SHORT COMMUNICATION

Can trapping control Asian paper wasp (*Polistes chinensis antennalis*) populations?

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Abstract: Asian paper wasps reach very high densities in some areas of the far north of the North Island, and concerns about their impact on native biota have led to a search for potential control methods. We simulated the effects of kill-trapping adults by manually removing either 50% or 75% of adults from nests and comparing subsequent counts of adults and capped pupal cells with paired untreated nests. Five weeks after treatment, the 50% removal group had an average of *c.* 29% fewer wasps than the untreated group, while the 75% removal group had *c.* 34% fewer than the untreated group. The rate of growth of both the 50% and 75% treatment groups after manipulation was similar to the untreated nests. We conclude that trapping is unlikely to be viable as a control tool unless it can be targeted at early-season queens, and that other options are better pursued at this stage.

Keywords: Asian paper wasp; control; *Polistes*; trapping.

Introduction

Asian paper wasps (*Polistes chinensis antennalis*) were first recorded in New Zealand in 1979, and have since spread through much of the North Island and the north of the South Island (Clapperton *et al.*, 1996; Rees, 1999). Large populations of Asian paper wasps can develop in warm, lowland areas of open habitat, such as shrublands, swamps and salt meadows (Clapperton *et al.*, 1996). Densities of more than 200 nests per ha and 6300 wasps per ha have been recorded in the far north of the North Island (Clapperton, 1999), and managers of the conservation estate have expressed fears about the potential impact of such high densities of paper wasps on the native ecosystem. For comparison with another major wasp pest, Thomas *et al.* (1990) found the nest density of *Vespula vulgaris* in the beech forests of the South Island is rarely more than about 30 per ha, but because the numbers of individuals per nest is greater in *V. vulgaris*, the mean density of wasps was about 10 000 per ha, and they can reach in excess of 48 000 per ha.

Asian paper wasps prey on invertebrates, especially caterpillars (Clapperton, 1999). It has been estimated paper wasps consume 957 g per ha per season of invertebrate biomass in short shrubland at Lake Ohia, Northland, N.Z. (Clapperton, 1999). In addition to this predation pressure and competition with other insectivores, paper wasps also compete for nectar and honeydew resources (Clapperton, 1999; Kleinpaste, 2000).

Unlike *Vespula* wasps, *Polistes* are not attracted to dead forms of protein such as meat. Therefore, they cannot be controlled using the toxic chicken or fish baits developed for poisoning *Vespula* species (Spurr *et al.*, 1996; Harris and Etheridge, 2001). Carbohydrate-based toxic baits may be a possibility, but have inherent problems of attractiveness to beneficial non-target species such as honeybees (Spurr, 1996). Paper wasp nests have a very low traffic rate relative to *Vespula* wasps [0.23–0.46 wasps per minute recorded by Clapperton (1999)], making them difficult to locate by flight path, and they are often hidden inside dense shrubs, so manually destroying nests over large areas of shrubland would be both difficult and labour intensive.

In this paper we explore the potential of trapping as a control method for Asian paper wasps. Currently, there are no trapping methods that show much promise for the control of paper wasp populations in New Zealand. Before much time and energy is spent on developing such methods, we need to understand how trapping might affect Asian paper wasp populations to assess the level of trapping success required. We conducted a simulated trapping trial by artificially removing a proportion of adults from nests in the major growth phase of their development and comparing the productivity of treated and untreated nests.

Methods

The Asian paper wasp nests we used in this trial were located in suburban properties around Nelson at the north end of the South Island, New Zealand. Manipulation of the nests began in early February 2000.

Nest population counts were done at night, when all adults were likely to be on the nest. We counted capped cells (pupae) as well as adults to get more accurate pairings of treated and untreated nests at the start of the experiment, and as a more robust measure of productivity. We removed *c.* 50% (range 50–55.6) of adults from ten of the nests and *c.* 75% (range 66.7–77.8) of adults from a further ten nests. The 75% removal trial began a week after the 50% trial. To minimise disturbance, all the wasps to be removed from a nest were picked off with forceps on one night. In this species, the founding queen is very difficult to distinguish from worker females and may have been removed from some nests. In such cases, it is known that the workers will continue to rear all the existing brood and begin producing some of their own, which will develop into productive males (Miyano, 1986). Some nests contained a few adult males at the start of the trial, and we attempted to remove these in similar proportions to females. Our subsequent counts did not distinguish between females and males. Each nest in the treatment groups was paired with a similar-sized untreated nest, so that the effect of nest size at the start could be largely removed from the estimates of trapping effect.

The number of adults and capped cells combined in each nest was recorded immediately before manipulation (T0), immediately after manipulation (T1), and then 2 (T2) and 5 weeks (T3) after manipulation. The data were log transformed and the standard deviations of the differences between matched pairs calculated to provide a standard error for assessing the mean difference between treated and untreated nests at T0, T2 and T3. As the 50% and 75% treatments began at different times, a direct comparison of the treatments was not possible. For each treatment, we examined the interaction of time and treatment (i.e. growth rate post treatment) by calculating the difference between each treatment nest and its paired untreated nest at time intervals T1, T2 and T3, then applying a two-way ANOVA using time and nest pair as factors, with time incorporating a linear effect. Results were back-transformed for graphical presentation.

One nest of the 50% removal group and one of the 75% removal group were deserted within two weeks of beginning the trial, and both were discovered with large numbers of ants (*Technomyrmex albipes*) removing eggs and larvae. These nests and their paired untreated nests were left out of the statistical analyses because desertion/predation of nests with workers occurs naturally and there was no basis for assuming it was related to our manipulation of worker numbers. Thus, there were 9 treated and untreated pairings for each of the 50% and 75% removal trials.

Results

The mean counts of workers and pupae for each treated and untreated group at the four time periods are shown in Figure 1. We removed only adults but counted adults plus pupae, so even immediately after manipulation the proportional difference between the treatment groups and the untreated groups is less than the proportion of adults removed.

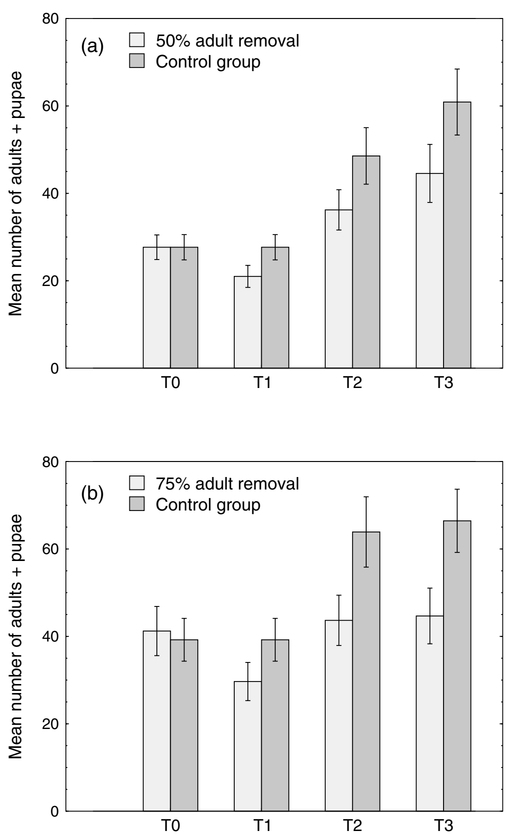

Figure 1. Mean counts of adults plus capped cells for (a) 50% adult removal group and paired unteated nests, and (b) 75% adult removal group and paired untreated nests. Vertical bars are standard errors. T0 = immediately before treatment, T1 = immediately after treatment, T2 = 2 weeks after treatment, T3 = 5 weeks after treatment.

There was practically no difference between the 50% removal group and its paired untreated group before manipulation, but immediately afterwards the reduction was 26% (SE = 6), then 29% (SE = 7) after five weeks. These near-constant differences over time (SED = 7, where SED = standard error of the change in the treated and control difference between different measurement times) indicate that the growth rate between the two groups was similar after manipulation. The 75% removal group also had similar counts to its control group before manipulation, but had a 27% (SE = 5) reduction after manipulation, 31% (SE = 7) reduction after two weeks and 34% (SE = 9) reduction after five weeks. These differences changed very little over time (SED = 9) indicating that the growth rate was similar after manipulation. The increasing trend we detected was not statistically significant ($F_{1,16} = 0.57$, $P = 0.46$).

Discussion

The results of the simulated trapping trial indicate that a trapping programme would need to be extraordinarily successful to cause a substantial decline in the paper wasp population. The instantaneous removal of 50% and 75% of adults during the rapid growth phase of the season resulted in an average reduction of about 29% and 34% in the colony size at the peak of the season (i.e. the time at which sexually reproductive individuals are produced). Even with the 75% removal trial, there was no measurable impact in the rate of colony growth.

A real trapping programme is unlikely to have such a massive instantaneous impact as 50 or 75% removal on one night, but would tend to remove individuals over a longer period. This is likely to reduce the impact of adult removal even further. We investigated the fitting of models to our data to predict a level of trapping success that would lead to a significant reduction in growth rate, but found this approach unsuitable due to the high variability around each of the reduction levels simulated (50 and 75%), and a lack of data points for greater or lesser reduction levels.

It may be possible to reduce populations of paper wasps by trapping queens and the first brood of workers early in the season. However, experience with *Vespula* wasps indicates it can be more difficult to attract wasps to baits and traps at that time, probably because there is less pressure on their natural resources while wasp numbers are low (Spurr, 1995; Beggs *et al.*, 1998). If a suitable pheromone lure could be developed, it might also be possible to trap newly-emerged queens during the autumn mating period, although work with *Vespula* again indicates that this may not have the desired result because the number of autumn queens produced may not be a major factor in the density of wasps the following year (Barlow *et al.*, 2002).

It would take considerable research funding to develop a trapping system capable of achieving even a 50% reduction in wasp numbers over a short time period, and no guarantee that this would ever be achievable in a natural environment or that the by-catch of such an operation would be acceptable. Given the results of this experiment, we conclude that other control options are better pursued at this stage.

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