Indirect interactions between elephants (*Loxodonta africana*) and mopane caterpillars (*Imbrasia belina*) through their shared food resource – mopane trees (*Colophospermum mopane*).

by

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Summary

Mopane (*Colophospermum mopane*) trees are browsed upon by two key species, namely mopane caterpillars (*Imbrasia belina*) and African elephants (*Loxodonta africana*), which each inflict a different type of damage while feeding, namely defoliation (leaf removal) and pruning (branch and/or stem breakage). Damage type can have a significant influence on plant responses, and these induced changes in morphological and chemical characteristics of regrowth can influence the subsequent feeding behaviour by each species. The objective of this study was therefore partly to investigate the differential effect of defoliation by mopane caterpillars and pruning by elephants on mopane trees, and then to investigate whether these two taxonomically different species interact through

their shared food resource, by looking specifically at the effect of elephant utilisation of mopane on mopane caterpillar abundance.

To determine the comparative effect of each browsing type, mopane trees were subjected to simulated mopane caterpillar or elephant utilisation treatments, at various frequencies and times within the year. Regrowth characteristics were then measured on treatment and control trees, as well as on naturally utilised and unutilised trees. Reproductive investment was also recorded on naturally utilised and unutilised trees. Additionally, the impact of mopane caterpillar defoliation and elephant pruning on plant stress was investigated by measuring the level of fluctuating asymmetry (FA) in leaves. Then, to determine whether there is an interaction between elephants and mopane caterpillars, mopane caterpillar egg mass abundance in areas of high elephant impact was compared to that in areas of low elephant impact. Firstly, however, in areas without elephant damage, those tree characteristics determining host tree preference by ovipositing mopane moths were identified. From this, an understanding of how elephant utilisation may influence mopane caterpillar abundance could therefore be gained.

Defoliation and pruning had a significant different effect on mopane regrowth responses. Shoot and leaf length were significantly longer on pruned trees than control trees, for both naturally utilised and simulated elephant treatment trees, while there was no difference in shoot density. Defoliation, however, resulted in shorter shoots and leaves, particularly on naturally defoliated trees, which also had leaves of a higher nutritional value (tannin:protein ratio and total polyphenolic content) than control trees. A similar increase in leaf nutritional value was recorded in areas of high elephant impact in the Kruger National Park, but not after simulated or natural elephant damage in Venetia, where natural elephant utilization was less intense. Time since damage (i.e. first versus second flush) had a significant influence on regrowth after pruning, as shoot and leaf

length were significantly longer on trees flushing for the first time, while within-season timing of damage was important for defoliation, as late-season defoliation had a greater negative impact than mid-season defoliation. Late-season defoliation also had a negative effect on leaf carriage into the dry season, while pruning appeared to aid leaf retention.

Reproductive investment was found to be unaffected by mopane caterpillar defoliation or elephant pruning, as mean pod density and pod mass on utilised trees was no different to unutilised trees. Defoliation also had no influence on a plant's likelihood of flowering that same season, with flowering being determined more by tree height. Unlike pod production, however, mean leaf density was significantly reduced in the regrowth of defoliated trees, presumably due to the use of stored resources for reproduction prior to the onset of regrowth.

Neither simulated nor natural defoliation by mopane caterpillars and pruning by elephants was found to affect the level of leaf FA in mopane trees, even though the degree of damage inflicted on trees was considerably higher than in studies on other species where increases in FA were observed. Mopane therefore appears to be extremely tolerant of herbivory in comparison to other species. A positive relationship between leaf nutritional value (higher protein and lower tannin and polyphenolic content) and FA was detected, but only when trees from all study areas (i.e. a wide range of environmental conditions) were considered simultaneously. Environmental conditions, rather than herbivory, therefore appear to have a greater stressing affect on mopane.

In the absence of heavy elephant utilisation of mopane trees, tree size, rather than shoot length, leaf length, leaf FA or leaf nutritional value, was found to have the greatest influence on oviposition behaviour of mopane moths. Ovipositing moths showed a preference for the tall riverine habitat over the shorter woodland and scrub mopane. This preference for large trees was, however, not evident at the individual tree level, as even

though egg mass number per tree was positively related to tree height, large trees were not utilised more than expected according to the available canopy volume in each size class (resource availability).

Heavy elephant utilisation of mopane had a negative impact on the density of tall trees within an area, due to branch and stem breakage while feeding. Unsurprisingly then, mopane caterpillar egg mass abundance was also significantly reduced in these areas, even though the nutritional value of leaves was higher than in non-elephant impacted areas. Elephants therefore appear to have a negative effect on mopane caterpillar abundance, primarily due to their negative impact on the density of tall mopane trees. This megaherbivore and invertebrate do therefore interact through their shared food resource, mopane trees.

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