Aspects of the ecology of *Microgaster demolitor*, a larval parasitoid of *Helicoverpa punctigera* and *Helicoverpa armigera* in Australia.

Thesis submitted by
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I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institute of tertiary education. Information derived from the published or unpublished works of others has been acknowledged in the text and a list of references is given.

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Dedication.

To Freddo,

this is as much yours as it is mine.

Abstract.

M. demolitor (Wilkinson), a solitary braconid parasitoid of *Heliocoverpa* spp in Australia, displays a humidity related diapause strategy. At low humidities, diapause is more likely to be initiated and is maintained longer than at high humidities. This strategy is effective in areas where decreases in rainfall, resulting in a decrease in the number of hosts, due to increased mortality and/or migration, leave the parasitoid without suitable oviposition sites. Diapause initiation and maintenance were not affected by photoperiod or temperature.

The incidence of diapause in *M. demolitor* increased with latitude in both hosts, being lowest at Mareeba, (the most northern sampling site), and highest at Grafton, (the most southern site). This correlates with a similar pattern in the diapause distribution of the host, that is, with increasing latitude the incidence of diapause in the host also increases.

At Mareeba, host species affected diapause incidence: parasitoids reared in *H. armigera* never entered diapause, while those reared in *H. punctigera* did. This is thought to be related to the differences in seasonal distributions of the hosts. That is, *H. armigera* is present all year round in Mareeba but *H. punctigera* is not. The higher migratory tendencies of *H. punctigera* result in periods of the year when, although conditions may be suitable for it, it may migrate from the area. Thus the possibility of some of the parasitoids entering a

diapause state if they emerge from *H. punctigera* would then safeguard against the possibility of the hosts migrating from the area and leaving the parasitoid population to perish due to a lack of hosts.

Parasitoids that entered diapause were significantly heavier as prepupae. The increase in weight of the diapausing prepupae may result from increased fat or water reserves which enable the parasitoid to survive its dormancy period. The cocoons of diapausing parasitoids were heavier and had a ribbed appearance, with a tighter silken weave. This increase in the closeness of the weave may reduce evaporation and hence decrease the desiccation rate of the diapausing prepupae. The cocoon is a vital component in the maintenance of diapause, as partial removal of the cocoon results in termination of diapause. The duration of diapause was unaffected by the sex of the parasitoid, the host it was reared in, the weight of the prepupae or the weight of the cocoon.

Parasitoids reared in field based cultures of *Heliocoverpa* spp. developed slower than those reared from a laboratory based culture. This result may be due to a decrease in the genetic fitness of the laboratory maintained culture, as no field animals have been added to this population in over 14 years. Hosts in which parasitoids were reared were always smaller than non parasitised hosts of the same age, with 100% mortality occurring in all parasitised hosts once the parasitoid emerged.

The larval developmental thresholds of the parasitoid in the three sites studied were all significantly different and were all higher than that of their hosts. Similarly, the pupal developmental thresholds of the parasitoids were similar to, or higher than, their two hosts, however the Mareeba population had a significantly lower pupal threshold than the other two populations.

Longevity of the parasitoid was affected by both temperature and food. At high temperatures, longevity was short and increased as temperature decreased. A quiescence strategy was initiated in the parasitoid when temperatures dropped below 20°C, significantly increasing their longevity. Longevity could also be increased by supplying the parasitoid with a 10% honey and water solution.

Parasitoids showed a preference for 2nd and 3rd instar larvae for oviposition. This preference minimised direct injury of the parasitoid. That is, when later instars were parasitised the probability of physical damage to the parasitoid was greater. Host species preference varied with latitude. In the northern sampling sites a preference for *H. armigera* was displayed, in the southern areas a preference for *H. punctigera*, while at Toowoomba, the two hosts were attacked with equal frequency. This correlates with the relative spatial and temporal distribution of the hosts, that is, *H. armigera* occurs in relatively greater concentrations in the north, while *H. punctigera* occurs in relatively higher concentrations in the south. However, in areas such as Toowoomba, where *M. demolitor* displays no preference, both hosts occur in substantial numbers, but at different times of the year.

These results then suggest that *M. demolitor* in Australia is not a homogeneous species but that perhaps clinal variation or a group of sibling species exists. Genetic work is required to consolidate this theory.

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