

Presence of adult *Ochlerotatus (Finlaya) notoscriptus* (Skuse) and *Culex (Culex) pervigilans* Bergroth (Diptera: Culicidae) in tree canopy in Wellington, New Zealand

José G. B. Derraik^{1,4}, David Slaney¹, Philip Weinstein^{1,3}, Phil Lester² and Gordon Purdie¹

¹ Ecology and Health Research Centre, Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago, P.O. Box 7343, Wellington, New Zealand

² School of Biological Sciences, Victoria University of Wellington, PO Box 600, Wellington, New Zealand.

³ Current address: School of Population Health, University of Western Australia, 35 Stirling Hwy, Crawley, Western Australia 6009, Australia.

⁴ Author for correspondence, jderraik@wnmeds.ac.nz

Abstract

This study was set up to test whether or not the mosquito species present in the Wellington region are active in the tree canopy. The two species collected, the endemic *Culex (Culex) pervigilans* and the exotic *Ochlerotatus (Finlaya) notoscriptus*, were both recorded from CO₂/light traps 10 m off the ground. The latter species was collected in greater abundance in traps set in the canopy compared to those on the ground. Our results indicate that both *C. pervigilans* and *O. notoscriptus* forage for blood meals at ground level and in the forest canopy.

Key words: Adult mosquitoes, tree canopy, New Zealand

Introduction

In tropical forests where abundant arboreal hosts are present, mosquito species have been shown to occur in a wide vertical range within the forest column (e.g. Bates 1944), with *Aedes (Stegomyia) africanus* (Theobald) for instance, ovipositing from ground level up to 30 m (Corbet 1964). In contrast, other species, such as *Aedes (Aedes) cinereus* Meigen are constantly near the ground, and only seem to fly up to bite the lower parts of animal bodies that walk through the ground vegetation (Wesenberg-Lund 1921).

New Zealand has a relatively species poor Culicidae fauna (Laird 1990, 1995) consisting of 12 native species and four established exotic mosquito species (Holder *et al.* 1999). Little is known about the ecology of mosquitoes in New Zealand forests. The leaf axils of the widespread native epiphyte *Collospermum hastatum* Skotts. (Liliaceae) are abundant natural breeding habitats for container-breeders, and in the Auckland Region, the endemic *Culex (Culex) asteliae* Belkin was found to be widespread in *C. hastatum* leaf axils in the forest

column, with larvae being collected on ground plants and as high as 18 m in the canopy (Derraik *et al.* unpublished data). In contrast, such breeding habitats seem to be highly underutilized in the Wellington Region (Derraik *et al.* unpublished data). One possible explanation might be the general absence of mosquitoes foraging within the tree canopy. This study therefore aimed at testing whether or not mosquitoes move up the tree canopy when potential hosts are available.

Materials and Methods

This study was carried out in Wellington, New Zealand (41° 20' S; 174° 46' E). Two different sites were selected for sampling. The first site was Otari-Wilton's Bush, a 90 ha urban forest reserve that has been protected for over 100 years (Wellington City Council 1996). It is a native coniferous-broadleaved forest dominated by angiosperms, with emerging podocarp trees. The Wellington Zoo was chosen as another site due to its relatively high density of culicids (JGBD, pers. obs.). The Zoo is located near an urban residential district. It is surrounded partly by a near monospecific stand of exotic *Pinus* sp., and a belt of highly modified regenerating native forest dominated by *Pittosporum crassifolium*.

Three native trees within each site were selected for sampling. At Otari, the three rimu trees (*Dacrydium cupressinum*) were chosen as they were better suited to be safely climbed. They were located from 5 to 100 m from the forest edge. At the Zoo, one trap was set at the forest edge while the others were set on planted pohutukawa, which formed a fragmented tree belt and were chosen due to the difficulty in finding trees tall enough within the regenerating forest.

Mosquitoes were sampled over three nights (with no rain) in March 2002 using fan-light/CO₂ traps.

Two traps were set at each selected tree, with one trap being installed at ground level, and another at 10 m. Control of CO₂ flow rate was achieved with a pressure regulator with output fixed at 50 psig, and 10 m polythene pipes were used to link traps at both heights to respective gas cylinders, and ensure similar gas flows. The traps were set up at least one hour before sunset and collected at least one hour after sunrise.

The data were analysed using a mixed model Poisson regression, which allowed for autoregressive errors across the nights (temporal auto-correlation). The significance level used was $P < 0.05$.

Results

The difference in mosquito abundance between the two sites was considerable, with 227 mosquitoes being collected at the Zoo compared to only 10 at Otari (Table 1). Only two Culicidae species were recorded, the exotic *Ochlerotatus (Finlaya) notoscriptus* and the endemic *Culex (Culex) pervigilans* Bergroth. While 18 native *C. pervigilans* (7.9%) were collected at the Zoo, only the exotic *O. notoscriptus* was collected in the native forest at Otari (Table 1). All but 2 *O. notoscriptus* specimens were females.

At the Zoo, there were significantly more *O. notoscriptus* collected at 10 m than at ground level ($P = 0.006$). In total, 182 *O. notoscriptus* were collected at the canopy, and 27 near the ground (Table 1). At Otari however, there was no significant difference between the numbers of individuals collected at the two heights ($P = 0.301$). For the *C. pervigilans* collected at the Zoo, the difference between heights was not significant ($P = 0.726$).

The number of mosquitoes collected each night

varied quite significantly, particularly at the Zoo (78, 104 and 27 respectively).

Discussion

The results indicate that adults of at least two mosquito species, the exotic *Ochlerotatus notoscriptus* and endemic *Culex pervigilans*, were actively responding to host-presence cues in the tree canopies in Wellington. Consequently, this study provides evidence that the underutilization of canopy breeding habitats, in particular the epiphyte *Collospermum hastatum*, cannot be attributed to the absence of mosquitoes.

A previous study on the ecology of *O. notoscriptus* in New Zealand (Foot 1970) showed that females may oviposit in containers almost 8 m off the ground, and Derraik *et al.* (unpublished data) recorded the species in the Wellington Zoo, in ovitraps at 6 m. *Ochlerotatus notoscriptus* larvae have also been recorded in the leaf axils of *C. hastatum* in the Auckland region (Derraik *et al.* unpublished data). It is possible therefore, that host availability may be the factor limiting the utilization of such natural breeding containers by *O. notoscriptus* in the native forest at Otari. The large numbers of culicids recorded at the Zoo would seem to support this hypothesis.

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Table 1. Number of adult mosquitoes in fan-light/CO₂ traps from survey at the Zoo and Otari-Wilton's Bush, in Wellington, New Zealand.

		<i>Ochlerotatus notoscriptus</i>			<i>Culex pervigilans</i>		
	Trap height	1st night	2nd night	3rd night	1st night	2nd night	3rd night
Zoo	Ground	7	13	7	3	3	4
	10 m	71	91	20	2	6	-
Otari	Ground	2	3	1	-	-	-
	10 m	2	1	1	-	-	-

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