

PANZER MITES ON THE FOREST PHYLLOPLANE

VANESSA M. BARNES

Department of Ecology and Evolutionary Biology, Monash University, Clayton, Victoria, 3168, Australia

Abstract

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The distribution and abundance of the phylloplane specialist, *A. polyphyllus*, appears to be influenced by architectural complexities of the leaf.

Introduction

Over the last decade, canopy fogging in a variety of tropical forests has changed our perception of the biodiversity of insects. However, most of these studies have probably underestimated both the abundance and species richness of a more obscure group of arthropods, the mites (Acari) (Walter and O'Dowd, 1995a). Usually considered denizens of the soil and litter, these tiny mites may exploit the wide variety of food resources and microhabitats (ranging from the leaf surface, or phylloplane, to bark crevices) available in the forest canopy (Walter et al., 1994; Walter and O'Dowd, 1995b). For example, the diverse Oribatida or 'Panzer mites' (a German term referring to their 'tank-like' exoskeleton) are typically stereotyped as a soil-dwelling group. Yet, some Panzer mites may lead arboreal lifestyles or even be microhabitat specialists within the forest canopy (Walter and Behan-Pelletier, 1993).

In forests in southeastern Australia, I studied the distributional ecology of one such oribatid mite, *Adhaesozetes polyphyllus* (Acari: Oribatida: Licneremaeoidea) asking three questions:

1. Is *A. polyphyllus* a phylloplane specialist?
2. Does the morphology of *A. polyphyllus* correlate with its arboreal lifestyle?
3. Is *A. polyphyllus* a habitat specialist at a larger scale, e.g., forest type?

Is *Adhaesozetes* a phylloplane specialist?

To determine whether *A. polyphyllus* specialised on any particular microhabitat in the forest canopy, I compared its distribution with that of other oribatid species across microhabitats (bark, stem & leaves) on four plant species and in the soil (Fig. 1). From one plant, four soil and leaf litter cores (7 cm by 4 cm), four bark and moss strips (8 cm by 2 cm), four stem sections (12-15 cm in length) and eight leaves were collected. The sampling numbers remained con-

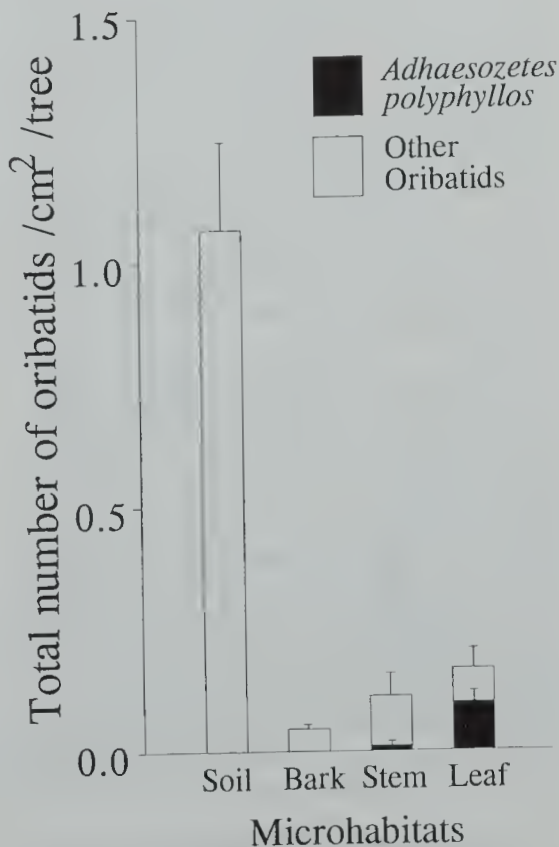


Figure 1. The mean number (\pm standard error) of *A. polyphyllus* (nymphs and adults combined) and other oribatid mite species per cm of microhabitat sample per tree. The tree species (Musk Daisy-bush, Silver Banksia, Snowy Daisy-bush, and Lilly-pilly) are pooled.

stant for the Musk Daisy-bush and the Snowy Daisy-bush. However, the number of leaf samples was increased to 20 for each of the Lilly-pilly plants and the Silver Banksia plants, as the population densities were unknown. Shoots,

approximately 7 cm in length, were collected from the Silver Banksia to represent leaves as this plant species had considerably smaller leaves than the other three species.

The four microhabitats within the tree were not directly comparable. One way to equalise the comparison was to transform the numbers of mites per cm. As expected, the abundance and species richness of oribatid species was greatest in the soil. On a per cm basis, the mean number was almost ten times greater in the soil than any of the plant microhabitats (bark, stem, and leaf) sampled. Of the oribatid species on the phylloplane, *A. polyphyllos* (mean total length: male c. 400 µm, female c. 430 µm) was the most abundant on all plant species sampled. Furthermore, all life stages of *A. polyphyllos* were abundant on the leaf surface and rare or absent in the other microhabitats (Fig. 2). With the exception of the Lilly-pilly (*Acmena smithii*), which has smooth leaves, *A. polyphyllos* and its remains (exuviae) were almost entirely restricted to the phylloplane. My results and observations show that *A. polyphyllos* lives, eats, reproduces, and dies on the forest phylloplane.

Although *A. polyphyllos* occurred on the leaves of all plant species examined, its abundance varied between plant species. Some of this variation could be explained by the differences in the leaf surface features. For example, the 'forest' of trichomes (leaf hairs) found on the Musk Daisy-bush (*Olearia argophylla*), Silver Banksia (*Banksia marginata*) and Snowy Daisy-bush (*Olearia lirata*) may provide footholds for attachment, and protection from the elements and predators. Additionally, trichomes may trap fungal spores and pollen, which are important foods for many oribatid species. In contrast, the smooth, 'desert-like' surface of the Lilly-pilly may not provide the architectural complexity that may be necessary for an arboreal lifestyle.

Does the morphology of *Adhaesozetes* correlate with its arboreal lifestyle?

Life on the phylloplane presents several hurdles. The morphological characteristics of *A. polyphyllos* may aid in its arboreal lifestyle. Firstly, its tarsal claws, and adhesive pulvilli may anchor the mite to the phylloplane by attaching to surface irregularities. Secondly, its dorsoventrally flattened body may help it to remain within a narrow boundary layer, aiding with water balance. A flattened body shape would also reduce the chances of dislodgment by wind or by leaves rubbing together.

Life on the phylloplane may also present difficulties in obtaining adequate food, and in avoiding competition and predation. Trichomes may aid in trapping fungal spores, and competition and predation may be reduced as there are fewer mites on the phylloplane compared with the soil. The thick, hard exoskeleton of *A. polyphyllos* may protect adults from predators, and the bothridial sensillum (thought to be an 'anemoreceptor' sensing movement of air currents) may enable these blind mites to sense movements of nearby predators.

The morphological characteristics of *A. polyphyllos* are consistent with other arboreal oribatid species and distinct from soil-dwelling ones, suggesting morphological correlates with an arboreal habit. Furthermore, these arboreal oribatid species are taxonomically distinct from their relatives in the soil.

Is *Adhaesozetes* a habitat specialist at a larger scale?

The architectural complexity of the phylloplane appears to influence the distribution and abundance of *A. polyphyllos*, but do habitat differences at a larger scale, that is, forest type, also play an important role? To answer this question, I sampled 20 leaves from eight Musk Daisy-bushes in wet sclerophyll forest and rainforest at three different sites. The distribution and abundance of *A. polyphyllos* did not differ significantly between forest habitats. The apparent preference of *A. polyphyllos* for the wet sclerophyll forest (Fig. 3A) may be explained by the distribution and abundance of the Musk Daisy-bush, a preferred plant species. It is a wet sclerophyll forest specialist and a coloniser of disturbed areas, which are more common in wet sclerophyll forest than rainforest.

In addition, I sampled a variety of plant species in three forest types, dry sclerophyll forest, wet sclerophyll forest, and warm temperate rainforest. These results (Fig. 3B) differed only slightly from the above survey. All life stages of *A. polyphyllos* were distributed across all three forest types and its abundance did not differ significantly between forest habitats. Independent of forest type, mites and their exuviae were more common on plant species with leaf trichomes, such as the Musk Daisy-bush and ferns. Thus, the distribution and abundance of *A. polyphyllos* appears more strongly related to the fine-scale differences in leaf surface structure within forest types than coarse-scale differences in forest type itself.

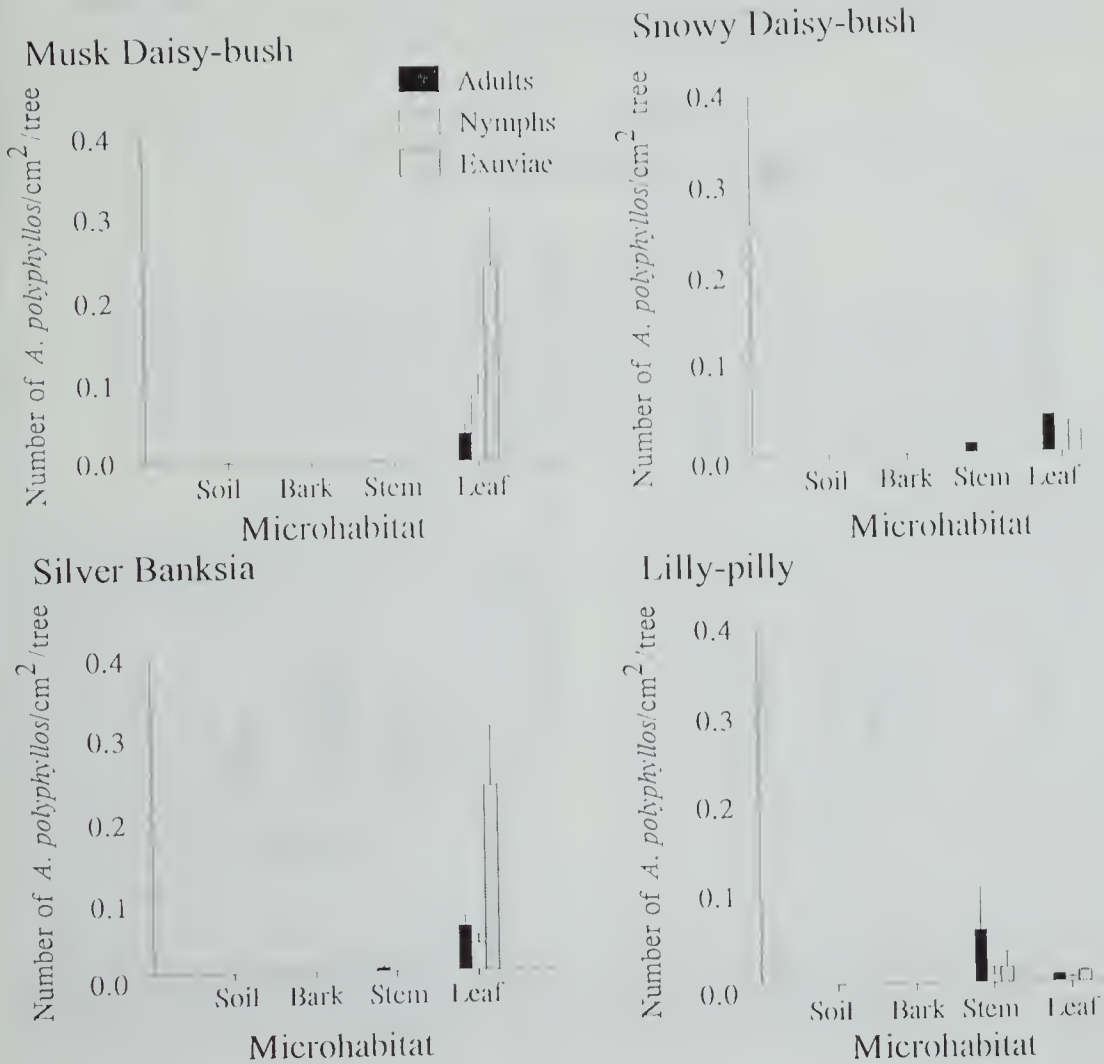


Figure 2. The abundance of *A. polyphyllus* (mean no. cm⁻² tree⁻¹ ± SE) on the Musk Daisy-bush (N = 15 trees), Silver Banksia (N = 3), Snowy Daisy-bush (N = 1) and Lilly-pilly (N = 3).

Conclusions

Adhaesozetes polyphyllus is an arboreal mite and a specialist on the leaf surface. All life stages (eggs, nymphs, and adults) were abundant on the phylloplane, while few if any individuals were found in the three other microhabitats. The abundance of exuviae on the phylloplane suggests that the development of the life stages occur there. Furthermore, *A. polyphyllus* has morphological characteristics (well-developed

tarsal claws, adhesive pulvilli, club-shaped bothridial sensillum, and a dorsoventrally flattened body) consistent with an arboreal habit. These appear to be consistent with other arboreal oribatid species and distinct from soil-dwelling ones.

Within the forest types examined, fine-scale differences in leaf structural complexity (including trichomes, raised midrib and veins) appear to have a larger effect on the distribution and abundance of *A. polyphyllus* and other oribatid

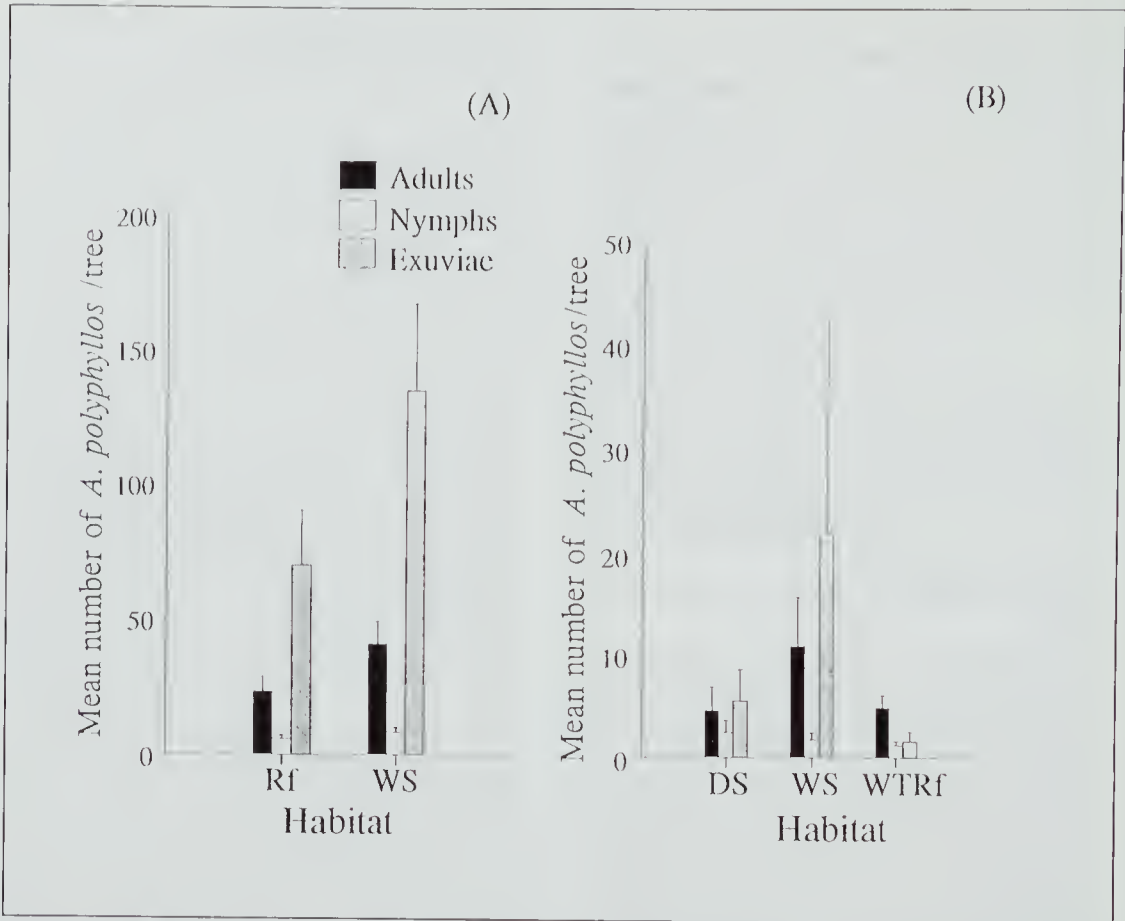


Figure 3. The mean number of *A. polyphyllus* per tree (\pm SE) on (A) the Musk Daisy-bush in rainforest (Rf) and wet sclerophyll forest (WS) ($N = 24$ trees in each forest type pooled across three sites). (B) The abundance of *A. polyphyllus* (mean number per tree \pm SE) pooled across a variety of plant species sampled in dry sclerophyll forest (DS), wet sclerophyll forest (WS) and warm temperate rainforest (WTRf) ($N = 30$ trees in each forest type pooled across two sites).

species than coarser scale differences in forest type. Phylloplane specialists, like *A. polyphyllus* appear to select those plant species that offer them 'mite-sized' architectural complexity which may help them to overcome the substantial hurdle of a phylloplane existence.

References

- Walter, D.E. and Behan-Pelletier, V., 1993. Systematics and ecology of *Adhaesozetes polyphyllus*, sp. nov. (Acari: Oribatida: Licneremaeoidea) leaf-inhabiting mites from Australian rainforests. *Canadian Journal of Zoology* 71: 1024–1040.
- Walter, D.E. and O'Dowd, D.J., 1995a. Life on the forest phylloplane: hairs, little houses, and myriad mites. Pp. 325–351 in Lowman, M. D. and N. M. Nadkarni (eds.), *Forest canopies*. Academic Press: San Diego.
- Walter, D.E. and O'Dowd, D.J., 1995b. Beneath biodiversity: factors influencing the diversity and abundance of canopy mites. *Selbyana* 16: 12–20.
- Walter, D.E., O'Dowd, D.J. and Barnes, V., 1994. The forgotten arthropods: foliar mites in the forest canopy. *Memoirs of the Queensland Museum* 36: 221–226.