A Survey of the Predators and Parasitoids of Aphids in Manitoba with Emphasis on the Interaction Between the Thirteen Spotted Lady Beetle *Hippodamia trecimpunctata* L. and the Pea Aphid *Acyrthosiphon pisum* Harris.

A Thesis

Submitted to the Faculty of Graduate Studies

The University of Manitoba

by

Barbara Alison Batulla

In Partial Fulfillment of the

Requirements for the Degree

of Master of Science

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A SURVEY OF THE PREDATORS AND PARASITOIDS OF APHIDS IN MANITOBA WITH EMPHASIS ON THE INTERACTION BETWEEN THE THIRTEEN SPOTTED LADY BEETLE *HIPPODAMIA TRECEMPUNCTATA* L. AND THE PEA APHID *ACYRTHOSIPHON PISUM* HARRIS

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MASTER OF SCIENCE

ABSTRACT

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A Survey of the Predators and Parasitoids of Aphids in Manitoba with Emphasis on the Interaction Between the Thirteen Spotted Lady Beetle Hippodamia tredecimpunctata L. and the Pea Aphid Acyrthosiphon pisum Harris. Major advisor: Dr. A.G. Robinson.

The thesis is divided into two parts. Part I is a study of the effects of pea aphid density variation on the predation rate of the thirteen spotted lady beetle. Part II is a survey of predators and parasitoids of aphids collected in Manitoba during 1980 and 1981.

In Part I, the results of predation trials using aphid densities of 10 or 20 were analyzed using a series of regression analyses of variance. Results of these analyses revealed that, at the densities tested, both adult female and male lady beetles display a partial Type III functional reponse, and no density dependence in response to increasing pea aphid densities. Results of 2-hour observations of predation rate over a 6-hour period revealed that the lady beetles consumed a proportionately larger amount of food during this 6 hours than during the remaining portion of the day. The lady beetles did not respond to density on a bi-hourly basis.

The survey in Part II was conducted in various areas of Manitoba south of the 52nd parallel, and in Churchill, Manitoba. In 407 samples, 108 species of aphids were collected. Associated with these aphids were at least 69 species of predators from 21 families, and over 27 species of hymenopteran parasitoids from 2 families. Eleven of the aphid species did not appear to be attacked by natural enemies. Of the predators tested, specimens from 51 species would consume pea

aphids, and specimens from 19 species would not. Over 24 species of parasitic Hymenoptera from 5 families attacked the predators of aphids, while 15 species of secondary parasitoids from 5 families attacked parasitoids of aphids. Host/prey, and habitat preferences of some parasitoids and predators are discussed.

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CHAPTER 1

INTRODUCTION

This thesis is divided into two sections. The first section deals with the interaction between the pea aphid (Acyrthosiphon pisum Harris), and one of its predators, the thirteen-spotted lady beetle (Hippodamia tredecimpunctata L.). The experiments were conducted to determine the effects of different pea aphid densities on the predation rate of adult thirteen-spotted lady beetles. This work was initially to be a follow-up to a portion of Chiang's (1979) work on the same two species. However, discrepancies in the results of the two studies made comparisons difficult.

The second section of the thesis is a survey of the predators and parasites of aphids in Manitoba, with emphasis on the host/prey preferences of certain species of natural enemies. Samples of aphid colonies, including their predators and parasitoids were collected over a two year period. The samples were sorted in the laboratory, parasitoids and mummified aphids were retained, and immature predators were reared through to adults on a diet of pea aphids. Their reactions to the diet and general behavior were noted. At the end of each season, all adult aphids, predators, and parasitoids were identified.

II REVIEW OF THE LITERATURE

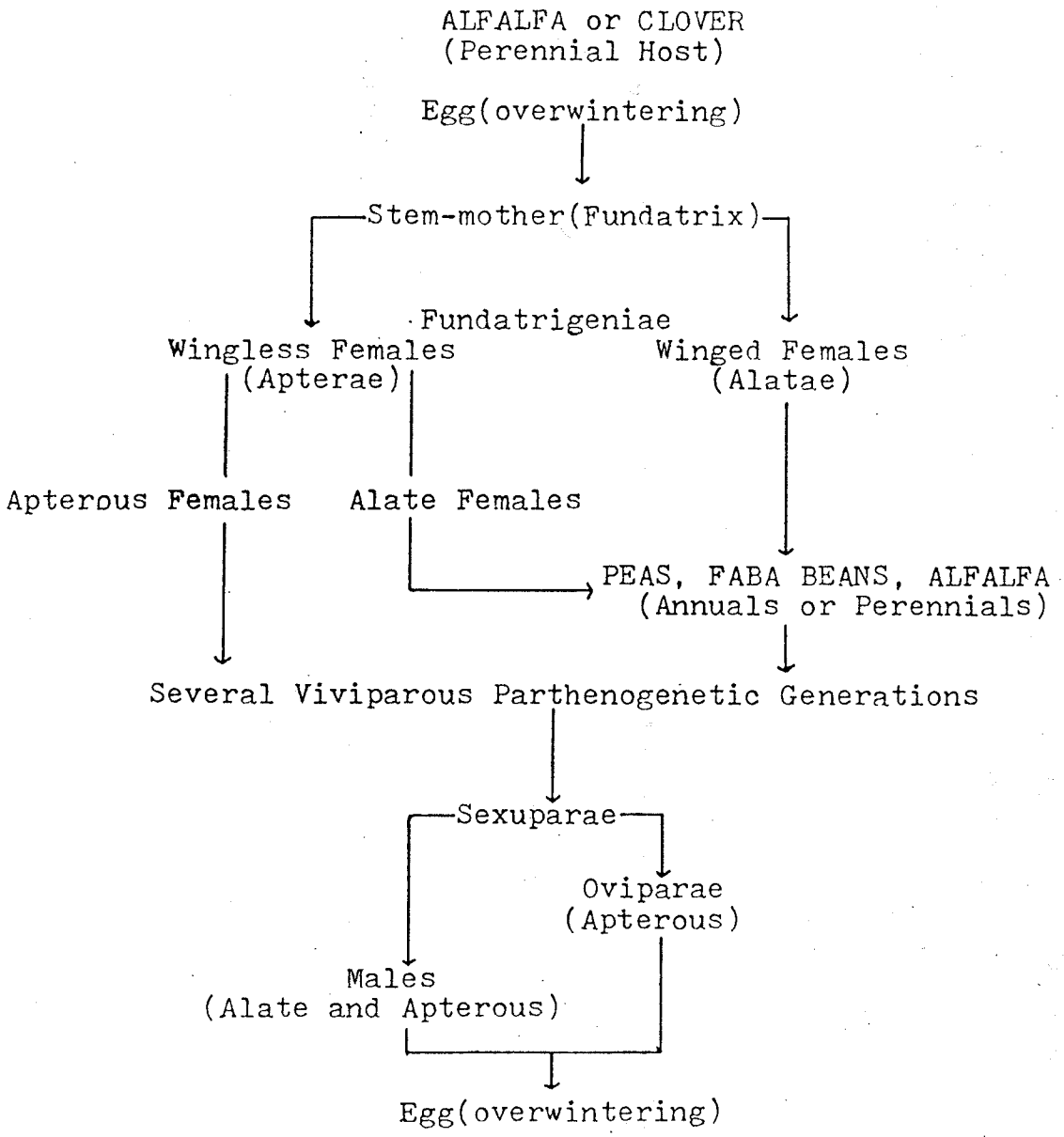
THE PEA APHID

The pea aphid, Acyrthosiphon pisum (Harris), is a holocyclic monoecious species attacking a number of plants in the Papilionoideae(Muller, 1980). It was introduced to North America in 1878 (Markkula, 1963), and since then has developed several biotypes or strains found annually in certain geographic areas and/or on certain plants (Muller, 1980). The faba bean, Vicia faba L. appears to be one of the most suitable hosts for the species (Muller, 1980). In addition, pea aphids are common on field peas, alfalfa, and clover. In North America A. pisum can severely injure peas during blossoming and early podding periods, and can result in viral infections, poor pea quality and yield (Maltais and Cartier, 1962; Cooke, 1963). Normally, pea aphids cause little injury in Canadian alfalfa and clover fields.

A. Life History

Acyrthosiphon pisum overwinters as eggs on leaves and stems of alfalfa and clover (Harper, 1972). In spring, when the plant resumes growing, the eggs hatch, and the first generation 'stem mothers' or fundatrices begin to feed (Figure 1). Upon reaching maturity, these fundatrices parthenogenetically produce the first generation of alate and apterous viviparous females (fundatrigeniae) (Stary, 1968). A number of viviparous parthenogenetic generations then follow; the members of these generations may be alate or apterous depending on host plant conditions, colony size, and climatic conditions (Stary, 1968). The alate individuals migrate to other acceptable host plants, where they settle down, their flight muscles degenerate, and they produce alate and apterous viviparous

Figure 1. Life history of the pea aphid (Acyrthosiphon) pisum) from spring to late fall.


ALFALFA or CLOVER
(Perennial Host)
Egg(overwintering)
Stem-mother(Fundatrix)
Fundatrigeniae
Wingless Females
(Apterae)
Winged Females
(Alatae)
Apterous Females
Alate Females
PEAS, FABA BEANS, ALFALFA
(Annuals or Perennials)
Several Viviparous Parthenogenetic Generations
Sexuparae
Oviparae
(Apterous)
Males
(Alate and Apterous)
Egg(overwintering)

progeny (Johnson, 1957). The apterous fundatrigeniae remain on the original host plant, giving rise to succeeding generations of aphids on that plant.

In late September or October, the last generation of viviparae, the sexuparae, produce alate and apterous males, and apterous egg-laying females (oviparae), in response to changing photoperiod and temperatures (Stary, 1968; Harper, 1972; Muller, 1980). The sexuparae produce oviparae first, then after a brief reproductive pause, they produce males (Lamb and Pointing, 1975) (Figure 1). In Sherbrooke Quebec, the critical photoperiod for the formation of sexuales is 13 h. and 15 min. to 13 h. and 17 min. (Sharma et al., 1974). After mating, pea aphid oviparae in the Blue Mountain area of Eastern Washington and Oregon, lay up to 25 eggs (Cooke, 1963). In southern areas such as California and Virginia, the sexual forms do not normally appear, and overwintering is exclusively by the virginoparae (Cooke, 1963).

A. pisum develops from birth to maturity in 5 to 50 days depending on weather. The average development time in Southern Alberta is 5 to 7 days (Harper, 1972). The apterous adult starts reproducing approximately 3 hours after its last moult. The apterous virginoparae produce an average of 106.3 nymphs during their 20 day reproductive period (Sharma et al., 1973). Generally, total life span of A. pisum is approximately 39 days (Sharma et al., 1973).

In the Blue Mountain region (Washington and Oregon), pea aphids produce 15 or more generations per year (Cooke, 1963). Pea aphid populations are often high in early spring in many areas e.g. Czechoslovakia (Stary, 1968; Hozak, 1970), Kentucky (Pass and Parr, 1971), and East Anglia (Dunn and Wright, 1955). These populations

decrease during late spring and summer, and increase again in the fall (Stary, 1968; Hozak, 1970; Pass and Parr, 1971; Dunn and Wright, 1955). The decrease may be due, at least in part to a) migration of alates to annual crops such as faba beans and peas (Stary, 1968; Pass and Parr, 1971); b) heavy rain (Dunn and Wright, 1955); or c) pressure from natural enemy complexes (Frazer et al., 1981a).

B. Aphid Response to Disturbance

Aphids respond to predator disturbance in various ways. The kind and degree of response shown by an aphid is dependent upon its age, species, the habitat it is found in, and the nature of the disturbance.

According to Lowe and Taylor (1964), the alarm reactions of pea aphids disturbed by a 'shot' of moist air were as follows: the antennae were lowered over the back, the stylets were withdrawn, the legs were folded up to the body, and the aphids dropped off the plant. The dropping aphid can cause other aphids to drop in a 'chain reaction' (Lowe and Taylor, 1964). Tamaki et al., (1970) reported that pea aphids react in this manner when 'harassed' by the parasitoid Aphidius smithi Sharma and Subba Rao females.

When pea aphids are disturbed, they may also produce cornicle secretions containing the alarm pheromone trans-B-farnesene (Nault, 1973) (Note: other aphid species also produce this alarm pheromone). Nault et al. (1973), reported that 48.7% of the aphids attacked by nabids in their study produced cornicle secretions. The droplets were often smeared on the nabid's rostrum and eyes or on the aphid's body and antennae. This smearing may accelerate volatilization of repellent odours (Strong, 1967), while non-volatile triglycerides may have a limited defensive function (Nault et al., 1973). In a few instances,

nabids with cornicle secretions smeared on their antennae, eyes or mouthparts would violently wipe the smeared parts on the leaf surface, or would fall to the ground and continue to clean themselves (Nault et al., 1973). Similarly, Dixon (1958) reported Dactynotus jaceicola (Hille Ris Lambers) aphids secreting cornicular 'wax' on the heads of their attackers. In several cases, third instar Adalia decempunctata (L.) larvae were unable to free themselves from the secretion, and consequently died (Dixon, 1958).

According to Nault et al. (1973), only when aphids were pierced by the predator's stylets did they secrete cornicle droplets. Aphids of all instars are capable of producing droplets, however, only 60 - 70% of pea aphids tested by Strong (1967) produced droplets. The pheromone trans-B-farnesene is perceived up to 3 cm away by the primary and secondary sensoria on the aphid's antennae. Effective levels of alarm pheromone are emitted up to 60 minutes after secretion (Nault et al., 1973).

Adult and fourth instar pea aphids responded to alarm pheromones by either dropping, running, or backing up (Roitberg and Harper, 1978). Younger instars responded only when a vibratory stimulus was associated with the pheromone. This more conservative response may be due to the younger instar's lack of agility on the ground (Roitberg and Myers, 1979). Pea aphids from hot dry areas of British Columbia respond to alarm pheromones and general disturbance by backing up rather than by dropping (Roitberg and Myers, 1979). This is perhaps due to the high risks associated with exposure to high ground temperatures and evaporation rates (Roitberg and Myers, 1979). When aphids drop off, back up, or run away, the distance dispersed is positively correlated with the density of aphids on the plant or colony that the aphid leaves (Roitberg et al., 1979).

THE COCCINELLID

A. General Life History

Adult coccinellids are long lived, generally living for approximately one year (Smith and Hagen, 1956). One female Coccinella septempunctata L. was reported by Sundby (1966) to overwinter twice. The oviposition period begins in early spring, and may be as long as 3 months (Sundby, 1968). During the early stages of aphid infestations, coccinellids will often lay their egg batches on uninfested stems (Banks, 1957). According to Blackman (1965), adult coccinellids show some degree of specificity in their choice of oviposition sites, on the basis of habitat (e.g.) height of plants), and only secondarily on presence or abundance of aphids. Conversely Hodek (1967), stated that eggs are laid close to essential prey species colonies.

The bright yellow eggs of coccinellids are laid in groups of 10 to 50 (Banks, 1956). Hippodamia tredecimpunctata L. females on average lay 23 eggs per batch (Chiang, 1979). One female coccinellid may lay over 1000 eggs in her lifetime (Knowlton, 1947). The larvae hatch in 3 to 7 days depending on the species (Knowlton, 1947; Smith and Hagen, 1956). Once the first instar larva has emerged through the apical slit in the egg chorion, it generally has 1 1/2 days in which to find food or die (Banks, 1956). Eating eggs and partially emerged larvae increase the individual's chances for survival (Banks, 1957). Larval development takes two to four weeks depending on food supply, temperature, and the species (Smith and Hagen, 1956; Sundby, 1968). On average, development of H. tredecimpunctata from egg to adult emergence takes 23 to 37 days (Chiang, 1979).

Coccinellid pupae require 4 to 8 days for development (Hodek, 1967). Copulation takes place a few days after emergence, and several times thereafter (Hodek, 1967). Lady beetles usually overwinter as adults (Smith and Hagen, 1956; Sundby, 1968). Many species form overwintering aggregations in ditches, under logs, and bark, or in depressions near bodies of water (Smith and Hagen, 1956; Benton and Crump, 1979).

B. Coccinellid Foraging Behavior

There are several factors influencing the number of aphids consumed by a predator and thus the predator's effect on the prey population. The most basic of these is the predator's 'search and attack' pattern. Banks (1957) gave the following description of a coccinellid's search pattern: 'While searching, the coccinellid larva will often halt, fix the end of its abdomen to the leaf surface, and move its body in an arc from side to side. If no prey is encountered, it releases its hold, moves and repeats the action'. . .' Coccinellid larvae often attack aphids from the rear using their forelegs to grasp the struggling aphid, while the adhesive tip of the abdomen holds the larva fast' (Banks, 1957). First and second instar larvae often suck out the juices of the aphid. This is accompanied by occasional regurgitation of the larva's stomach contents into the aphid. A first instar larva may take several hours to consume one small aphid (Banks, 1957). Third and fourth instar larvae eat the aphid with or without prior sucking of the juices. The aphids are often only partly consumed and may be discarded while still alive (Banks, 1957). Adult coccinellids eat the aphid without prior sucking of the juices. The aphid may be partly or totally consumed depending on the hunger level of the adult coccinellid.

After feeding, a coccinellid will often make a series of small turning movements in what appears to be an effort to locate neighboring aphids (Banks, 1957). Although Stubbs (1980) found that some Coccinellidae including Coccinella septempunctata L. fourth instars and adults could detect prey from up to 1.0 cm away, often an aphid may not be detected until the coccinellid actually comes into physical contact with it (Frazer, 1976).

According to Dixon (1970), a first instar Adalia bipunctata (L.) wastes 25 to 50% of its time searching areas that it has already searched. In addition, time is wasted searching leaves on lower portions of the plant (Banks, 1957). Later instars and adults appear to spend more time at the apex of plants (Frazer et al., 1981 b). Coccinellid movements appear to be based on geotaxis, with upward movement in early daylight hours, and downward movements in late morning (Benton and Crump, 1981). Observations of daylight activity of adult A. bipunctata showed that 49% of available time was spent inactively (remaining time was spent: 29% searching, 10% eating, and 12% copulating or ovipositing) (Mills, 1982).

Knowledge of a predator's behavior and factors affecting behavior are required in order to predict how or if a predator species will affect an aphid species population. Factors such as habitat, prey species preferences, dependence on aphid density, temperature, dispersal, search patterns, and inter- or intraspecific competition can all play important roles in this interaction. Recently several papers attempting to model the coccinellid's role in aphid population regulation have been published. Most of these models are based on a simplified version of Holling's (1966) functional response model as presented by Frazer and

Gilbert (1976). Basically this model combined an aphid (Acyrthosiphon pisum) population model with a quantitative empirical formula for predation rate of Coccinella trifasciata L. Until this time, most models were based mainly on laboratory experiments. Frazer and Gilbert (1976) included the results of field observations as well as laboratory observations in their calculations. Frazer and Gilbert (1976) studied the components of the predation process in detail. Components studied included predator and prey densities, predator voracity, prey age distribution, parasitism of aphids, and temperature. They discovered that all current methods of counting adult coccinellids in the field greatly underestimate their true numbers, since no more than 25% of the beetles were seen at any one time. The rest were inactively hiding in the stubble (Frazer and Gilbert, 1976). Frazer and Gill (1981) concluded that predator potential is a more practical and useful parameter than numbers or maximum voracity in estimating the impact of coccinellids on aphid populations. Frazer and Gilbert (1976) also found that while temperature has a single effect on rate of aphid development, it has a double effect on predation rate (i.e. coccinellids are more effective predators at high temperatures, than at low)!

Components of the predation process which were not included in the Frazer and Gilbert (1976) model, or which required more study included: the effects of temperature, immature stages, prey aggregation, dispersal, predator feeding responses, and competition by other predator species. Several papers written since then have filled in many of these gaps. Ives (1981 a), reported higher dispersal rates in Coccinella californica Mannerheim as temperature increased. Ives (1981 b) discovered that different species of predators react differently to temperature change. Coccinella trifasciata L. can lay eggs and consume aphids at lower

temperatures than can C. californica. C. californica can eat more, and convert food to eggs more efficiently at higher temperatures than can C. trifasciata (Ives, 1981 b). Adalia bipunctata also increases its development rate and consumption rate in response to increases in temperature (Mills, 1981). Both C. transversoguttata and C. septempunctata can develop faster at high temperatures than can A. bipunctata (Obrycki and Tauber, 1981). Hippodamia tredecimpunctata develops slower than any of the above species (Chiang, 1979). Thus, the model must be adjusted to 'fit' the species being studied.

Baumgaertner et al. (1981), extended the Frazer and Gilbert (1976) model to fit larvae and adults of Hippodamia convergens Guerin and Chrysopa carnea Stephens. All larval instars, except first instar C. carnea, visited more stems per unit time with increasing hunger level (Baumgaertner et al.,1981). Effects of low food levels on weight gain, development time, and mortality of all larvae varied with predator size and species (Baumgaertner et al., 1981).

Frazer et al.(1981 c) extended the Frazer and Gilbert (1976) model to predict survival rates and requirements for all stages of C. trifasciata including the egg stage. The extended model predicts the number of aphids per terminal required for larval survival (Frazer et al., 1981 c). Similarly Guiterrez et al.(1981) constructed a model for biomass flow for H. convergens.

The studies thus far mentioned fail to account effectively for the fact that most aphid prey are found in aggregations (i.e. most studies assume a random prey distribution). Hassell (1982), presented a formula which accounts for this prey aggregation behavior. According to Hassell (1982), searching efficiency is sensitive to two factors: (1) the specific,

intrinsic searching ability of the predators, and (2) the extent to which the distribution of the predators to the prey is non-random.

Control of an aphid population (i.e. maintaining aphid numbers below economic threshold), by more than one predator species is usually much more effective than single species control. Different species' life cycles and foraging strategies can overlap so that the aphid population always experiences some predation pressure. In years when there is a large spring population of Aphis fabae (Scopoli) on Euonymus europaeus L. populations of predators including coccinellids, syrphids, anthocorids, arachnids, parasitic mites, and cantharids are primarily responsible for the great decline of aphid numbers from mid July to September (Way and Banks, 1968). Similarly, Frazer et al., (1981a) concluded that while early season populations of pea aphids can be limited by coccinellids alone, later limitations are brought about by the combined action of several species of predators. It would be very advantageous indeed, if a model predicting predation rates of an entire predator complex could be formulated, however this would take many people and a great deal of time.

III METHODS AND MATERIALS

Pea aphids (Acyrthosiphon pisum) used in this experiment were obtained from a clone originally collected from an alfalfa field at the Glenlea Research Station in 1979. In the laboratory the pea aphids were raised on faba beans (Vicia faba cv.'Diana') under artificial lighting (16 h. light: 8 h. dark), with a 18 to 22°C temperature range.

Constant supplies of adult aphids of similar age were maintained using the following 7-day plant rotation scheme: Each day 5 adult female aphids were placed on a faba bean plant. These aphids were left on the plant to produce young for a 24 hour period. At the end of this period, the adult aphids were removed, and their progeny (usually 5 nymphs per female), were allowed to mature. The following week (7 days later) a supply of approximately 25 adult aphids per plant would then be available for experiments, and for feeding beetles in the stock cultures. The number of plants used each day varied depending on the number of aphids required the following week. Plants used for raising aphids were grown three to a pot, and were discarded after one month.

Adult Hippodamia tredecimpunctata were collected from various areas in the City of Winnipeg. These individuals and their progeny were kept in ventilated 8 cm wide petri dishes at densities of 4 to 6 beetles per dish. Each dish contained a damp filter paper lining, a faba bean leaf, 5 or 6 aphids per beetle, and one or more 2 cm strips of corrugated cardboard (which the beetles used as hiding, resting, oviposition, and moulting areas). In order to reduce cannibalism, only beetles in the same life stage or instar were kept together. The aphid and beetle colonies were maintained from August 1980 to September 1980, and from May 1981 to September 1981.

Predation Trials

The experiment consisted of thirteen replicates of nine predation trials. For each trial, the number of aphids disappearing was recorded daily for four days. On the second day, the number of aphids lost was measured every two hours over an eight hour period.

In the predation trials, a predetermined number of adult aphids were evenly placed on the leaves of a two week old, approximately 20 cm high faba bean growing in a 13 cm high, 13 cm wide clay pot. The plant was enclosed in a 30 cm high cage which consisted of a petri dish (15 cm wide and 9 cm deep), supported by four equal lengths of 2 mm diameter wire, the ends of which were embedded in the soil of the pot. A removable cylinder of 1 mm mesh nylon netting was attached to the petri dish, and to the pot using elastic bands (Figure 3). The soil surface was covered with approximately 5 mm of silica sand. This aided in aphid location and counting.

Adult H. tredecimpunctata were presented with one of two kinds of aphid density trials (Table 1). In the first kind, beetles were presented with initial aphid densities of either 10 or 20 adult aphids. Each day after counting, the number of aphids lost in each trial were replaced to the original number. In the second kind, beetles were presented with an initial density of 20 adult aphids per trial. This density decreased as the aphids were consumed (or lost); each day, aphids were counted, but lost aphids were not replaced (Table 1). In both kinds of trials, first instar aphid nymphs were removed daily. In order to measure the loss of aphids due to factors other than predation, controls containing only aphids were maintained for both the replacement and no-replacement

Figure 2. Acyrthosiphon pisum and Hippodamia tredecim-punctata on a faba bean leaf.

Figure 3. A potted faba bean plant and cage used in the predation trials.

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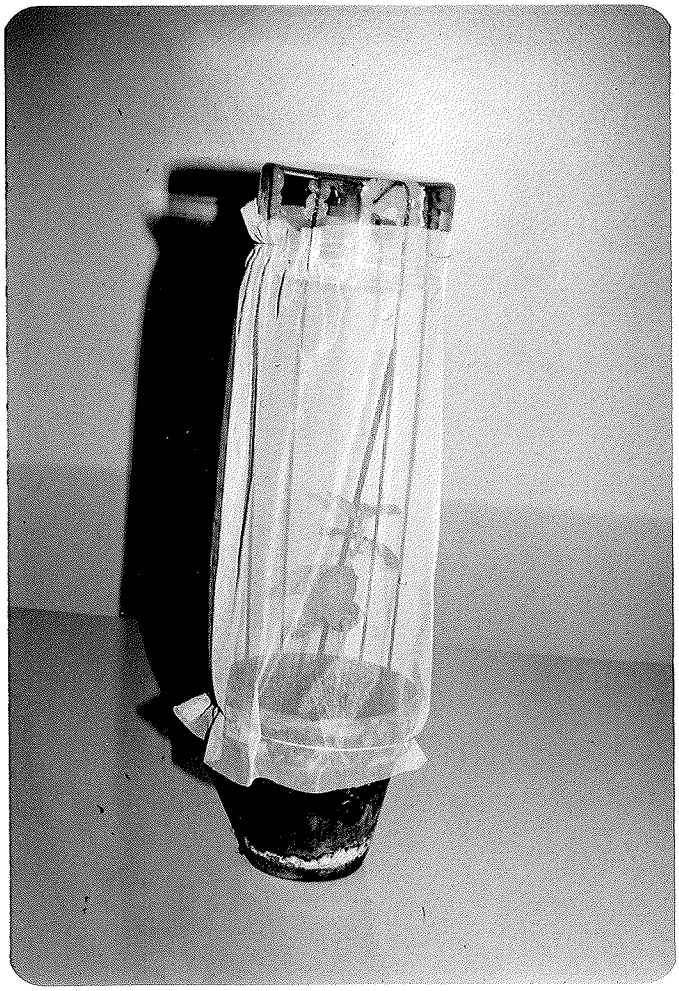


Table 1. Predation trials, and mean and standard error for aphids lost per day in the replacement trials(N=13). Note: figures for no-replacement trials were not included since density varied from day to day, thus means are meaningless.

Trial Number	1	2	3	4	5	6
Title	Control replace to 20	Control replace to 10	Female replace to 20	Male replace to 20	Female replace to 10	Male replace to 10
Mean No. of Aphids Lost/Day	0	0	4.17	2.29	3.04	1.27
Standard Error	-	-	.32	.23	.21	.12

Trial Number	7	8	9
Title	Male no replacement from 20	Female no replacement from 20	Control no replacement from 20

trials. Both female and male beetles were tested individually at each density.

Statistical Methods

The results of the replacement trials were analysed using a 3-level factorial analysis of variance. A square root transformation was used in order to normalize the data. Orthogonal contrasts were then performed on group interaction in order to determine if controls differed from males and females. Orthogonal polynomials were performed on males and females in order to determine if either sex showed a significant variation in their feeding habits in response to days.

Data from the no-replacement trials were first analysed using a 2-level factorial analysis of variance and an orthogonal contrast, in order to determine whether controls differed significantly from females and males, and to determine if the number of aphids lost in the controls differed significantly from zero. A multiple regression analysis with 6 independent variables (Day (=D), D^2, D^3, Density (=R), R^2, R^3) measuring variance from zero was conducted for both males and females. The variation was measured from zero in order to obtain a zero intercept (since aphids cannot be consumed if they do not exist). In order to determine if measurement of variation from zero produced a line comparable with that obtained from measurement of variation from the mean, a regression analysis measuring one X variable and variation from the mean was then calculated for both males and females.

A multiple regression analysis measuring variance from the mean for both males and females incorporating the no-replacement and replacement results into one line was done. This regression was performed in order to fill in the graph by including the initial density of ten, and to

further test the influence of day on aphid consumption. A regression analysis using k-values (log density before predation - log density after predation) vs. log (initial density) was then done for both males and females. This regression tested the dependence of the rate of predation by beetles on aphid density (Varley and Gradwell, 1960). For the females, an outlying point was tested to see whether its deviation from the regression line was within sampling error. Two tests were done, the first test involved the recomputing of the regression line, omitting the suspected point. The suspect Y was then treated as a new individual Y at point X and the standard error of the prediction Y_x was calculated for that X. This standard error was then used to predict the confidence limits for the X. The second test used the original regression line and the suspected point was tested for unusual deviation from the line (Snedecor and Cochran, 1980).

Finally, multiple regression analyses of the 2-hour counts were done for both males and females. The mean and standard error for number of aphids lost per 2 hour period for the 6 hours, were calculated, multiplied by 3 and compared with the mean and standard error for the number of aphids consumed over the remaining 18 hours of that test day for each trial type using an unpaired t-test.

IV RESULTS

Replacement Trials

Results of the 3-level factorial analysis of variance (Table 2), showed that: a) there was a significant difference in the number of aphids lost between the three groups (control, female and male); b) there was a significant difference in number of aphids lost between the two densities (10 and 20); and c) there was a significant difference in aphid loss between the four days (Table 2).

Orthogonal contrasts (Table 3), comparing aphid loss in the controls, males, and females, indicated that, a) controls differed significantly from males and females (aphid loss in the controls was equal to zero); b) males differed significantly from females (females consumed more aphids than did the males). Orthogonal polynomials conducted on days for females and males, showed females to have a significant linear response to days (as days progressed, aphid consumption by female beetles decreased). All polynomial tests (Table 4), conducted on males proved to be non-significant ($P>0.05$), thus, male's consumption of aphids did not differ according to day.

No-replacement Trials

The 2-level factorial analysis of variance showed that there was a significant difference between aphid loss in the three groups (control, females and males) ($P<0.05$) (there was also a significant difference between days however, since initial densities for each day were not held constant, this significance is not indicative of a true difference) (Table 5).

Orthogonal contrasts revealed a significant difference between

Table 2. Results of the 3-level factorial analysis of variance for number of aphids lost in the replacement trials. Asterisk(*) denote significant F-values($P<0.05$).

Subject	D.F.	M.S.	F	Significance
Replications	12	.05	1.43	-
Group	2	7.1	192.69	*
Aphid Number	1	132.32	3590.4	*
Days	3	.17	4.72	*
GxA	2	.06	1.54	-
GxD	6	.06	1.59	-
AxD	3	.03	.79	-
GxDxA	6	.01	.39	-
Error	276	.0368		

Table 3. Results of the orthogonal contrasts for number of aphids lost in the replacement trials.

Contrast	D.F.	M.S.	F	Significance(P<0.05)
Control vs. Female and Male	1	10.05	272.88	*
Female vs. Male	1	4.147	112.54	*
Error	276	.0368		

Table 4. Results of the orthogonal polynomial test for the effect of days on aphid consumption by lady beetles in the replacement trials.

Contrast	D.F.	M.S.	F.	Significance(P<0.05)
Female-linear	1	.547	14.84	*
Male-linear	1	.105	2.84	-
Male-quadratic	1	.0104	.28	-
Male-cubic	1	.073	1.96	-
Male(l+q+c)	3	.063	1.71	-
Error	276	.0368		

Table 5. Results of(a) 2-level factorial analysis of variance and,(b) orthogonal contrasts of the number of aphids lost in the no-replacement trials.

(a)

Subject	D.F.	M.S.	F.	Significance($P<0.05$)
Replications	12	.24	1.2	-
Group	2	33.24	163.83	*
Days	3	2.26	11.16	*
GxD	6	.8	3.96	*
Error	132	.2		

(b)

Contrast	D.F.	M.S.	F	Significance
Control vs. Female and Male	1	64.68	323.4	*
Female vs. Male	1	3.60	18.02	*
Error	122	.11997		

aphid loss in controls, females, and males ($P<0.05$); loss was again highest in the females (Table 3). In all of the thirteen replicates, only one aphid was lost on one day of one control trial; this loss was not significantly different from zero ($P>0.05$). Thus, no adjustments were made to account for aphids lost due to factors other than predation when a regression analysis was performed on the female and male trials.

In the multiple regression analysis of variance from zero for the females, the correlation matrix indicated that both day and density contributed largely to the number of aphids lost, but that density was most closely correlated. A step-up analysis showed that addition of other variables to the relationship of density with numbers lost did not significantly improve the fit of the line (Figure 4). Consumption of aphids by the male beetles was also linear in response to density (Figure 5). Variation resulting from other variables (including day) did not significantly improve the fit of the line.

Results of the conventional regression analysis for females, measuring variance from the mean, with one X-variable (density) were comparable with those obtained from the multiple regression analysis (y-intercepts .08 and 0 respectively, and gradient .207 and .202 respectively). Density accounted for 20% of the variation from the mean. Remaining variation was probably due to factors which were not measured (e.g. age of beetles, behavior and activity of the beetles, etc.).

The conventional regression analysis line for the males was not significant ($P>0.05$), and, the y-intercept was higher (.27) when variation was measured from the mean as compared to variation from zero. (Density accounted for only 3% of the variation from the mean) (Figure 5).

Figure 4. Multiple regression analysis measuring variation from zero for the number of aphids consumed per day by female lady beetles in the no-replacement trials.

∘ - one point

⊙ - two points

③ - three points

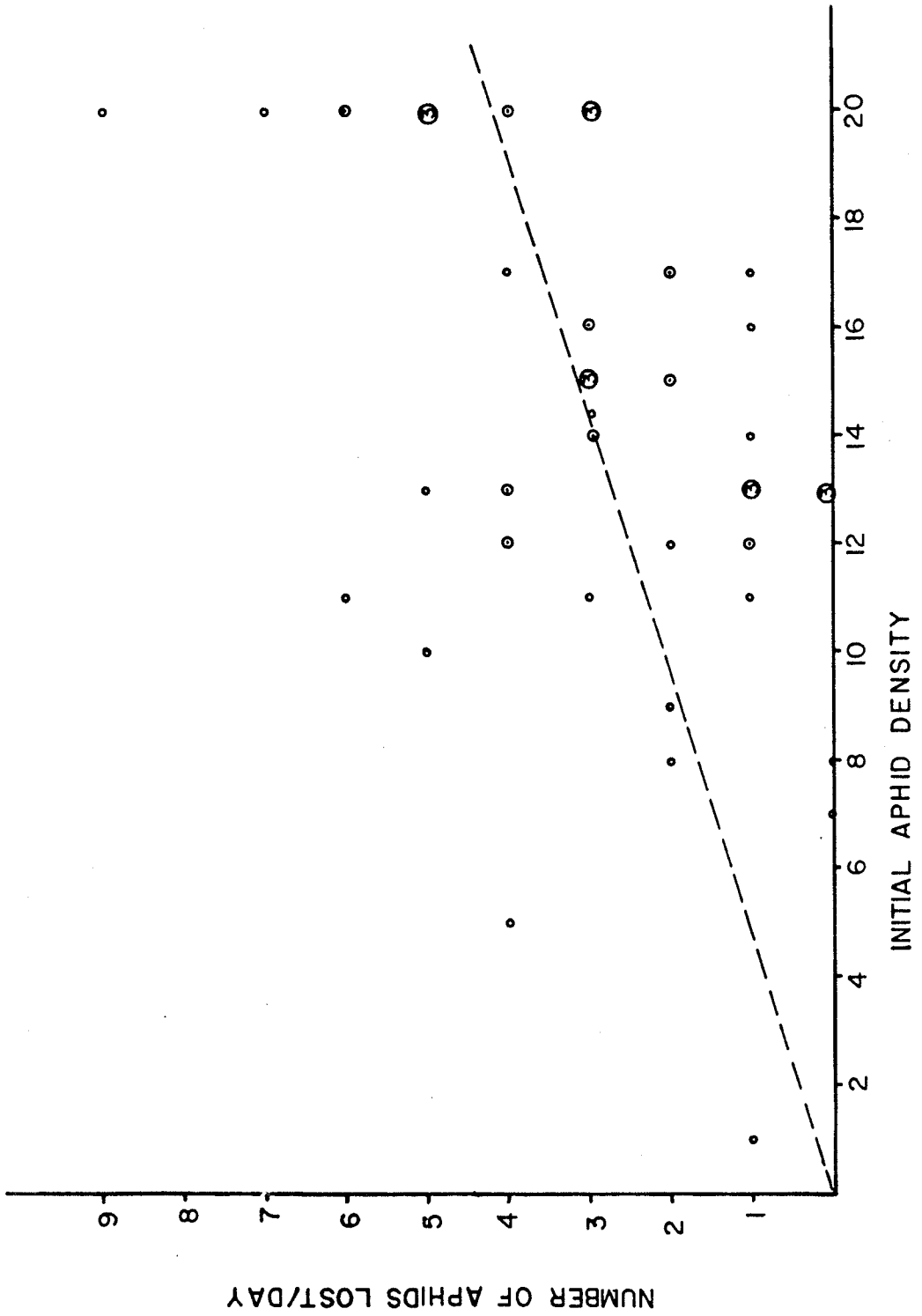

NUMBER OF APHIDS LOST/DAY
1
2
3
4
5
6
7
8
9
INITIAL APHID DENSITY
2
4
6
8
10
12
14
16
18
20

Figure 5. The number of aphids consumed per day by male lady beetles in the no-replacement trials.

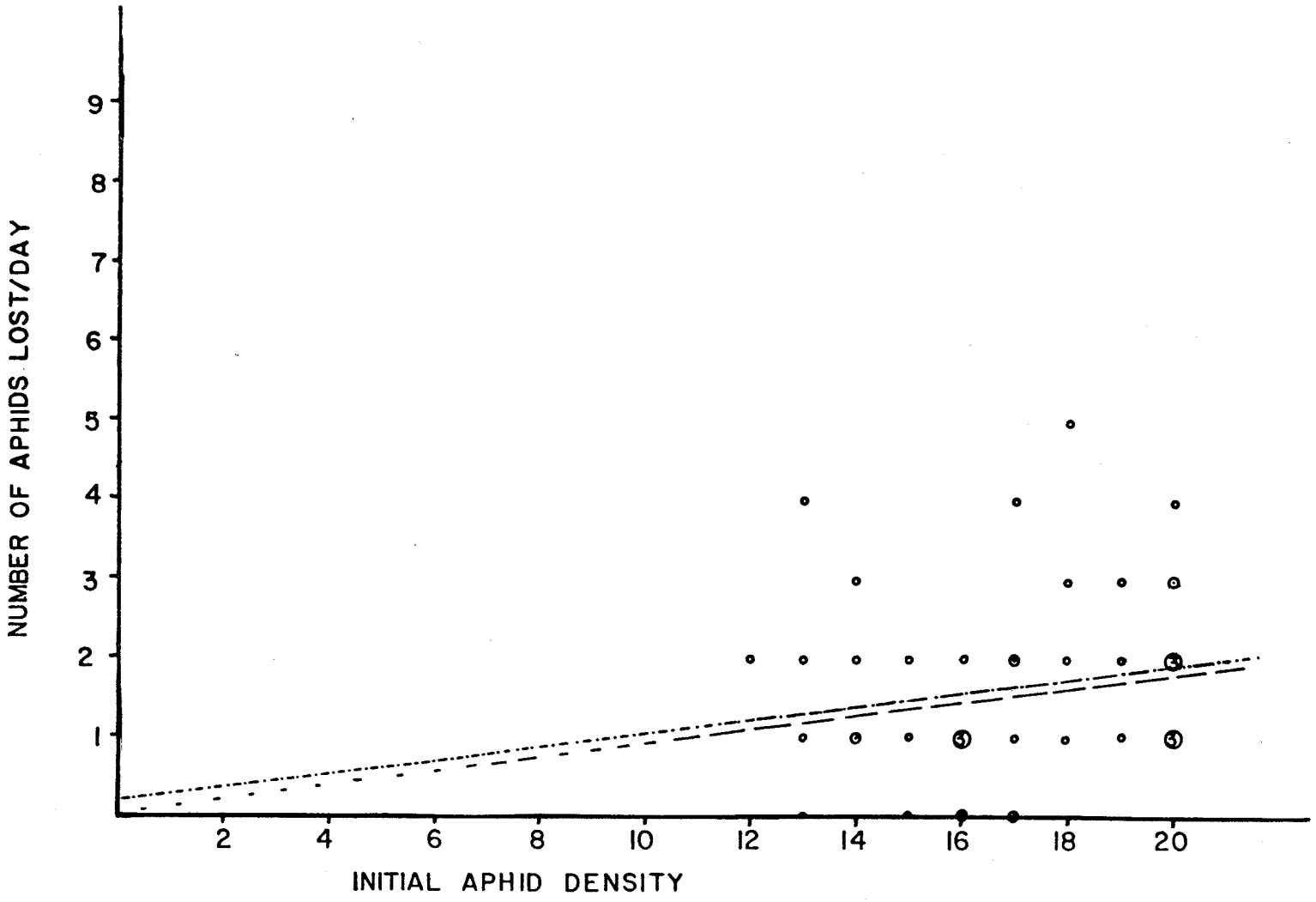
------ multiple regression analysis from zero

-·-·- regression analysis measuring variation from the mean

∘ - one point

⊙ - two points

③ - three points


NUMBER OF APHIDS LOST/DAY
9
8
7
6
5
4
3
2
1
2
4
6
8
10
12
14
16
18
20
INITIAL APHID DENSITY

All Trials

Results of the multiple regression analysis with both replacement and no-replacement trials for the males, showed that days (D, D^2, D^3) were negatively correlated with number of aphids lost, and density (R, R^2, R^3) were positively correlated with number of aphids lost. Density cubed (R^3) accounted for the most variation from the mean, and addition of other variables did not significantly improve the fit of the line ($P>0.05$) (Figure 6).

Results of the females all-trials using the same regression analysis showed density to be positively correlated and days negatively correlated with the number of aphids lost. Density cubed (R^3) accounted for the most variation from the mean, and day significantly improved the fit of the line ($P<0.05$) (Figure 7).

The regression analysis for females and males to test for density dependence using k-values vs log (initial density) revealed a somewhat different trend. In both the females and males, the slope of the regression was negative (i.e. a slightly larger proportion of aphids were consumed at low densities than at high densities. The regression was not significant in the males ($P>0.05$) (Figure 8). However, the regression for the females was significant ($P<0.05$) (Figure 9). The validity of this significance was in doubt because there was one point which was particularly far from the regression line (Figure 9). The tests performed on the outlying point indicated that the point was a) beyond the confidence limits of the recomputed line, and b) an unusual deviation from the original line.

Figure 6. Regression line calculated from a multiple regression analysis of the number of aphids consumed per day by male lady beetles in all trials.

∘ - one point
⊙ - two points
③ - three points
④ - four points
  - etc.

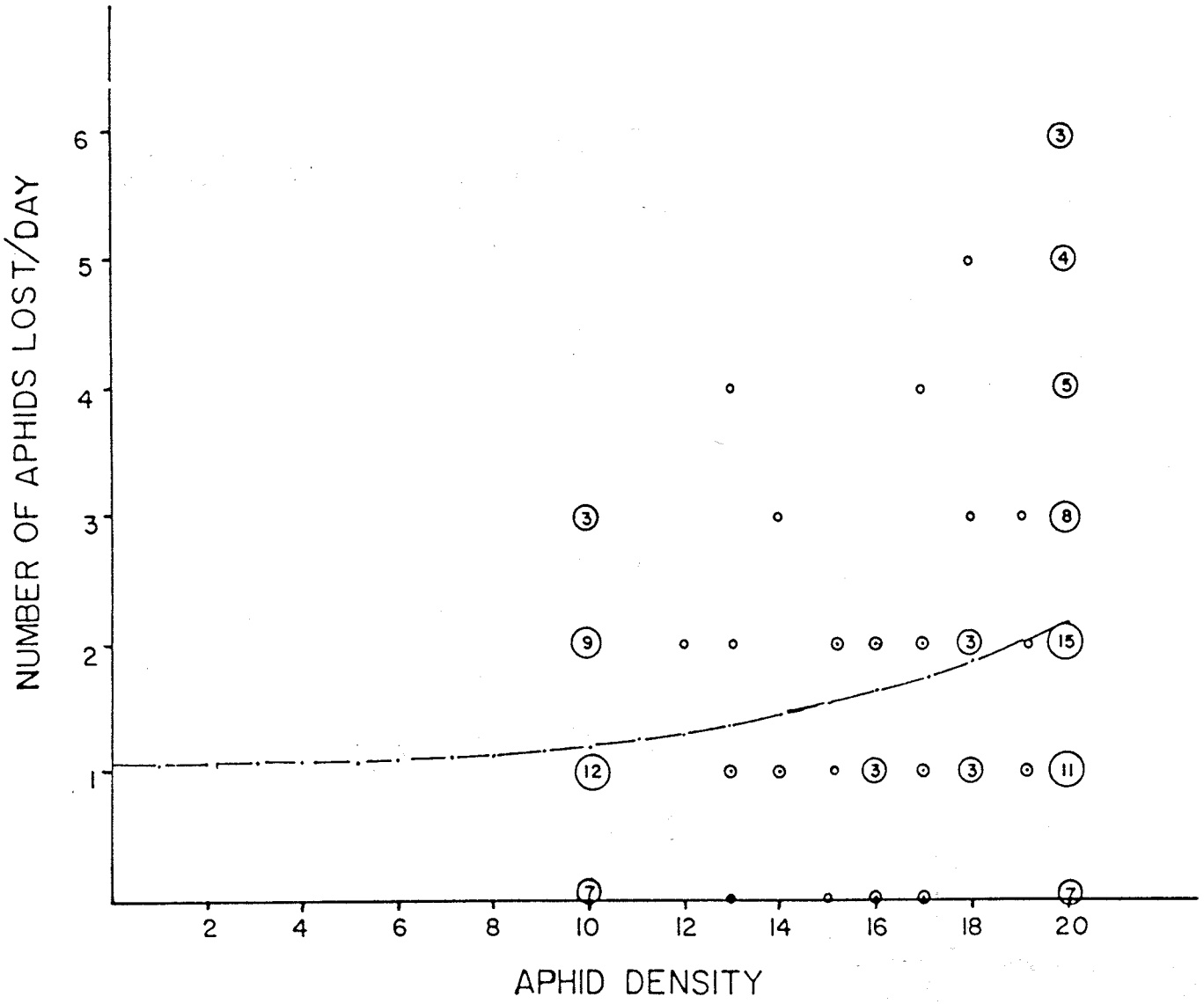
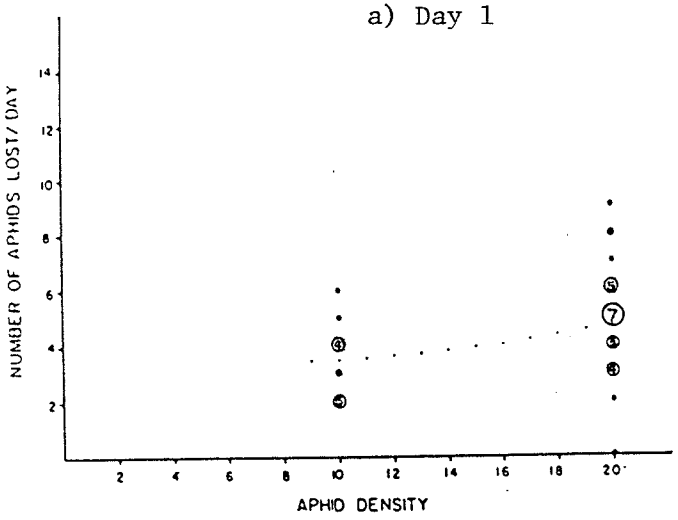

NUMBER OF APHIDS LOST/DAY
APHID DENSITY
1
2
3
4
5
6
2
4
6
8
10
12
14
16
18
20

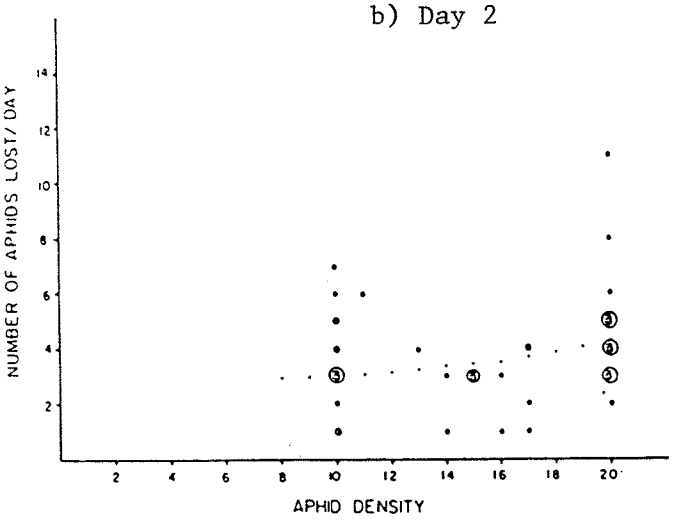
Figure 7. Regression lines for the multiple regression analysis of aphids consumed per day by female lady beetles in all trials, a) day 1; b) day 2; c) day 3; d) day 4.

∘ - one point
⊙ - two points
③ - three points
④ - four points
  - etc.

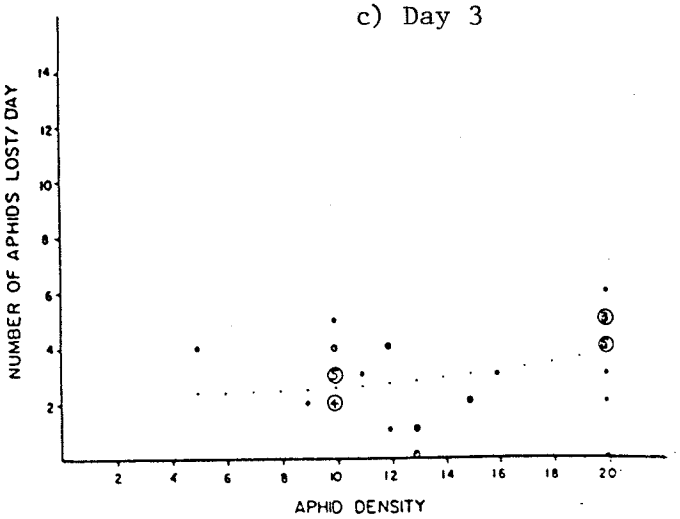
a) Day 1



b) Day 2



c) Day 3



d) Day 4

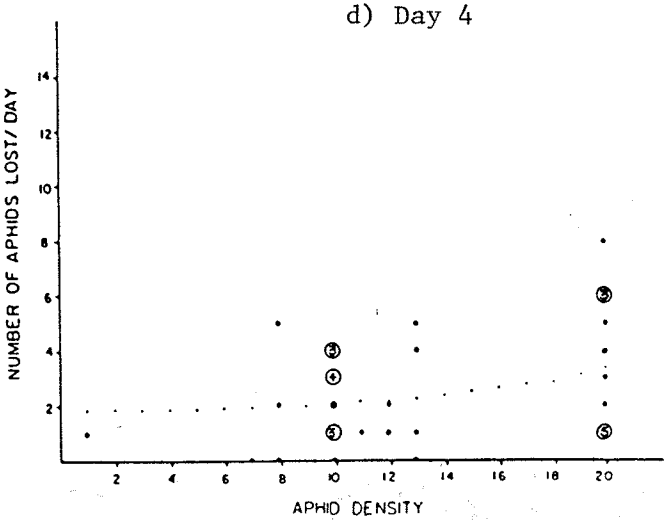


Figure 8. k-values plotted against log(aphid density) for predation trials with male lady beetles.

∘- one point
⊙- two points
③- three points
◯- etc.

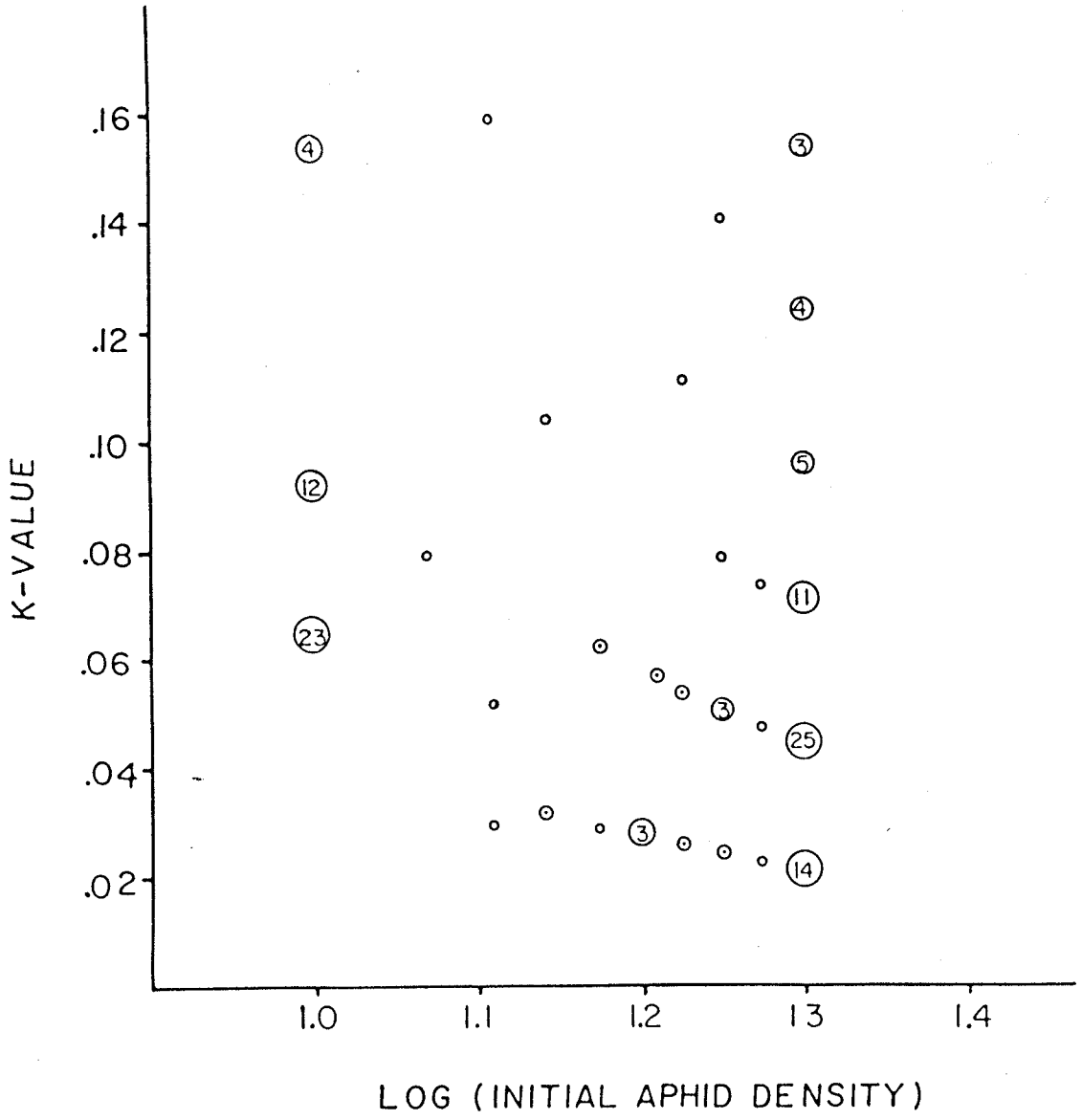
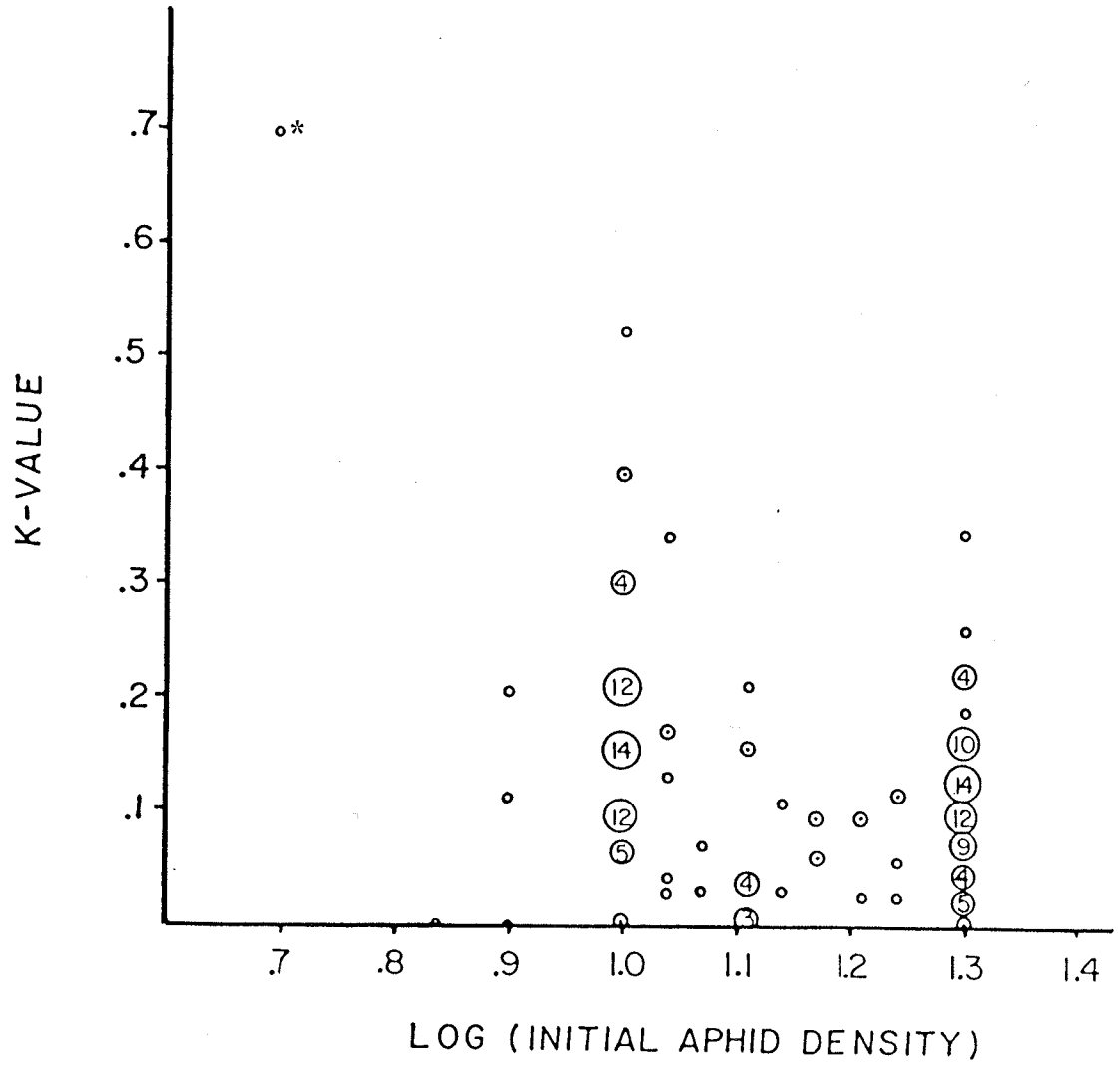

K-VALUE
.16
.14
.12
.10
.08
.06
.04
.02
1.0
1.1
1.2
1.3
1.4
LOG (INITIAL APHID DENSITY)
4
3
4
5
12
11
23
3
25
3
14

Figure 9. k-values plotted against log(aphid density) for for predation trials with female lady beetles. Note the outlying point(*).

- one point
- two points
- three points
- etc.


K-VALUE
.7
.6
.5
.4
.3
.2
.1
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
LOG (INITIAL APHID DENSITY)

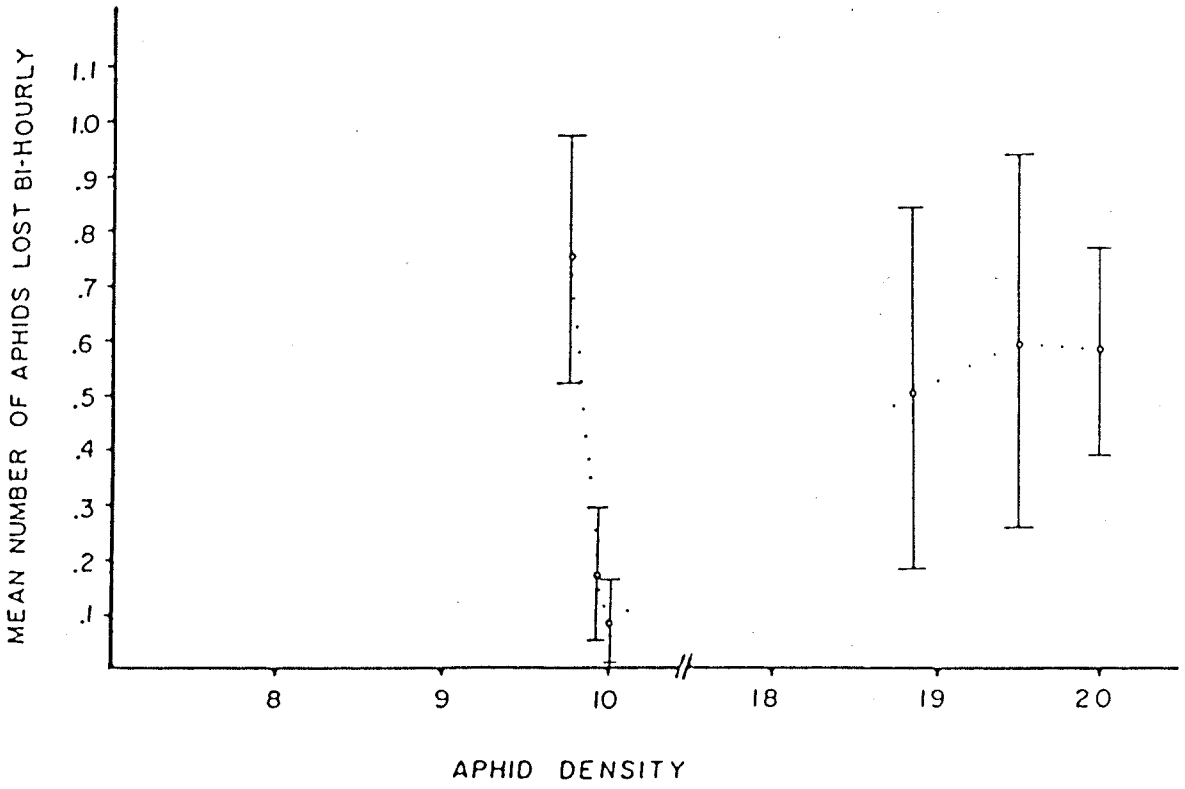
2-Hour Counts

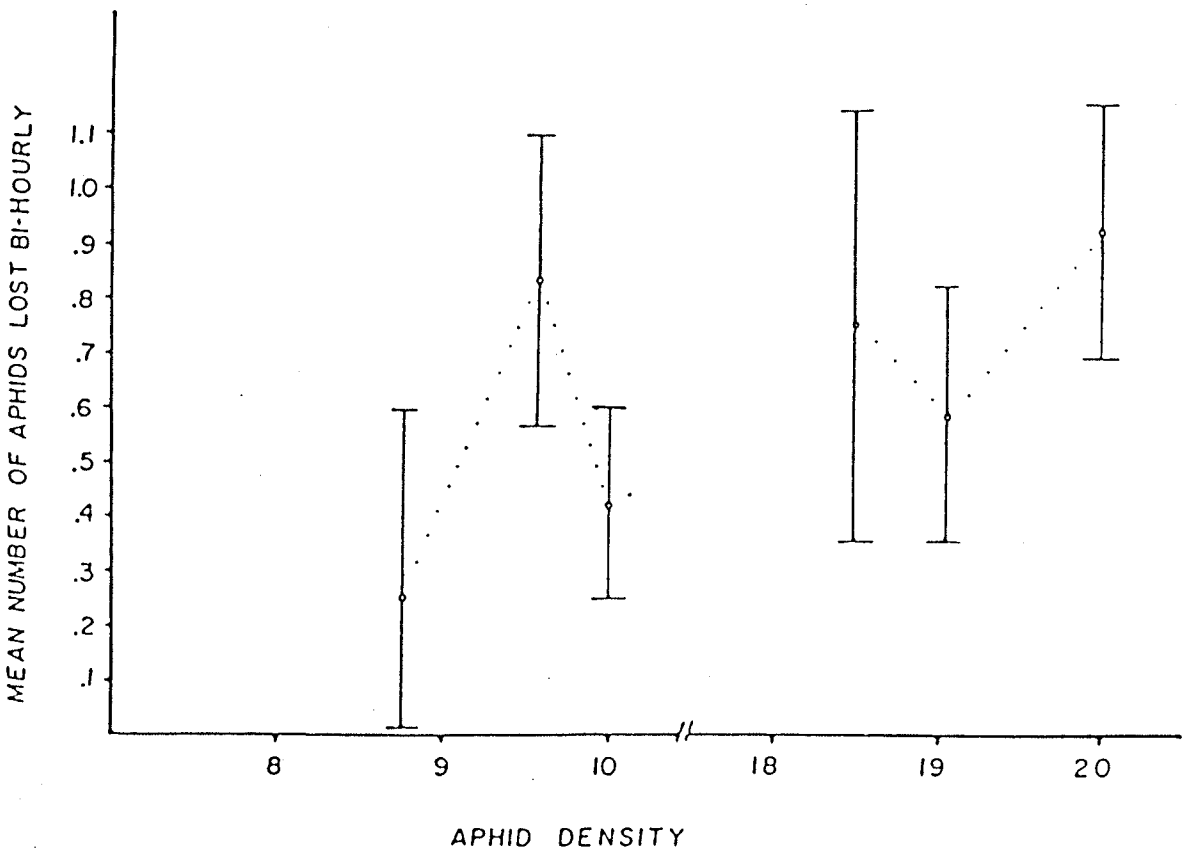
Multiple regression analyses using once again, 6 variables, showed for both males and females, that the number of aphids consumed over a 2-hour period were not significantly affected by density or hour (time) (Figures 10 and 11). A one-way analysis of variance also revealed no significant variation in time ($P>0.05$).

Do adult H. tredecimpunctata consume food at a constant rate, or do they have an active feeding period? To answer this question, the number of aphids consumed over the 6-hour period was multiplied by three, and then compared with the number of aphids consumed over the remaining 18 hours using an unpaired t-test. The results indicated that the two sets of figures were significantly different ($P<0.05$), and that the rate of predation was greater in the six hour period than in the remaining portion of the day.

Figure 10. Mean and standard error of the number of aphids consumed by male lady beetles at 2-hour intervals at different aphid densities.

Figure 11. Mean and standard error of the number of aphids consumed by female lady beetles at 2-hour intervals at different aphid densities.


MEAN NUMBER OF APHIDS LOST BI-HOURLY
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
8
9
10
18
19
20
APHID DENSITY


MEAN NUMBER OF APHIDS LOST BI-HOURLY
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
8
9
10
18
19
20
APHID DENSITY

V DISCUSSION

The predation experiments attempted to determine the effects of different pea aphid densities on the predation rates of adult thirteen-spotted lady beetles. Initially these experiments were conducted as a follow-up to a portion of Chiang's (1979) work on the same species. However, in Chiang's experiments, a large number of aphids were lost due to factors other than predation. This did not happen in the present experiment, thus the results of the two experiments are not directly comparable.

Results of the predation trials revealed a few trends, and posed many questions. In all factorial and regression analyses, and orthogonal contrasts, female beetles consumed significantly more aphids than did male beetles, and controls differed significantly from trials containing beetles. In many coccinellid species the females, especially during oviposition periods, tend to consume more than do the males (Hodek, 1973). Females require this added amount of food in order to develop their ovaries.

The coccinellid's reaction to variation in aphid density was analysed in two ways. First, the aphid consumption rate was analysed at various aphid densities. Then the k-value vs log (aphid density) was studied. In almost all cases where the first method was used, results indicated that increasing aphid density resulted in a significant increase in aphid consumption by adult *H. tredecimpunctata*. In both cases where the second method was used, the adjusted results indicated that the proportion of aphids consumed by the lady beetles changed very little with changing aphid density. When there was a change, it was

a negative one (i.e. there was a larger proportion of the aphids consumed at low densities than at high densities).

Although there was a definite response by the lady beetles to aphid density, in the initial density vs number of aphids consumed analysis, density accounted for only 20% of the variation from the mean for females (all-trials), and 10% for males (all-trials). In the no-replacement trial analysis, density accounted for even less of the variation (10%-females; 3%-males).

Initially the analysis of female beetles (all-trials) comparing log (aphid density) with k-values revealed a significant negative slope (Figure 9). However one Y-value looked suspiciously large. This point was tested and found to be significantly far away from the regression line. The computed regression (omitting the outlier), was not significant. Similarly the regression analysis of the same comparison using male lady beetles was not significant. Thus, while the lady beetles were increasing their consumption rate with increasing pea aphid density, this increase in prey consumption was not large enough to be a proportionate increase. These findings agree with those of Chiang (1979) who worked with the same two species.

In order for a predator to regulate a prey's population growth (i.e. keep the prey population below a certain level), the predator's consumption rate must increase superproportionately to the prey's population growth (i.e. show density dependence) (Holling, 1959). It may be concluded then, that although adult H. tredecimpunctata does show some functional response to increases in its prey's (A. pisum) density, this response is not a density dependent one. Thus adult H. tredecimpunctata alone could not maintain pea aphid populations

at a constant level under the conditions tested.

How reliable are these conclusions? If the effects of density represented only a small amount of the variation from the regression mean, where was the rest of the variation coming from, and why was overall aphid consumption so low? What would happen if no-replacement trials were set up at densities starting at 5, 10, and/or 30? How do other life stages of the lady beetle react to prey density?

In the females, some of the variation was due to the effects of days (i.e. as days progressed, comsumption of aphids by beetles decreased). Possibly females were not receiving enough food in the stock cultures. (This is suggested because aphid supplies in the stock cultures were often completely consumed by the end of each day). When they were exposed to a larger food supply, their consumption may have increased initially, and then dropped off as the beetles became satiated. Hodek (1973) states that hungry coccinellids completely devour the first few prey they tackle, but exploit subsequent prey with a gradually decreasing efficiency. Since males require less food than do females, perhaps the male beetles were receiving enough food in the stock cultures, thus explaining why they did not respond to 'days' as much as did the female beetles.

Remaining variation (from the mean) could be due to a combination of variables. These variables include behavioral characteristics, generation, age and condition of the beetle, as well as the condition and behavior of the aphids. (The age of the aphid would not be a factor since adult aphids used were all the same age plus or minus a few hours.)

In several instances, lady beetles were found more often crawling about on the screening of their cages, than on the faba bean plants. Males were especially prone to this behaviour. Could it be that dispersal behaviour was negatively influencing the predation rate of the lady beetles? According to Frazer (1976), when aphid populations decrease beyond a certain critical density, most species of coccinellids will disperse to another area in search of a new food source. Some coccinellids disperse fron an area after a certain time period, regardless of aphid densities in the area (Frazer personal comm.). In addition, most coccinellid species disperse from overwintering areas in the spring, regardless of the amount of food available in that area (Ives, 1981a). Results of early season trials in which overwintered H. tredecimpunctata were used, may have been influenced by this last factor. Some lady beetles raised in petri dishes may have suffered "stress" from captivity, or possibly from sub-optimal food supplies, and thus displayed dispersal behaviour when placed in the cages. Alternatively, some beetles may have spent a great deal of time just caught up in the netting of the cage.

The generation to which a lady beetle is born may indirectly effect its aphid consumption rate. According to Hagen and Sluss (1966), in studies of the pre-oviposition periods of adult Hippodamia convergens and H. quinquesignata punctulata Leconte (fed on A. pisum), there was an increase in the length of the preoviposition period in the first generation over the overwintered generation. In the second generation, this period increased in H. q. punctulata, and decreased in H. convergens (i.e. the number of aphids consumed between the generations varied) (Hagen and Sluss, 1966). If this variability also occurs in H. tredecimpunctata, then, the number of aphids consumed by females from

different generations may have varied within the predation trials (thus contributing to variation from the regression mean). Hagen and Sluss (1966) also reported that the total number of pea aphids consumed by H. convergens in the preoviposition period decreased with each succeeding generation. It was suggested that selection for individuals best suited to a diet of pea aphids, may have occurred in the laboratory cultures (Hagen and Sluss, 1966). This may also have occurred in the cultures used in the present study.

The age of the lady beetle may affect its degree of activity, appetite and possibly even its searching behaviour. Newly emerged beetles are inactive for several hours while their cuticle is hardening. Lady beetles used in the predation trials were at least 3 days into the adult stage, thus they would be past this inactive stage. Possibly young adults are more active, and have larger appetites (and consumption rates), than older adults. More nutrients would be required for ovary development in young females and possibly for more active mate search in young males. This higher activity rate might lead to more frequent "collisions" with prey. Pea aphids have well developed defense mechanisms, when disturbed they will either back up or fall off the plant (Roitberg et al., 1979; Roitberg and Myers, 1979). When captured they secrete alarm pheromone which "alerts" neighboring aphids to the presence of an enemy (Nault, 1973). Both reactions initiate a chain reaction in which many aphids in one area will drop off the plant (Lowe and Taylor, 1964; Roitberg and Harper, 1978). Thus an active young predator might lessen the number of aphids it can attack merely by its behaviour.

The sensitivity of an aphid to disturbance may vary depending on the aphid's genotype, condition of the host plant, and the degree of crowding to which the aphid and its ancestors were exposed. Different

clones react differently to certain stimuli. This could not be a factor in this experiment since all of the aphids originated from one clone. If the condition of the host plant is such that the aphids are not receiving certain essential nutrients, then the aphids will be much more sensitive to disturbances (Sunderland, 1969a). Similarly, an aphid which has been crowded might be more sensitive to disturbance (Sunderland, 1969b). In this experiment, the condition of the plants, and the degree of crowding was usually carefully controlled. However, occasionally infestations of thrips, an unhealthy plant, or an overcrowded leaf may have gone unnoticed; thus, these factors may have contributed to variation from the mean. Finally, variation in the temperature and light intensity of the growth incubators may have also contributed to variation.

The Functional Response

According to Holling (1959, 1965), there are three basic functional responses to prey density which predators can display. The response could be a linear one where the number of prey consumed rises linearly and then levels to a plateau (type I response). It could be a negatively accelerated rise to a plateau (type II response), or it could be an S-shaped rise to a plateau (type III response). Holling (1965) believed that type I and II responses were mainly characteristic of invertebrate predators, while type III was restricted mainly to predaceous birds and mammals. The S-shaped curve is often a response by a predator to a choice between two different types of prey items (Holling, 1965).

Hassell (1978) cited several examples of invertebrates demonstrating a type III functional response. According to Hassell (1978), predators showing a sigmoid response tend to search more actively as prey density rises, making one or more components of searching activity dependent on

prey density. As prey density is reduced, reward rate becomes insufficient to maintain a constant searching activity, and an increasing proportion of time is spent in non-hunting activities (Hassell, 1978). Once prey density rises beyond a certain point, the type III response is replaced by a type II response.

The response curves for the number of pea aphids consumed vs initial aphid density for both male and female H. tredecimpunctata in the present study, resemble the beginning of an S-shaped type III response (Figure 6 and 7). If Hassell's (1978) predictions are true in this case, then the lady beetles should display an increased consumption rate at higher aphid densities. (It would be interesting to see if the proportions consumed increased as well). In addition, the predictions would also explain why lady beetles were so often found (dispersing) on the walls of the cages (i.e. a non-hunting activity).

Two Hour Counts

Holling (1965) postulates that predators have a 16 hour feeding period during the daylight, and an 8 hour non-feeding period during the night. At the beginning of the 16 hour period, the predator's hunger level is high. Until the first prey is caught and consumed, this hunger level will continue to increase (Holling, 1965). The hunger level then abruptly decreases, and a new cycle of search and attack begins (Figure 13). Holling (1965) suggested that the overall hunger level decreases with each successive capture.

Although no evidence was found in the present study to substantiate the gradual decline in overall hunger level, analysis with unpaired t-testing definitely indicated that the lady beetles were consuming a large proportion of their daily (24 hour) intake during the 6 hour test

Figure 12. Hypothetical changes in the hunger of a predator during its 16-hour feeding period(Holling,1965).

A- beginning of attack cycle

B- end of attack cycle

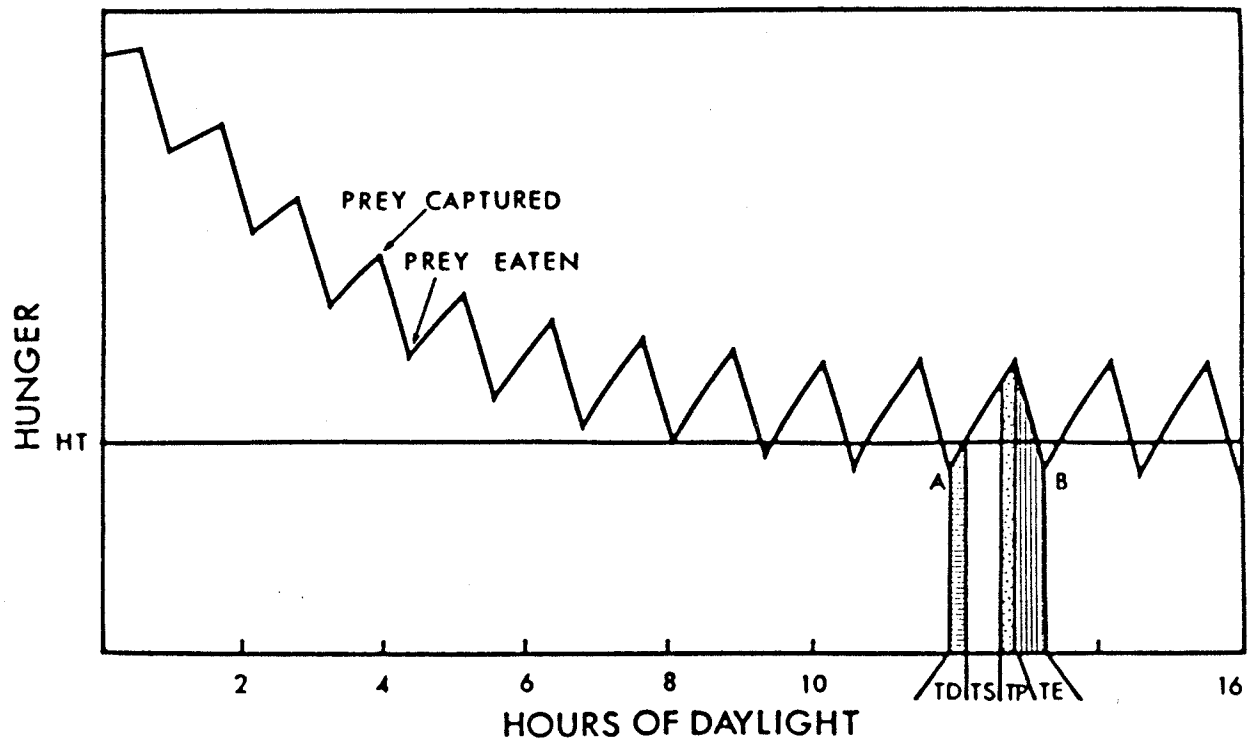
HT- hunger level at which searching begins

TD- Time taken in a digestive pause after a prey is eaten

TE- time spent eating each prey

TP- time spent pursuing each prey

TS- time spent searching for each prey


HUNGER
HT
PREY CAPTURED
PREY EATEN
A
B
TD
TS
TP
TE
2
4
6
8
10
16
HOURS OF DAYLIGHT

period. These findings are verified by Frazer and Gill (1981), who stated that coccinellid activity was affected by circadian rhythm and hunger.

Alternatives and Solutions

No-replacement trials starting at aphid densities of 10 and 30 per trial should be done. A no-replacement from 10 aphids per trial would be beneficial since, the data in this study leave a gap below an aphid density of 10, thus we are uncertain what the reactions of lady beetles would be at very low densities. Information about these reactions would be important because often A. pisum densities do not rise above 10 aphids per terminal in alfalfa fields (Frazer personal comm.) and above 4 aphids per terminal in faba bean fields (Chiang, 1977).

No replacement trials from 30 aphids per trial (or even higher) would reveal whether or not H. tredecimpunctata displays a full type III functional response (i.e. the response in this study was only partial). It would also be interesting to test the effects of prey aggregations on the predation rate of H. tredecimpunctata.

There are several experiments which could be conducted in order to test the effects of other variables on the regression line. Closer observations of adult beetle behaviour, and its effect on aphid behaviour could be conducted by monitoring the number of times lady beetles came in contact with aphids, how often the aphids were attacked and captured, or alternatively escaped. If the aphid did escape, did it drop from the plant or run away, and how sensitive to the approach of beetles was it after its first encounter?

Other factors deserving further attention include the 'suspected' dispersal tendencies of the lady beetles, and cage structure. Often the

lady beetles were found wandering around on the netting of the cage, or caught in the folds of the netting. One solution might be to use an alternative type of cage, or at least one with less excess netting.

The effects of age, generation and activity rate on predation rate in H. tredecimpunctata could also be examined. These could be important factors in determining the efficiency of beetles in the field during a season. Finally, trials could be conducted in the field as well as in the laboratory using a greater range of aphid densities.

VI SUMMARY AND CONCLUSIONS

In order to determine the effects of Acyrthosiphon pisum densities on the predation rates of adult Hippodamia tredecimpunctata, an experiment consisting of thirteen replicates with nine trials in each replicate was set up. In each trial the number of aphids disappearing was recorded daily for four days. On the second day, aphid loss was recorded at two hour intervals over a six hour period. Both male and female beetles were tested in two types of trials: trials where aphids lost were replaced daily starting at densities of 10 or 20, and trials where aphids lost were not replaced to the original density of 20. Controls with no lady beetles were set up for both trial types.

Statistical analyses showed that there was a significant difference between a) the number of aphids lost in the controls and trials containing beetles; b) the number of aphids consumed by males and females, and c) the number of aphids lost and the original density in both males and females - except in the no-replacement trials with male beetles; here the regression (aphid number lost vs initial aphid density) was not significant. In all other regression analyses plotting aphid number lost vs initial aphid density, density ^{3} accounted for the most variation from the mean. In the females, effects of day significantly added to this variation. However, when log (density) was plotted against k-values, both male and female beetles responded with a non-significant negative regression line.

Aside from density and days, other possible sources of variation from the mean included age, generation, physiological condition, behavioral characteristics of individual beetles, condition and behavior of the aphids, condition of the plants used, and variation in the conditions of

the growth chambers.

H. tredecimpunctata does not demonstrate a significant reaction to density on a bi-hourly basis. The lady beetles did feed more actively during the 6 hour test period than during the remainder of the day.

According to Hodek (1973), 40-60% of total food intake in most coccinellid species occurs during the fourth instar. Since this study analysed only one stage of the life history of H. tredecimpunctata, and that stage (the adult), although it is the most common stage found in the field, is not one which consumes the most food, thus no conclusions can be drawn about the functional response of this species as a whole. Similarly, the analyses were done on a limited range of prey densities, thus no real conclusions can be made as to the amount of density dependence displayed by this lady beetle species. Finally, certain responses of predators to prey in the field can be very different from responses displayed in the laboratory (Frazer and Gilbert, 1976). Since all trials in the present study were done in the laboratory, responses shown may not represent what occurs in the field.

Conclusions that can be drawn on the basis of the findings of this study are as follows: female H. tredecimpunctata consumed more adult aphids than did the males; under the given densities of A. pisum, adult H. tredecimpunctata displayed a functional type III response to changes in pea aphid density, however this response was not density dependent; and H. tredecimpunctata adults have an active diurnal feeding period of at least 6 hours duration.

PART II

VII REVIEW OF THE LITERATURE

SURVEYS AND LISTS

There have been numerous surveys and lists of the predators and parasitoids of aphids compiled throughout the world. In the following two sections, a review of a number of these papers will be given. The first section will deal with predators, the second with parasitoids.

A. Predators of Aphids

Most lists of predators deal with a particular aphid pest species or geographical region. Fluke (1929), in North America, Harper (1972), in Alberta, and Cooke (1973), in the Blue Mountain area of Washington and Oregon, listed the predators of the pea aphid from their areas. Banks (1955 and 1968), listed the coccinellids and other predators associated with Aphis fabae Scop. in Britain. Similarly, Hodek et al. (1962), studied the natural enemy complex of A. fabae in Czechoslovakia.

An annotated list of the predators associated with the balsam woolly aphid, Adelges piceae(Ratz.), in Eastern Canada was published by Brown and Clarke in 1956. Meier (1965), and Shands et al.(1972), listed arthropod predators of the potato aphid, Macrosiphum euphorbiae(Thomas), in Europe, and in North Eastern Maine respectively. Wagner and Ruesink (1982), listed the predators of the corn leaf aphid Rhopalosiphum maidis(Fitch), in Central Illinois. Smith and Hagen(1956) listed the natural enemies of the spotted alfalfa aphid. Malyk and Robinson (1971) and Edwards et al.(1979), listed some predators of cereal aphids.

Works involving surveys of syrphids and their prey include Laska and Stary (1980), for Czechoslovakia, Dusek and Laska (1966) for Europe, and Vockeroth (1969), for North America. Several workers who have contributed to knowledge of the distribution of coccinellids and their prey in Western Canada and Alaska, are listed in Belicek (1976). Hukusima and Watanabe (1966), listed aphid species attacked by coccinellids in Japan.

B. Parasitoids of Aphids

Parasitoids of pea aphids have been listed and studied by Fluke (1929), and Mackauer and Finlayson (1967), in North America, by Halfhill et al.(1972), in the Pacific Northwest, and by Hozak (1968) in Czechoslovakia. Johnson et al.(1970, 1979), studied the parasitoids of the greenbug and other graminaceous aphids in Oklahoma. Mackauer (1968), surveyed the parasitoids of the green peach aphid Myzus persicae Sulz. in British Columbia. Watterson and Stone (1982), listed and studied the parasitoids of the black margined aphid, Monellia caryella Fitch, in Western Texas. Shands et al., (1972), published a survey of parasitoids of potato infesting aphids in N.E. Maine.

Surveys of cereal aphid parasitoids have been done by Stary (1981a), for the Western Palaearctic region, and by Jones (1972), in Britain. Lists of a) parasitoids of aphids(Prociphilus spp.), associated with ash(Fraxinius excelsior L.), and b) parasitoids of arboricolous callaphidid aphids, including species distributions, host ranges, and host specificity were done by Stary 1982 and 1978 respectively

Surveys of parasitoids of aphids from specific geographic regions have been published by Stary (1981b), for Cuba, by Stary and Remaudière

(1977), for portions of Quebec and New England, and by Mackauer (1965), for the genus Trioxys occurring in Canada.

Two catalogs which include the work of many scientists are Peck's (1963) Catalog of the Nearctic Chalcidoidea, and the more recent Catalog of Hymenoptera in America North of Mexico, Volume I: Symphyta and Apocrita (Parasitica)(Krombein et al., 1979).

In Manitoba, surveys of predators and parasitoids of aphids have been conducted by Bradley (1961), on aphids of the genus Cinara, by Malyk (1971) on grain aphids, by Bakker (1974), on the grain aphid Rhopalosiphum padi(L.), and by Melvin (1966), on Rhopalosiphum niger(Richards), attacking wild rice.

PREDATORS OF APHIDS

There are hundreds of different aphidophagous species of animals in the world. The most that can be done here, is to list them by families, and to name a few of the more unusual species.

A large number of predators of aphids occur in the families Coccinellidae (Belicek, 1976), Syrphidae (Vockeroth, 1969), and Chrysopidae (Tauber, 1969; Tauber and Tauber, 1974). Other predators include several species of Anthocoridae (Russell, 1970; Anderson, 1962), Nabidae (Smith and Hagen, 1956), Cecidomyiidae (Davis, 1916), Chamaemyiidae (Clark and Brown, 1957), Hemerobiidae (Borror et al., 1976), and Araneida (Muniappan and Chada, 1970).

Occasional predators (or generalists) that will feed on aphids include the Lygaeidae (Smith and Hagen,1956), Carabidae (Edwards et al., 1979), Staphylinidae (Banks, 1968), and the Cantharidae (Smith, 1966). Certain species of parasitic and predaceous Acari, particularly the

Trombidiidae, will also attack aphids (Brown and Clark, 1956).

The dermapteran, Forficula auricularia Linnaeus occasionally aids in Aphis fabae population regulation (Way and Banks,1968). Eusstilbus apicalis Melsh (Phalacrididae, Coleoptera), preys on young pea aphids on alfalfa in Wisconsin (Fluke, 1929). The rare and unusual harvester butterfly (Feneseca tarquinius(Fabr.)), preys only on woolly aphids such as Adelges piceae(Ratz.)(Brown in Brown and Clark, 1956), and the alder aphid Prociphilus(Paraprociphilus)tessellatus(Fitch).

Various bird species will feed on heavy infestations of aphids (Bird and Smith, 1964; Knowlton, 1954; Fluke, 1929; Smith,1966; and Way and Banks, 1968). In addition, Knowlton (1954) recovered various species of aphids from the stomachs of two species of lizards.

PARASITOIDS OF APHIDS

Like many insect groups, parasitoids of aphids suffer from a lack of nomenclatural clarity (Schlinger and Mackauer, 1963). Taxonomy at the family and sub-family level is also unclear due to disputes involving the phylogenetic ancestory of these groups. These Hymenoptera occur primarily in two groups, the Aphelininae (Encyrtidae), and the Aphidiidae(Krombein et al. (1979) raised the Aphidiinae, formerly a sub-family of the Braconidae, to the family level). Peck (1963) recognized 19 genera of aphidophagous Aphelininae in the Nearctic region, and Stary (1970b) recognized 30 genera of Aphidiidae in the world.

SPECIFICITY OF HOST/PREY SELECTION

Selection of a prey or host species is greatly influenced by the natural enemy's habitat preferences and geographic range (Van Emden

et al., 1969; Gurney and Hussey, 1970; van den Bosch et al., 1979). Fluke (1929) for example, reported some syrphids occur only in forested areas. Most aphids are restricted to certain species or groups of plants, thus those living in open areas would rarely be attacked by these syrphids. Predators and parasitoids may have preferences for certain areas of the plant. Ephedrus nitridus Graham for example, attacks aphids on exposed areas of tomato and tobacco plants, whereas Aphidius phorodontes Ashm. attacks aphids on unexposed areas of the plants (McLeod, 1937).

The ability of a predator/parasitoid to locate and attack a prey/host will also influence its selection of a prey/host item(Schneider, 1969; Smith and Hagen, 1956; Russel, 1970; Dureseau et al., 1972; Schlinger and Hall, 1959). In addition, species of predators which require the presence of aphids in order to oviposit, are more likely to show specificity to certain prey species, than are those predators with non-specific oviposition tendencies (Blackman, 1965; Sundby, 1966). Finally, morphological, and physiological suitability of the aphid also greatly influences host/prey selection by a natural enemy (Dixon, 1958; Hodek, 1966; Blackman, 1965; El-Hariri, 1966; Griffiths, 1961).

ENEMIES OF NATURAL ENEMIES

A. Enemies of Predators of Aphids

Over 65 different species of parasitoids of syrphids exist in the Braconidae, Ichneumonidae, Encyrtidae, Eupelmidae, Pteromalidae, Chalcididae, Figitidae, Ceraphronidae, and the Diapriidae(Schneider, 1969). Many are specific for one or a few closely related host species. Typically, the parasitoid eggs are laid in syrphid eggs or in young larvae,

and adult parastoids emerge from the syrphid puparia (Schneider, 1969).

Hymenoptera parasitizing coccinellids are found mainly in the Braconidae, and to a lesser extent, in the Encyrtidae and Eulophidae (Hodek, 1973). Coccinellids are also parasitized by species from three genera of Diptera (Phalacortophora, Degeeria, Hyalomyodes), several Acarina, and several Nematoda (Hodek, 1973). The Hymenoptera attack the larval stages (Remaudière and LeClant, 1971), Phalacortophora spp. attack the prepupal or pupal stages, and Degeeria spp., Hyalomyodes sp., the Acarina, and the Nematoda attack adult coccinellids (Hodek, 1973).

Although one hymenopteran parasitoid Trichogramma minutum Riley, attacks chyrsopid eggs, and a few species of mites (Erythraeous spp.) attack chrysopid larvae, the pupa is the most commonly parasitized life stage of the chrysopids (Smith, 1922). Parasitoids attacking chrysopid pupae in North America are found in the Encyrtidae, Eupelmidae, Pteromalidae, and the Eulophidae (Peck, 1963).

There are several reports of predation by both arthropods and vertebrates on aphid predators (Knowlton, 1969; Schneider, 1969; Sluss, 1967; Howell and Pienkowski, 1971; Belicek, 1976).

B. Enemies of Aphid Parasitoids

Parasitoid larvae in early stages of development, are frequently destroyed when insect predators feed on living parasitized aphids (Lundie, 1924). In addition, several predators including certain Chrysopidae, Coccinellidae, Nabidae, Miridae, and the Argentine ant, Iridomyrmex humulinus Mayr (Formicidae), appear to exhibit preferences for pupae and prepupae of parasitoids in mummified cocoons(Hamilton, 1974; Wheeler et al., 1968; Frazer and van den Bosch, 1973).

There are two types of secondary parasitoids attacking parasitoids of aphids: 1) Endoparasitoids- the female oviposits into the primary parasitoid while the aphid host is still alive; 2) Ectoparasitoids-the egg is deposited on the surface of the primary or another secondary parasitoid after the aphid is mummified (Sullivan, 1972). Secondary parasitoids occur mainly in the Pteromalidae, Ceraphronidae, Megaspilidae, and Alloxystidae (Krombein et al., 1979). The pteromalids, ceraphronids, and megaspilids are ectoparasitoids, and the alloxystids are endoparasitoids (Peck, 1963). Secondary endoparasitoids are very habitat and host specific (Kamijo and Takeda, 1973; Gutierrez, 1970; Gutierrez and van den Bosch, 1970; Matejko and Sullivan, 1980), while ectoparasitoids such as Asaphes spp., Dendrocerus spp.,and Pachyneuron spp. are widely associated with various groups of Aphidoidea and Aphidiidae (Takeda, 1973; Kamijo and Takeda, 1973).

VIII METHODS AND MATERIALS

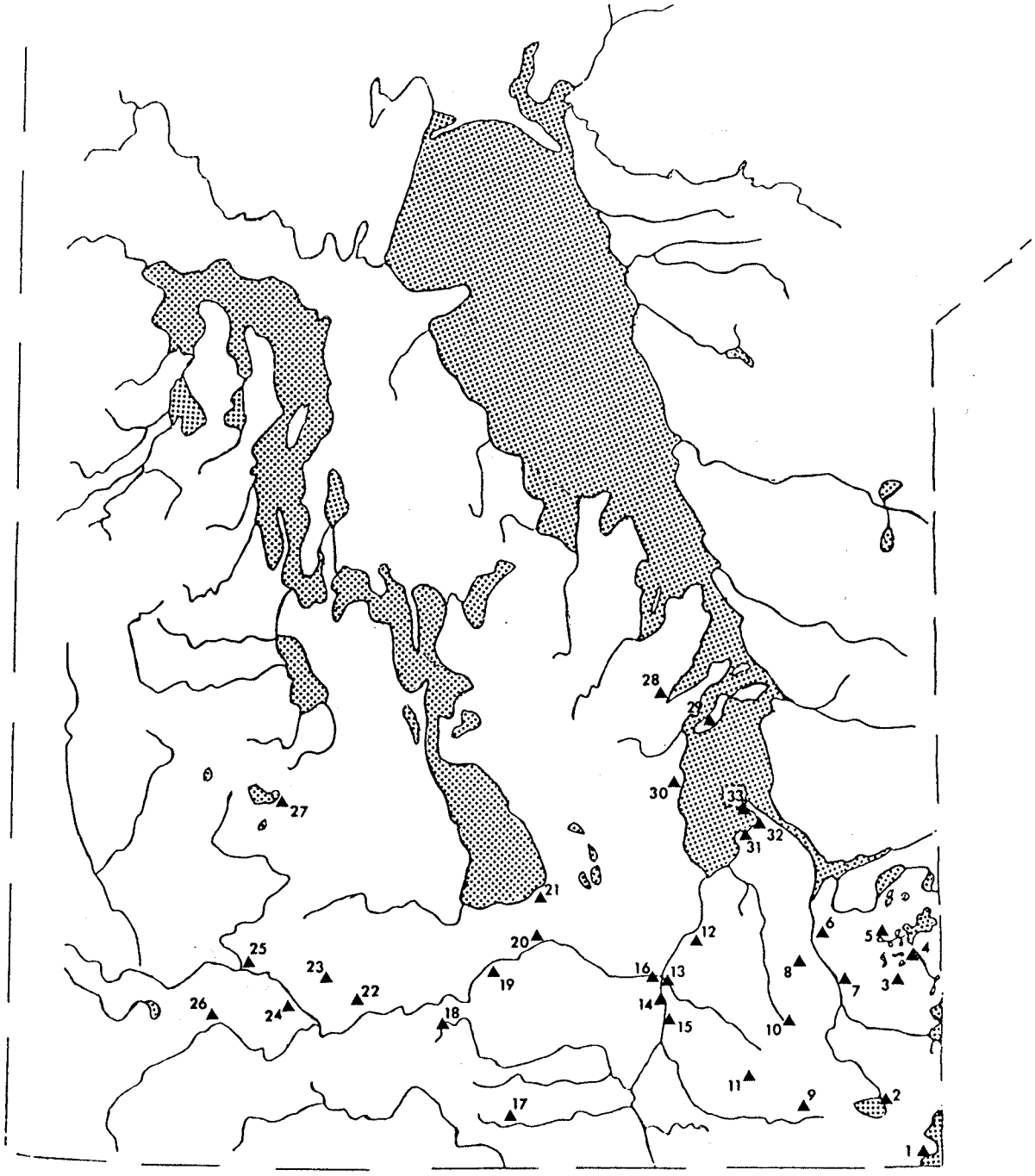
During the summers of 1980 and 1981, collections of aphids and their predators and parasitoids were taken from many areas of Manitoba south of the 52nd parallel (Figure 13). Collection areas included Belair Provincial Forest, Grand Beach Provincial Park, Whiteshell Provincial Park, Hecla Island Provincial Park, Beaver Creek, Sandilands Provincial Forest, Agassiz Provincial Forest, Spruce Woods Provincial Park, Riding Mountain National Park, St. Ambroise area, Morden area, Winnipeg area, Northwest Angle Provincial Forest, Whitemouth Lake, Rathwell area, Zhoda, Pine Grove Halt, Brandon, Souris, Glenlea, and Arnes Park (Figure 13). In addition, a 10 day survey of the Churchill area (northern Manitoba) was conducted in August of 1981. Habitats collected in included deciduous forest, mixed forest, coniferous forest, open and semi-open prairie, taiga, and tundra.

Samples were collected in 1 or ½ pint (.57 or .28 liter) size ice cream containers, and were brought back to the labortatory for sorting. A sample consisted of one or more colonies (i.e. aggregations of an aphid species), from one or more host plants of the same species from one area. The size of each sample was noted (size being dependent on the abundance of the aphid species in the area).

Adult aphids from each sample were preserved in 70 percent ethyl alcohol for later processing. All aphid identifications were done by Dr. A.G. Robinson. Predators were placed in aerated plastic petri dishes of 5, 8, or 14 cm diameter, for observation and rearing. Parasitoids of aphids and mummified aphids containing parasitoid pupae,

Figure 13. Map of Southern Manitoba showing collection sites for 1980 and 1981(excluding Churchill).

1) Northwest Angle Provincial Forest
2) Whitemouth Lake
3) Lilypond
4) Hanson Creek
5) Alf Hole Goose Sanctuary and Telford
(3–5: Whiteshell Provincial Park)
6) Agassiz Provincial Forest
7) Pine Grove Halt
8) Brokenhead
9) Sandilands Provincial Forest
10) Whispering Lake (Sandilands)
11) Zhoda
12) Birds Hill Provincial Park
13) Winnipeg(St. Vital, and Fort Garry)
14) La Barriere
15) Glenlea
16) Winnipeg(Charleswood)
17) Morden
18) Rathwell
19) St. Claude
20) St. Ambroise
21) St. Ambroise
22) Spruce Woods Provincial Park
23) Aweme
24) Treesbank
25) Brandon
26) Souris
27) Clear Lake (in Riding Mountain National Park)
28) Beaver Creek
29) Hecla Island Provincial Park
30) Arnes Park
31) Patricia Beach
32) Grand Beach Provincial Park
33) Belair Provincial Forest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were placed in 1½ or 2 cm sized gelatin 'emergence' capsules. The predators were fed pea aphids, and their preference for, or lack of preference for pea aphids was noted.

At the end of each season, all adult specimens were pinned, identified as best as was possible, and sent to the Biosystematics Research Institute (B.R.I.) in Ottawa for verifications, and further identification. Voucher specimens of most species collected were retained for the Entomology collection at the University of Manitoba, and rare, new, or other requested material was returned to B.R.I. upon completion of the study.

IX RESULTS

IDENTIFICATIONS

Four hundred and seven samples of aphid colonies were collected in Manitoba during 1980 and 1981. Identification of the aphids and their host plants in these samples revealed at least 108 aphid species in 42 genera, and at least 71 host plant species(Table 8). The term 'at least' is used because some specimens were identified only to the genus level, and more than one species from these genera may have been collected (Certain genera of aphids, plants, predators, parasitoids, and secondary parasitoids require revision, are under revision, or the species in the group can only be identified from certain life stages).

At least 69 species of predators of aphids from 21 families were present in the aphid colonies collected (Table 6, Table 9). Included in the predator collections were 7 samples of two new species of Leucopis(Chamaemyiidae). At least 27 species from 2 families of hymenopteran parasitoids of aphids were also collected from the aphid colonies(Table 7, Table 9).

Table 10 lists over 24 species of Hymenoptera which parasitized predators of aphids in this survey. Both Chrysopidae and Coccinellidae were attacked by one species of Encyrtidae. Syrphidae were parasitized by at least 11 species of Ichneumonidae, 1 species of Encyrtidae, 1 species of Figitidae, and 1 species of Megaspilidae. Chamaemyiidae were parasitized by 2 species of Encyrtidae, 2 species of Pteromalidae, at least 1 species of Figitidae, and a new species of Dendrocerus(Megaspilspilidae). Three species of egg parasitoids (host unknown) were also

found associated with aphid colonies (Table 10).

The parasitoids of aphids were attacked by at least 15 species of secondary parasitoids from 5 families (Table 11). There were 7 species of Alloxystidae, at least 4 species of Pteromalidae, 2 species of Eulophidae, 1 species of Megaspilidae, and 1 species of Ceraphronidae. The primary parasitoids associated with the secondary parasitoids were not identified except for Praon spp.(by their distinctive cocoons). Secondary parasitoids attacking Praon spp. included Alloxysta victrix, Phaenoglyphis americana, and Dendrocerus carpenteri(Table 11).

Sixteen of the 108 aphid species appeared to have no predators or parasitoids associated with their colonies; in addition, 4 aphid species were attacked by only 1 or 2 natural enemies, and these could not be reared through to adult(Table 12)(Note: authority names for all specimens collected appear in the tables, and will not be repeated in the text).

PEA APHIDS

The reactions of predators to a diet of pea aphids are indicated in Table 6. These reactions varied from totally acceptable(*), acceptable when no other food was available(*-), to totally unacceptable(**). Unfortunately many of the larvae of predators which would not consume pea aphids did not survive to an identifiable stage. Of those that survived, specimens from 19 species would not eat pea aphids, while specimens from 51 species would.

HABITAT SELECTION

Table 13 lists those predators and parasitoids which were collected at least 7 times, and the various habitats in which they were found.

Certain habitats tended to overlap, or were not distinct. River and stream banks included treed flood bank areas, and muddy herb covered banks; lake and ocean shorelines included beach communities, gravel shorelines, and vegetation above ocean high tide lines(ocean refers to Hudson Bay near Churchill). Deciduous and coniferous forests varied from densely treed areas to more open areas bordering scrub areas(i.e. clear cut areas). Clear cut and burned areas were dominated by shrubs and herbs, and often overlapped into forest habitats. Cultivated areas included mostly urban areas in which the vegetation had been planted by man.

Table 6. List of predators of aphids collectd in Manitoba during 1980 and 1981 including aphid species, host plant, location, and date collected. An asterisk(*) indicates a specimen which would consume pea aphids in the laboratory, and (**) indicates those which would not; those with no asterisk were not tested.

Predator	Prey	Host Plant	Location	Date
ARACHNIDA_ ACARI				
Erythraeidae (imagochrysalis)	Nearctaphis crataegifoliae(Fitch)	Crataegus rotundifolia Moench	Zhoda	19/8/80
	Uroleucon(Uroleucon) solirostratum(Richards)	Solidago sp.	Zhoda	19/8/80
Leptus sp.(larva)	Macrosiphum pseudorosae Patch	Rosa sp.	Birds Hill	6/7/81
Bochartia sp. (larva)	Uroleucon(Uroleucon) ambrosiae(Thomas)	Solidago sp.	Treesbank	28/7/81
Trombidiidae				
Podothrombium sp. (larva)	Asiphonaphis pruni Wilson and Davis	Prunus virginiana L.	Sandilands	24/6/81
	Macrosiphum pseudorosae	Potentilla sp.	Pine Grove Halt	24/6/81
Allothrombium sp. (larva)	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
Anystidae				
Anystis sp. (larva)	Macrosiphum pseudorosae	Ranunculus sp.	Hanson Creek	21/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
ARACHNIDA- ARANEIDA				
Dictynidae				
Dictyna sublata (Hentz)	* Rhopalosiphum insertum(Walker)	Crataegus rotundifolia	Winnipeg	22/5/81
Dictyna alaskae Chamberlin and Ivie	Symydobius americanus Baker	Betula sp.	Beaver Creek	9/7/81
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
Dictyna sp. (juvenile)	* Aphis viburniphila Patch	Viburnum trilobum Marsh	Spruce Woods	28/7/81
	* Uroleucon(Uroleucon) ambrosiae	Solidago sp.	St. Ambroise	26/8/81
	Uroleucon(Uroleucon) eupatoricolens(Patch)	Eupatorium sp.	Patricia Beach	30/8/81
	* Aphis neogillettei Palmer	Cornus alba L.	Patricia Beach	30/8/81
	* Uroleucon(Uroleucon) olivei Moran	Aster sp.	Patricia Beach	30/8/81
	Aphis neogillettei	Cornus alba	Brandon	6/9/81
	Aphis neogillettei	Cornus alba	Alf Hole Goose Sanctuary	11/9/81
	* Uroleucon sp.	Solidago sp.	Hanson Creek	11/9/81
Theridiidae				
Theridion frondeum Hentz	* Eriosoma americana (Riley)	Ulmus americana L.	Winnipeg	2/6/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Theridion frondeum	**Thecabius affinis(Kaltenbach), &/or Chaitophorus populifolii (Essig)	Populus balsamifera L.	Birds Hill Provincial Park	23/6/80
	Aphis neogillettei	Cornus alba	Brandon	6/9/81
Araneidae				
Neoscona arabesaca (Walkenaer)	Meliarhizophagus fraxinifolii(Riley)	Fraxinus pennsylvanica Marsh	Spruce Woods	14/7/81
Nuctenea cornuta (Clerck)	* Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica Marsh	Spruce Woods	14/7/81
Tetragnathidae				
Tetragnatha sp. (juv.)	* Uroleucon(Uroleucon) ambrosiae	Solidago sp.	St. Ambroise	26/8/81
Clubionidae				
Clubiona sp.	Nasonovia(Kakimia) borealis Heie	Heuchera sp.	Winnipeg	20/6/81
	Aphis neogillettei	Cornus alba	Clear Lake	12/7/81
	* Aphis neogillettei	Amelanchier alnifolia Nutt.	Clear Lake	12/7/81
	Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	* Chaitophorus populicola Thomas	Prunus virginiana L.	Grand Beach	19/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Clubiona sp.	Aphis helianthi Monell	Humulus lupulus L.		
Thomisidae			Spruce Woods	28/7/81
Philodromus rufus Walckenaer (juv.)	Chaitophorus populicola	Populus tremuloides Michx.	Whitemouth Lake	19/8/80
	* Uroleucon sp.	Solidago sp.	Birds Hill	21/8/81
Philodromus cespitum(Walckenaer)(juv.)	* Aphis helianthi	Cornus alba	Winnipeg	17/5/81
Misumena vatia (Clerck)(juv.)	Uroleucon(Uroleucon) nigrotuberculatum(Olive)	Solidago sp.	Birds Hill	6/7/81
	Macrosiphum pseudorosae	Solidago sp.	Beaver Creek	9/7/81
	Uroleucon sp.	Solidago sp.	Grand Beach	25/7/81
	* Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
	Uroleucon sp.	Solidago sp.	Birds Hill	21/8/81
	Uroleucon(Uroleucon) paucosensoriatum (Hille Ris Lambers)	Aster sp.	Sandilands	4/9/81
	Uroleucon(Uroleucon) pieloui(Richards)	Solidago sp.	A.H. Goose Sanc.	11/9/81
	Uroleucon russellae (Hille Ris Lambers)	Anaphalis margaritacea(L.)C.B. Clarke	Lilypond	11/9/81
Salticidae				
Eris marginata (Walckenaer)	* Myzus cerasi (Fabricius)	Prunus pensylvanica L.f.	Birds Hill	6/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Metaphidippus protervus(Walckenaer)	?	Crataegus sp.	Birds Hill	6/7/81
INSECTA				
HEMIPTERA				
Nabidae				
Nabis ferus(L.)	* Sitobion avenae (Fabricius)	Triticum aestivum L.	Glenlea	7/8/80
Nabis sp.(larvae)	* Hyadaphis tataricae (Aizenberg)	Lonicera sp.	Winnipeg	20/8/81
Reduviidae				
Zelus socius Uhler	Cinara pergandei (Wilson)	Pinus banksiana Lamb	Hanson Creek	21/7/81
Miridae				
Lygus elisus Van Duzee	* Uroleucon(Uroleucon) olivei	Aster sp.	Souris	6/9/81
Lygus sp.	* Hyadaphis tataricae	Lonicera sp.	Winnipeg	20/8/81
Anthocoridae				
Tetraphleps uniformis Parsh	**Cinara laricifex Fitch	Larix laricina (Du Roi)K. Koch	Churchill	5/8/81
Anthocoris musculus(Say)	Hyadaphis tataricae	Lonicera tatarica L.	Winnipeg	20/8/81
	**Hyadaphis tataricae	Lonicera tatarica	Winnipeg	11/8/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Anthocoris musculus	Aphis helianthi	Humulus lupulus	Spruce Woods	28/7/81
	* Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81
Orius tristicolor (White)	* Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
	Uroleucon(Lambersius) sp.	Aster sp.	Agassiz Forest	11/9/81
	Uroleucon(Lambersius) erigeronensis(Thomas)	Erigeron sp.	Hanson Creek	11/9/81
Deraeocoris sp.	* Rhopalosiphum insertum	Cotoneaster acutifolia Turcz.	Winnipeg	31/5/80
	* Eriosoma americanum	Ulmus americana	Grand Beach	18/6/80
	Eriosoma americanum	Ulmus americana	Winnipeg	2/6/80
NEUROPTERA				
Chrysopidae				
Chrysopa carnea Stephens	* Hyalopterus pruni (Geoffroy)	Phragmites	St. Ambroise	26/8/81
	Hyadaphis tataricae	Lonicera sp.	Winnipeg	20/8/81
	* Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
	Aphis heraclella Davis	Cicuta maculata L.	St. Ambroise	26/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Chrysopa carnea	Eriosoma lanigerum (Hausmann)	Ulmus americana	Winnipeg	10/6/81
	Macrosiphum pseudo-rosae	Ranunculus sp.	Hanson Creek	21/7/81
	Aphis neogillettei	Cornus alba	Winnipeg	20/8/81
	Macrosiphum pseudo-rosae	Solidago sp.	Beaver Creek	9/7/81
	* Hyadaphis tataricae	Lonicera tatarica	Aweme	28/7/81
	Hyalopterus pruni	Phragmites sp.	Spruce Woods	14/7/81
	* Macrosiphum pseudo-rosae	Rosa sp.	Lilypond	21/7/81
	* Prociphilus(Paraprociphilus) tessellatus (Fitch)	Alnus viridis (Chaix)	Rathwell	14/7/81
	* Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81
Chrysopa oculata Say	* Sitobion avenae	Triticum aestivum	Glenlea	7/8/80
	* Aphis sp.	Prunus virginiana	Rathwell	14/7/81
	* Macrosiphoniella ludovicianae(Oestlund)	Artemesia sp.	Birds Hill	6/7/81
Chrysoperla carnea (Stephens)	Hyperomyzus lactucae(L.)	Sonchus arvensis L.	La Barriere	6/8/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Chrysoperla carnea	* Macrosiphoniella absinthii(L.)	Artemesia biennis Willd.	La Barriere	6/8/80
	* Acyrthosiphon caraganae(Cholodkovsky)	Caragana arborescens Lam.	Winnipeg	1/8/80
	* Sitobion avenae	Triticum aestivum	Glenlea	7/8/80
Hemerobiidae				
Hemerobius humulinus L.	* Sitobion manitobensis(Robinson)	Cornus alba	Winnipeg	21/5/80
	* Chaitophorus populifolii	Populus tremuloides	Sandilands	24/6/81
	Eriosoma lanigerum	Ulmus americana	Winnipeg	10/6/81
	* Hyadaphis tataricae	Lonicera tatarica	Aweme	28/7/81
	**Ceruraphis viburnicola(Gillette)	Viburnum trilobum	Birds Hill	21/8/81
	* Aphis salicariae Koch	Cornus alba	Pine Grove Halt	24/6/81
	* Hyadaphis tataricae	Lonicera tatarica	Winnipeg	11/8/81
	* Aphis farinosa Gmelin	Salix sp.	Hanson Creek	21/7/81
	* Aphis neogillettei	Cornus alba	Clear Lake	12/7/81
	* Aphis neogillettei (Stray migrants?)	Amelanchier alnifolia	Clear Lake	12/7/81
	* Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	Aphis neogillettei	Cornus alba	Rathwell	14/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Hemerobius humulinus	Hyperomyzus pallidus Hille Ris Lambers	Sonchus arvensis	Grand Beach	1/9/81
	Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	* Uroleucon(Uroleucon) paucosensoriatum	Aster ciliolatus Lindl.	Sandilands	4/9/81
	Pachypappa tremulae(L.)	Populus tremuloides	Sandilands	24/6/81
	Aphis salicariae	Cornus alba	Pine Grove Halt	24/6/81
Micromus angulatus* (Stephens)	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Spruce Woods	14/7/81
	Chaitophorus populicola	Populus tremuloides	Whitemouth Lake	19/8/80
	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
Micromus posticus (Walker)	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Spruce Woods	14/7/81
COLEOPTERA				
Coccinellidae				
Scymnus(Pullus) brullei Muls.	**Rhopalosiphum cerasifoliae(Fitch)	Cotoneaster acutifolia	Winnipeg	21/5/81
	**Aphis helianthi &/or Aphis neogillettei	Cornus alba	Winnipeg	22/5/81
	**Eriosoma lanigerum	Ulmus americana	Winnipeg	30/5/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Scymnus(Pullus) brullei	**Eriosoma lanigerum	Ulmus americana	La Barriere	11/6/81
	**Eriosoma americanum	Ulmus americana	Winnipeg	15/6/81
Scymnus(Pullus) iowensis Csy.	**Rhopalosiphum cerasifoliae(Fitch)	Prunus virginiana	Birds Hill	11/6/80
	" "	" "	" "	23/6/80
	**Aphis varians Patch	Epilobium angustifolium L.	Lilypond	26/6/80
	" "	" "	"	21/7/81
	**Aphis oestlundi Gillette	Oenothera biennis L.	Lilypond	26/6/80
	**Myzus cerasi (Fabricius)	Prunus pensylvanica	Sandilands	21/7/80
	** ?	Prunus virginiana	Spruce Woods	6/8/80
	**Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	**Aphis farinosa	Salix sp.	Hanson Creek	21/7/81
Scymnus(Pullus) lacustris Lec.	**Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	" "	" "	" "	11/6/80
	**Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	**Rhopalosiphum cerasifoliae	Prunus virginiana	Belair Forest	18/6/80
	**Rhopalosiphum cerasifoliae	Prunus virginiana	Hanson Creek	26/6/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Scymnus(Pullus) lacustris	**Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	**Aphthargelia symphoricarpi(Thomas)	Symphoricarpos albus(L.)Blake	Sandilands	10/6/80
	**Myzus cerasi	Prunus pensylvanica	Birds Hill	11/6/80
	**Myzus cerasi	Prunus pensylvanica	Sandilands	21/7/80
	" "	" "	"	24/6/81
	**Myzus cerasi	Prunus pensylvanica	Agassiz Forest	26/6/80
	** ?	Prunus virginiana	Spruce Woods	6/8/80
	** ?	Populus tremuloides	Sandilands	21/7/80
	**Aphis helianthi	Cornus alba	Grand Beach	18/6/80
	**Aphis manitobensis Robinson and Rojanavongse	Ribes rubrum L.	Spruce Woods	12/8/80
	**Rhopalosiphum padi L.	Prunus virginiana	Spruce Woods	14/7/81
	**Aphis viburniphila	Viburnum rafinesquianum Schultes	Birds Hill	6/7/81
	Aphis neogillettei	Cornus alba	Beaver Creek	7/7/81
	**Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	**Aphis varians	Epilobium angustifolium	Hanson Creek	21/7/81
Scymnus(Pullus) spp.	**Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	**Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	**Myzus cerasi	Prunus pensylvanica	Pine Grove Halt	24/6/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Scymnus(Pullus) spp.	Aphis varians	Epilobium angustifolium	Hanson Creek	21/7/81
	**Alphitoaphis loni-cericola(Williams)	Lonicera dioica	Sandilands	4/9/81
Hyperaspis binotata(Say)	?	Ulmus americana	Winnipeg	20/8/81
Adalia bipunctata L.	Rhopalosiphum insertum	Cotoneaster acutifolia	Winnipeg	21/5/80
	* Sitobion manitobensis	Cornus alba	Winnipeg	21/5/80
	Aphis citricola Van der Goot	Spiraea alba Du Roi	Winnipeg	28/7/80
	Aphis viburniphila	Viburnum sp.	Winnipeg	2/6/80
	* Uroleucon sp.	Ambrosia trifida L.	Winnipeg	28/7/80
	* Aphis maculatae Oestlund	Populus tremuloides (Swedish var.)	Winnipeg	1/8/80
	**Aphis maculatae	Populus tremuloides	Winnipeg	7/8/80
	Aphis helianthi &/or Aphis neogillettei	Cornus alba	Winnipeg	22/5/81
	* Aphis pomi De Geer	Cotoneaster acutifolia	Winnipeg	11/8/81
	Hyadaphis tataricae	Lonicera tatarica	Winnipeg	20/8/81
Adalia spp.	Pachypappa tremulae	Populus tremuloides	Pine Grove Halt	24/6/81
	* Aphis neogillettei	Cornus alba	Rathwell	14/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Adalia spp.	**Cinara laricifex	Larix laricina	Churchill	4/8/81
Anatis labiculata (Say)	* Prociphilus(Paraprociphilus) tessellatus	Alnus viridis	Pine Grove Halt	24/6/81
	* Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	* Aphis neogillettei	Cornus alba	Rathwell	14/7/81
	Aphis viburniphila	Viburnum trilobum	Spruce Woods	28/7/81
Calvia quattuordecimguttata	Periphyllus negundinis (Thomas)	Acer negundo L. var. interius(Britt.)Sarg.	Winnipeg	5/6/81
Coccinella transversoguttata richardsoni Brown	Chaitophorus populicola	Populus tremuloides	Winnipeg	6/6/80
	**Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80
	**Rhopalosiphum cerasifoliae	Prunus virginiana	Belair Forest	18/6/80
	* Therioaphis riehmi (Borner)	Melilotus alba Medic.	Sandilands	21/7/80
	* Uroleucon spp.	Erigeron sp.	Belair Forest	26/7/80
	Capitophorus eleagni(del Guercio)	Cirsium arvense (L.) Scop.	Whitemouth Lake	19/8/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	* Aphis sp.	Prunus virginiana	Rathwell	14/7/81
	* Rhopalosiphum padi	Prunus virginiana	Spruce Woods	14/7/81

Table 6 continued

Predator		Prey	Host Plant	Location	Date
Coccinella transversoguttata		Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
		Sitobion avenae	Calamagrostis canadensis(Michx.)Beauv.	Churchill	5/8/81
		Pleotrichophorus pseudopatonkus Corpuz-Raros & Cooke &/or Macrosiphoniella tapuskae(Hottes & Frison)	Achillea millefolium L.	Churchill	8/8/81
	*	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
	*	Uroleucon sp.	Solidago sp.	Birds Hill	21/8/81
		Uroleucon sp.	Solidago sp.	St. Ambroise	26/8/81
	*	Aphis heraclella	Cicuta maculata	St. Ambroise	26/8/81
	*	Aphthargelia symphoricarpi	Symphoricarpos alba	Sandilands	4/9/81
Coccinella trifasciata perplexa Muls.		Uroleucon sp.	Erigeron sp.	Belair Forest	26/7/80
	*	Uroleucon sp.	Solidago sp.	Birds Hill	21/8/81
Hippodamia convergens Guerin	*	?	Aster sp.	St. Ambroise	9/6/80
		Aphis pomi	Cotoneaster acutifolia	Winnipeg	22/5/81
		Rhopalosiphum insertum	Crataegus rotundifolia	Winnipeg	26/5/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Hippodamia convergens	Aphis citricola	Spiraea alba	Winnipeg	9/6/81
	* Cinara pinea (Mordvilko)	Pinus banksiana	La Barriere	11/6/81
	* Uroleucon(Uroleucon) obscuricaudatum(Olive)	Aster sp.	Winnipeg	19/6/81
	Macrosiphum euphorbiae (Thomas)	Rosa sp.	Pine Grove Halt	24/6/81
	* Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	Uroleucon(Uroleucon) nigrotuberculatum(Olive) &/or U. ambrosiae	Solidago sp.	Birds Hill	6/7/81
	* Macrosiphum pseudo-rosae	Solidago sp.	Beaver Creek	9/7/81
	* Cinara pinea	Pinea banksiana	Morden	16/7/81
	* Acyrthosiphon caraganae	Caragana arbor-escens	Hanson Creek	21/7/81
	Uroleucon(Uroleucon) ambrosiae	Crepis tectorum L.	Whiteshell	21/7/81
	Cinara laricifex	Larix laricina	Churchill	5/8/81
	Nasonovia(Kakimia) houghtonensis similis Heie	Ribes oxyacanthoides	Churchill	5/8/81
	* Sitobion avenae	Calamagrostis canadensis	Churchill	5/8/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Hippodamia convergens	* Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
	* Hyalopterus pruni	Phragmites sp.	St. Ambroise	26/8/81
	* Hyperomyzus lactucae	Sonchus arvensis	St. Ambroise	26/8/81
	* Aphis heraclella	Cicuta maculata	St. Ambroise	26/8/81
	* Rhopalosiphum maidis (Fitch)	Zea mays	Glenlea	2/9/81
	* Aphthargelia symphoricarpi	Symphoricarpos alba	Sandilands	4/9/81
	Uroleucon(Uroleucon) paucosensoriatum	Aster ciliolatus	Sandilands	4/9/81
	* Uroleucon(Lambersius) sp.	Aster sp.	Agassiz	11/9/81
Hippodamia tredecimpunctata tibialis (Say)	* Rhopalosiphum insertum	Crataegus rotundifolia	La Barriere	11/6/81
	* Sitobion avenae	Triticum aestivum	Glenlea	7/8/80
	* Chaitophorus populicola	Populus tremuloides	Hanson Creek	21/7/81
	?	Ulmus americana	Winnipeg	20/8/81
	* Hyalopterus pruni	Phragmites sp.	St. Ambroise	26/8/81
	* Rhopalosiphum maidis	Zea mays	Glenlea	2/9/81
	**Hyalopterus pruni	Phragmites sp.	Sandilands	4/9/81
	* Uroleucon sp. &/or Macrosiphoniella absinthii	Artemesia sp.	Lilypond	11/9/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
LEPIDOPTERA				
Lycaenidae				
Feniseca tarquinius (Fabricius)	**Prociphilus(Paraprociphilus) tessellatus	Alnus viridis	Sandilands	21/7/80
	**Prociphilus(Paraprociphilus) tessellatus	Alnus viridis	Pine Grove Halt	24/6/81
	" "	" "	" "	4/9/81
	**Prociphilus(Paraprociphilus) tessellatus	Alnus viridis	Rathwell	14/7/81
DIPTERA				
Cecidomyiidae				
Aphidoletes aphidimyza(Rondani)	**Hyperomyzus lactucae	Sonchus arvensis	La Barriere	6/9/80
	**Hyalopterus pruni	Phragmites sp.	Morden	16/7/81
	**Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
	**Hyadaphis tataricae	Lonicera tatarica	Winnipeg	24/7/81
	" "	" "	"	11/8/81
Syrphidae				
Allograpta obliqua (Say)	* Hyadaphis tataricae	Lonicera tatarica	Winnipeg	19/6/81
	" "	" "	"	24/7/81
	" "	" "	"	11/8/81
	* Cavariella pastinacae (L.)	Heracleum lanatum Michx.	Clear Lake	12/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Allograpta obliqua	Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81
Epistrophe emarginata(Say)	**Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Spruce Woods	14/7/81
	*-Aphis maculatae	Populus balsamifera	Spruce Woods	28/7/81
	*-Chaitophorus populicola	Populus balsamifera	Spruce Woods	28/7/81
	* Chaitophorus nudus Richards	Populus tremuloides	Birds Hill	21/8/81
Eupeodes volucris Osten Sacken	Aphis neogillettei	Cornus alba	Clear Lake	12/7/81
	Aphis barberae Robinson	Arctium minus(Hill) Bernh.	Grand Beach	19/7/81
Melangyna fisherii (Walton)	Hyperomyzus lactucae	Sonchus arvensis	Spruce Woods	12/8/80
	Aphis heraclella	Cicuta maculata	St. Ambroise	26/8/81
Melangyna triangulifera(Zetterstedt)	* Pterocomma smithiae (Monell)	Salix sp.	Sandilands	4/9/81
Metasyrphus americanus(Wiedemann)	Aphis maculatae	Populus tremuloides (Swedish var.)	Winnipeg	1/9/80
	Chaitophorus populicola	Populus balsamifera	Clear Lake	16/9/80
	Aphis pomi	Cotoneaster acutifolia	Winnipeg	22/5/81

Table 6 continued

Predator		Prey	Host Plant	Location	Date
Metasyrphus americanus		Periphyllus negundinis	Acer negundo	Winnipeg	5/6/81
		Nasonovia(Kakimia) borealis	Heuchera sp.	Winnipeg	20/6/81
	*	Aphis maculatae	Populus tremuloides	Birds Hill	6/7/81
	*	Cavariella pastinacae	Heracleum lanatum	Clear Lake	12/7/81
	*	Aphis farinosa	Salix sp.	Hanson Creek	21/7/81
		Hyperomyzus lactucae	Sonchus arvensis	Hanson Creek	21/7/81
	*	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
Metasyrphus perplexus(Osburn)		Hyperomyzus lactucae	Sonchus arvensis	Belair Forest	26/7/80
		Macrosiphum subarcticum Robinson	Epilobium angustifolium	Churchill	4/8/81
	*	Macrosiphum subarcticum	Epilobium angustifolium	Churchill	6/8/81
		Sitobion avenae	Calamagrostis canadensis	Churchill	6/8/81
	*	Uroleucon(Lambersius) erigeronensis(Thomas)	Erigeron sp.	Hanson Creek	11/9/81
	*	Aphis oenotherae	Oenothera biennis	Lilypond	11/9/81
Metasyrphus pomus (Curran)	*	Chaitophorus populicola	Populus tremuloides	Sandilands	10/6/80
		Aphis helianthi	Cornus alba	Spruce Woods	12/8/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Metasyrphus pomus	Hyperomyzus lactucae	Sonchus arvensis	Clear Lake	16/8/80
	* Aphis oenotherae	Epilobium angustifolium	Clear Lake	16/8/80
	Macrosiphum pseudorosae	Rosa sp.	Spruce Woods	14/7/81
	Chaitophorus populicola	Prunus virginiana	Grand Beach	19/7/81
	Hyadaphis tataricae	Lonicera tatarica	Winnipeg	24/7/81
	*-Cinara canatra Hottes and Bradley	Pinus banksiana	Sandilands	4/9/81
Metasyrphus spp.	* Sitobion manitobensis	Cornus alba	Winnipeg	21/5/80
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Grand Beach	22/6/80
	* Chaitophorus populicola	Populus balsamifera	Sandilands	21/7/80
	* ?	Populus tremuloides	Sandilands	21/7/80
	* Hyperomyzus lactucae	Sonchus arvensis	Sandilands	21/7/80
	Chaitophorus nigrae Oestlund	Salix sp.	Morden	30/7/80
	* Aphis maculatae	Populus tremuloides (Swedish var.)	Winnipeg	1/8/80
	Hyperomyzus lactucae	Sonchus arvensis	La Barriere	6/8/80
	Sitobion avenae	Triticum aestivum	Glenlea	7/8/80
	Hyperomyzus lactucae	Sonchus arvensis	Spruce Woods	12/8/80
	Aphis helianthi &/or Aphis neogillettei	Cornus alba	Winnipeg	22/5/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Metasyrphus spp.	Rhopalosiphum insertum	Crataegus rotundifolia	Winnipeg	22/5/81
	" "	" "	"	26/5/81
	* Aphis citricola	Spiraea alba	Winnipeg	9/6/81
	* Aphis fabae Scopoli	Rumex sp.	Winnipeg	19/6/81
	Nasonovia (Kakimia) borealis	Heuchera sp.	Winnipeg	20/6/81
	* Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	* Aphis neogillettei	Cornus alba	Clear Lake	12/7/81
	* Cavariella pastinacae	Heracleum lanatum	Clear Lake	12/7/81
	* Aphis citricola	Cicuta maculata	Spruce Woods	14/7/81
	Chaitophorus populicola	Prunus virginiana	Grand Beach	19/7/81
	Aphis neogillettei	Cornus alba	Winnipeg	19/7/81
	* Acyrthosiphon caraganae	Caragana arborescens	Hanson Creek	21/7/81
	Hyperomyzus lactucae	Sonchus arvensis	Hanson Creek	21/7/81
	* Aphis maculatae	Populus balsamifera	Spruce Woods	28/7/81
	* Uroleucon(Lambersius) erigeronensis	Erigeron sp.	Hanson Creek	11/9/81
Metasyrphus lapponicus(Zetterstedt)	?	?	Churchill	7/8/81
Paragus(Pandasyopthalmus)	Aphis sp.	Diervilla lonicera Mill.	Belair Forest	18/6/80

Table 6 continued

Predator		Prey	Host Plant	Location	Date
Paragus(Pandasyopthalmus)sp.		Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	24/6/81
	*	Aphis oestlundi	Oenothera biennis	Telford	21/7/81
Platycheirus hyperboreus(Say)		Hyperomyzus lactucae	Sonchus arvensis	St. Ambroise	26/8/81
Platycheirus scambus Staeg.	*	Hyperomyzus pallidus	Sonchus arvensis	La Barriere	6/8/80
Sphaerophoria contigua Macquart	*	Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	*	Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	10/6/80
	*	Uroleucon sp.	Solidago sp.	Belair Forest	18/6/80
	*	Myzus cerasi	Prunus pensylvanica	Agassiz Forest	26/6/80
		Chaitophorus populicola	Populus balsamifera	Agassiz Forest	26/6/80
		Aphis spiraephila	Spiraea sp.	Agassiz Forest	26/6/80
		Aphis oestlundi	Oenothera biennis	Lilypond	26/6/80
		Hyperomyzus lactucae	Sonchus arvensis	Sandilands	21/7/80
	*	Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	*	Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	24/6/81
	*	Uroleucon(Uroleucon) ambrosiae	Compositae	Brokenhead	25/6/81
	*	Aphis neogillettei	Cornus alba	Clear Lake	12/7/81

Table 6 continued

Predator		Prey	Host Plant	Location	Date
Sphaerophoria contigua	*	Rhopalosiphum padi	Prunus virginiana	Spruce Woods	14/7/81
	*	Aphis sp.	Prunus virginiana	Rathwell	14/7/81
	*	Chaitophorus populicola	Populus balsamifera	Clear Lake	12/7/81
Sphaerophoria philanthus(Meigen)	*	Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
Sphaerophoria sp.		Nasonovia(Kakimia) houghtonensis similis	Ribes oxyacanthoides	Churchill	5/8/81
Syrphus rectus Osten Sacken		Aphis helianthi	Cornus alba	Winnipeg	17/5/81
	*	Rhopalosiphum insertum	Crataegus rotundifolia	Winnipeg	26/5/81
		Rhopalosiphum insertum	Crataegus sp.	La Barriere	11/6/81
		Myzus cerasi	Prunus pensylvanica	Sandilands	24/6/81
	*	Pachypappa tremulae	Populus tremuloides	Sandilands	24/6/81
	*	Pachypappa sacculi (Gillette)	Populus tremuloides	Pine Grove Halt	24/6/81
	*	Macrosiphum pseudo-rosae	Rosa sp.	Birds Hill	6/7/81
		Cavariella konoi	Cicuta maculata	Clear Lake	12/7/81
	*	Cavariella pastinacae	Heracleum lanatum	Clear Lake	12/7/81
		Hyperomyzus lactucae	Sonchus arvensis	Hanson Creek	21/7/81
Syrphus ribesii(L.)	*	Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Syrphus ribesii	* Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	Myzus cerasi	Prunus virginiana	Grand Beach	18/6/80
	* Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	Hysteroneura setariae (Thomas)	Prunus nigra Ait.	Winnipeg	15/8/80
	Hyperomyzus lactucae	Sonchus arvensis	Clear Lake	16/8/80
	Chaitophorus populicola	Populus balsamifera	Clear Lake	16/8/80
	Aphis farinosa	Salix sp.	Clear Lake	16/8/80
	**Prociphilus(Parapro-ciphilus)tesselatus	Alnus viridis	St. Claude	10/10/80
	* Macrosiphum euphorbiae	Asclepias sp.	Sandilands	24/6/81
	Pachypappa tremulae	Populus tremuloides	Sandilands	24/6/81
	* Pachypappa sacculi	Populus tremuloides	Pine Grove Halt	24/6/81
	* Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	Cavariella pastinacae	Heracleum lanatum	Clear Lake	12/7/81
	**Prociphilus(Parapro-ciphilus) tessellatus	Alnus viridis	Rathwell	14/7/81
	**Hyalopterus pruni	Phragmites sp.	Spruce Woods	14/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Syrphus ribesii	* Hyalopterus pruni	Phragmites sp.	Morden	16/7/81
	?	?	Churchill	7/8/81
	* Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
	Hyadaphis tataricae	Lonicera tatarica	Winnipeg	11/8/81
	* Uroleucon(Uroleucon) olivei Moran	Aster sp.	Patricia Beach	30/8/81
	* Uroleucon(Uroleucon) olivei	Aster sp.	Souris	6/9/81
Syrphus torvus Osten Sacken	Hyperomyzus lactucae	Sonchus arvensis	Clear Lake	16/8/80
	Chaitophorus populicola	Populus tremuloides	Clear Lake	16/8/80
	Nearctaphis crataegi-foliae	Crataegus rotundi-folia	Zhoda	18/8/80
	* Aphis salicariae	Cornus alba	Pine Grove Halt	24/6/81
Syrphus vitripennis Meigen	*Aphis neogillettei or Aphis helianthi	Cornus alba	Winnipeg	22/5/81
	* Rhopalosiphum insertum	Crataegus sp.	Winnipeg	26/5/81
Syrphus vitripennis or S. rectus	Myzus persicae	Zebrina pendula	Winnipeg	23/8/80
	?	?	Clear Lake	16/8/80
	Hyperomyzus pallidus	Ribes americanum Mill.	Winnipeg	26/5/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Syrphus vitripennis or S. rectus	Rhopalosiphum padi	Prunus nigra	Winnipeg	27/5/81
	* Rhopalosiphum insertum	Crataegus sp.	Winnipeg	26/5/81
	Myzus cerasi	Prunus pensylvanica	Sandilands	24/6/81
	* Pachypappa sacculi	Populus tremuloides	Pine Grove Halt	24/6/81
	* Chaitophorus essigi Gillette and Palmer	Populus balsamifera	Pine Grove Halt	24/6/81
	Pachypappa tremulae	Populus tremuloides	Pine Grove Halt	24/6/81
	* Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	* Aphis maculatae	Populus tremuloides	Birds Hill	6/7/81
	* Cavariella pastinacae	Heracleum lanatum	Clear Lake	12/7/81
	* Myzus cerasi	Prunus pensylvanica	Hanson Creek	21/7/81
	* Acyrthosiphon caraganae	Caragana arborescens	Hanson Creek	21/7/81
Syrphus sp.	* Chaitophorus nudus	Populus tremuloides	Sandilands	4/9/81
	* Acyrthosiphon caraganae	Caragana arborescens	Hanson Creek	21/7/81
Toxomerus geminatus(Say)	* Uroleucon(Uroleucon) nigrotuberculatum	Solidago sp.	Birds Hill	6/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Chamaemyiidae				
Leucopis albipunc-tata complex	** Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	** Rhopalosiphum cerasifoliae	Prunus virginiana	Belair Forest	18/6/80
	** Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	** Myzus cerasi	Prunus pensylvanica	Agassiz Forest	26/6/80
	** Aphis oestlundi	Oenothera biennis	Lilypond	26/6/80
	** Aphis spiraephila	Spiraea alba	Lilypond	26/6/80
	** Sipha kurdjumovi Mordwilko	Graminae	Winnipeg	7/7/80
	Asiphonaphis pruni	Prunus virginiana	Sandilands	21/7/80
	** Myzus cerasi	Prunus pensylvanica	Sandilands	21/7/80
	** Aphis viburniphila	Viburnum rafinesquianum	Sandilands	21/7/80
	Aphis pomi	Cotoneaster acuti-folia	Winnipeg	21/7/80
	** Chaitophorus sali-ciniger(Knowlton)	Salix sp.	Morden	30/7/80
	** Hayhurstia atri-plicus(L.)	Chenopodium album L.	Morden	30/7/80
	Aphthargelia symphoricarpi	Symphoricarpos albus	Morden	30/7/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Leucopis albipunctata complex	Aphis maculatae	Populus tremuloides (Swedish var.)	Winnipeg	1/8/80
	?	Prunus virginiana	Spruce Woods	6/8/80
	**Hyperomyzus lactucae	Sonchus arvensis	Spruce Woods	12/8/80
	** ?	Salix sp.	Clear Lake	16/8/80
	Aphis oenotherae	Epilobium angustifolium	Clear Lake	16/8/80
	**Aphis neogillettei	Cornus alba	Clear Lake	16/8/80
	**Rhopalosiphum padi	Prunus nigra	Winnipeg	27/5/81
	**Myzus cerasi	Prunus pensylvanica	Sandilands	24/6/81
	**Macrosiphum euphorbiae	Asclepias sp.	Sandilands	24/6/81
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	**Aphis viburniphila	Viburnum rafinesquianum	Birds Hill	6/7/81
	Macrosiphum pseudorosae	Solidago sp.	Beaver Creek	9/7/81
	Rhopalosiphum padi	Prunus virginiana	Spruce Woods	14/7/81
	**Nearctaphis crataegifoliae	Crataegus rotundifolia	Morden	16/7/81
	**Aphis farinosa	Salix sp.	Hanson Creek	21/7/81
	**Hyperomyzus lactucae	Sonchus arvensis	Hanson Creek	21/7/81
	** ?	Epilobium angustifolium	Hanson Creek	21/7/81

Table 6 continued

Predator		Prey	Host Plant	Location	Date
Leucopis albipunctata complex	**	Aphis oestlundi	Oenothera biennis	Telford	21/7/81
	**	Hyadaphis tataricae	Lonicera tatarica	Winnipeg	24/7/81
	**	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
		Hyadaphis tataricae	Lonicera tatarica	Winnipeg	20/8/81
	**	Aphis maculatae	Populus balsamifera	St. Ambroise	26/8/81
	**	Aphis oenotherae	Oenothera biennis	Lilypond	11/9/81
Leucopis albipunctata complex 'b'	**	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	11/6/80
	**	Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80
	**	Asiphonaphis pruni	Prunus virginiana	Sandilands	21/6/80
	**	Aphthargelia symphoricarpi	Symphoricarpos albus	Morden	30/7/80
	**	?	Prunus virginiana	Spruce Woods	6/8/80
Leucopis americana Malloch	**	Aphis viburniphila	Viburnum sp.	Winnipeg	26/5/80
	**	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	11/6/80
	**	Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80
	**	Aphis spiraephila	Spiraea alba	Lilypond	26/6/80
	**	Aphis neogillettei	Cornus alba	Winnipeg	3/7/80
	**	Chaitophorus populicola	Populus tremuloides	Arnes Park	4/7/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Leucopis americana	**Aphis varians	Epilobium angustifolium	Sandilands	21/7/80
	**Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	21/7/80
	**Aphis maculatae	Populus balsamifera	Sandilands	21/7/80
	Aphis pomi	Cotoneaster acutifolia	Winnipeg	21/7/80
	Chaitophorus saliciniger	Salix sp.	Morden	30/7/80
	**Nearctaphis sp.	Crataegus rotundifolia	Morden	30/7/80
	**Aphthargelia symphoricarpi	Symphoricarpos albus	Morden	30/7/80
	**Aphis heraclella	Heracleum lanatum	Morden	30/7/80
	**Aphis neogillettei	Cornus alba	Winnipeg	1/8/80
	** ?	Prunus virginiana	Spruce Woods	6/8/80
	**Aphis maculatae	Populus tremuloides (Swedish var.)	Winnipeg	7/8/80
	**Aphis spiraephila	Spiraea alba	Spruce Woods	12/8/80
	Pterocomma smithiae	Populus balsamifera	Birds Hill	6/7/81
	**Aphis viburniphila	Viburnum rafinesquianum	Birds Hill	6/7/81
	**Nearctaphis crataegifoliae	Crataegus sp.	Birds Hill	6/7/81

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Leucopis americana	**Aphis varians	Epilobium angustifolium	Lilypond	21/7/81
	**Aphis neogillettei	Cornus alba	Rathwell	14/7/81
	**Chaitophorus nigrae	Salix sp.	Spruce Woods	14/7/81
	**Aphis barberae	Arctium minus	Grand Beach	19/7/81
	** ?	Epilobium angustifolium	Hanson Creek	21/7/81
	**Aphis oestlundi	Oenothera biennis	Telford	21/7/81
	**Asiphonaphis pruni	Prunus virginiana	Spruce Woods	28/7/81
Leucopis sp.(possibly L. americana)	Asiphonaphis pruni	Prunus virginiana	Sandilands	4/9/81
	Chaitophorus saliciniger	Salix sp.	Sandilands	4/9/81
Leucopis sp. (variants of L. americana?)	**Chaitophorus populicola	Populus balsamifera	St. Ambroise	26/8/81
	**Chaitophorus nigrae	Salix sp.	Morden	16/7/81
Leucopis sp. IV	**Chaitophorus saliciniger	Salix sp.	Sandilands	4/9/81
Leucopis sp. (new species?)	**Periphyllus negundinis	Acer negundo	Morden	30/7/80
	Aphthargelia symphoricarpi	Symphoricarpos albus	Morden	30/7/80
	?	Salix sp.	Clear Lake	16/8/80

Table 6 continued

Predator	Prey	Host Plant	Location	Date
Leucopis sp. (new species)	**Aphis oenotherae	Epilobium angustifolium	Clear Lake	16/8/80
Leucopis sp. (new species)	**Hyalopterus pruni	Phragmites sp.	Morden	16/7/81
	**Hyalopterus pruni	Phragmites sp.	St. Ambroise	26/8/81
	**Hyalopterus pruni	Phragmites sp.	Sandilands	4/9/81
Megaselia sp.	Thecabius affinis (Kaltenbach)	Populus balsamifera	Grand Beach	18/6/80

Table 7. List of some parasitoids of aphids in Manitoba, including host plant, location, and date specimens were collected.

Parasitoid	Aphid Host	Host plant	Location	Date
HYMENOPTERA				
Braconidae				
Acanthocaudus tissoti Smith	Uroleucon russellae (Hille Ris Lambers)	Anaphalis margaritacea(L.) C.B. Clarke	Lilypond	21/7/81
	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
Adialytus salicaphis(Fitch)	Chaitophorus populicola	Populus tremuloides	Pine Grove Halt	24/6/81
	Chaitophorus populicola	Populus balsamifera	Telford	21/7/81
	Chaitophorus populicola	Populus balsamifera	Spruce Woods	28/7/81
	Aphis citricola	Cornus alba	Spruce Woods	28/7/81
	Chaitophorus populicola	Populus tremuloides	Birds Hill	21/8/81
	Chaitophorus populicola	Populus balsamifera	Birds Hill	21/8/81
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	St. Ambroise	26/8/81
	Chaitophorus populicola (oviparae)	Populus balsamifera	Sandilands	4/9/81
	Chaitophorus populicola	Populus tremuloides	Sandilands	4/9/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Adialytus salicaphis	Chaitophorus populicola (males and oviparae)	Populus balsamifera	Agassiz Forest	11/9/80
Adialytus sp.	Chaitophorus populicola	Populus balsamifera	Spruce Woods	12/8/80
	Chaitophorus viminalis Monell	Salix sp.	Spruce Woods	12/8/80
	Chaitophorus populicola	Populus balsamifera	Spruce Woods	12/8/80
	Chaitophorus nigrae	Salix sp.	Spruce Woods	12/8/80
	Chaitophorus populicola	Populus balsamifera	Clear Lake	16/8/80
	?	Salix sp.	Clear Lake	16/8/80
	Acyrthosiphon caraganae	Caragana arborescens	Clear Lake	16/8/80
	Chaitophorus populicola	Populus balsamifera	Clear Lake	16/8/80
	Aphis oenotherae	Epilobium angustifolium	Clear Lake	16/8/80
	Chaitophorus populicola	Populus tremuloides	Moose Lake	19/8/80
Aphidius matricariae Hal.	Nasonovia(Kakimia) aquilegiae(Essig)	Aquilegia canadensis L.	Clear Lake	16/8/80
	Capitophorus elaeagni	Cirsium arvense	Glenlea	18/8/80
Aphidius nigripes Ashmead	Nasonovia(Kakimia) borealis	Heuchera richardsonii R.Br.	Winnipeg	20/6/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Aphidius nigripes	Macrosiphum pseudo-rosae	Rosa sp.	Pine Grove Halt	24/6/81
	?	Corylus sp.	Birds Hill	6/7/81
	Pterocomma smithiae	Populus balsamifera	Birds Hill	6/7/81
	Macrosiphum pseudo-rosae	Rosa sp.	Lilypond	21/7/81
	Nasonovia(Kakimia) houghtonensis	Ribes oxyacanthoides	Churchill	5/8/81
	Sitobion avenae	Calamagrostis canadensis	Churchill	5/8/81
	Sitobion avenae	Calamagrostis canadensis	Churchill	6/8/81
	Pleotrichophorus pseudopatonkus &/or Macrosiphoniella tapuskae	Achillea millefolium	Churchill	6/8/81
	Acyrthosiphon churchillensis Robinson	Hedysarum boreale mackenzii(Richardson) C.L. Hitchc.	Churchill	8/8/81
	Illinoia sp.	Epilobium angustifolium	Churchill	8/8/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Aphidius nigripes	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
	Aphis viburniphila	Viburnum rafinesquianum	Sandilands	4/9/81
Aphidius obscuripes Ashmead	Sitobion avenae	Triticum aestivum	Glenlea	7/8/80
Aphidius rosae Haliday	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
Aphidius ribis Haliday	Nasonovia(Kakimia) borealis	Heuchera richardsonii	Winnipeg	20/6/81
	Uroleucon(Lambersius) erigeronensis	Erigeron sp.	Hanson Creek	11/9/81
Aphidius sp.	Uroleucon sp.	Solidago sp.	Birds Hill	18/6/80
	Capitophorus hippophaes(Walker)	Shepherdia canadensis(L.)Nutt.	Arnes Park	4/7/80
	?	Salix sp.	Clear Lake	16/8/80
	Acyrthosiphon caraganae	Caragana arborescens	Clear Lake	16/8/80
	Chaetosiphon fragaefolii	Rosa sp.	Zhoda	19/8/80

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Aphidius sp.	Cavariella pastinacae	Heracleum lanatum	Clear Lake	12/7/81
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
	Aphis viburniphila	Viburnum rafines-quianum	Morden	16/7/81
	Acyrthosiphon caraganae	Caragana arbores-cens	Hanson Creek	21/7/81
	Acyrthosiphon churchillense	Hedysarum boreale Nutt. var. mackenzii	Churchill	8/8/81
Ephedrus incompletus Provancher	Chaitophorus populicola	Populus balsamifera	Spruce Woods	12/8/80
	Chaitophorus viminalis	Salix sp.	Spruce Woods	12/8/80
	Uroleucon(Uroleucon) nigrotuberculatum	Solidago sp.	Birds Hill	6/7/81
	Chaitophorus populicola	Populus tremuloides	Clear Lake	12/7/81
	Chaitophorus nigrae	Salix sp.	Morden	16/7/81
	Chaitophorus populicola	Populus tremuloides	Telford	21/7/81
	Aphis viburniphila	Viburnum trilobum	Spruce Woods	28/7/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Ephedrus incompletus	Chaitophorus nudus	Populus tremuloides	Birds Hill	21/8/81
	Chaitophorus populicola (oviparae)	Populus tremuloides	Sandilands	4/9/81
Lysiphlebus testaceipes(Cresson)	Aphis viburniphila	Viburnum sp.	Winnipeg	26/5/80
	Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Agassiz Forest	27/6/80
	Chaitophorus populicola or Aphis maculatae	Populus balsamifera	Arnes Park	4/7/80
	Asiphonaphis pruni	Prunus virginiana	Sandilands	21/7/80
	Aphthargelia symphoricarpi	Symphoricarpos albus	Morden	30/7/80
	Aphis heraclella	Heracleum lanatum	Morden	30/7/80
	?	Prunus virginiana	Spruce Woods	6/8/80
	Aphis maculatae	Populus tremuloides	Winnipeg	7/8/80

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Lysiphlebus testaceipes	Capitophorus elaeagni	Cirsium arvense	Glenlea	18/8/80
	?	Cornus alba	Winnipeg	7/8/80
	Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	Aphis neogillettei	Cornus alba	Beaver Creek	9/7/81
	Rhopalosiphum padi	Prunus virginiana	Spruce Woods	14/7/81
	Aphis farinosa	Salix sp.	Hanson Creek	21/7/81
	Aphis varians	Epilobium angustifolium	Hanson Creek	21/7/81
	Aphis neogillettei	Cornus alba	Hanson Creek	21/7/81
	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	28/7/81
	Asiphonaphis pruni	Prunus virginiana	Birds Hill	21/8/81
	Aphis varians	Epilobium angustifolium	Sandilands	4/9/81
	Aphis barberae	Arctium lappa	Grand Beach	5/9/81
	Aphis neogillettei	Cornus alba	Souris	6/9/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Lysiphlebus testaceipes	Aphis neogillettei	Cornus alba	Alf Hole Goose Sanctuary	11/9/81
Lysiphlebus sp.	Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	21/7/80
	Aphis maculatae	Populus tremuloides (Swedish aspen)	Winnipeg	1/8/80
Pauesia sp.	Cinara laricifex	Larix laricina	Churchill	5/8/81
	Macrosiphum subarcticum or M. euphorbiae	Larix laricina	Churchill	7/8/81
Praon artemisaphis Smith	Aphis neogillettei	Cornus alba	Winnipeg	22/5/80
	Chaitophorus nudus	Populus tremuloides	Spruce Woods	12/8/80
	Aphis helianthi	Cornus alba	Winnipeg	22/5/81
Praon sp.	Macrosiphum euphorbiae	Rosa sp.	Winnipeg	2/6/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Hanson Creek	26/6/80
	Chaitophorus nudus	Populus tremuloides	Spruce Woods	12/8/80

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Praon sp.	Aphis oenotherae	Epilobium angustifolium	Clear Lake	16/8/80
	Aphis helianthi or Aphis neogillettei	Cornus alba	Winnipeg	22/8/80
	Hyperomyzus pallidus	Ribes sp.	Winnipeg	26/5/81
	Periphyllus negundinis	Acer negundo	Winnipeg	5/6/81
	Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	Uroleucon(Uroleucon) ambrosiae	Compositae	Brokenhead	25/6/81
	Cavariella konoi	Cicuta maculata	Clear Lake	12/7/81
	Chaitophorus populicola	Populus tremuloides	Clear Lake	12/7/81
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
	Uroleucon sp.	Solidago sp.	Winnipeg	11/8/81
Praon sp. ?	Rhopalosiphum insertum	Cotoneaster acutifolia	Winnipeg	21/5/80
	Sitobion manitobensis	Cornus alba	Winnipeg	21/5/80
	Periphyllus negundinis	Acer negundo	Morden	30/7/80

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Praon sp. ?	Chaitophorus nudus	Populus tremuloides	Whitemouth Lake	19/8/80
	Rhopalosiphum padi	Prunus nigra	Winnipeg	27/5/81
Trioxys sp.	Hayhurstia atriplicis	Chenopodium album	Winnipeg	30/5/80
	Aphis helianthi	Cornus alba	Grand Beach	18/6/80
	Aphis varians	Epilobium angustifolium	Hanson Creek	26/6/80
	Aphis spiraephila	Spiraea alba	Lilypond	26/6/80
	Sipha kurdjumovi	Graminae	Winnipeg	7/7/80
	Aphis neogillettei	Cornus alba	Winnipeg	21/7/80
	Aphis helianthi or Aphis neogillettei	Cornus alba	Hecla Island Prov. Park	3/8/80
	?	Cornus alba	Winnipeg	7/8/80
	Aphis helianthi	Cicuta maculata	Spruce Woods	12/8/80
	Chaitophorus nudus	Populus tremuloides	Whitemouth Lake	19/8/80
Trioxys(Binodoxys) sp.	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Pine Grove Halt	24/6/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Trioxys(Binodoxys) sp.	Macrosiphum pseudo-rosae	Solidago sp.	Beaver Creek	9/7/81
	Aphis neogillettei	Cornus alba	Beaver Creek	9/7/81
	Aphis neogillettei	Cornus alba	Clear Lake	12/7/81
	Aphis neogillettei	Cornus alba	Rathwell	14/7/81
	Uroleucon(Uroleucon) rudbeckiae	Rudbeckia hirta L.	Spruce Woods	14/7/81
	Aphis spiraephila	Spiraea alba	Rathwell	14/7/81
	Aphis citricola	Cicuta maculata	Spruce Woods	14/7/81
	Aphis neogillettei	Cornus alba	Winnipeg	19/7/81
Encyrtidae-Aphelininae				
Aphelinus mali (Haldeman)	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	6/7/81
	Nearctaphis crataegifoliae	Crataegus rotundifolia	Birds Hill	6/7/81
	Nearctaphis crataegifoliae	Crataegus rotundifolia	Morden	16/7/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Aphelinus mali	Asiphonaphis pruni	Prunus virginiana	Birds Hill	21/8/81
	Rhopalosiphum maidis	Zea mays	Glenlea	2/9/81
Aphelinus semi-flavus Howard	Eriosoma lanigerum	Ulmus americana	La Barriere	11/6/81
	Nasonovia(Kakimia) borealis	Heuchera richard-sonii	Winnipeg	20/6/81
	Symydobius americanus Baker	Betula occidentalis Hook	Beaver Creek	9/7/81
	Meliarhizophagus fraxinifolii	Fraxinus pennsyl-vanicus	Spruce Woods	14/7/81
	Chaitophorus populi-cola	Prunus virginiana	Grand Beach	19/7/81
Aphelinus sp.	Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	Aphthargelia sym-phoricarpi	Symphoricarpos albus	Sandilands	21/7/80
	Aphis neogillettei	Cornus alba	Winnipeg	21/7/80
	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	6/8/80
	Aphis oenotherae	Epilobium angusti-folium	Clear Lake	16/8/80

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Aphelinus sp.	Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	6/8/80
	Hyperomyzus lactucae	Sonchus arvensis	La Barriere	6/8/80
Aphelinus sp.	Aphis neogillettei	Cornus alba	Moose Lake	19/8/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	11/6/80
	Aphis neogillettei	Cornus alba	Hecla Island	3/8/80
Aphelinus sp.	Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	Aphis spiraephila	Spiraea alba	Sandilands	24/6/81
	Pterocomma smithiae	Populus balsamifera	Birds Hill	6/7/81
	Aphis neogillettei	Cornus alba	Hanson Creek	21/7/81
	Asiphonaphis pruni	Prunus virginiana	Sandilands	4/9/81
	Chaitophorus populicola	Populus tremuloides	Sandilands	4/9/81

Table 7 continued

Parasitoid	Aphid Host	Host Plant	Location	Date
Aphidencyrtus aphidivorus(Mayr)*	Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	4/9/81
	Aphis neogillettei	Cornus alba	Winnipeg	11/8/81
		Betula glandulifera (Regel)Butler	Rathwell	12/8/80
Aphytis sp.	Chaitophorus nigrae	Salix sp.	Spruce Woods	12/8/80
	Chaitophorus populicola	Populus tremuloides	Spruce Woods	12/8/80

*It is uncertain whether this species is a primary or secondary aphid parasitoid.

Table 8 . List of aphids collected in Manitoba in 1980-1981, including their natural enemies, host plant, location, and date specimens were collected.

Aphid	Natural Enemy	Host Plant	Location	Date
Acyrthosiphon caraganae	Chrysopidae-Chrysoperla carnea	Caragana arborescens	Winnipeg	1/8/80
	Coccinellidae-Hippodamia convergens	Caragana arborescens	Hanson Creek	21/7/81
	Syrphidae-Metasyrphus sp.	Caragana arborescens	Hanson Creek	21/7/81
	Syrphus vitripennis or S. rectus	Caragana arborescens	Hanson Creek	21/7/81
	Braconidae-Adialytus sp.	Caragana arborescens	Clear Lake	16/8/80
	Aphidius sp.	Caragana arborescens	Clear Lake	16/8/80
	Aphidius sp.	Caragana arborescens	Hanson Creek	21/7/81
Acyrthosiphon churchillensis	Braconidae-Aphidius nigripes	Hedysarum boreale var. mackenzii	Churchill	8/8/81
	Aphidius sp.	Hedysarum boreale	Churchill	8/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Alphitoaphis lonicericola	Coccinellidae-Scymnus(Pullus) sp.	Lonicera dioica	Sandilands	4/9/81
Aphis barberae	Syrphidae-Eupeodes volucris	Arctium minus	Grand Beach	19/7/81
	Chamaemyiidae-Leucopis americana	Arctium minus	Grand Beach	19/7/81
	Braconidae-Lysiphlebus testaceipes	Arctium minus	Grand Beach	5/9/81
Aphis citricola	Coccinellidae-Adalia bipunctata	Spiraea alba	Winnipeg	28/7/80
	Hippodamia convergens	Spiraea alba	Winnipeg	9/6/81
	Syrphidae-Metasyrphus sp.	Spiraea alba	Winnipeg	9/6/81
	Metasyrphus sp.	Cicuta maculata	Spruce Woods	14/7/81
	Braconidae-Adialytus salicaphis	Cornus alba	Spruce Woods	28/7/81
	Trioxys sp.	Cicuta maculata	Spruce Woods	14/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis fabae	Syrphidae- Metasyrphus sp.	Rumex sp.	Winnipeg	19/6/81
Aphis farinosa	Hemerobiidae- Hemerobius humulinus	Salix sp.	Hanson Creek	21/7/81
	Coccinellidae- Scymnus(Pullus)iowensis	Salix sp.	Hanson Creek	21/7/81
	Syrphidae- Metasyrphus americanus	Salix sp.	Hanson Creek	21/7/81
	Syrphus ribesii	Salix sp.	Clear Lake	16/8/80
	Chamaemyiidae- Leucopis albipunctata	Salix sp.	Hanson Creek	21/7/81
	Braconidae- Lysiphlebus testaceipes	Salix sp.	Hanson Creek	21/7/81
Aphis helianthi	Clubionidae- Clubiona sp.	Humulus lupulus	Spruce Woods	28/7/81
	Thomisidae- Philodromus cespitum	Cornus alba	Winnipeg	17/5/81
	Anthocoridae- Anthocoris musculus	Humulus lupulus	Spruce Woods	28/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis helianthi	Coccinellidae-Scymnus brullei	Cornus alba	Winnipeg	21/5/81
	Scymnus(Pullus) lacustris	Cornus alba	Grand Beach	18/6/80
	Adalia bipunctata	Cornus alba	Winnipeg	22/5/81
	Syrphidae-Metasyrphus pomus	Cornus alba	Spruce Woods	12/8/80
	Metasyrphus sp.	Cornus alba	Winnipeg	22/5/81
	Syrphus rectus	Cornus alba	Winnipeg	17/5/81
	Syrphus vitripennis	Cornus alba	Winnipeg	22/5/81
	Braconidae-Praon artemisaphis	Cornus alba	Winnipeg	22/5/81
	Trioxys sp.	Cornus alba	Grand Beach	18/5/81
	Trioxys sp.	Cicuta maculata	Spruce Woods	12/8/80
Aphis heraclella	Chrysopidae-Chrysopa carnea	Cicuta maculata	St. Ambroise	26/8/81
	Coccinellidae-Coccinella transversoguttata richardsoni	Cicuta maculata	St. Ambroise	26/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis heraclella	Hippodamia convergens	Cicuta maculata	St. Ambroise	26/8/81
	Syrphidae- Melangyna fisherii	Cicuta maculata	St. Ambroise	26/8/81
	Chamaemyiidae- Leucopis americana	Heracleum lanatum	Morden	30/7/80
	Braconidae- Lysiphlebus testaceipes	Heracleum lanatum	Morden	30/7/80
Aphis maculatae	Coccinellidae- Adalia bipunctata	Populus tremuloides (Swedish var.)	Winnipeg	1/8/80
	Adalia bipunctata	Populus tremuloides (Swedish var.)	Winnipeg	7/8/80
	Syrphidae- Epistrophe emarginata	Populus balsamifera	Spruce Woods	28/7/81
	Metasyrphus americanus	Populus tremuloides	Winnipeg	1/8/80
	Metasyrphus americanus	Populus tremuloides	Birds Hill	6/7/81
	Metasyrphus sp.	Populus tremuloides	Winnipeg	1/8/80
	Metasyrphus sp.	Populus balsamifera	Spruce Woods	28/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis maculatae	Syrphus vitripennis or S. rectus	Populus tremuloides	Birds Hill	6/7/81
	Chamaemyiidae-Leucopis albipunctata	Populus tremuloides	Winnipeg	1/8/80
	Leucopis albipunctata	Populus tremuloides	Winnipeg	7/8/80
	Leucopis albipunctata	Populus balsamifera	St. Ambroise	26/8/81
	Leucopis americana	Populus balsamifera	Sandilands	21/7/80
	Leucopis americana	Populus tremuloides	Winnipeg	7/8/80
	Braconidae-Lysiphlebus testaceipes	Populus tremuloides	Winnipeg	7/8/80
	Lysiphlebus sp.	Populus tremuloides	Winnipeg	1/8/80
Aphis manitobensis	Coccinellidae-Scymnus(Pullus)lacustris	Ribes rubrum	Spruce Woods	12/8/80
Aphis neogillettei	Dictynidae-Dictyna sp.	Cornus alba	Brandon	6/9/81
	Dictyna sp.	Cornus alba	Patricia Beach	30/8/81
	Dictyna sp.	Cornus alba	Alf Hole Goose Sanctuary	11/9/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis neogillettei	Theridiidae-Theridion frondeum	Cornus alba	Brandon	6/9/81
	Clubionidae-Clubiona sp.	Cornus alba	Clear Lake	12/7/81
	Clubiona sp.	Amelanchier alnifolia	Clear Lake	12/7/81
	Chrysopidae-Chrysopa carnea	Cornus alba	Winnipeg	20/8/81
	Hemerobiidae-Hemerobius humulinus	Cornus alba	Clear Lake	12/7/81
	Hemerobius humulinus	Cornus alba	Rathwell	14/7/81
	Coccinellidae-Scymnus brullei	Cornus alba	Winnipeg	22/5/81
	Scymnus(Pullus) lacustris	Cornus alba	Beaver Creek	7/7/81
	Adalia bipunctata	Cornus alba	Winnipeg	22/5/81
	Adalia sp.	Cornus alba	Rathwell	14/7/81
	Anatis labiculata	Cornus alba	Rathwell	14/7/81
	Syrphidae-Eupeodes volucris	Cornus alba	Clear Lake	12/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis neogillettei	Metasyrphus sp.	Cornus alba	Winnipeg	22/5/81
	Metasyrphus sp.	Cornus alba	Clear Lake	12/7/81
	Metasyrphus sp.	Cornus alba	Winnipeg	19/7/81
	Sphaerophoria contigua	Cornus alba	Clear Lake	12/7/81
	Syrphus vitripennis	Cornus alba	Winnipeg	22/5/81
	Chamaemyiidae-Leucopis albipunctata	Cornus alba	Clear Lake	16/8/80
	Leucopis americana	Cornus alba	Winnipeg	3/7/80
	Leucopis americana	Cornus alba	Winnipeg	1/7/80
	Leucopis americana	Cornus alba	Rathwell	14/7/81
	Braconidae-Lysiphlebus testaceipes	Cornus alba	Beaver Creek	9/8/81
	Lysiphlebus testaceipes	Cornus alba	Hanson Creek	21/7/81
	Lysiphlebus testaceipes	Cornus alba	Souris	6/9/81
	Lysiphlebus testaceipes	Cornus alba	Alf Hole Goose Sanctuary	11/9/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis neogillettei	Praon artemisaphis	Cornus alba	Winnipeg	22/5/80
	Trioxys sp.	Cornus alba	Winnipeg	21/7/80
	Trioxys(Binodoxys) sp.	Cornus alba	Beaver Creek	9/7/81
	Trioxys(Binodoxys) sp.	Cornus alba	Clear Lake	12/7/81
	Trioxys(Binodoxys) sp.	Cornus alba	Rathwell	14/7/81
	Trioxys(Binodoxys) sp.	Cornus alba	Winnipeg	19/7/81
	Encyrtidae-Aphelinus sp.	Cornus alba	Winnipeg	21/7/80
	Aphelinus sp.	Cornus alba	Moose Lake	19/8/80
	Aphelinus sp.	Cornus alba	Hecla Island	3/8/80
	Aphelinus sp.	Cornus alba	Hanson Creek	21/7/81
	Aphidencyrtus aphidivorus	Cornus alba	Winnipeg	11/8/81
Aphis oenotherae	Syrphidae-Metasyrphus perplexus	Oenothera biennis	Lilypond	11/9/81
	Metasyrphus pomus	Epilobium angustifolium	Clear Lake	16/8/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis oenotherae	Chamaemyiidae-Leucopis albipunctata	Epilobium angustifolium	Clear Lake	16/8/80
	Leucopis albipunctata	Oenothera biennis	Lilypond	11/9/81
	Leucopis(new species)	Epilobium angustifolium	Clear Lake	16/8/80
	Braconidae-Adialytus sp.	Epilobium angustifolium	Clear Lake	16/8/80
	Praon sp.	Epilobium angustifolium	Clear Lake	16/8/80
	Encyrtidae-Aphelinus sp.	Epilobium angustifolium	Clear Lake	16/8/80
Aphis oestlundi	Coccinellidae-Scymnus(Pullus) iowensis	Oenothera biennis	Lilypond	26/6/80
	Syrphidae-Paragus(Pandasyopthalmus)	Oenothera biennis	Lilypond	21/7/81
	Sphaerophoria contigua	Oenothera biennis	Lilypond	26/6/80
	Chamaemyiidae-Leucopis albipunctata	Oenothera biennis	Telford	21/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis oestlundi	Leucopis albipunctata	Oenothera biennis	Lilypond	26/6/80
	Leucopis americana	Oenothera biennis	Telford	21/7/81
Aphis pomi	Coccinellidae-Adalia bipunctata	Cotoneaster acutifolia	Winnipeg	11/8/81
	Hippodamia convergens	Cotoneaster acutifolia	Winnipeg	22/5/81
	Syrphidae-Metasyrphus americanus	Cotoneaster acutifolia	Winnipeg	22/5/81
	Chamaemyiidae-Leucopis albipunctata	Cotoneaster acutifolia	Winnipeg	21/7/80
	Leucopis americana	Cotoneaster acutifolia	Winnipeg	21/7/80
Aphis salicariae	Hemerobiidae-Hemerobius humulinus	Cornus alba	Pine Grove Halt	24/6/81
	Syrphidae-Syrphus torvus	Cornus alba	Pine Grove Halt	24/6/81
Aphis spiraephila	Syrphidae-Sphaerophoria contigua	Spiraea sp.	Agassiz Forest	26/6/80
	Chamaemyiidae-Leucopis albipunctata	Spiraea alba	Lilypond	26/6/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis spiraephila	Leucopis americana	Spiraea alba	Lilypond	26/6/80
	Leucopis americana	Spiraea alba	Spruce Woods	12/8/80
	Braconidae-Trioxys sp.	Spiraea alba	Lilypond	26/6/80
	Trioxys(Binodoxys) sp.	Spiraea alba	Rathwell	14/7/81
	Encyrtidae-Aphelinus sp.	Spiraea alba	Sandilands	24/6/81
Aphis varians	Coccinellidae-Scymnus(Pullus)iowensis	Epilobium angustifolium	Lilypond	26/6/80
	Scymnus(Pullus)iowensis	Epilobium angustifolium	Lilypond	21/7/81
	Scymnus(Pullus) lacustris	Epilobium angustifolium	Hanson Creek	21/7/81
	Scymnus(Pullus) sp.	Epilobium angustifolium	Hanson Creek	21/7/81
	Chamaemyiidae-Leucopis americana	Epilobium angustifolium	Sandilands	21/7/80
	Leucopis americana	Epilobium angustifolium	Lilypond	21/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis varians	Braconidae-Lysiphlebus testaceipes	Epilobium angustifolium	Hanson Creek	21/7/81
	Lysiphlebus testaceipes	Epilobium angustifolium	Sandilands	4/9/81
	Trioxys sp.	Epilobium angustifolium	Hanson Creek	26/6/80
Aphis viburniphila	Dictynidae-Dictyna sp.(juv.)	Viburnum trilobum	Spruce Woods	28/7/81
	Coccinellidae-Scymnus(Pullus)lacustris	Viburnum rafinesquianum	Birds Hill	6/7/81
	Adalia bipunctata	Viburnum sp.	Winnipeg	2/6/80
	Anatis labiculata	Viburnum trilobum	Spruce Woods	28/7/81
	Chamaemyiidae-Leucopis albipunctata	Viburnum rafinesquianum	Sandilands	21/7/80
	Leucopis albipunctata	Viburnum rafinesquianum	Birds Hill	6/7/81
	Leucopis americana	Viburnum sp.	Winnipeg	26/5/80
	Leucopis americana	Viburnum rafinesquianum	Birds Hill	6/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphis viburniphila	Leucopis sp.(possibly L. americana)	Viburnum rafinesquianum	Birds Hill	6/7/81
	Braconidae-Aphidius nigripes	Viburnum rafinesquianum	Sandilands	4/9/81
	Aphidius sp.	Viburnum rafinesquianum	Morden	16/7/81
	Ephedrus incompletus	Viburnum trilobum	Spruce Woods	28/7/81
	Lysiphlebus testaceipes	Viburnum sp.	Winnipeg	26/5/80
Aphis sp.	Chrysopidae-Chrysopa oculata	Prunus virginiana	Rathwell	14/7/81
	Coccinellidae-Coccinella transversoguttata richardsoni	Prunus virginiana	Rathwell	14/7/81
	Syrphidae- Paragus (Pandasyopthalmus)sp.	Diervilla lonicera	Belair Forest	18/6/80
	Sphaerophoria contigua	Prunus virginiana	Rathwell	14/7/81
Aphthargelia symphoricarpi	Coccinellidae-Scymnus(Pullus) lacustris	Symphoricarpos albus	Sandilands	10/6/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphthargelia symphoricarpi	Coccinella transverso-guttata	Symphoricarpos albus	Sandilands	4/9/81
	Hippodamia convergens	Symphoricarpos albus	Sandilands	4/9/81
	Syrphidae- Paragus (Pandasyopthalmus) sp.	Symphoricarpos albus	Sandilands	24/6/81
	Sphaerophoria contigua	Symphoricarpos albus	Sandilands	10/6/80
	Sphaerophoria contigua	Symphoricarpos albus	Sandilands	24/6/81
	Chamaemyiidae- Leucopis albipunctata	Symphoricarpos albus	Morden	30/7/80
	Leucopis americana	Symphoricarpos albus	Sandilands	21/7/80
	Leucopis americana	Symphoricarpos albus	Morden	30/7/80
	Leucopis(new species?)	Symphoricarpos albus	Morden	30/7/80
	Braconidae- Lysiphlebus testaceipes	Symphoricarpos albus	Morden	30/7/80
	Lysiphlebus testaceipes	Symphoricarpos albus	Sandilands	21/7/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Aphthargelia symphoricarpi	Encyrtidae-Aphelinus sp.	Symphoricarpos albus	Sandilands	21/7/80
	Aphidencyrtus aphidivorus	Symphoricarpos albus	Sandilands	4/9/81
Asiphonaphis pruni	Trombidiidae-Podothrombium sp.	Prunus virginiana	Sandilands	24/6/81
	Hemerobiidae-Hemerobius humulinus	Prunus virginiana	Sandilands	24/6/81
	Coccinellidae-Scymnus(Pullus)iowensis	Prunus virginiana	Sandilands	24/6/81
	Scymnus(Pullus)lacustris	Prunus virginiana	Sandilands	24/6/81
	Scymnus(Pullus) sp.	Prunus virginiana	Sandilands	24/6/81
	Syrphidae-Metasyrphus sp.	Prunus virginiana	Sandilands	24/6/81
	Sphaerophoria contigua	Prunus virginiana	Sandilands	24/6/81
	Sphaerophoria philanthus	Prunus virginiana	Sandilands	24/6/81
	Chamaemyiidae-Leucopis albipunctata	Prunus virginiana	Sandilands	21/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Asiphonaphis pruni	Leucopis americana	Prunus virginiana	Spruce Woods	28/7/81
	Leucopis sp.(possibly L. americana)	Prunus virginiana	Spruce Woods	28/7/81
	Leucopis sp.(possibly L. americana)	Prunus virginiana	Sandilands	4/9/81
	Braconidae-Lysiphlebus testaceipes	Prunus virginiana	Sandilands	21/7/81
	Lysiphlebus testaceipes	Prunus virginiana	Sandilands	24/6/81
	Lysiphlebus testaceipes	Prunus virginiana	Spruce Woods	28/7/81
	Lysiphlebus testaceipes	Prunus virginiana	Birds Hill	21/8/81
	Praon sp.	Prunus virginiana	Sandilands	24/6/81
	Encyrtidae-Aphelinus mali	Prunus virginiana	Birds Hill	21/8/81
	Aphelinus sp.	Prunus virginiana	Spruce Woods	6/8/80
	Aphelinus sp.	Prunus virginiana	Sandilands	24/6/81
	Aphelinus sp.	Prunus virginiana	Sandilands	4/9/81
Capitophorus elaeagni	Coccinellidae-Coccinella transverso-guttata richardsoni	Cirsium arvense	Whitemouth Lake	19/8/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Capitophorus elaeagni	Braconidae-Aphidius matricariae	Cirsium arvense	Glenlea	18/8/80
	Lysiphlebus testaceipes	Cirsium arvense	Glenlea	18/8/80
Capitophorus hippophaes	Braconidae-Aphidius sp.	Shepherdia canadensis	Arnes Park	4/7/80
Cavariella konoi	Syrphidae-Syrphus rectus	Cicuta maculata	Clear Lake	12/7/81
	Braconidae-Praon sp.	Cicuta maculata	Clear Lake	12/7/81
Cavariella pastinacae	Syrphidae-Allograpta obliqua	Heracleum lanatum	Clear Lake	12/7/81
	Metasyrphus americanus	Heracleum lanatum	Clear Lake	12/7/81
	Metasyrphus sp.	Heracleum lanatum	Clear Lake	12/7/81
	Syrphus rectus	Heracleum lanatum	Clear Lake	12/7/81
	Syrphus ribesii	Heracleum lanatum	Clear Lake	12/7/81
	Syrphus vitripennis or S. rectus	Heracleum lanatum	Clear Lake	12/7/81
	Braconidae-Aphidius sp.	Heracleum lanatum	Clear Lake	12/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Ceruraphis viburnicola	Hemerobiidae- Hemerobius humulinus	Viburnum trilobum	Birds Hill	21/8/81
Chaetosiphon fragaefolii	Braconidae- Aphidius sp.	Rosa sp.	Zhoda	19/8/80
Chaitophorus essigi	Syrphidae- Syrphus vitripennis or S. rectus	Populus balsamifera	Pine Grove Halt	24/6/81
Chaitophorus nigrae	Syrphidae- Metasyrphus sp.	Salix sp.	Morden	30/7/80
	Chamaemyiidae- Leucopis americana	Salix sp.	Spruce Woods	14/7/81
	Leucopis ?americana	Salix sp.	Morden	16/7/81
	Braconidae- Adialytus sp.	Salix sp.	Spruce Woods	12/8/80
	Ephedrus incompletus	Salix sp.	Morden	16/7/81
Chaitophorus nudus	Syrphidae- Epistrophe emarginata	Populus tremuloides	Birds Hill	21/8/81
	Syrphus sp.	Populus tremuloides	Sandilands	4/9/81
	Braconidae- Ephedrus incompletus	Populus tremuloides	Birds Hill	21/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Chaitophorus nudus	Praon artemisaphis	Populus tremuloides	Spruce Woods	12/8/80
	Praon sp.	Populus tremuloides	Spruce Woods	12/8/80
	Praon sp.	Populus tremuloides	Whitemouth Lake	19/8/80
	Trioxys sp.	Populus tremuloides	Whitemouth Lake	19/8/80
Chaitophorus populicola	Clubionidae-Clubiona sp.	Populus tremuloides	Grand Beach	19/7/81
	Thomisidae-Philodromus rufus	Populus tremuloides	Whitemouth Lake	19/8/80
	Hemerobiidae-Micromus angulatus	Populus tremuloides	Whitemouth Lake	19/8/80
	Coccinellidae-Coccinella transversoguttata richardsoni	Populus tremuloides	Winnipeg	6/6/80
	Hippodamia tredecimpunctata tibialis	Populus tremuloides	Hanson Creek	21/7/81
	Syrphidae-Epistrophe emarginata	Populus balsamifera	Spruce Woods	28/7/81
	Metasyrphus americanus	Populus balsamifera	Clear Lake	16/9/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Chaitophorus populicola	Metasyrphus pomus	Populus tremuloides	Sandilands	10/6/80
	Metasyrphus pomus	Prunus virginiana	Grand Beach	19/7/81
	Metasyrphus sp.	Populus balsamifera	Sandilands	21/7/80
	Metasyrphus sp.	Prunus virginiana	Grand Beach	19/7/81
	Sphaerophoria contigua	Populus balsamifera	Agassiz Forest	26/6/80
	Sphaerophoria contigua	Populus balsamifera	Clear Lake	12/7/81
	Syrphus ribesii	Populus balsamifera	Clear Lake	16/8/80
	Syrphus torvus	Populus tremuloides	Clear Lake	16/8/80
	Chamaemyiidae-Leucopis americana	Populus tremuloides	Arnes Park	4/7/80
	Leucopis ?americana	Populus balsamifera	St. Ambroise	26/8/81
	Braconidae-Adialytus salicaphis	Populus tremuloides	Pine Grove Halt	24/6/81
	Adialytus salicaphis	Populus balsamifera	Telford	21/7/81
	Adialytus salicaphis	Populus balsamifera	Spruce Woods	28/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Chaitophrus populicola	Adialytus salicaphis	Populus tremuloides	Birds Hill	21/8/81
	Adialytus salicaphis	Populus balsamifera	Birds Hill	21/8/81
	Adialytus salicaphis	Populus balsamifera	Sandilands	4/9/81
	Adialytus salicaphis	Populus tremuloides	Sandilands	4/9/81
	Adialytus salicaphis	Populus balsamifera	Agassiz Forest	11/9/80
	Adialytus sp.	Populus balsamifera	Spruce Woods	12/8/80
	Adialytus sp.	Populus balsamifera	Clear Lake	16/8/80
	Adialytus sp.	Populus tremuloides	Moose Lake	19/8/80
	Ephedrus incompletus	Populus balsamifera	Spruce Woods	12/8/80
	Ephedrus incompletus	Populus tremuloides	Clear Lake	12/7/81
	Ephedrus incompletus	Populus tremuloides	Telford	21/7/81
	Ephedrus incompletus	Populus tremuloides	Sandilands	4/9/81
	Praon sp.	Populus tremuloides	Clear Lake	12/7/81
	Encyrtidae Aphelinus semiflavus	Prunus virginiana	Grand Beach	19/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Chaitophorus populicola	Aphelinus sp.	Populus tremuloides	Sandilands	4/9/81
Chaitophorus populifolii	Theridiidae-Theridion frondeum	Populus balsamifera	Birds Hill	23/6/80
	Hemerobiidae-Hemerobius humulinus	Populus tremuloides	Sandilands	24/6/81
Chaitophorus saliciniger	Chamaemyiidae-Leucopis albipunctata	Salix sp.	Morden	30/7/80
	Leucopis americana	Salix sp.	Morden	30/7/80
	Leucopis ?americana	Salix sp.	Sandilands	4/9/81
	Leucopis sp.IV	Salix sp.	Sandilands	4/9/81
Chaitophorus viminalis	Braconidae-Adialytus sp.	Salix sp.	Spruce Woods	12/8/80
	Ephedrus incompletus	Salix sp.	Spruce Woods	12/8/80
Cinara canatra	Syrphidae-Metasyrphus pomus	Pinus banksiana	Sandilands	4/9/81
Cinara laricifex	Anthocoridae-Tetraphleps uniformis	Larix laricina	Churchill	5/8/81
	Coccinellidae-Adalia sp.	Larix laricina	Churchill	4/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Cinara laricifex	Hippodamia convergens	Larix laricina	Churchill	5/8/81
	Eraconidae- Pauesia sp.	Larix laricina	Churchill	5/8/81
Cinara pergandei	Reduviidae- Zelus socius	Pinus banksiana	Hanson Creek	21/7/81
Cinara pinea	Coccinellidae- Hippodamia convergens	Pinus banksiana	La Barriere	11/6/81
	Hippodamia convergens	Pinus banksiana	Morden	16/7/81
Eriosoma americanum	Theridiidae- Theridion frondeum	Ulmus americana	Winnipeg	2/6/80
	Anthocoridae- Deraeocoris sp.	Ulmus americana	Grand Beach	18/6/80
	Deraeocoris sp.	Ulmus americana	Winnipeg	2/6/80
	Coccinellidae- Scymnus brullei	Ulmus americana	Winnipeg	15/6/81
Eriosoma lanigerum	Chrysopidae- Chrysopa carnea	Ulmus americana	Winnipeg	10/6/81
	Hemerobiidae- Hemerobius humulinus	Ulmus americana	Winnipeg	10/6/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Eriosoma lanigerum	Coccinellidae-Scymnus brullei	Ulmus americana	Winnipeg	30/5/80
	Scymnus brullei	Ulmus americana	La Barriere	11/6/81
	Encyrtidae-Aphelinus semiflavus	Ulmus americana	La Barriere	11/6/81
Hamamelistes spinosus	Encyrtidae-Aphidencyrtus aphidivorus	Betula glandulifera	Rathwell	12/8/80
Hayhurstia atriplicus	Chamaemyiidae-Leucopis albipunctata	Chenopodium album	Morden	30/7/80
	Braconidae-Trioxys sp.	Chenopodium album	Winnipeg	30/5/80
Hyadaphis tataricae	Nabidae-Nabis sp.(larvae)	Lonicera tatarica	Winnipeg	20/8/81
	Miridae-Lygus sp.	Lonicera tatarica	Winnipeg	20/8/81
	Anthocoridae-Anthocoris musculus	Lonicera tatarica	Winnipeg	20/8/81
	Anthocoris musculus	Lonicera tatarica	Winnipeg	11/8/81
	Chrysopidae-Chrysopa carnea	Lonicera tatarica	Winnipeg	20/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Hyadaphis tataricae	Chrysopa carnea	Lonicera sp.	Aweme	28/7/81
	Hemerobiidae-Hemerobius humulinus	Lonicera sp.	Aweme	28/7/81
	Hemerobius humulinus	Lonicera tatarica	Winnipeg	11/8/81
	Coccinellidae-Adalia bipunctata	Lonicera tatarica	Winnipeg	20/8/81
	Cecidomyiidae-Aphidoletes aphidimyza	Lonicera tatarica	Winnipeg	24/7/81
	Aphidoletes aphidimyza	Lonicera tatarica	Winnipeg	11/8/81
	Syrphidae-Allograpta obliqua	Lonicera tatarica	Winnipeg	19/6/81
	Allograpta obliqua	Lonicera tatarica	Winnipeg	24/7/81
	Allograpta obliqua	Lonicera tatarica	Winnipeg	11/8/81
	Metasyrphus pomus	Lonicera tatarica	Winnipeg	24/7/81
	Syrphus ribesii	Lonicera tatarica	Winnipeg	11/8/81
	Chamaemyiidae-Leucopis albipunctata	Lonicera tatarica	Winnipeg	24/7/81
	Leucopis albipunctata	Lonicera tatarica	Winnipeg	20/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Hyalopterus pruni	Chrysopidae- Chrysopa carnea	Phragmites sp.	St. Ambroise	26/8/81
	Chrysopa carnea	Phragmites sp.	Spruce Woods	14/7/81
	Coccinellidae- Hippodamia convergens	Phragmites sp.	St. Ambroise	26/8/81
	Hippodamia tredecim- punctata tibialis	Phragmites sp.	St. Ambroise	26/8/81
	Hippodamia tredecim- punctata tibialis	Phragmites sp.	Sandilands	4/9/81
	Cecidomyiidae- Aphidoletes aphidimyza	Phragmites sp.	Morden	16/7/81
	Syrphidae- Syrphus ribesii	Phragmites sp.	Spruce Woods	14/7/81
	Syrphus ribesii	Phragmites sp.	Morden	16/7/81
	Chamaemyiidae- Leucopis(new species)	Phragmites sp.	Morden	16/7/81
	Leucopis(new species)	Phragmites sp.	St. Ambroise	26/8/81
	Leucopis(new species)	Phragmites sp.	Sandilands	4/9/81
Hyperomyzus lactucae	Chrysopidae- Chrysoperla carnea	Sonchus arvensis	La Barriere	6/9/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Hyperomyzus lactucae	Coccinellidae-Hippodamia convergens	Sonchus arvensis	St. Ambroise	26/8/81
	Cecidomyiidae-Aphidoletes aphidimyza	Sonchus arvensis	La Barriere	6/9/80
	Syrphidae-Melangyna fisherii	Sonchus arvensis	Spruce Woods	12/8/80
	Metasyrphus americanus	Sonchus arvensis	Hanson Creek	21/7/81
	Metasyrphus perplexus	Sonchus arvensis	Belair Forest	26/7/80
	Metasyrphus pomus	Sonchus arvensis	Clear Lake	16/8/80
	Metasyrphus sp.	Sonchus arvensis	Sandilands	21/7/80
	Metasyrphus sp.	Sonchus arvensis	La Barriere	6/7/80
	Metasyrphus sp.	Sonchus arvensis	Spruce Woods	12/8/80
	Metasyrphus sp.	Sonchus arvensis	Hanson Creek	21/7/81
	Platycheirus hyperboreus	Sonchus arvensis	St. Ambroise	26/8/81
	Sphaerophoria contigua	Sonchus arvensis	Sandilands	21/7/80
	Syrphus rectus	Sonchus arvensis	Hanson Creek	21/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Hyperomyzus lactucae	Syrphus ribesii	Sonchus arvensis	Clear Lake	16/8/80
	Syrphus torvus	Sonchus arvensis	Clear Lake	16/8/80
	Chamaemyiidae-Leucopis albipunctata	Sonchus arvensis	Spruce Woods	12/8/80
	Leucopis albipunctata	Sonchus arvensis	Hanson Creek	21/7/81
	Encyrtidae-Aphelinus sp.	Sonchus arvensis	La Barriere	6/8/80
Hyperomyzus pallidus	Hemerobiidae-Hemerobius humulinus	Sonchus arvensis	Grand Beach	1/9/81
	Syrphidae-Platycheirus scambus	Sonchus arvensis	La Barriere	6/8/80
	Syrphus vitripennis or S. rectus	Ribes oxyacanthoides	Winnipeg	26/5/81
	Braconidae-Praon sp.	Ribes oxyacanthoides	Winnipeg	26/5/81
Hysteroneura setariae	Syrphidae-Syrphus ribesii	Prunus nigra	Winnipeg	15/8/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Illinoia sp.	Braconidae- Aphidius nigripes	Epilobium angustifolium	Churchill	8/8/81
Macrosiphoniella absinthii	Chrysopidae- Chrysoperla carnea	Artemesia biennis	La Barriere	6/8/80
	Coccinellidae- Hippodamia tredecim- punctata tibialis	Artemesia sp.	Lilypond	11/9/81
Macrosiphoniella ludovicianae	Chrysopidae- Chrysopa oculata	Artemesia sp.	Birds Hill	6/7/81
Macrosiphoniella tapuskae	Coccinellidae- Coccinella transverso- guttata	Achillea millefolium	Churchill	8/8/81
	Braconidae- Aphidius nigripes	Achillea millefolium	Churchill	6/8/81
Macrosiphum euphorbiae	Coccinellidae- Hippodamia convergens	Rosa sp.	Pine Grove Halt	24/6/81
	Syrphidae- Syrphus ribesii	Asclepias sp.	Sandilands	24/6/81
	Chamaemyiidae- Leucopis albipunctata	Asclepias sp.	Sandilands	24/6/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Macrosiphum euphorbiae	Braconidae- Praon sp.	Rosa sp.	Winnipeg	2/6/80
Macrosiphum pseudorosae	Erythraeidae- Leptus sp.(larva)	Rosa sp.	Birds Hill	6/7/81
	Trombidiidae- Podothrombium sp.(larva)	Potentilla sp.	Pine Grove Halt	24/6/81
	Anystidae- Anystis sp.(larva)	Ranunculus sp.	Hanson Creek	21/7/81
	Thomisidae- Misumena vatia(juv.)	Solidago sp.	Beaver Creek	9/7/81
	Chrysopidae- Chrysopa carnea	Ranunculus sp.	Hanson Creek	21/7/81
	Chrysopa carnea	Solidago sp.	Beaver Creek	9/7/81
	Chrysopa carnea	Rosa sp.	Lilypond	21/7/81
	Coccinellidae- Hippodamia convergens	Solidago sp.	Beaver Creek	9/7/81
	Syrphidae- Metasyrphus pomus	Rosa sp.	Spruce Woods	14/7/81
	Syrphus rectus	Rosa sp.	Birds Hill	6/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Macrosiphum pseudorosae	Chamaemyiidae- Leucopis albipunctata	Solidago sp.	Beaver Creek	9/7/81
	Braconidae- Aphidius nigripes	Rosa sp.	Pine Grove Halt	24/6/81
	Aphidius nigripes	Rosa sp.	Lilypond	21/7/81
	Trioxys sp.	Solidago sp.	Beaver Creek	9/7/81
Macrosiphum subarcticum	Syrphidae- Metasyrphus perplexus	Epilobium angustifolium	Churchill	4/8/81
	Metasyrphus perplexus	Epilobium angustifolium	Churchill	6/8/81
Meliarhizophagus fraxinifolii	Araneidae- Neoscona arabesca	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Nuctenea cornuta	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Clubionidae-. Clubiona sp.	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Anthocoridae- Anthocoris musculus	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Chrysopidae- Chrysopa carnea	Fraxinus pennsylvanica	Spruce Woods	14/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Meliarhizophagus fraxinifolii	Hemerobiidae- Hemerobius humulinus	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Coccinellidae- Anatis labiculata	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Syrphidae- Allograpta obliqua	Fraxinus pennsylvanica	Spruce Woods	14/7/81
	Encyrtidae- Aphelinus semiflavus	Fraxinus pennsylvanica	Spruce Woods	14/7/81
Myzus cerasi	Salticidae- Eris marginata	Prunus pensylvanica	Birds Hill	6/7/81
	Coccinellidae- Scymnus(Pullus)iowensis	Prunus pensylvanica	Sandilands	21/7/80
	Scymnus(Pullus)lacustris	Prunus pensylvanica	Birds Hill	11/6/80
	Scymnus(Pullus)lacustris	Prunus pensylvanica	Sandilands	21/7/80
	Scymnus(Pullus)lacustris	Prunus pensylvanica	Agassiz Forest	26/6/80
	Scymnus(Pullus)lacustris	Prunus pensylvanica	Sandilands	24/6/81
	Scymnus(Pullus) sp.	Prunus pensylvanica	Pine Grove Halt	24/6/81
	Coccinella transverso-guttata richardsoni	Prunus virginiana	Birds Hill	11/6/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Myzus cerasi	Syrphidae- Sphaerophoria contigua	Prunus pensylvanica	Agassiz Forest	26/6/80
	Syrphus rectus	Prunus pensylvanica	Sandilands	24/6/81
	Syrphus ribesii	Prunus virginiana	Birds Hill	11/6/80
	Syrphus ribesii	Prunus virginiana	Grand Beach	18/6/80
	Syrphus rectus or S. vitripennis	Prunus pensylvanica	Hanson Creek	21/7/81
	Chamaemyiidae- Leucopis albipunctata	Prunus pensylvanica	Agassiz Forest	26/6/80
	Leucopis albipunctata	Prunus pensylvanica	Sandilands	21/7/80
	Leucopis albipunctata	Prunus pensylvanica	Sandilands	24/6/81
	Leucopis albipunctata	Prunus virginiana	Birds Hill	11/6/80
	Leucopis americana	Prunus virginiana	Birds Hill	11/6/80
	Braconidae- Lysiphlebus testaceipes	Prunus virginiana	Birds Hill	11/6/80
Myzus persicae	Syrphidae- Syrphus vitripennis or S. rectus	Zebrina pendula	Winnipeg	23/8/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Nasonovia(Kakimia) aquilegiae	Braconidae-Aphidius matricariae	Aquilegia canadensis	Clear Lake	16/8/80
Nasonovia(Kakimia) borealis	Clubionida-Clubiona sp.	Heuchera richardsonii	Winnipeg	20/6/81
	Syrphidae-Metasyrphus americanus	Heuchera sp.	Winnipeg	20/6/81
	Metasyrphus sp.	Heuchera sp.	Winnipeg	20/6/81
	Braconidae-Aphidius nigripes	Heuchera richardsonii	Winnipeg	20/6/81
	Aphidius ribis	Heuchera richardsonii	Winnipeg	20/6/81
	Encyrtidae-Aphelinus semiflavus	Heuchera richardsonii	Winnipeg	20/6/81
Nasonovia(Kakimia) houghtonensis similis	Coccinellidae-Hippodamia convergens	Ribes oxyacanthoides	Churchill	5/8/81
	Syrphidae-Sphaerophoria sp.	Ribes oxyacanthoides	Churchill	5/8/81
	Braconidae-Aphidius nigripes	Ribes oxyacanthoides	Churchill	5/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Nearctaphis crataegifoliae	Erythraeidae-genus?(imagochysalis)	Crataegus rotundifolia	Zhoda	19/8/80
	Syrphidae-Syrphus torvus	Crataegus rotundifolia	Zhoda	19/8/80
	Chamaemyiidae-Leucopis albipunctata	Crataegus rotundifolia	Morden	16/7/81
	Leucopis americana	Crataegus sp.	Birds Hill	6/7/81
	Encyrtidae-Aphelinus mali	Crataegus rotundifolia	Morden	16/7/81
	Aphelinus mali	Crataegus sp.	Birds Hill	6/7/81
Nearctaphis sp.	Chamaemyiidae-Leucopis americana	Salix sp.	Morden	30/7/80
Pachypappa sacculi	Syrphidae-Syrphus rectus	Populus tremuloides	Pine Grove Halt	24/6/81
	Syrphus ribesii	Populus tremuloides	Pine Grove Halt	24/6/81
Pachypappa tremulae	Hemerobiidae-Hemerobius humulinus	Populus tremuloides	Sandilands	24/6/81
	Coccinellidae-Adalia sp.	Populus tremuloides	Pine Grove Halt	24/6/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Pachypappa tremulae	Syrphidae-Syrphus rectus	Populus tremuloides	Sandilands	24/6/81
	Syrphus ribesii	Populus tremuloides	Sandilands	24/6/81
	Syrphus vitripennis or S. rectus	Populus tremuloides	Pine Grove Halt	24/6/81
Periphyllus negundinis	Coccinellidae-Calvia quattuordecim-guttata	Acer negundo var. interius	Winnipeg	5/6/81
	Syrphidae-Metasyrphus americanus	Acer negundo var. interius	Winnipeg	5/6/81
	Chamaemyiidae-Leucopis(new species?)	Acer negundo	Morden	30/7/80
	Braconidae-Praon sp.	Acer negundo interius	Winnipeg	5/6/81
	Praon sp.	Acer negundo	Morden	30/7/80
Pleotrichophorus pseudopatonkus	Coccinellidae-Coccinella transverso-guttata richardsoni	Achillea millefolium	Churchill	8/8/81
	Braconidae-Aphidius nigripes	Achillea millefolium	Churchill	8/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Prociphilus(Paraprociphilus)tessellatus	Chrysopidae- Chrysopa carnea	Alnus viridis	Rathwell	14/7/81
	Coccinellidae- Anatis labiculata	Alnus viridis	Pine Grove Halt	24/7/81
	Lycaenidae- Feneseca tarquinius	Alnus viridis	Sandilands	21/7/80
	Feneseca tarquinius	Alnus viridis	Pine Grove Halt	24/6/81
	Feneseca tarquinius	Alnus viridis	Rathwell	14/7/81
	Feneseca tarquinius	Alnus viridis	Pine Grove Halt	4/9/81
	Syrphidae- Syrphus ribesii	Alnus viridis	St. Claude	10/10/81
	Syrphus ribesii	Alnus viridis	Rathwell	14/7/81
Pterocomma smithiae	Syrphidae- Melangyna triangulifera	Salix sp.	Sandilands	4/9/81
	Chamaemyiidae- Leucopis americana	Populus balsamifera	Birds Hill	6/7/81
	Braconidae- Aphidius nigripes	Populus balsamifera	Birds Hill	6/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Pterocomma smithiae	Encyrtidae-Aphelinus sp.	Populus balsamifera	Birds Hill	6/7/81
Rhopalosiphum cerasifoliae	Coccinellidae-Scymnus(Pullus)iowensis	Prunus virginiana	Birds Hill	11/6/80
	Scymnus(Pullus)iowensis	Prunus virginiana	Birds Hill	23/6/80
	Scymnus(Pullus) lacustris	Prunus virginiana	Birds Hill	23/6/80 11/6/80 6/7/81
	Scymnus(Pullus) lacustris	Prunus virginiana	Sandilands	10/6/80
	Scymnus(Pullus) lacustris	Prunus virginiana	Belair Forest	18/6/80
	Scymnus(Pullus) lacustris	Prunus virginiana	Hansen Creek	26/6/80
	Coccinella transverso-guttata richardsoni	Prunus virginiana	Belair Forest	18/6/80
	Coccinella transverso-guttata	Prunus virginiana	Birds Hill	6/7/81
	Hippodamia convergens	Prunus virginiana	Birds Hill	6/7/81
	Syrphidae-Sphaerophoria contigua	Prunus virginiana	Sandilands	10/6/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Rhopalosiphum cerasifoliae	Syrphus ribesii	Prunus virginiana	Sandilands	10/6/80
	Syrphus ribesii	Prunus virginiana	Birds Hill	23/6/80 6/7/81
	Syrphus vitripennis or S. rectus	Prunus virginiana	Birds Hill	6/7/81
	Chamaemyiidae- Leucopis albipunctata	Prunus virginiana	Sandilands	10/6/80
	Leucopis albipunctata	Prunus virginiana	Belair Forest	18/6/80
	Leucopis albipunctata	Prunus virginiana	Birds Hill	23/6/80 6/7/81
	Leucopis americana	Prunus virginiana	Birds Hill	11/6/80
	Braconidae- Lysiphlebus testaceipes	Prunus virginiana	Birds Hill	23/6/80 6/7/81
	Lysiphlebus testaceipes	Prunus virginiana	Agassiz Forest	27/6/80
	Praon sp.	Prunus virginiana	Hanson Creek	26/6/80
	Encyrtidae- Aphelinus mali	Prunus virginiana	Birds Hill	6/7/81
	Aphelinus sp.	Prunus virginiana	Sandilands	10/6/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Rhopalosiphum cerasifoliae	Aphelinus sp.	Prunus virginiana	Birds Hill	23/6/80 11/6/80
Rhopalosiphum insertum	Dictynidae- Dictyna sublata	Crataegus rotundifolia	Winnipeg	22/5/81
	Anthocoridae- Deraeocoris sp.	Cotoneaster acutifolia	Winnipeg	31/5/80
	Coccinellidae- Scymnus brullei	Cotoneaster acutifolia	Winnipeg	21/5/81
	Adalia bipunctata	Cotoneaster acutifolia	Winnipeg	21/5/81
	Hippodamia convergens	Crataegus rotundifolia	Winnipeg	26/5/81
	Hippodamia tredecim-puctata tibialis	Crataegus rotundifolia	La Barriere	11/6/81
	Syrphidae- Metasyrphus sp.	Crataegus rotundifolia	Winnipeg	22/5/81 26/5/81
	Syrphus rectus	Crataegus rotundifolia	Winnipeg	26/5/81
	Syrphus rectus	Crataegus sp.	La Barriere	11/6/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Rhopalosiphum insertum	Syrphus vitripennis	Crataegus rotundifolia	Winnipeg	26/5/81
	Braconidae-Praon sp.	Crataegus rotundifolia	Winnipeg	21/5/80
Rhopalosiphum maidis	Coccinellidae-Hippodamia convergens	Zea mays	Glenlea	2/9/81
	Hippodamia tredecim-punctata	Zea mays	Glenlea	2/9/81
	Ecyrtidae-Aphelinus mali	Zea mays	Glenlea	2/9/81
Rhopalosiphum padi	Coccinellidae-Scymnus(Pullus) lacustris	Prunus virginiana	Spruce Woods	14/7/81
	Coccinella transverso-guttata richardsoni	Prunus virginiana	Spruce Woods	14/7/81
	Syrphidae-Sphaerophoria contigua	Prunus virginiana	Spruce Woods	14/7/81
	Syrphus vitripennis or S. rectus	Prunus nigra	Winnipeg	27/5/81
	Chamaemyiidae-Leucopis albipunctata	Prunus nigra	Winnipeg	27/5/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Rhopalosiphum padi	Leucopis albipunctata	Prunus virginiana	Spruce Woods	14/7/81
	Braconidae-Lysiphlebus testaceipes	Prunus virginiana	Spruce Woods	14/7/81
	Praon sp.	Prunus nigra	Winnipeg	27/5/81
Sipha kurdjumovi	Chamaemyiidae-Leucopis albipunctata	Graminae	Winnipeg	7/7/80
	Braconidae-Trioxys sp.	Graminae	Winnipeg	7/7/80
Sitobion avenae	Nabidae-Nabis ferus	Triticum aestivum	Glenlea	7/8/80
	Chrysopidae-Chrysopa oculata	Triticum aestivum	Glenlea	7/8/80
	Chrysoperla carnea	Triticum aestivum	Glenlea	7/8/80
	Coccinellidae-Coccinella transversoguttata richardsoni	Calamagrostis canadensis	Churchill	5/8/81
	Hippodamia convergens	Calamagrostis canadensis	Churchill	6/8/81
	Hippodamia tredecimpunctata	Triticum aestivum	Glenlea	7/8/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Sitobion avenae	Syrphidae- Metasyrphus perplexus	Calamagrostis canadensis	Churchill	6/8/81
	Metasyrphus sp.	Triticum aestivum	Glenlea	7/8/80
	Braconidae- Aphidius nigripes	Calamagrostis canadensis	Churchill	5/8/81
	Aphidius obscuripes	Triticum aestivum	Glenlea	7/8/80
Sitobion manitobensis	Hemerobiidae- Hemerobius humulinus	Cornus alba	Winnipeg	21/5/80
	Coccinellidae- Scymnus(Pullus) sp.	Cornus alba	Winnipeg	21/5/80
	Syrphidae- Metasyrphus sp.	Cornus alba	Winnipeg	21/5/80
	Braconidae- Praon sp.	Cornus alba	Winnipeg	21/5/80
Symydobius americanus	Dictynidae- Dictyna alaskae	Betula occidentalis	Beaver Creek	9/7/81
	Encyrtidae- Aphelinus semiflavus	Betula occidentalis	Beaver Creek	9/7/81
Thecabius affinis	Theridiidae- Theridion frondeum	Populus balsamifera	Birds Hill	23/6/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Thecabius affinis	Chamaemyiidae-Megaselia sp.	Populus balsamifera	Grand Beach	18/6/80
Therioaphis riehmi	Coccinellidae-Coccinella transversoguttata richardsoni	Melilotus alba	Sandilands	21/7/80
Uroleucon russellae	Thomisidae-Misumena vatia	Anaphalis margaritacea	Lilypond	11/9/81
	Braconidae-Acanthocaudus tissoti	Anaphalis margaritacea	Lilypond	21/7/81
Uroleucon(Lambersius)erigeronensis	Anthocoridae-Orius tristicolor	Erigeron sp.	Hanson Creek	11/9/81
	Syrphidae-Metasyrphus perplexus	Erigeron sp.	Hanson Creek	11/9/81
	Metasyrphus sp.	Erigeron sp.	Hanson Creek	11/9/81
	Braconidae-Aphidius ribis	Erigeron sp.	Hanson Creek	11/9/81
Uroleucon(Lambersius) sp.	Anthocoridae-Orius tristicolor	Aster sp.	Agassiz Forest	11/9/81
	Coccinellidae-Hippodamia convergens	Aster sp.	Agassiz Forest	11/9/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Uroleucon(Uroleucon) ambrosiae	Erythraeidae-Bochartia sp.(larva)	Solidago sp.	Treesbank	28/7/81
	Dictynidae-Dictyna alaskae	Solidago sp.	Morden	16/7/81
	Dictyna sp.(juv.)	Solidago sp.	St. Ambroise	26/8/81
	Tetragnathidae-Tetragnatha sp.(juv.)	Solidago sp.	St. Ambroise	26/8/81
	Anthocoridae-Orius tristicolor	Solidago sp.	Morden	16/7/81
	Chrysopidae-Chrysopa carnea	Solidago sp.	Morden	16/7/81
	Hemerobiidae-Micromus angulatus	Solidago sp.	Spruce Woods	14/7/81
	Micromus posticus	Solidago sp.	Spruce Woods	14/7/81
	Coccinellidae-Coccinella transversoguttata	Solidago sp.	Morden	16/7/81
	Hippodamia convergens	Solidago sp.	Birds Hill	6/7/81
	Hippodamia convergens	Crepis tectorum	Whiteshell	21/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Uroleucon(Uroleucon) ambrosiae	Cecidomyiidae-Aphidoletes aphidimyza	Solidago sp.	Morden	16/7/81
	Syrphidae-Epistrophe emarginata	Solidago sp.	Spruce Woods	14/7/81
	Metasyrphus sp.	Solidago sp.	Grand Beach	22/6/80
	Sphaerophoria contigua	Compositae	Brokenhead	25/6/81
	Braconidae-Adialytus salicaphis	Solidago sp.	St. Ambroise	26/8/81
	Aphidius rosae	Solidago sp.	Morden	16/7/81
	Aphidius sp.	Solidago sp.	Morden	16/7/81
	Praon sp.	Compositae	Brokenhead	25/6/81
	Praon sp.	Solidago sp.	Morden	16/7/81
	Trioxys sp.	Solidago sp.	Pine Grove Halt	24/6/81
Uroleucon(Uroleucon) eupatoricolens	Dictynidae-Dictyna sp.(juv.)	Eupatorium sp.	Patricia Beach	30/8/81
Uroleucon(Uroleucon) nigrotuberculatum	Thomisidae-Misumena vatia	Solidago sp.	Birds Hill	6/7/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Uroleucon(Uroleucon) nigrotuberculatum	Coccinellidae-Hippodamia convergens	Solidago sp.	Birds Hill	6/7/81
	Syrphidae-Toxomerus geminatus	Solidago sp.	Birds Hill	6/7/81
	Braconidae-Ephedrus incompletus	Solidago sp.	Birds Hill	6/7/81
Uroleucon(Uroleucon) obscuricaudatum	Coccinellidae-Hippodamia convergens	Aster sp.	Winnipeg	19/6/81
Uroleucon(Uroleucon) olivei	Dictynidae-Dictyna sp.(juv.)	Aster sp.	Patricia Beach	30/8/81
	Syrphidae-Syrphus ribesii	Aster sp.	Patricia Beach	30/8/81
	Syrphus ribesii	Aster sp.	Souris	6/9/81
Uroleucon(Uroleucon) paucosensoriatum	Thomisidae-Misumena vatia	Aster ciliolatus	Sandilands	4/9/81
	Hemerobiidae-Hemerobius humulinus	Aster ciliolatus	Sandilands	4/9/81
	Coccinellidae-Hippodamia convergens	Aster ciliolatus	Sandilands	4/9/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Uroleucon(Uroleucon) pieloui	Thomisidae-Misumena vatia(juv.)	Solidago sp.	Alf Hole Goose Sanctuary	11/9/81
Uroleucon(Uroleucon) rudbeckiae	Braconidae-Trioxys(Binodoxys) sp.	Rudbeckia hirta	Spruce Woods	14/7/81
Uroleucon(Uroleucon) solirostratum	Erythraeidae-?genus(imagochrysalis)	Solidago sp.	Zhoda	19/8/80
Uroleucon spp.	Trombidiidae-Allothrombium sp.(larva)	Solidago sp.	Winnipeg	11/8/81
	Dictynidae-Dictyna sp.(juv.)	Solidago sp.	Hanson Creek	11/9/81
	Thomisidae-Philodromus rufus	Solidago sp.	Birds Hill	21/7/81
	Misumena vatia	Solidago sp.	Grand Beach	25/7/81
	Misumena vatia	Solidago sp.	Winnipeg	11/8/81
	Misumena vatia	Solidago sp.	Birds Hill	21/8/81
	Coccinellidae-Adalia bipunctata	Ambrosia trifida	Winnipeg	28/7/80
	Coccinella transversoguttata richardsoni	Erigeron sp.	Belair Forest	26/7/80

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Uroleucon spp.	Coccinella transverso-guttata richardsoni	Solidago sp.	Winnipeg	11/8/81
	Coccinella transverso-guttata richardsoni	Solidago sp.	Birds Hill	21/8/81
	Coccinella transverso-guttata richardsoni	Solidago sp.	St. Ambroise	26/8/81
	Coccinella trifasciata perplexa	Erigeron sp.	Belair Forest	26/7/80
	Coccinella trifasciata perplexa	Solidago sp.	Birds Hill	21/8/81
	Hippodamia convergens	Solidago sp.	Winnipeg	11/8/81
	Hippodamia tredecim-punctata tibialis	Artemesia sp.	Lilypond	11/9/81
	Syrphidae-Sphaerophoria contigua	Solidago sp.	Belair Forest	18/6/80
	Syrphus ribesii	Solidago sp.	Winnipeg	11/8/81
	Chamaemyiidae-Leucopis albipunctata	Solidago sp.	Winnipeg	11/8/81

Table 8 continued

Aphid	Natural Enemy	Host Plant	Location	Date
Uroleucon spp.	Braconidae- Acanthocaudus tissoti	Solidago sp.	Winnipeg	11/8/81
	Aphidius nigripes	Solidago sp.	Winnipeg	11/8/81
	Aphidius sp.	Solidago sp.	Birds Hill	18/6/80
	Praon sp.	Solidago sp.	Winnipeg	11/8/81

Table 10. List of some hymenopteran parasitoids attacking predators of aphids in Manitoba during 1980 and 1981.

Predator	Parasitoid	Location	Date
Chrysopidae Chrysopa oculata	Encyrtidae- Homalotylus sp.	Glenlea	7/8/80
Coccinellidae Coccinella sp.	Encyrtidae- Homalotylus terminalis californicus Girault	La Barriere	11/6/81
Syrphidae	Ichneumonidae- Diplazon angustus Dasch	Churchill	5/8/81
	Diplazon laetatorius(Fabricius)	Winnipeg	21/5/80
	Diplazon laetatorius	Winnipeg	1/7/80
	Diplazon laetatorius	Spruce Woods	12/8/80
	Diplazon laetatorius	Hanson Creek	21/7/81
	Diplazon laetatorius	Winnipeg	22/5/81
	Diplazon laetatorius	Winnipeg	24/6/81
	Diplazon laetatorius	Spruce Woods	14/7/81
	Diplazon laetatorius	Winnipeg	27/5/81

Table 10. continued

Predator	Parasitoid	Location	Date
Syrphidae	Diplazon laetatorius	Winnipeg	26/5/81
	Diplazon laetatorius	Morden	16/7/81
	Diplazon laetatorius	Winnipeg	11/8/81
	Diplazon laetatorius	Hanson Creek	21/7/81
	Diplazon laetatorius	Lilypond	21/7/81
	Diplazon laetatorius	Lilypond	21/7/81
	Diplazon laetatorius	St. Ambroise	26/8/81
	Diplazon laetatorius	La Barriere	11/6/81
	Diplazon pectoratorus (Thumberg)	Churchill	6/8/81
	Diplazon scutellaris (Cresson)	Birds Hill	6/7/81
	Diplazon tetragonus Thunberg	Pine Grove Halt	10/6/80
	Diplazon tetragonus	Winnipeg	3/7/80
	Diplazon tetragonus	Winnipeg	26/5/81

Table 10. continued

Predator	Parasitoid	Location	Date
Syrphidae	Diplazon tetragonus	Spruce Woods	14/7/81
	Homotropus maculifrons Cresson	Winnipeg	21/5/80
	Homotropus nigritarsus (Gravenhorst)	Lilypond	21/7/81
	Homotropus nigritarsus	Churchill	6/8/81
	Homotropus sp.	Pine Grove Halt	24/6/81
	Homotropus sp.	Clear Lake	12/7/81
	Syrphophilus bizonarius(Gravenhorst)	Winnipeg	15/3/81
	Syrphoctonus citropectoralis Schmiedeknecht	Winnipeg	22/5/81
	Syrphoctonus citropectoralis	Clear Lake	12/7/81
	Syrphoctonus flavolineatus(Gravenhorst)	Winnipeg	22/5/81
	Syrphoctonus flavolineatus	Spruce Woods	28/7/81

Table 10. continued

Predator	Parasitoid	Location	Date
Syrphidae	Encyrtidae-Bothriothorax sp.	Birds Hill	23/6/80
	Figitidae-Callaspidia sp.	Zhoda	19/8/81
	Megaspilidae-Trichosteresis foersteri Kieffer	Winnipeg	7/8/80
	Trichosteresis foersteri	Winnipeg	22/5/81
Chamaemyiidae	Encyrtidae-Coccidencyrtus sp.	Spruce Woods	6/8/80
	Coccidencyrtus sp.	Whitemouth Lake	19/8/80
	Coccidencyrtus sp.	Birds Hill	23/6/80
	Coccidencyrtus sp.	Clear Lake	16/8/80
	Paralitomastix sp.	Hanson Creek	21/7/81
	Paralitomastix sp.	Beaver Creek	9/7/81
	Paralitomastix sp.	Winnipeg	11/8/81
	Paralitomastix sp.	St. Ambroise	26/8/81

Table 10. continued

Predator	Parasitoid	Location	Date
Chamaemyiidae	Pteromalidae- Euneura lachni(Ashmead)	Rathwell	14/7/81
	Pachyneuron sp.	Morden	16/7/81
	Figitidae- Melanips iowensis Ashmead	Pine Grove Halt	24/6/81
	Melanips iowensis	Sandilands	24/6/81
	Melanips iowensis	Spruce Woods	12/7/81
	Melanips iowensis	Rathwell	14/7/81
	Melanips iowensis	Winnipeg	11/8/81
	Melanips iowensis	Morden	16/7/81
	Melanips iowensis	Sandilands	4/9/81
	Melanips iowensis	Patricia Beach	30/8/81
	Melanips iowensis	Sandilands	4/9/81
	Melanips iowensis	Winnipeg	11/8/81
	Melanips sp.	Birds Hill	11/6/80

Table 10. continued

Predator	Parasitoid	Location	Date
Chamaemyiidae (Leucopis sp.?)	Melanips sp.	Birds Hill	23/6/80
	Melanips sp.	Sandilands	21/7/80
	Melanips sp.	Morden	30/7/80
	Melanips sp.	Winnipeg	1/8/80
	Melanips sp.	Hecla Island	3/8/80
	Melanips sp.	Spruce Woods	6/8/80
	Melanips sp.	Spruce Woods	12/8/80
	Melanips sp.	Clear Lake	16/8/80
	Melanips sp.	Whitemouth Lake	19/8/80
	Megasphilidae-Dendrocerus(new species)	Morden	30/7/80
	Dendrocerus(n.sp.)	Hecla Island	3/8/80
	Dendrocerus(n.sp.)	Hanson Creek	21/7/81
Eggs in aphid colony	Mymaridae-Polynema sp.	Winnipeg	11/8/81
	Trichogrammatidae-Trichogramma sp.	Spruce Woods	28/7/81
	Eulophidae-Tetrastichus sp. ?	Patricia Beach	30/8/81

Table 11. List of some secondary parasitoids of aphid parasitoids collected in Manitoba in 1980-1981.

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Alloxystidae				
Alloxysta lachini (Ashmead)	Rhopalosiphum cerasifoliae	Prunus virginiana	Sandilands	10/6/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	Aphthargelia symphoricarpi	Symphoricarpos alba	Sandilands	21/7/80
	Periphyllus negundinis	Acer negundo	Morden	30/7/80
	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	6/8/80
	Hamamelistes spinosus	Betula glandulifera	Rathwell	12/8/80
	Capitophorus elaeagni	Cirsium arvense	Glenlea	18/8/80
	Aphis neogillettei	Cornus alba	Moose Lake	19/8/80
	Chaitophorus populicola	Populus tremuloides	Moose Lake	19/8/80
	Uroleucon(Uroleucon) solirostratum	Solidago sp.	Zhoda	19/8/80

Table 11. continued

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Alloxysta victrix (Westwood)	Macrosiphum pseudo-rosae	Rosa sp.	Pine Grove Halt	24/6/81
	?	Corylus sp.	Birds Hill	6/7/81
	Chaitophorus populicola(parasitoid: Praon sp.)	Populus tremuloides	Clear Lake	12/7/81
	Macrosiphum pseudo-rosae	Rosa sp.	Lilypond	21/7/81
	Macrosiphoniella tapuskae or Pleotrichophorus pseudopatonkus	Achillea millefolium	Churchill	8/8/81
	Pterocomma smithiae	Salix sp.	Sandilands	4/9/81
Alloxysta halli Andrews	Uroleucon(Uroleucon) ambrosiae(Thomas)	Solidago sp.	St. Ambroise	26/8/81
Alloxysta megourae Complex	Aphis viburniphila	Viburnum rafinesquianum	Birds Hill	6/7/81
	Aphis neogillettei	Cornus alba	Beaver Creek	9/7/81
	Uroleucon sp.	Solidago sp.	Grand Beach	25/7/81
	Aphis neogillettei	Cornus alba	Winnipeg	11/8/81

Table 11. continued

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Lytoxysta brevipalpis Kieffer	Asiphonaphis pruni	Prunus virginiana	Sandilands	24/6/81
	Aphthargelia symphoricarpi	Symphoricarpos albus	Sandilands	4/9/81
Phaenoglyphis americana Baker	Cavariella pastinacae(L.)	Heracleum lanatum	Clear Lake	12/7/81
	Chaitophorus populicola	Populus tremuloides	Pine Grove Halt	24/6/81
	Uroleucon(Uroleucon) ambrosiae	Compositae	Brokenhead	25/6/81
	Macrosiphum pseudorosae	Rosa sp.	Birds Hill	6/7/81
	Chaitophorus nigrae	Salix sp.	Morden	16/7/81
	Aphis helianthi	Cornus alba	Winnipeg	22/5/81
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	Morden	16/7/81
Phaenoglyphis ambrosiae(Ashmead)	Uroleucon(Uroleucon) ambrosiae	Composite	Brokenhead	25/6/81

Table 11. continued

Secondary Paraistoid	Aphid	Host Plant	Location	Date
Pteromalidae				
Asaphes vulgaris Walker	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	6/8/80
	Sitobion avenae	Triticum aestivum	Glenlea	7/8/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Whitemouth Lake	19/8/80
	Uroleucon(Uroleucon) solirostratum	Solidago sp.	Zhoda	18/8/80
	Rhopalosiphum padi	Prunus nigra	Winnipeg	27/5/81
	Periphyllus negundinis	Acer negundo	Winnipeg	5/6/81
	Chaitophorus populicola	Populus balsamifera	Spruce Woods	28/7/81
	Chaitophorus populicola	Populus tremuloides	Pine Grove Halt	24/6/81
	Cavariella konoi	Cicuta maculata	Clear Lake	12/7/81
	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	St. Ambroise	26/8/81
	Meliarhizophagus fraxinifolii	Fraxinus pennsylvanica	Spruce Woods	14/7/81

Table 11. continued

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Asaphes vulgaris	Uroleucon(Uroleucon) rudbeckiae	Rudbeckia sp.	Spruce Woods	14/7/81
Pachyneuron sp.	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	6/8/80
	Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Birds Hill	23/6/80
	Hyperomyzus lactucae	Sonchus arvensis	La Barriere	6/8/80
	Hamamelistes spinosus	Betula glandulifera	Rathwell	12/8/80
	Chaitophorus viminalis	Salix sp.	Spruce Woods	12/8/80
	Rhopalosiphum cerasifoliae	Prunus virginiana	Whitemouth Lake	19/8/80
	Cinara pergandei	Pinus banksiana	Sandilands	24/6/81
	Rhopalosiphum padi	Prunus virginiana	Spruce Woods	14/7/81
	Chaitophorus populicola	Populus tremuloides	Treesbank	28/7/81

Table 11. continued

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Euneura lachni (Ashmead)	Myzus cerasi	Prunus pensylvanicus	Birds Hill	6/7/81
	Pterocomma smithiae	Populus balsamifera	Birds Hill	6/7/81
Eupteromalus sp.	Hyperomyzus lactucae	Sonchus arvensis	St. Ambroise	26/8/81
Eulophidae				
Diglyphus begini (Ashmead)	Uroleucon sp.	Lonicera tatarica	Winnipeg	24/7/81
Diglyphus pulchripes(Crawford)	Uroleucon sp.	Lonicera tatarica	Winnipeg	24/7/81
	Hyadaphis tataricae	Lonicera tatarica	Winnipeg	11/8/81
	Aphis neogillettei	Cornus alba	Winnipeg	20/8/81
Megaspilidae				
Dendrocerus carpenteri(Kieff)	Asiphonaphis pruni	Prunus virginiana	Spruce Woods	6/8/80
	Aphis viburniphila	Viburnum sp.	Winnipeg	21/5/80
	Sitobion manitobensis	Cornus alba	Winnipeg	21/5/80

Table 11. continued

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Dendrocerus carpenteri	Myzus cerasi	Prunus virginiana	Birds Hill	11/6/80
(in Praon sp.)	Rhopalosiphum padi	Prunus nigra	Winnipeg	27/5/81
	Chaitophorus populicola	Populus tremuloides	Pine Grove Halt	24/6/81
	Uroleucon(Uroleucon) ambrosiae	Compositae	Brokenhead	25/6/81
	Aphis neogillettei	Cornus alba	Beaver Creek	9/7/81
	Macrosiphum pseudorosae	Solidago sp.	Beaver Creek	9/7/81
	Cavariella konoi	Cicuta maculata	Clear Lake	12/7/81
	Aphis neogillettei	Cornus alba	Rathwell	14/7/81
	Rhopalosiphum padi	Prunus virginiana	Spruce Woods	14/7/81
	Macrosiphum pseudorosae	Rosa sp.	Lilypond	21/7/81
	Nasonovia(Kakimia) houghtonensis similis	Ribes oxyacanthoides	Churchill	5/8/81
	Sitobion avenae	Calamagrostis canadensis	Churchill	6/8/81

Table 11. continued

Secondary Parasitoid	Aphid	Host Plant	Location	Date
Dendrocerus carpenteri	Uroleucon(Uroleucon) ambrosiae	Solidago sp.	St. Ambroise	26/8/81
	Hyperomyzus lactucae	Sonchus arvensis	Grand Beach	1/9/81
	Hyperomyzus pallidus	Sonchus arvensis	Grand Beach	1/9/81
	Aphis barberae	Arctium lappa	Grand Beach	5/9/81
Dendrocerus sp.	Cinara laricifex	Larix laricina	Churchill	6/8/81
Ceraphronidae				
Aphanogmus sp.	Chaitophorus populifolii	Populus tremuloides	Sandilands	24/6/81

Table 12. List of aphids collected in Manitoba in 1980-1981, which were not attacked by natural enemies(Species marked with an asterisk(*) had natural enemy(ies) which could not be reared through to adult).

Aphid	Host Plant	Location	Date
Anoecia cornicola (Walsh)	Cornus alba	Brandon	6/9/81
Aphis craccae L.	Vicia cracca L.	Hanson Creek	21/7/81
Aphis gossypii Glover*	Diervilla lonicera Mill	Hanson Creek	26/6/80
Aphis rumicis L.*	Rumex sp.	Churchill	4/8/81
Cavariella aegopodii(Scopoli)*	Anethum graveolens L.	Winnipeg	24/6/81
Cinara obscura Bradley	Picea glauca (Moench)Voss	Churchill	5/8/81
Cryptomyzus ribis(L.)	Ribes sp.	Hanson Creek	26/6/80
Eriosoma crataegi(Oestlund)	Crataegus sp.	Winnipeg	1/8/80
Gypsoaphis oestlundi Hottes	Lonicera dioica	Sandilands	4/9/81
Hyperomyzus(Neonasonovia)nabali (Oestlund)	Ribes sp.	Churchill	5/8/81
Macrosiphum(Neocorylobium) coryli Davis*	Corylus sp.	Winnipeg	6/6/80
Maculolachnus sijpkensi Hille Ris Lambers	Rosa sp.	Spruce Woods	12/8/80
Pterocomma bicolor(Oestlund)	Salix sp.	Beaver Creek	9/7/81
Stagona xylostei (De Geer)	Lonicera oblongifolia(Goldie)Hook	Birds Hill	6/7/81

Table 12 continued

Aphid	Host Plant	Location	Date
Thecabius(Para-thecabius) gravi-cornis(Patch)	Polygonum sp.	Spruce Woods	28/7/81
Uroleucon chry-santhemi(Oest-lund)	Bidens cernua L.	Clear Lake	16/8/80

Table 13. Most commonly collected predators and parasitoids of aphids, and the habitats in which they were found(numbers indicate frequency of occurrence in each habitat).

	Wetlands				Woodlands					Other				
Habitat	Marsh	River and Stream Banks	Lake Shoreline and Beach	Ocean Shoreline and Beach	Deciduous Forest	Mixed Forest	Coniferous Forest	Taiga	Shrubby Burn/ Clear Cut Area	Road Side	Open Prairie	Field	Urban Area	Tundra
Dictyna sp.	2	3	4											
Misumena vatia		1							3	2	1			
Chrysopa carnea	3	2	2		2								3	
Hemerobius humulinus		1			3	3	1		1	1			3	
Scymnus iowensis			3		3	2	1							
Scymnus lacustris			1		9	2	1		7					
Adalia bipunctata													10	
Coccinella transversoguttata	1		1	1	3	1		1	2	2	2			
Hippodamia convergens	2	1	1		2			1	3	2	2	1	4	1
Hippodamia tredecimpunctata	2	1	1		1							2		
Metasyrphus americanus		1					1				1		4	
Metasyrphus perplexus								3		4				
Sphaerophoria contigua		1			3	1			4	4				
Syrphus rectus	1	1			2	3				1			1	
Syrphus ribesii	3				7	2				1	1		1	
Leucopis albipunctata		1	3		6	1	1		9	5	3		7	
Leucopis americana		4	5		7	3			4	2			6	
Adialytus salicaphis					6	3								
Ephedrus incompletus			1		4	2								
Lysiphlebus testaceipes		2	1		5	1			6	2			1	
Praon sp.					4	1			1		1		9	
Trioxys sp.		1	2		5	2				1			5	
Aphelinus sp.		1			2	1			8	4			1	

X DISCUSSION

The 1981 collections contained a greater diversity of aphid, predator, and parasitoid species than did the 1980 collections. The lower diversity in 1980 can be attributed (at least in part) to the unusually hot, dry weather at the beginning of that season. During this dry period, the most common aphid species collected were those in ant attended colonies on shrubs and tree saplings(eg. Prunus spp., Cornus alba, Crataegus spp., Populus spp.). According to Schneider (1969), ants will vigorously defend a large food supply. Possibly due to food shortages associated with a dry spring, the ants were very protective of honey dew supplies, and of the aphids producing the honey dew. As a result of reduced predator pressure, these aphid populations flourished, while unprotected colonies remained scarce. Certain predator species, particularly those most commonly found in ant attended colonies (eg. Scymnus lacustris, Scymnus iowensis, and Adalia bipunctata), were collected more often in 1980 than in 1981.

Because of the limited aphid species diversity in early 1980, some predators and parasitoids may have chosen suboptimal prey/hosts. In this way, some of the 1980 prey/host records may not represent 'typical' records for some species. In addition, there was some bias in the sampling in both years, since areas in the vicinity of Winnipeg (i.e within 120 km) were sampled more often than areas a greater distance away. Thus, this survey is by no means an exhaustive survey of natural enemies of aphids in Manitoba.

PREDATORS OF APHIDS

A. Collections

Several interesting patterns of behavior in aphids and their predators were noted while collecting samples in the field. According to Dixon (1958), in order to avoid approaching predators, many aphid species face towards the leaf petiole, or downward on the host plant stem. Several species (including Anoecia cornicola, and many Chaitophorus sp.) collected in this study faced towards the leaf petiole. Uroleucon spp. feeding on stems of Compositae, exhibited a 'wriggling' motion and a downward posture. According to Dureseau et al.,(1972), Ephedrus plagiator Nees is repelled by any violent movements of the host prior to oviposition. Since only a few specimens of parasitoids of aphids were collected from Uroleucon colonies (Table 8 pages 159 to 165), it is possible that this 'wriggling' discourages parasitoid attack. In addition, many aphid species (incl. Uroleucon spp., Macrosiphum spp., and Acyrthosiphon spp.), were quick to 'drop' off the plant when disturbed. Certain adult coccinellids, especially Scymnus spp. were also quick to drop from aphid colonies when disturbed.

Some predator species had ways of avoiding disturbance. Larvae of Epistrophe emarginata are very dorso-ventrally flattened, and very distinctively coloured. The 2 to 3 mm long early instars are bright yellow anteriorly, and bright pink posteriorly. Later instars are yellow or peach with a pink stripe running dorsally from the head to the prominent hind tubercles. Despite their distinctive colouration, E. emarginata larvae are often not noticed because they remain close to the bark of the host plant, resembling a bright scale insect, and are often covered by the aphid colony. This scale-like appearance, along with their slow

movements may be an adaptation to avoiding harassment by ants which were frequently tending aphid colonies where Epistrophe sp. occurred. In support of this, Way (1963) stated that camouflage and slow or gentle movements by a predator in an ant attended aphid colony often decrease the chances of it being attacked by ants. The feeding behavior of E. emarginata differed from that observed in other syrphid species. Instead of groping along and grabbing any portion of the aphid's body they contacted, E. emarginata larvae would grab the aphid by its venter. This 'scooping' motion is probably related to their flat shape, and habit of 'burying' themselves beneath the aphid colonies. Another species with similar larval characteristics and behavior was Melangyna triangulifera. This species was also found covered by a colony of ant attended bark aphids, however, M. tringulifera's colouration(beige with mustard green markings), was much less distinctive.

Larvae of Feneseca tarquinius and several Syrphus ribesii larvae were found 'beneath' colonies of the woolly alder aphid Prociphilus (Paraprociphilus)tessellatus. The colonies, consisting of layers of woolly cast skins and dead aphids on the surface, and living aphids beneath, provided the predators with protection as well as food. Of all the specimens of Chrysopa carnea collected, only those found in woolly aphid colonies, and in one colony of Aphis helianthi piled dead aphids on their backs. Once a Chrysopa larva had piled a few dead woolly aphids on its back, it would be well camouflaged; however, the larva may not gain the same advantage in colonies of other types of aphids (i.e. individuals displaying backpiling behavior in 'non-woolly' aphid colonies might be selected against by being more conspicuous to both their enemies and to their prey).

On three occasions, adult female Leucopis spp. were observed resting on a leaf near an ant attended colony. When the ants left the colony, or were some distance away from the flies, the flies would enter the colony and oviposit or simply walk around. It seemed as if these females were 'waiting' for an opportunity to oviposit or possibly feed on honey dew, without being attacked by ants.

The highest concentration of predators in any one area was found at St. Ambroise Marsh in late August of 1981. Almost every blade of Phragmites sp. in the marsh bore a colony of Hyalopterus pruni, and most of these colonies were being attacked by 2 to 3 larvae or adult Hippodamia convergens and H. tredecimpunctata. Aphis heraclella on Cicuta maculata in the marsh were also heavily predated on by these two coccinellids, and by Coccinella transversoguttata. Perhaps infestations in areas like this (i.e. close to lakes) are responsible for the lake shore overwintering coccinellid masses reported by many authors.

B. Predator Rearing and Pea Aphid Consumption

While rearing immature predators through to adult in the laboratory, a few observations regarding predator feeding behavior were made. When feeding on early instars of pea aphids, the larvae of Orius tristicolor would often attack their prey by puncturing one of the prey's leg articulations with their proboscis. The aphid's body fluids were then drawn out(As far as is known, this behavior has not been previously reported for Orius spp.).

Many predaceous Neuroptera are not predaceous in the adult stage (Sundby, 1967; Tauber and Tauber, 1974). Of all the Neuroptera collected

and reared during 1980 and 1981, Micromus angulatus and Hemerobius humulinus were the only species in which the adults would consume aphids (first instar pea aphids) in the laboratory.

Most Syrphus ribesii larvae readily accepted and consumed pea aphids in the laboratory. S. ribesii from woolly alder aphid (P. tessellatus) colonies were an exception; these specimens died when deprived of alder aphids. Perhaps speciation through population isolation is in process here.

i) Rearing Problems

There were several problems associated with rearing aphid predators in the laboratory on a diet of pea aphids. For some predators, pea aphids were an unacceptable food item, and unfortunately in certain instances, by the time this unacceptability was noticed, the original prey species was no longer available. A number of Chamaemyiidae from several samples were lost for this reason. Many syrphid larvae (particularly Epistrophe spp.), entered diapause in response to a lack of acceptable food. According to Dusek and Laska(1966), this response to food shortage is common to many syrphid species. In some cases (some Syrphidae, most Cecidomyiidae, and certain Chamaemyiidae), disturbance, or removal of the predator from the aphid colony was enough to cause fasting and/or diapause. Attempts to break diapause by a) changing moisture levels, or b) placing predators in a cold chamber (4°C) were futile, and the specimens eventually died. Other individuals, particularly some hemerobiids and syrphids, consumed a minimal number of pea aphids, and then entered a pupal or pre-pupal stage from which they never emerged (these individuals may have not had

sufficient nutrients to complete metamorphosis). The loss of specimens means that there is a bias in Table 6 towards those predators which would consume pea aphids.

Perhaps the most unfortunate losses were of predators collected in Churchill. Many syrphids collected from Cinara laricifex and Aphis rumicis colonies died in transit, or in the laboratory from what appeared to be a viral disease. Changes in temperature, high humidity in the petri dishes, and changes in prey species may have contributed to these fatalities.

C. Identifications

At least 2 new species of Leucopis(Chamaemyiidae) were collected during 1980 and 1981. Since little information on the biology of the Chamaemyiidae in Canada is available, many of the host records reported here are 'new' as well.

Several species of Syrphidae including Paragus spp., Toxomerus geminatus, Melangyna fisherii, Epistrophe emarginata, Platycheirus scambus, and Metasyrphus perplexus, are 'rare' or uncommon, and little is known of their life histories and host preferences (Vockeroth, personal comm.). Other uncommon predator species collected include Feneseca tarquinius (Lycaenidae), Calvia quatuorodecimguttata (Coccinellidae), Micromus posticus and M. angulatus (Hemerobiidae) (Table 6). F. tarquinius is uncommon due to its preferences for certain relatively uncommon woolly aphids. Locally it is common almost where ever the alder aphid Prociphilus(Paraprociphilus)tessellatus is found.

D. Prey Selection

Most aphid predators are polyphagous, i.e. they will prey upon

more than one species of aphid. In this survey, four species of predators collected were specific to one group of aphids. Feneseca tarquinius as previously discussed, attacked only Prociphilus(Paraprociphilus) tessellatus, and the anthocorid Orius tristicolor was found only in colonies of Uroleucon spp.. In 7 out of 8 collections, the thomisid Misumena vatia was collected in colonies of Uroleucon spp.. However, since this light yellow spider was collected only in aphid colonies in the inflorescence of yellow or white flowering composites, it may have 'chosen' the plant species for camouflage, rather than for the aphid species living there. Fourthly, the active, rather robust larvae of one of the new species of Leucopis was collected exclusively in Hyalopterus pruni colonies on Phragmites sp..

Although the other predators of aphids collected were polyphagous, some species, particularly those which oviposit only in or near aphid colonies, displayed a preference for one 'group' of aphids over other 'groups'. Leucopis albipunctata, for example, in 25 of 37 samples preyed on aphids which curled the leaves of their host plants(8 Aphis spp., Myzus cerasi, and Rhopalosiphum cerasifoliae were attacked)(Table 6 pages 95to 97). Similarly, Scymnus(Pullus)iowensis was found in 15 of 15 collections in leaf curling aphid colonies, as were 7 of 9 collections of Adalia bipunctata (Table 6 pages 78 and 80 resp.). These 3 species are not specific to the same habitats (L. albipunctata was found in a variety of habitats, S. lacustris was found mainly in woodland areas, and A. bipunctata was found only in cultivated areas)(Table 13). They are however, all small species, and thus may be taking advantage of the protection afforded by the curled leaves of the host plants. In addition, the small size of these predators may make capture and consumption

of a large aphid difficult. Conversely Hippodamia convergens, a generalist in habitat, appeared to prefer (in 15 of 24 samples) large, long legged aphid species, particularly Uroleucon spp., over other species.

Many predators of aphids did not appear to have any specific prey preferences. According to Schneider (1969), aphids and their exudations emanate odours which stimulate oviposition response in syrphids (so that most syrphid species will oviposit only in or near aphid colonies). It would seem reasonable to expect at least some species would prefer one group or species of aphids over others. Yet in this survey, almost all of the syrphid species collected occurred in a variety of aphid species colonies. It is interesting to note that Hyperomyzus lactucae was attacked by almost all of the common species of Syrphidae. Perhaps the yellow flowers of the host plant (Sonchus arvensis) of H. lactucae initially attracted the adult syrphids to the plant, and the presence of the aphids on the flowers and upper stems consequently stimulated oviposition behavior in the female syrphids. Metasyrphus perplexus was almost certainly attracted to flowering plants, since 6 of 7 collections of this species were taken from aphid colonies in or near the inflorescence of herbs.

In addition to the syrphids, Coccinella transversoguttata, Hippodamia tredecimpunctata, and Chrysopa carnea were also generalist predators of aphids. The two coccinellids did not appear to prefer any one habitat, while C. carnea did show some preference for habitats near bodies of water. All of the common syrphid species appeared to prefer woodland or roadside habitats(Table 13).

E. Parasitoids of Predators

Of the 269 syrphid specimens collected, only about 18% were parasitized(Table 10). This is considerably lower than the 35% parasitization rate reported by Remaudière and LeClant (1971) for syrphids in peach orchards in France. Both Chrysopidae and Coccinellidae had a less than 1% parasitization rate. This contrasts greatly with the 20% parasitization rate of coccinellids in vegetable and grain fields in Central Missouri (Richerson and DeLoach, 1973). The higher percentages obtained from cultivated areas may be due to the concentration of aphid colonies and hense a more concentrated population of predators available for parasitoid attack. Of the over 420 specimens of Chamaemyiidae collected, an estimated 15% were parasitized. One of the species of parasitoids of Chamaemyiidae was a new species of Dendrocerus.

In addition to the parasitic Hymenoptera collected, one nematode parasitoid was collected from an adult Hippodamia convergens. Unfortunately, due to improper preservation methods, this specimen could not be identified.

PARASITOIDS OF APHIDS

A. Collections

Fourty-seven percent of the aphid species collected were parasitized by one or more species of Aphidiidae, and 16% by Encyrtidae. The most common species of parasitoid collected was Lysiphlebus testaceipes(Table 7, page 106), and at least one new species of Praon from Uroleucon spp. was collected. Most of the parasitoids of aphids (except Praon spp.) were collected in woodland areas, particularly in deciduous forests, and clear-cut areas(Table 13). Praon spp. were most

common in cultivated areas. Only a few parasitoids were obtained from aphid colonies near bodies of water.

B. Emergence

A few emergence problems arose possibly due to dry conditions in the laboratory. In addition, many of the parasitoids in overwintering cocoons collected in both the spring and fall did not emerge. This also may have been due to low humidity, or in the case of spring collections, the parasitoids may have not survived the winter.

C. Host Selection

According to Stary (1968b), Aphidiidae tend to be host specific due to their parallel evolution with the Aphidoidea. Unfortunately, due to taxonomic problems in the Aphidiidae and Aphelininae, and due to improper mounting of the Aphelininae, many specimens were not identified to species. As a result, observations of host selection were limited.

In 11 of 24 collections, L. testaceipes was associated with aphid colonies on Prunus virginiana (often with Rhopalosiphum cerasifoliae, and Asiphonaphis pruni colonies). In 8 of 10 collections, Adialytus salicaphis parasitized Chaitophorus populicola. Alternatively, Aphidius nigripes attacked a wide range of aphid species in a variety of habitats, including ocean shorelines and tundra near Churchill, where aphid colonies are few and widely dispersed. In order to take advantage of, and survive in habitats such as these, a parasitoid would have to be a generalist.

All but one sample of Aphelininae were collected from 'small' aphid

species. This seems logical since a) a small parasitoid would have difficulty attacking a large aphid, and b) the developing parasitoid larva would not be able to utilize the entire aphid, thus killing and mummifying the aphid might be difficult.

D. Secondary Parasitoids

Of the 800 specimens of parasitoids of aphids collected, 43% were parasitized by secondary parasitoids. More secondary parasitoids were collected in 1981 than in 1980. In 1980 only one species of Alloxystidae was collected(Table 11). Since endoparasitoids are reported to be host and habitat specific (Guitierrez, 1970; Kamijo and Takeda, 1973), this lack of species diversity in 1980 may be related to a limited primary parasitoid species diversity, stemming from the limited aphid species diversity in spring and early summer 1980.

APHIDS WITH NO NATURAL ENEMIES

Eleven of the 108 species of aphids collected appeared to have no predators or parasitoids. Five of these 11 species were woolly or wax-covered aphids. According to Johnson and Hawkes in Dixon, 1958; and Hodek, 1966, highly coloured, woolly, or wax-covered aphids are often not readily acceptable as food by predators. It is apparent from host records reported in Table 8, that this is not always the case. However, for the 5 species mentioned above, unacceptability may be the reason for absence of enemies. The waxy aphid Aphis craccae appeared to have no natural enemies. It might be argued that this species was only introduced to North America approximately 17 years ago(Quednau, 1966; Russell, 1966), and has probably not had time to

'acquire' natural enemies. However, the wax-covered aphid Hyadaphis tataricae, which was introduced to North America within the last 4 years (Boisvert et al., 1981), has already been exploited as a food source by many predators (Table 8, page 139).

Other species with no apparent natural enemies were all relatively rare.

XI SUMMARY AND CONCLUSIONS

During the summers of 1980 and 1981, samples of aphid colonies were collected from various areas of Manitoba south of the 52nd parallel, and from Churchill, Manitoba. Predators and parasitoids of aphids from these colonies were sorted, and immature predators were reared through to adult on a diet of pea aphids. Notes on the predators' reaction to this diet, and general behavior were recorded. At the end of each year, adult predators and parasitoids were sorted and identified.

A greater aphid, predator, and parasitoid species diversity was obtained in 1981 than in 1980. This was attributed, at least in part, to hot dry weather in spring of 1980.

At least 108 aphid species from 42 genera were collected from over 71 host plant species. At least 69 species of predators, from 21 families, and over 27 species from 2 families of hymenopteran parasitoids of aphids were collected from the aphid colonies. Eleven of the aphid species appeared to have no predators or parasitoids associated with their colonies. Of the predators tested, specimens from 51 species would consume pea aphids, and specimens from 19 would not.

Over 24 species of parasitic Hymenoptera from 5 families parasitized predators of aphids, and 15 species of secondary parasitoids from 5 families attacked parasitoids of aphids. Three species of egg parasitoids(hosts unknown) were also associated with the aphid colonies.

Of all the predators collected, only four species of predators

showed a preference for one particular aphid species(or genus) over all others. Several predator species appeared to prefer one group of aphids over others. Habitat preferences of various predators were discussed in relation to their choice of prey. In some cases, habitat and prey choice were correlated, while in others, they were not.

Not all of the parasitoids of aphids were identified to species, thus host preferences could not be discussed in any great detail. At least one species of Adialytus appeared to have a definite preference for Chaitophorus populicola over all other aphids. In addition, in those species that were identified, it appeared that the degree of habitat and host preference were positively related.

Some of the prey/host preferences discussed may reflect which aphids were most commonly collected rather than distinct preferences of predators and parasitoids. In addition, some records may not be representative of a predator's normal prey choice, since when a predator is starving, it may in an effort to survive, feed on a colony of aphids which are nutritionally sub-optimal for that predator.

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