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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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in March 1991

for the degree of Doctor of Philosophy in
the Department of Zoology at
James Cook University of North Queensland.

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DECLARATION

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 Information derived from the published or unpublished works of others has been acknowledged in the text and a list of references is given.

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and the countless others who helped along the way.

To you all, I could not have done it with out you,

Thanks heaps.....

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.

Table of Contents

Chapter 1	Introduction	1
Chapter 2	General Biology of Braconid parasitoids	4
2.1	Introduction	4
2.2	Developmental Biology	5
2.2.1	Temperature effects.	5
2.2.1.1	Constant temperatures	6
2.2.1.2	Fluctuating temperatures.	6
2.2.1.3	Developmental thresholds.	7
2.2.2	Photoperiod.	8
2.2.3	Host effects.	9
2.2.4	Sex effects.	10
2.3	Synchrony of generations	11
2.4	Diapause.	13
2.4.1	Diapause induction.	13
2.4.1.1	Temperature effects.	14
2.4.1.2	Photoperiod effects	15
2.4.1.3	Physiological effects.	16
2.4.2	Diapause termination.	17
2.5	Longevity.	18
2.5.1	Temperature effects.	18
2.5.2	Sex effects.	18
2.5.3	Interaction effects.	19
2.5.4	Diet effects.	19
2.6	Conclusion	20
Chapter 3	Sampling Sites.	21
3.1.1	Site 1. Mareeba.	21
3.1.2	Site 2. Grafton.	23
3.1.3	Site 3: Darling Downs; Toowoomba.	23
3.1.4	Site 4. Townsville	25
3.1.5	Site 5: Emerald	28
3.2	Populations of <i>Microgaster demolitor</i> collected.	28
Chapter 4	Natural History	31
4.1	Introduction	31
4.1.1	Host range of the parasitoid.	32
4.1.2	Distribution and parasitism rates.	32
4.1.3	Developmental biology.	33
4.1.4	Host searching behaviour and preference.	36
4.1.5	Interactions between the parasitoid, pathogens and insecticides	37

4.2	Methods	38
4.2.1	Taxonomic studies	38
4.2.2	Host Parasitisation	39
4.2.3	Mating of the parasitoid	39
4.2.4	Egg content of female parasitoids	40
4.2.5	Damage to internal organs of host	40
4.2.6	Weights of parasitised and non parasitised larvae	41
4.2.7	Longevity	41
4.2.7.1	Food effects	41
4.2.7.2	Temperature effects	42
4.3	Results	42
4.3.1	Taxonomy	42
4.3.2	Host attack	43
4.3.3	Egg content of female parasitoids	44
4.3.4	Weights of parasitised and unparasitised larvae	45
4.3.5	Internal damage to host	45
4.3.6	Mating of the parasitoids.	46
4.3.7	Longevity.	47
4.3.7.1	Food effects	47
4.3.7.2	Temperature effects	47
4.4	Discussion	53
Chapter 5	Developmental biology.	57
5.1	Introduction	57
5.2	Methods.	59
5.2.1	Effects of laboratory and field strains of hosts on development.	59
5.2.1.1	Laboratory host strain	59
5.2.1.2	Field host strain	60
5.2.2	Oviposition of the hosts	61
5.2.3	Developmental rates	62
5.3	Results.	64
5.3.1	Field and laboratory host effects	64
5.3.2	Larval development.	65
5.3.3	Pupal development.	66
5.4	Discussion.	71
5.4.1	Laboratory/field results	71
5.4.2	Developmental thresholds.	72
5.4.2.1	Larval developmental thresholds	72
5.4.2.2	Pupal developmental thresholds	73
5.4.3	Total developmental time	74

Chapter 6	Factors affecting diapause initiation.	76
6.1	Introduction	76
6.2	Methods	80
6.2.1	Humidity and Temperature	81
6.2.2	Photoperiod	82
6.2.3	Location, sex and host effects	83
6.2.4	Parent and Host effects	83
6.3	Results	84
6.3.1	Humidity and Temperature	84
6.3.2	Photoperiod	85
6.3.3	Sex and location effects	86
6.3.4	Host effects	90
6.3.5	Toowoomba Parental effects.	90
6.4	Discussion.	91
Chapter 7	Diapause effects on prepupal weight, cocoon weight and cocoon structure	97
7.1	Introduction	97
7.2	Methods	99
7.2.1	Prepupal and cocoon weights	99
7.2.2	Structural differences between cocoon types	100
7.3	Results	100
7.3.1	Cocoon and prepupal weights	100
7.3.2	Parasitoid prepupal weight	105
7.3.3	Cocoon structure	106
7.4	Discussion.	109
Chapter 8	Factors affecting diapause duration.	112
8.1	Introduction	112
8.2	Methods	114
8.2.1	General	114
8.2.2	Sex and host effects	115
8.2.3	Temperature effects	115
8.2.4	Photoperiod effects	116
8.2.5	Humidity changes	116
8.2.6	The effects of cocoon weight and prepupal weight	117
8.2.7	Effects of cocoon damage	118
8.3	Results	118
8.3.1	Host and sex effects	118
8.3.2	Temperature and photoperiod effects.	119
8.3.3	Humidity effects	120
8.3.4	Cocoon and prepupal weight effects.	120
8.3.5	Cocoon damage	121
8.4	Discussion	126

Chapter 9	Host Preferences	129
9.1	Introduction	129
9.2	Methods	131
9.2.1	Host species preference	131
9.2.2	Host instar preference	132
9.2.3	Source of hosts	133
9.3	Results	133
9.3.1	Host species preference	133
9.3.2	Host instar preference	134
9.4	Discussion	137
Chapter 10	Conclusion	142
References		148
Appendix one		163
Appendix two		164

Table of tables.

Table 5.1: Sample sizes of parasitoids used to determine larval developmental rate for different sites.	63
Table 5.2: Sample sizes of parasitoids used to determine pupal developmental rate for different sites.	63
Table 5.3: Mean developmental times for <i>M. demolitor</i> reared in laboratory and field strains of <i>H. punctigera</i> at 26 degrees.	65
Table 5.4: Summary of the results from an ANCOVA on larval development time of <i>Microgaster demolitor</i> reared in <i>H. punctigera</i> and <i>H. armigera</i>	67
Table 5.5: Developmental thresholds and equations for the larval development of <i>Microgaster demolitor</i> from different sites.	67
Table 5.6: Summary of the results from an ANCOVA on pupal development times of <i>Microgaster demolitor</i> reared in <i>H. punctigera</i> and <i>H. armigera</i>	69
Table 5.7: Developmental thresholds and equations for the larval development of <i>Microgaster demolitor</i> from different sites	69
Table 6.1: Summary of unweighted logistic regression for humidity and temperature against proportion of parasitoids from Toowoomba reared in <i>H. punctigera</i> entering diapause.	84
Table 6.2: Proportion of <i>M. demolitor</i> , (from Toowoomba), entering diapause under different photoperiods.	85
Table 7.1: Summary of the results of analysis of covariance of the effects of sex, host species and diapause state on cocoon weight with prepupal weight as a covariate.	101
Table 7.2 Summary of values used for adjustment of cocoon weight for different variables	105
Table 7.3: Summary of the effects of sex, host species and diapause state on prepupal weight.	106

Table 8.1: Diapause duration, in days, with associated standard errors for <i>M. demolitor</i> reared in different hosts as well as differences between sexes.	119
Table 8.2: Diapause duration, in days, with associated standard errors for <i>M. demolitor</i> reared at different temperatures and photoperiods. . . .	119
Table 8.3: Results of a multiple regression analysis on diapause duration versus cocoon and pupal weight.	120

Table of Figures

Figure 3:1. Mean monthly maximum and minimum temperatures with associated mean monthly rainfall for Mareeba	22
Figure 3:2. Mean monthly maximum and minimum temperatures with associated mean monthly rainfall for Grafton	24
Figure 3:3. Mean monthly maximum and minimum temperatures with associated mean monthly rainfall for Toowoomba	26
Figure 3:4. Mean monthly maximum and minimum temperatures with associated mean monthly rainfall for Townsville	27
Figure 3:5. Mean monthly maximum and minimum temperatures with associated mean monthly rainfall for Emerald	29
Figure 4:1. The effect of different food types on the longevity of <i>M. demolitor</i>	51
Figure 4:2. The longevity of <i>M. demolitor</i> from Toowoomba, reared in <i>H. punctigera</i> , for various temperatures.	52
Figure 5:1. Developmental rate for three different populations of <i>M. demolitor</i> for egg to prepupal emergence from the host	68
Figure 5:2. Developmental rate for three different populations of <i>M. demolitor</i> for prepupal to adult emergence from the cocoon.	70
Figure 6:1. The effect of humidity on the incidence of diapause in <i>M. demolitor</i>	87
Figure 6:2. The proportion of <i>M. demolitor</i> entering diapause, reared in <i>H. punctigera</i> , for both males and females, for three separate locations	88
Figure 6:3. The proportion of <i>M. demolitor</i> entering diapause, reared in <i>H. armigera</i> , for both males and females, for three separate locations.	89
Figure 7:1. Plot of cocoon weight of <i>M. demolitor</i> , adjusted for sex and diapause state, against prepupal weight of the parasitoid, reared in two different host species.	102
Figure 7:2. Plot of cocoon weight of <i>M. demolitor</i> , adjusted for host species reared in and diapause state, against prepupal weight, for both male and female parasitoids.	103

Figure 7:3. Plot of cocoon weight of <i>M. demolitor</i> , adjusted for host species reared in and sex of the parasitoid, against prepupal weight, for diapausing and non-diapausing individuals.	104
Figure 7:4. Graphic representation of the interaction between sex and diapause state on prepupal weight of the parasitoid	107
Figure 8:1. Time, in days, to terminate diapause in <i>M. demolitor</i> when transferred to high or low humidities.	122
Figure 8:2. Scatter plot of prepupal weight, (in mg), of diapausing <i>M. demolitor</i> versus diapause duration (in days)	123
Figure 8:3. Scatter plot of cocoon weight, (in mg), of diapausing <i>M. demolitor</i> versus diapause duration (in days).	124
Figure 8:4. Time taken, in days, for <i>M. demolitor</i> to terminate diapause after partial removal of the cocoon.	125
Figure 9:1. Host preference, for either <i>H. punctigera</i> or <i>H. armigera</i> , shown by four separate populations of <i>M. demolitor</i>	135
Figure 9:2. Instar preference for <i>H. punctigera</i> displayed by <i>M. demolitor</i> from Toowoomba.	136

Table of Plates.

- Plate 1. Longitudinal section of *H. punctigera* with developing larval *M. demolitor*, 4 days after parasitisation. 48
- Plate 2. Longitudinal section of *H. punctigera* with developing larval *M. demolitor*, 7 days after parasitisation. 49
- Plate 3a. Electron micrograph of a cocoon of a diapausing prepupae of *M. demolitor*. 108
- Plate 3b. Electron micrograph of a cocoon of a non-diapausing prepupae of *M. demolitor*. 108