

## More chorus cicadas emerge from kiwifruit orchard blocks than from adjacent native forest

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### Introduction

Chorus cicada, *Amphipsalta zelandica* (Boisduval) (Homoptera; Cicadidae), is a widespread endemic forest species that has colonised kiwifruit orchards (Logan *et al.* 2014). They can occur at such high densities that orchard workers may refuse to work in orchard blocks because of the loud song and frequent contact with flying cicadas escaping from disturbance. In addition, sooty mould on fruit is partly attributed to feeding by cicadas and leads to productivity losses, as does the breaking of fruiting canes where egg-nests occur. Kiwifruit orchard blocks adjacent to native forest may be at risk of regular invasion by *A. zelandica* and this has important consequences for the success of any management strategies. The aim of our study was to compare emergence densities in native forest and kiwifruit, in order to estimate that risk.

### Materials and Methods

Numbers of *A. zelandica* exuviae were counted in *Actinidia deliciosa* ‘Hayward’ kiwifruit orchard blocks and native or mixed native/exotic forest at seven sites in the Bay of Plenty kiwifruit-growing region. Population density of *A. zelandica* in kiwifruit and neighbouring forest may be correlated, as adult *A. zelandica*, like other cicadas (Moulds 1990; Simões & Quartau 2007), are apparently poor or slow dispersers; *A. zelandica* tend to have flights of less than 100 m (D.P. Logan, pers. obs.). We assumed that *A. zelandica* colonised kiwifruit orchard blocks from adjacent forest. To account for the influence of spatial correlation on density estimates, we selected paired sites that shared a common boundary or when access was restricted, were in the same locality and shared similar topography. Five of the seven sites were separated by 60-650 m; however, two were separated by 1.8 and 2.5 km (Table 1). All sample sites were roughly equivalent in area (c. 0.1-0.2 ha). At each site counts were made

in eight quadrats (4 m x 2.5 m) in each habitat. In forest areas, quadrats were placed in haphazardly chosen areas that included large trees; in kiwifruit orchard blocks, quadrats were centred on haphazardly chosen vines. Counts were made at four paired sites during late February-early March 2013 near Te Puke and three paired sites during early March 2014 near Katikati (n=2) and lower Kaimai (n=1), when most cicada emergence was likely to be complete.

## Results

More exuviae were found in quadrats on kiwifruit orchard blocks (overall mean  $\pm$  standard deviation,  $54.4 \pm 66.2$ ) than in the adjacent forest sites ( $1.3 \pm 4.5$ ) (Table 1). The difference was consistent and large enough (6- to 276-fold) between the two groups not to warrant inferential statistical comparison. Difference in the density of exuviae between paired habitats was not related by linear regression to distance ( $P > 0.05$ ).

## Discussion

We found that *A. zelandica* emerged at much higher densities in mature ‘Hayward’ kiwifruit orchard blocks than from adjacent native and modified forest. These results are consistent with an earlier study at a single site (Logan & Connolly 2005) in which about four times fewer *A. zelandica* were captured by emergence traps in native forest than in kiwifruit orchard blocks. As most *A. zelandica* within a kiwifruit orchard probably emerged from beneath kiwifruit vines, we consider that successful control within orchard blocks will not be compromised by invasion from adjacent forest. Reasons for the relatively large numbers of *A. zelandica* in kiwifruit are speculative. They may include reduced control by natural enemies (e.g. egg parasitism, mortality of nymphs from entomopathogen infection), more preferred oviposition sites (i.e. branches with preferred diameter and texture), and higher food quality of xylem fluid because of fertilisation (Andersen & Brodbeck 1991), leading to better survival of cicada nymphs in kiwifruit orchard blocks than in forest

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Site, Year	Habitat		Distance between habitats (m)
	Forest	Kiwifruit	
Te Puke 1, 2013	0.1±0.4	34.5±17.5	70
Te Puke 2, 2013	0	70.4±30.5	650
Te Puke 3, 2013	1.6±1.9	150.1±126.5	170
Te Puke 4, 2013	3.3±4.9	45.0±38.8	80
Katikati 1, 2014	0.4±0.5	47.1±19.1	2480
Katikati 2, 2014	3.8±10.6	24.1±24.2	1800
Kaimai, 2014	0.1±0.4	9.9±5.8	60

**Table 1** Density of *Amphipsalta zelandica* exuviae per 10 m<sup>2</sup> in two habitats: native forest and kiwifruit. Values are mean counts of exuviae in eight 4 m x 2.5 m quadrat samples in each habitat. The errors are one standard deviation.

## References

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