected food plant species, soil seed bank status of selected woody plant species.

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Informed consent

Not applicable.

Ethical approval

The Animal & Plant ethical guidelines are followed in the study for observation & identification.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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