A tale of two enemies: will the introduction of a generalist predator improve or disrupt biological control?

Sarah MANSFIELD[1], Alison HOPKINS[2], John BAIN[1], Diane JONES[1] & Dean SATCHELL[3]

[1]*Forest Biosecurity and Protection, PB 3020, Rotorua, New Zealand, sarah.mansfield@ensisjv.com;*
[2]*Department of Science and Technology, University of Waikato, Hillcrest Road, Hamilton, New Zealand*
[3]*33(b) Skudders Beach Road, Kerikeri, New Zealand*

AIMS
Quantify feeding preferences of the ladybird, *Cleobora mellyi* Mulsant for parasitised and unparasitised eggs of the eucalyptus tortoise beetle *Paropsis charybdis* Stål.

Assess the impact of predation by *C. mellyi* on the egg parasitoid *Enoggera nassaui* (Girault) and their roles as biological control agents of *P. charybdis*.

{photo gallery - captions}
Paropsis charybdis adults and larvae feed on eucalypt foliage. The key pest of eucalypt plantations in New Zealand.

Cleobora mellyi introduced to New Zealand between 1979 and 1987. Feeds on eucalypt psyllids and *P. charybdis* eggs.

Enoggera nassaui first introduced to New Zealand in 1987, now well established. Attacks a high proportion of *P. charybdis* eggs.

BACKGROUND
Cleobora mellyi requires psyllids to mate and reproduce successfully. Only one eucalypt psyllid species at time of introduction, several psyllids now present. Lack of suitable prey may have prevented widespread establishment of *C. mellyi*. There is a new opportunity to mass rear and release *C. mellyi* around New Zealand. Will this enhance or reduce suppression of *P. charybdis* by *E. nassaui*?

METHODS
Experiments conducted in a controlled environment room set to 22°C, 65% rh, 12L:12D. Each ladybird was used only once and a 50:50 sex ratio maintained in each experiment. *P. charybdis* egg batches came from a laboratory colony and were laid directly onto *Eucalyptus nitens* foliage. To produce parasitised egg batches, fresh eggs were exposed to *E. nassaui* wasps for 24 hours then incubated for 3-4 days until colour changes indicated which eggs had been parasitised. All prey items were presented on their original foliage. [fig of parasitised and unparasitised eggs]

a) 20 ladybirds placed into individual petri dishes (90 mm diameter), each with water and two batches of *P. charybdis* eggs of approximately equal number (± 1 egg), one batch parasitised by *E. nassaui*, one unparasitised. Number of parasitised and unparasitised eggs eaten was recorded after 24 hours. Ladybirds were watched for one hour to record their first choice of prey (if any).
b) Same procedure except parasitised *P. charybdis* egg batches were replaced with a minimum of 10 eucalypt psyllids. The first prey choice and number of *P. charybdis* eggs eaten were recorded.
c) A group of 10 ladybirds was confined with water in a plastic mesh cage (300 x 300 x 300 mm). The cage contained 10 stems of *E. nitens* foliage in water. Each stem had one

parasitised and one unparasitised *P. charybdis* egg batch attached to it. The 20 egg batches were selected so that the numbers of each egg type were approximately equal. Number of parasitised and unparasitised eggs eaten recorded after 24 hours. This test was replicated three times.

RESULTS

Figure 1. Individual ladybirds ate more unparasitised *P. charybdis* eggs (P) than parasitised (E, paired sample t-test, $t = 7.98$, $P < 0.001$) and consumption of unparasitised eggs increased slightly in the presence of psyllids (psy).

Figure 2. Ladybirds more frequently chose unparasitised eggs first than parasitised ($\chi^2 = 7.14$, $P = 0.008$). Twice as many ladybirds chose psyllids first over unparasitised eggs although the difference was not significant ($\chi^2 = 2.58$, $P = 0.108$).

Figure 3. Groups of 10 ladybirds consumed more unparasitised eggs than parasitised however consumption varied between groups and the difference was marginally non-significant (paired sample t-test, $t = 3.84$, $P = 0.062$).

CONCLUSIONS

Data trends indicate that adult *C. mellyi* prefer psyllids > *P. charybdis* eggs > parasitised eggs. This suggests that wider establishment of *C. mellyi* should not be detrimental to suppression of *P. charybdis* by *E. nassaui*.

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