Reproduction on top- canopy trees, and the birds and the bees

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Natural historians and other scientists have long studied the reproductive ecology of plants and the mechanics of fertilisation, the processes and techniques of attraction and visitor behaviour are well understood (see for example Proctor & Yeo 1972, Faegri & van der Pijl 1979). Limited access to the forest canopy, however, has meant that few studies have considered reproduction in this strata. The introduction of the Australian Canopy Crane at Cape Tribulation in far North Queensland has afforded new opportunities to understand plant-animal interactions in the rainforest canopy. This study using the access provided by the crane, investigated the reproductive ecology of two congeneric rainforest canopy trees *Syzygium sayeri* and *S. gustavioides* to identify the floral determinants of likely pollinators, the breadth of animals responding to flower opening and the candidate pollinators at the canopy crane site. A summary of our findings is presented below.

Clear distinctions were made between the attractants, flower morphology and flower availability of the two tree species. *S. sayeri* is a xenogamous species with poor self-compatibility and moderate levels of natural out-crossing. Robust flowers were produced in inflorescences held under the canopy. Copious amounts of weak to moderate nectar were produced throughout day and night. Flowering occurs annually for an intermediate duration. In contrast, *S. gustavioides* produced low levels of nectar, but with a higher sugar concentration than does *S. sayeri*. Variation in both the quantity and pattern of nectar production was detected at different times of the year. Flowering by this species is continuous with regular or irregular bursts of intense flowering. Displays of its small, fragile flowers held in large inflorescences are conspicuous above the canopy.

Morphological differences between the two *Syzygium* species were reflected in the make up of visitor arrays and different predicted pollination systems. *S. sayeri* demonstrated an important succession of visitors, with day time activity dominated by honeyeaters, Hymenoptera and butterflies, a brief period of sphingid “swarming” around dusk with bats and smaller moths making night time visits (Figure 1). The apparent dominance of conspicuous vertebrate visitors did not exclude a moderate diversity of insects visiting this species. In contrast, *S. gustavioides* visitors were exclusively insects. The extraordinary diversity of insect visitors was dominated by Thysanoptera, Coleoptera, Diptera. Other visitors frequently observed at the flowers include a diversity of Hymenoptera and butterflies . Nearly half the beetle visitors belonged to the families Mordelidae and Elatridae, although some ninety-seven morphospecies were sorted from twenty-six families. The most numerous dipteran visitor was from the family Cecidomyiidae, a taxa previously associated with pollination.

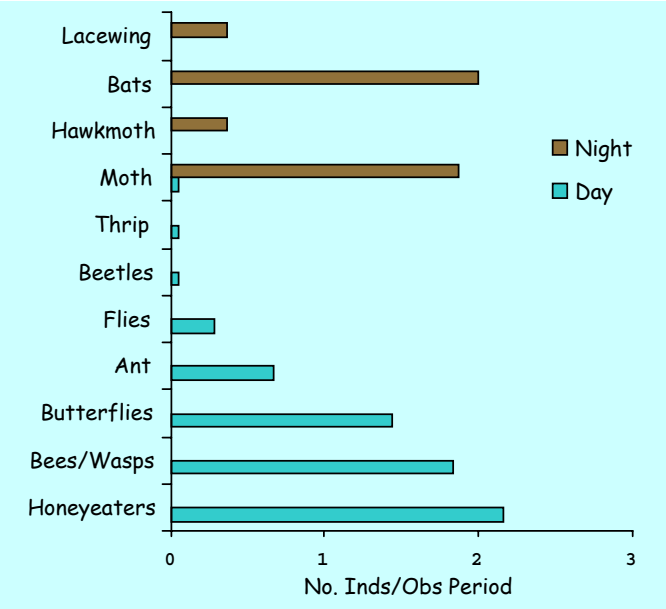

Figure 1 Animals observed visiting the flowers of *Syzygium sayeri* across 24 hrs demonstrated a clear succession of day and night visitors to this species.

A combination of ethanol washing, trapping and observation techniques, detected a considerably more diverse fauna than would have been determined by observations alone. Comparison of fauna visiting unopened and open flowers demonstrated a quantifiable increase in the number of insects attracted to open flowers. Both the abundance and identity of insects visiting S. gustavioides appeared to vary at different times of the year and levels of flowering intensity. Few taxa were observed to visit both *S. sayeri* and *S. gustavioides.*

Manipulation exclusions demonstrated that while large vertebrate visitors contributed considerably to the pollination success of *S. sayeri,* moderate levels of pollination were achieved in the absence of these visitors. No significant distinction could be made between the pollination success of day and night visitors. *S. gustavioides* on the other hand reached natural levels of pollination success when flower access was provided to insects no larger than 4.5 mm only. The availability of flowers to more, and larger visitors appeared to have an additive affect. Different species of Hymenoptera, Diptera and Coleoptera were all demonstrated capable of pollination.

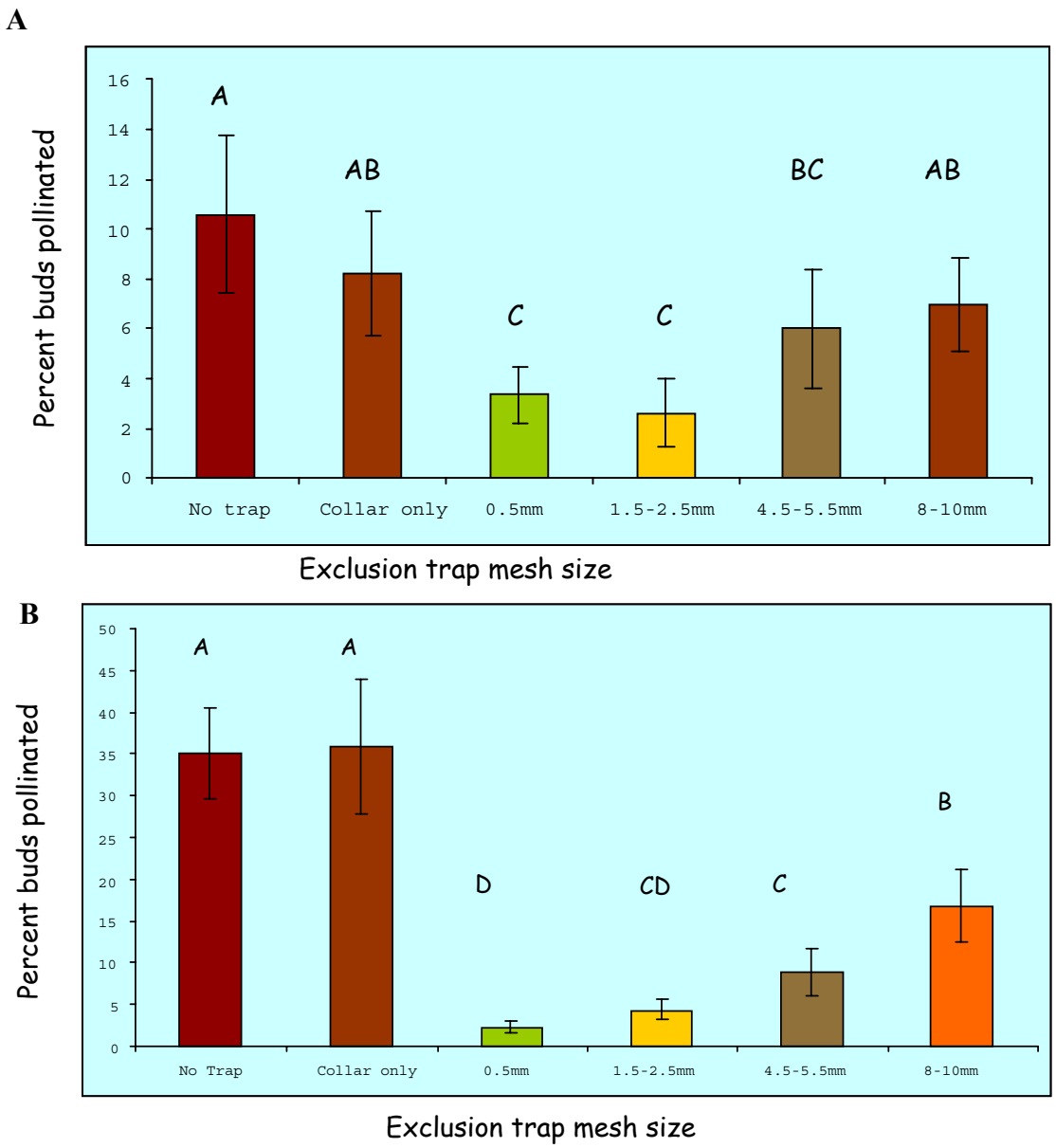

Figure 2 Exclusion of visitors to (a) *Syzygium sayeri* and (b) *S. gustavioides* using different mesh sizes demonstrates the pollination success of different visitor size classes.

Both *S. sayeri* and *S. gustavioides* demonstrated generalised pollination systems in which a variety of taxa provide pollen transfer. *S. gustavioides* however has a uniquely broad generalist pollination system, with no other Australian *Syzygium* demonstrating similar. In contrast, *S. sayeri* demonstrated many synergies with those few *Syzygiums* studied to date. The apparent anomaly of *S. gustavioides* can be explained by the phylogentic distance between this species and all other Australian taxa (Harrington & Gadek, *In review*). The possession of generalised pollination systems suggests that these two species could continue to reproduce in modified or disturbed landscapes.

References:

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