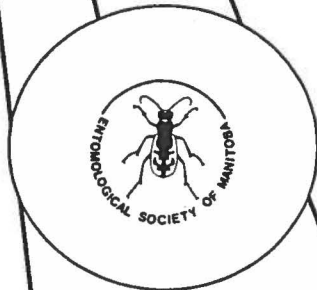


L. Brust

Proceedings
of the
Entomological
Society
of
Manitoba



Volume 50
1994

Published July, 1995
ISSN 0315-2146

**Proceedings of the
Entomological Society of
Manitoba.
VOLUME 50
1994.**

**A.R. Westwood,
Editor
Winnipeg, Manitoba.**

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ADULT LIFESPAN OF *CRYPTOLESTES FERRUGINEUS* (STEPHENS)
(COLEOPTERA: CUCUJIDAE) FOLLOWING LARVAL DEVELOPMENT AT
DIFFERENT TEMPERATURES OR AT DIFFERENT DENSITIES¹

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ABSTRACT

The lifespans of individually isolated virgin, *Cryptolestes ferrugineus* adults, were determined at 30°C following development at different temperatures and two densities. Larvae were raised from eggs in separate gelatin capsules containing ground wheat plus wheat germ at 25, 30, and 35°C. A fourth group of individually reared larvae was kept at 20°C for the first 30 days then transferred to 25°C until the adults formed. Larvae were also raised under relatively crowded conditions by starting with 100 eggs in a vial containing 3 g of ground wheat plus wheat germ. Mean developmental periods at different temperatures or at different densities were significantly different ($P < 0.05$), but mean adult lifespans were similar ($P > 0.05$). Adults raised at the high density treatment had significantly smaller head capsules than adults raised individually in gelatin capsules ($P < 0.01$).

INTRODUCTION

The length of adult life in holometabolous insects has often been reported to vary with changes in environmental conditions during the growth of the immature stages. Alpatov and Pearl (1929) found that adults of *Drosophila melanogaster* Meigen lived longer at 18, 25, and 28°C when they were raised from egg to adult at 18°C, than when they were raised at 28°C; adults of *Tribolium castaneum* (Herbst) lived longer at 35°C when they were raised at 25°C, than when they were raised at 35°C (Soliman and Lints 1982). Results of experiments by Burcombe and Hollingsworth (1970), and by Lints and Lints (1971) also indicated that the adult lifespan of *D. melanogaster* is inversely related to developmental temperature. However, in the

¹Research Centre Contribution No. 1549.

parasitic wasp, *Mormoniella vitripennis* Walk., adult lifespan and developmental temperature appear to be positively correlated; adults kept at 18, 25, and 30°C lived longer at each of these temperatures when development occurred at 30°C than they did when development occurred at 18°C (Clark and Kidwell 1967).

The influence of larval density on the adult lifespan of *D. melanogaster* was studied by Miller and Thomas (1958) and Lints and Lints (1969). Adult lifespan and larval development period were positively correlated with larval density, and adult size was negatively correlated with larval density.

In previous studies we observed the effects of mating status, sex ratio, food accessibility, adult population density, constant temperature throughout life, temperature varied during the adult period, and malathion resistance on longevity and reproductive capacity of *Cryptolestes ferrugineus* (Stephens) (White and Bell 1993, 1994, 1995). In the present study we examined the effect of four different developmental temperatures on the adult lifespan of *Cryptolestes ferrugineus* at 30°C, and the effect of crowding during the larval period on developmental period, adult size, and adult lifespan. *Cryptolestes ferrugineus* is one of the primary insect pests of stored cereals in western Canada (Sinha and Watters 1985), and the influence of environmental conditions during development on adult longevity may affect the infestation potential of this insect. This is especially relevant to older insects which may have survived the winter or reached adulthood in the spring several months before infesting newly harvested grain.

METHODS

The strain of *C. ferrugineus* used in this study originated from a mixture of adults collected from several farms in southern Manitoba over the past 20 years. Cultures were maintained in the laboratory at 30±1°C, 60–70% RH on whole kernel wheat and wheat germ (19:1, w/w). The feed used in the experiments was wheat plus wheat germ (4:1, w/w) that was ground fine enough to pass through a sieve with 420 µm apertures. During the experiments both the immature stages and the adults were kept in plastic containers in incubators with temperatures controlled to ±1°C. At the bottom of each container there was a large petri dish containing a saturated NaCl solution producing a relative humidity of 75±5% (Winston and Bates 1960).

The immature stages for the different temperature treatments were raised in gelatin capsules (size 00, 2.5 cm long, 0.8 cm diam). Eggs, 0–24 h old, were placed individually in separate gelatin capsules that were half-full of ground wheat plus wheat germ (0.2 g). This treatment had one larvae per capsule, equivalent to a density of 5 larvae/g. The temperatures used for three groups of immature stages were: 25, 30, and 35°C. A fourth group was kept at 20°C for the first 30 days, then transferred to 25°C until the adults were formed. This was done because very few larvae from another set of eggs, placed at 20°C at an earlier date, survived and completed development because this temperature is near the threshold for development (Smith 1965).

To produce larval development under crowded conditions, 100 eggs were placed in a vial, 2.8 cm by 7 cm, containing 3 g ground wheat plus wheat germ and allowed to develop into last (fourth) instars at 30°C (equivalent to 33 larvae/g food). The last instars were transferred individually to separate gelatin capsules to complete development because crowded larvae of this species do not pupate.

The sex of virgin adults from all five larval treatments was determined and insects were placed individually in separate vials, 1.5 cm by 4.5 cm, containing 1 g of ground wheat plus wheat germ. When the adults were 4 months old another 1/2 g of feed was added to each vial. The food was not changed during the experiments and the level of food in the vials did not appear to change and no molds were observed. All adult lifespans were determined at 30°C.

The widths of adult head capsules were measured for adults raised from larvae kept at 30°C in separate gelatin capsules and for adults raised from larvae kept at 30°C at high density. Using an ocular grid in a dissecting microscope the head capsules were measured across the mid-point of the eyes, from the outer edge of one eye to the outer edge of the other eye, after the adults had died.

Mean adult lifespans and mean developmental periods were compared by one-way analysis of variance tests.

RESULTS

Developmental periods of all immature stages increased as temperature decreased and the mean developmental period for the immature stages at the high density treatment was 30% longer than the mean developmental period for the immature stages that were reared in separate gelatin capsules at 30°C. All mean developmental periods were significantly different, both for males and females combined and for males and females tested separately ($P < 0.01$) (Table 1).

Mean adult lifespans at 30°C for adults raised from eggs at different temperatures were not significantly different for combined males and females ($P > 0.05$), but mean female adult lifespans were longer with immature stages kept at 25 than at 30°C ($P < 0.05$) (Table 1).

Mean adult lifespans at 30°C for adults from the high density larval treatment at 30°C were not significantly different from the mean adult lifespans of adults raised from eggs in separate gelatin capsules at 30°C ($P > 0.05$) (Table 1). Male adults lived longer than female adults for all larval treatments, but the differences were significant for only two of the five treatments ($P < 0.05$) (Table 1). Preliminary results with much higher larval densities which doubled and tripled development time (Smith 1966) also indicated no effect of crowding on adult lifespan (White and Bell, unpublished data).

Mean adult head capsule widths when larvae were raised at 30°C in separate gelatin capsules were 0.525 mm for males and 0.463 mm for females. When larvae were raised at 30°C at the high density treatment mean adult head capsule widths were 0.477 mm for males and 0.432 mm for females. The differences between the high and low density groups were significant for both males and females ($P < 0.01$), and within both density treatment groups the

differences between males and females were significant ($P < 0.01$).

DISCUSSION

Differences in developmental temperature do not affect the adult lifespan of *C. ferrugineus*. A comprehensive study by Economos and Lints (1986) has also called into question the validity of earlier findings on the relationship between developmental temperature and adult lifespan in *D. melanogaster*. In that study the whole range of temperatures at which *D. melanogaster* could complete development was used; flies were raised from eggs at 13 different temperatures increasing from 12 to 32.5°C by steps of 2 or 3°C, and mean adult lifespans at 25°C for flies raised at temperatures in the range 18 to 29°C were similar. Adults raised at temperatures above and below this optimum developmental temperature range had shorter lifespans. The authors concluded that physiological stresses occurring at both temperature extremes produced weaker adults with shortened lifespans. Earlier studies apparently did not have sufficient numbers of larval groups at different temperatures to reveal the stable phase in adult lifespan determined at a single temperature.

Larvae at relatively high density did not produce adults with different lifespans than adults raised from immature stages kept in separate gelatin capsules. In contrast, high density larval rearing in *D. melanogaster* seems to be a selection process in which only the most robust larvae survive and develop into flies with physiological characteristics that are superior, as a group, to flies raised in a low density, low stress environment. Populations of *D. melanogaster* selected for long lifespan for 15 generations by reproduction at increasingly later ages, lived longer than unselected flies (Rose 1984), had lower respiration rates (Service 1987), and greater resistance to starvation, desiccation, and ethanol vapour (Service *et al.* 1985). Since larval crowding inhibits feeding, as evidenced by delayed development, and smaller adults that emerge when larvae are raised at high density, genes for starvation resistance could be selected during the larval stage if larval mortality was relatively high. Similarly, genes for low respiration rate or desiccation resistance could be selected at the larval stage and remain active in the adult, contributing to longer adult survival.

C. ferrugineus adults produce fewer eggs (Smith 1966), and adult mortality increases (White and Bell 1993) as adult crowding increases. Little research has been done on the effects of larval crowding on lifespan in most stored-product insects. In *C. ferrugineus*, exposure to temperature that lies within the developmental range during the larval stage, and larval crowding did not have significant effects on adult longevity and the potential for future infestation of grain was not reduced.

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Table 1. Lifespan of *Cryptolestes ferrugineus* adults at 30°C, 75% RH raised from egg to adult at different temperatures or different densities (1 larva/0.2 g food or 100 larvae/3 g food).

Larval treatment	Number		Mean dev. period ¹ (days)	Mean dev. period ¹ (Egg to adult; days)		Mean adult lifespan ¹ (days)	Mean adult lifespan ¹ (days)		Difference between sexes ² (days)
	Females	Males		Females	Males		Females	Males	
35°C	55	63	22.7±0.1 ^a	22.5±0.1 ^a	22.9±0.1 ^a	216.1±4.5 ^a	213.0±6.3 ^{ab}	218.7±6.5 ^a	5.7 ^{ns}
30°C	51	64	27.8±0.1 ^b	27.8±0.1 ^b	28.0±0.1 ^b	226.8±5.3 ^a	219.6±8.5 ^a	232.6±6.8 ^a	13.0 ^{ns}
30°C Crowded ³	59	45	36.4±0.1 ^c	35.3±0.1 ^c	35.4±0.2 ^c	227.6±5.3 ^a	217.6±6.8 ^a	240.8±7.8 ^b	23.2 ^a
25°C	46	61	47.7±0.2 ^d	47.3±0.3 ^d	48.0±0.3 ^d	212.7±5.5 ^a	195.8±7.8 ^b	225.5±7.4 ^a	29.7 ^a
20—25°C ⁴	39	40	65.3±0.3 ^e	64.8±0.4 ^e	65.7±0.3 ^e	216.9±6.0 ^a	209.6±10.0 ^a	223.9±6.8 ^a	14.3 ^{ns}

¹Means in the same column followed by the same letter are not significantly different ($P > 0.05$).

²“^{ns}” means the difference in adult lifespan between males and females is significant ($P < 0.05$); “^{ns}” means the difference is not significant ($P > 0.05$).

³Development from egg to last instar starting with 100 eggs in 3 g of wheat plus wheat germ.

⁴This group was kept at 20°C for 30 days then transferred to 25°C until the adults emerged.

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**FLEA BEETLES (COLEOPTERA: CHRYSOMELIDAE) FEEDING ON CRUCIFERS
IN SOUTH EASTERN MANITOBA**

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ABSTRACT

Ten species of crucifer feeding flea beetles were found in Manitoba. Of these, *Glyptina abbreviata* (Gentner) was recorded from Manitoba for the first time. While all ten species may feed on crucifers, only two species, *Phyllotreta cruciferae* [Goeze], and *Phyllotreta striolata* [F.] significantly damage crucifers in Manitoba. Notes on the identification, distribution, and host plants of each species are given.

INTRODUCTION

Adult flea beetles are characterized by the presence of enlarged hind femora and a jumping habit. They represent a distinctive monophyletic group (subfamily Alticinae) of Chrysomelidae of which some species are significant pests of cruciferous crops, particularly oilseed rape¹ (*Brassica napus* L. and *B. rapa* L.), in the Canadian prairie provinces (Burgess

¹The oilseed rape grown in Canada is now known as canola.

1977). Flea beetle adults can destroy rape seedlings, damage leaves and flowers, and stunt seed growth by feeding on the pods (Wylie 1979).

Seventy-two species of flea beetles (Alticinae) are known from Manitoba to date (LeSage 1991). However, only some species are known to feed on crucifers or damage oilseed rape (Westdal and Romanow 1972). Within this complex, however, most workers conclude that *Phyllotreta cruciferae* (Goeze) is the most common and serious flea beetle pest. Nevertheless, there is a consistent potential for species to switch from other hosts to rape crops, and this prompted efforts to survey the species of flea beetles associated with crucifers in Manitoba.

In Saskatchewan, eight species of flea beetles namely *Phyllotreta armoraciae* (Koch), *P. albionica* (LeConte), *P. bipustulata* (F.), *P. cruciferae*, *P. oregonensis* (Crotch), *P. striolata* (F.), *P. robusta* LeConte and *Psylliodes punctulata* Melsh. were found on oilseed rape (Burgess 1977, 1981). Wylie (1979) reported five species namely *P. cruciferae*, *P. striolata*, *P. bipustulata*, *Psylliodes punctulata* and *P. robusta* Lec. on oilseed rape in Manitoba with *P. cruciferae* being the most common and serious flea beetle pest of this crop. Pivnick *et al.* (1992) added *P. pusilla* Horn to the known fauna based on specimens collected in yellow traps in Manitoba.

The purpose of this study is to determine the species composition and to review relevant information on the flea beetles feeding on crucifers in southeastern Manitoba. We list the host plants of crucifer flea beetles which are recorded from Manitoba for the first time.

MATERIALS AND METHODS

Crucifer feeding flea beetles were collected by the use of yellow pan traps baited with allylisothiocyanate at the experimental farm on the University of Manitoba campus in Winnipeg, and the Glenlea Experimental Farm, Glenlea, during April to October, 1992 and by sweeping from field plots at Glenlea seeded with various crucifers and from wild crucifers near Winnipeg in June and July 1992. Wild crucifer plants from which flea beetles were collected were brought to the laboratory and identified.

To supplement this information, we also examined specimens deposited in the insect collection, Agriculture Canada Research Station (ACRS) and in the J.B. Wallis Museum of Entomology, Department of Entomology, University of Manitoba, Winnipeg (JBWM).

RESULTS AND DISCUSSION

Species collected in 1992 and found in the insect collections are arranged alphabetically. An asterisk (*) is used to denote a species recorded from Manitoba for the first time.

**Glyptina abbreviata* (Gentner)

This species was the only member of the genus collected in the study. Five specimens were taken in yellow pan traps at Glenlea and Winnipeg in 1992. In addition, there are two pinned specimens collected by yellow traps on September 9, 1980 (ACRS).

Distribution within Canada: previously this species was known only from Ontario (LeSage 1991).

Host plants: the wild host plant of this species is not known but its attraction to allylisothiocyanate baited traps suggests that this species may use crucifers as a host.

Phyllotreta armoraciae (Koch)

The horseradish flea beetle was introduced into North America from Europe and was first recorded in 1893 at Chicago, Illinois (Chittenden 1895). *P. armoraciae* has been found mainly in the northern half of the United States and in southern Canada, east of the Rocky Mountains (Smith 1973).

This species feeds almost exclusively on horseradish (*Armoracia rusticana*) and is common in gardens or abandoned farmyards in the central agricultural region of Saskatchewan. Because of its host specificity, it is unlikely to become a pest of other cruciferous or garden crops (Burgess 1981).

Six specimens of *P. armoraciae* were collected from a white mustard (*Sinapis alba* L. cv. Ochre) field at the Campus, University of Manitoba, Winnipeg in June, 1992 and one specimen was taken by yellow traps at Glenlea in June, 1992. Two pinned specimens, had been collected by yellow traps in May 1979 at Glenlea, H.G. Wylie (ACRS), and one specimen was labelled Winnipeg, June 2, 1921, H. Pankiw (JBWM).

Distribution within Canada: this species has been known to occur in British Columbia (Burgess 1981) and in Saskatchewan, Manitoba, Ontario, Québec, New Brunswick, and Prince Edward Island (LeSage 1991).

Host plants: horseradish (*Armoracia rusticana*) (Smith 1973), marshcress (*Rorippa islandica* var Fernaldian), cabbage (*Brassica oleracea* L.), radish (*Raphanus sativus* L.) (Wilcox 1979), and white mustard, (*Sinapis alba*).

Phyllotreta albionica (LeConte)

Adults of the cabbage flea beetle are similar to *P. cruciferae*, but can be distinguished by the presence of an elongate fifth antennal segment in the female, and an elongate, broadened fifth antennal segment in the male. Also, adults have an overall bronzy lustre that contrasts with the blueish lustre of *P. cruciferae* (Burgess 1977). The life cycle of this species was investigated by Glendenning (1932) and was summarized in Campbell *et al.* 1989.

Chittenden (1927) recorded this species from California, Arizona, and New Mexico to British Columbia and Alberta. Burgess (1977) reported that this species was collected from rape fields across the parklands of Saskatchewan and southern Alberta, but in very small numbers.

One pinned specimen of this species had been collected by a yellow trap in April, 1980 at Glenlea, Manitoba, H.G. Wylie (ACRS).

s Distribution within Canada: LeSage (1991) recorded this species from British Columbia,
o Alberta, and Saskatchewan and Campbell *et al.* (1989) recorded it from Manitoba. The records
of this species from Newfoundland, New Brunswick, Ontario, and Québec, given by Beirne
(1971), are cited as misidentifications by Campbell *et al.* (1989).

o Host plant: cabbage, mangels, turnips, and radish (Burgess 1971). Campbell *et al.*
o (1989) reported that while the favoured host plants are radish and turnip, this species has also
been found on cabbage, cauliflower, kale, Brussel sprouts, candytuft, *Alyssum* spp., *Arabis* spp.,
Nasturtium spp., and various cruciferous weeds.

t *Phyllotreta bipustulata* (Fabricius)

y Adults of this species have a subbasal and subapical pale mark on the elytra (which may
s or may not be connected) and a subapical mark at the sutural margin that is straight and does
not curve inward toward the suture.

s Nine specimens of *B. bipustulata* were collected by yellow traps at Glenlea and ten
pinned specimens were collected by yellow traps, Winnipeg, 1979 to 1980, H.G. Wylie (ACRS).
Campbell *et al.* (1989) provides an extensive list of host plants used by this species.

1 *Phyllotreta cruciferae* (Goeze)

e The crucifer flea beetle is an important pest of cultivated crucifers and is widely
1 distributed in Europe, Asia, Africa, and North America (Westdal and Romanow 1972). Its host
s range is limited mainly to the Cruciferae. The life history is summarized by Campbell *et al.*
(1989).

a This species is a serious pest on rape crops throughout Manitoba, Saskatchewan, and
e southern and central Alberta (Burgess 1977). In North America, it was first collected at
e Agassiz, B.C. in the early 1920's (Burgess 1977) and within 20 years this species appears to
z have become a serious pest of cultivated crucifers on the prairies. A 1956 survey found this to
c be the most abundant flea beetle on rape crops in Manitoba (Westdal and Romanow 1972).

1 We collected many specimens of this species in Manitoba (Table 1), from ochre, *Brassica*
1 *napus* cv. Westar, *B. carinata*, *B. juncea* cv. Cutlass, common pepper grass, *Lepidium*
h *densiflorum* Schrad, flixweed *Descurainia sophia* (L.) Webb, dogmustard *Erucastrum gallicum*
1 (Willd), *S. arvensis*, and turnips. Using yellow traps, over 10,000 specimens were collected in
1 1992. There are three specimens labelled Brandon, July 16, 1956, P.H. Westdal (JBWM), two
specimens labelled Morden, June 9, 1956, C.F. Barrett (JBWM), and seven specimens labelled
Winnipeg, May 30, 1948, G.L. Warren (JBWM).

o *Phyllotreta pusilla* Horn

e The adult of the western black flea beetle is shiny metallic copper in colour and has an
o elongate, oval, and much flattened body. This species was first recorded in Manitoba from
yellow traps at Winnipeg in 1987 (Pivnick *et al.* 1992). The economic injury, hosts and life
history of this species are summarized by Campbell *et al.* (1989).

In our study, specimens were collected from ochre, cutlass, common pepper grass, and flixweed. Over 1,500 specimens were collected with yellow traps, at the two study sites in 1992.

Phyllotreta striolata (Fabricius)

The striped flea beetle is a small blackish flea beetle with distinct yellow elytral strips that do not reach the elytral margins posteriorly.

In the prairie provinces of Canada, it is present across the parkland agricultural region from southern Manitoba to north of the Peace River district in Alberta (Burgess 1977). Westdal and Romanow (1972) found *P. striolata* in Manitoba on rape crops in 1956 and this species was much less abundant than *P. cruciferae*.

In our study, we collected *P. striolata* from wormseed mustard, *Erysimum cheiranthoides* L. and ochre, and over 1,000 specimens by yellow traps. Economic injury, host plants and life history are summarized in Campbell *et al.* (1989).

Phyllotreta robusta LeConte

Adults of this species resemble *P. striolata* but can be distinguished by the yellow stripe on each elytron which on *P. robusta* extends posteriorly to the elytral margin (Burgess 1977). Economic injury, host plants and life history are summarized in Campbell *et al.* (1989).

There are two pinned specimens collected by yellow trap, Winnipeg, May, 1979, H.G. Wylie (ACRS) and one specimen labelled Winnipeg, May 3, 1976, J.S. Lee (JBWM).

Phyllotreta zimmermanni (Crotch)

This species was a pest that has apparently been displaced by the more competitive, introduced species, *P. cruciferae*.

Only five specimens were collected by yellow traps at Winnipeg, May, 1992.

Distribution within Canada: This species has been recorded from Northwest Territories, British Columbia, Alberta, Saskatchewan, Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland (LeSage 1991), and Manitoba (present study).

Host plants: *Arabis* sp., alfalfa, *Barbarea vulgaris* (L.), *Brassica nigra* (L.), *B. oleracea* L. var. *acephala* DC, cabbage, clover, *Dentaria diphylla* Michx, *Fragaria* sp., hickory, horseradish, *Lepidium* sp., *L. virginicum* L., pepper, pepper-grass, wild plum, potato vine, *Rorippa palustris* L., white turnip, and watercress (Smith 1973, Campbell *et al.* 1989).

Psylliodes punctulata Melsheimer

This is a sturdy black flea beetle with a distinct bronzy lustre. It has 10 antennal segments, compared to 11 for *Phyllotreta* species (Burgess 1977). In the Canadian prairie provinces, this species is common across the agricultural area from southern Manitoba to northern Alberta (Burgess 1977).

In our study, one specimen was collected from ochre in June and 96 by yellow traps from April to June, 1992. There are 20 specimens labelled Glenlea, fallow fields, June 7, 1972, R. Semple (JBWM), 17 specimens labelled Winnipeg, June 1, 1940, A.J. Thorsteinson (JBWM), and five specimens labelled Brandon, June 20, 1925, E. Kiteley (JBWM).

CONCLUSIONS

A comparison of the number of species of flea beetles and their relative abundance on crucifers in Manitoba and Saskatchewan (Table 1) showed that ten species were found in Manitoba and eight in Saskatchewan. *Glyptina abbreviata* has been recorded for the first time in Manitoba. *Phyllotreta cruciferae* is the most common species. *P. pusilla* and *P. striolata* are fairly common and the other species are relatively rare. Most of the native species did not appear to be feeding on cultivated rape crops. In part, this may be because rape is an unsuitable host, or that the introduced pest species are better competitors.

ACKNOWLEDGEMENTS

We extend our thanks to Larry Grenkow and Frank Matheson (Agriculture and Agri-Food Canada) for assistance with field collection of specimens. H.G. Wylie assisted with identification of specimens, and his experience, patience, and knowledge were greatly appreciated. Financial support, in part, was provided by NSERC Research Grant #A0428 to R.E. Roughley.

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Table 1: Comparison of the distribution of species of flea beetles among Manitoba and Saskatchewan with an indication of numbers collected in the present study during 1992.

Species	# Specimens	Manitoba	Saskatchewan
<i>P. armoracia</i>	7	*	*
<i>P. albionica</i>	1	*	*
<i>P. bipustulata</i>	9	*	*
<i>P. cruciferae</i>	over 10,000	*	*
<i>P. oregonesis</i>			*
<i>P. pusilla</i>	over 1,500	*	
<i>P. striolata</i>	over 1,000	*	*
<i>P. robusta</i>		*	*
<i>P. zimmermanni</i>	5	*	
<i>Ps. punctulata</i>	97	*	*
<i>G. abbreviata</i>	5	*	
Number of species		10	8

SCIENTIFIC PROGRAM OF THE 1995 JOINT ANNUAL MEETING

Sunday, 16 October

11:00 - 13:00 Registration

09:00 - 17:20 Canadian Forum for Biological Control (CFBC)

09:00 - 10:00 Annual Meeting CFBC

10:00 - 11:30 Workshop: "Risk Assessment of Biological Control" - Organizers: R. Bouchier and A. McClay

10:00 - 10:10 Introduction and Objectives

10:10 - 10:50 Applying risk-management concepts to biological control. **L. McCarty**

10:50 - 11:10 Risks in biological control; what regulators need. **C. Howard**

11:10 - 11:30 Results of the biocontrol professionals survey. **R. Bouchier**

11:30 - 13:00 LUNCH

13:00 - 16:00 Discussion Groups

16:00 - 17:20 Conclusions

13:00 - 17:00 Workshop: "Silvicultural Approaches to Integrated Pest Management" - Organizer: D. MacLean

Introduction: The Green Plan Silvicultural Insect Management Network. **D. MacLean**

The influence of plant genotype and site on resistance of white spruce to four insects. **C. Teerling**

Relationship between growth rate of white spruce and susceptibility to four insects. **M. McKinnon**

Impact of commercial thinning on the suitability of balsam fir for spruce budworm. **E. Bauce**

Sunday, 16 October con't.

Altering lodgepole pine stand environment by thinning and spacing to reduce susceptibility to the mountain pine beetle *Dendroctonus ponderosae*. L. Safranyik, T. L. Shore and R. Benton

Mechanisms of resistance of white spruce to the spruce budmoth. D. Quiring

Design of forest management strategies for the Fundy Model Forest to reduce damage caused by spruce budworm outbreaks. D. MacLean

Influence of stand conditions on the survival of the white pine weevil in jack pine. I. Bellocq and S. M. Smith

Genetic diversity in white pine weevil (*Pissodes strobi* Beck) in British Columbia as assessed with RAPD markers. K. Lewis, J. E. Carlson and J. A. McLean

Further observations on weevil behaviour at the Kalamalka Research Station. G. Kiss

Silvicultural control of the spruce weevil in B.C. R. I. Alfaro and S. Taylor

Observations on *Pissodes strobi* biology and dispersal in a reciprocal cross interior spruce plantation. R. McIntosh, G. Kiss and J. McLean

13:00 - 17:00 **Workshop: "Employment Opportunities in Entomology: What You Should Know Before You Graduate" - Organizer: E. Tomlin**

Speakers: Randy Baker (North-South Consultants)
 Roy Ellis (Prairie Pest Management)
 Randy Gadawski (City of Winnipeg)
 Dan Miller (Phero Tech Inc.)
 Margaret Gadsby (AgrEvo)
 Robert Trottier (Agriculture and Agri-Food Canada)

14:30 - 15:00 **COFFEE - Sponsor: Canadian Forest Service**

17:00 - 20:00 Registration

Sunday, 16 October con't.

19:00 - 20:00 Students meet the Board

20:00 - 23:00 Wine and Cheese Reception

Monday, 17 October

08:00 - 17:30 Registration

08:30 - 09:30 Opening Ceremonies

Introduction and Welcome

D. Dixon (General Chairperson, Joint Meeting)
G. Gerber (Entomological Society of Canada)
R. Roughley (Entomological Society of Manitoba)
B. Todd (Manitoba Agriculture)

E.S.C. Award Presentations - G. Gerber

C. Gordon Hewitt Award: D. Quiring

Gold Medal Award: T. Royama

Gold Medal Address: Observations, interpretations and syntheses: a personal endeavour in quest of scientific methods. T. Royama

09:30 - 10:00 COFFEE - Sponsor: Manitoba Natural Resources

Plenary Symposium: "Insect Movement"

Chairperson: P. Fields

10:00 - 10:30 Physiological links between migration and reproduction.

M. Rankin

10:30 - 11:00 Insects aren't airplanes: constraints and opportunities.

S. Vogel

11:00 - 11:30 An evolutionary perspective of short range movement in insects. **B. Roitberg**

11:30 - 12:00 Ecological and genetic aspects of long distance migration, with particular emphasis on Lepidoptera. **J. N. McNeil**

Monday, 17 October con't.

12:00 - 13:30 LUNCH

Submitted Papers: "Insect Movement"
Chairperson: J. McNeil

13:30 - 13:45 Accelerative escape motions and swimming in *Baetis tricaudatus* larvae (Baetidae: Ephemeroptera). D. A. Craig

13:45 - 14:00 Movement and the structure of pondskater populations. J. Spence

14:00 - 14:15 Factors affecting the dispersal of *Rhopalosiphum padi* (L.) on winter barley. S. Day and C. Hodgson

14:15 - 14:30 Movement of apterous *Myzus persicae* in winter: requirements, restrictions and repercussions. R. Harrington, S. P. Foster and E. Hawkins

14:30 - 14:45 Influence of crop cover on oviposition site selection by *Phyllophaga implicita* (Horn). P. Glogoza and M. Weiss

14:45 - 15:00 Obstacle perception by insect antennae during terrestrial locomotion. Y. Pelletier and C. D. McLeod

15:00 - 15:30 COFFEE - Sponsor: Cyanamid Canada

15:30 - 15:45 Effects of sex ratio on interplant movement by pear psylla in small cage studies. D. R. Horton

15:45 - 16:00 Body size and breeding behaviour of bark beetles. M. L. Reid

16:00 - 16:15 Movement of forest tent caterpillar and parasitoids in fragmented forest. P. D. Taylor and J. Roland

16:15 - 16:30 Harmonic RADAR for remote tracking of individual flying insects. J. Roland, P. Taylor and G. McKinnon

16:30 - 16:45 Night-time resting sites of black flies (Diptera: Simuliidae). L. McLaughlin and F. F. Hunter

Monday, 17 October con't.

16:45 - 17:00 The role of prey availability on foraging behaviour of syrphid larvae. **B. Tenhumberg**

Student Paper Award: Session 1

Chairperson: G. Boivin

13:30 - 13:45 DNA hybridization for detection of NPV in tent caterpillars. **B. Kukan**

13:45 - 14:00 Impact of *Bacillus thuringiensis* (Btk) on non-target Lepidoptera of wetland gaps in the boreal forest. **M. Williamson**

14:00 - 14:15 The arthropod biodiversity of *Populus* spp. coarse woody material in North and Central Alberta. **H. E. J. Hammond**

14:15 - 14:30 The role of competition in the community ecology of birch leafminers (Hymenoptera: Tenthredinidae) in Alberta. **S. Digweed**

14:30 - 14:45 Management of birch leafminers in northern cities. **R. L. McQueen**

14:45 - 15:00 Microsporidia and *Phytoseiulus persimilis*: biological control of a biological agent? **S. Bjornson**

15:00 - 15:30 COFFEE - Sponsor: Cyanamid Canada

15:30 - 15:45 Impact of ants on the survival of the egg parasitoid, *Trichogramma minutum*. **A. V. Braybrooks**

15:45 - 16:00 Potential for biological control of the spruce seed moth in Canada by introducing European parasitoids. **E. Brockerhoff**

16:00 - 16:15 Brood size and sex ratio in the spruce budworm parasitoid, *Elachertus cacoeciae* (Hymenoptera: Eulophidae). **J. G. Fidgen**

16:15 - 16:30 An ecological study of *Acanthoscelides tenuis* (Coleoptera: Bruchidae) on purple loosestrife (*Lythrum salicaria*). **J. Bueglas**

16:30 - 16:45 Coexistence strategies of two *Galerucella* species on purple loosestrife, *Lythrum salicaria* L. **C. P. Medina**

Monday, 17 October con't.

16:45 - 17:00 Definition and evolution of hyperparasitism, with special reference to the family Perilampidae (Hymenoptera: Chalcidoidea). S. Perlman

17:00 - 17:15 Influence of dispersing late instar spruce budworm (*Choristoneura fumiferana*) on conifer natural regeneration. R. T. Bichon

Student Paper Award: Session 2
Chairperson: J. Brodeur

13:30 - 13:45 DNA sequence variation in some members of the *Geocoris bullatus-pallens* species complex occurring in western Canada. D. S. Mulyk

13:45 - 14:00 Genotypic variation in the nuclear polyhedrosis virus isolated from Douglas-fir tussock moth. A. M. Laitinen

14:00 - 14:15 Host-seeking and upwind flight in *Delia antiqua* (Diptera: Anthomyiidae). R. S. McDonald

14:15 - 14:30 Chemosensory cues for larviposition behaviour of the flesh fly, *Neobellieria* (= *Sarcophaga*) *bullata*. G. D. W. Pommen

14:30 - 14:45 Alarm pheromone system of the western conifer seed bug. S. E. Blatt

14:45 - 15:00 Life history and pheromone monitoring of the fir coneworm, *Dioryctria abietivorella* (Lepidoptera: Pyralidae), in British Columbia. B. A. McEntire

15:00 - 15:30 COFFEE - Sponsor: Cyanamid Canada

15:00 - 15:45 Secondary attraction in *Pityokteines elegans* Swaine (Coleoptera: Scolytidae). J. Macias-Samano

15:45 - 16:00 Competitive interactions between the spruce beetle and two secondary bark beetle species. T. M. Poland

16:00 - 16:15 Host selection by the white pine weevils in three types of laboratory bioassay. E. S. Tomlin

16:15 - 16:30 Feeding ecology of white pine weevil adult in the province of Québec. M. Hamel

Monday, 17 October con't.

16:30 - 16:45 Influence of cone length on oviposition of *Strobilomyia* sp. (Diptera: Anthomyiidae) on spruce. L. L. Fidgen

16:45 - 17:00 Influence of plant growth rate and foliar nutrition on performance of a specialist herbivore *Zeiraphera canadensis*. M. L. McKinnon

17:00 - 17:15 The response of *Brassica napus* and *Sinapis alba* to different types of herbivory. J. Gavloski

Student Paper Award: Session 3
Chairperson: L. Dodsall

13:00 - 13:45 Overwintering of native elm bark beetles, *Hylurgopinus rufipes*, (Coleoptera: Scolytidae) in American elm in Manitoba. P. Anderson

13:45 - 14:00 Influence of regeneration techniques on biodiversity of forest Lepidoptera. B. Elliott

14:00 - 14:15 Factors affecting the survivorship of an oak gall wasp, *Neuroterus saltatorius* (Edwards). J. L. Smith

14:15 - 14:30 Centinelan extinctions: extirpation of northern temperate old-growth rainforest arthropod communities. N. N. Winchester

14:30 - 14:45 Insects attacking wild saskatoons in the boreal forest. A. Meyer

14:45 - 15:00 Effect of sulphur/lime contamination on carabid beetles. H. A. Cárcamo

15:00 - 15:30 COFFEE - Sponsor: Cyanamid Canada

15:30 - 15:45 Ground beetles near a kraft paper mill. A. Gallo

15:45 - 16:00 Life history studies in the waterstrider *Gerris buenoi*. C. P. Klingenberg

16:00 - 16:15 Sphere sizes optimally attractive to the apple maggot fly (*Rhagoletis pomonella*) on crabapple and standard-apple trees. E. B. Mondor

16:15 - 16:30 Phylogenetic analysis of cocoon spinning behaviour in black flies (Simuliidae). A. Stuart

Monday, 17 October con't.

16:30 - 16:45 Food density influences the number of head fan rays in black flies (Diptera: Simuliidae). P. Lucas

16:45 - 17:00 Structural and functional characterization of microtubules in an insect ovary. R. Harrison

17:00 - 17:15 Biochemical analysis of the white eye colour mutant of the tsetse fly, *Glossina morsitans submorsitans*. C. Challoner

17:00 - 18:00

Poster Session

Can we increase natural mortality of the white pine weevil? (CFBC) I. Belloq and S. M. Smith

Potential of *Amblyseius fallacis* for biological control of tomato russet mite. (CFBC) J. Brodeur, G. Turcotte and A. Bouchard

Growth inhibitory effects of toosendanin on the variegated cutworm, *Peridroma saucia*. W. Chen and M. B. Isman

Gregarious feeding improves performance of stinkbug used for biocontrol. (CFBC) C. Cloutier

Comparison of *Altica* spp. consumption of Canada thistle leaf disks using image analysis. (CFBC) R. DeClerck-Floate, E. Kokko and F. Leggett

Intersexes in the geometrid, *Lambdina fiscellaria fiscellaria*. J. Delisle, N. M. M. de Lima, and R. J. West

Non-target effects of ivermectin residues in cattle dung. (CFBC) K. D. Floate

Developing sampling protocols for *Aphthona* spp. flea beetles, leafy spurge biocontrol agents. R. Hansen

Mortality in grasshoppers exposed to soil-borne *Beauveria bassiana*. (CFBC) G. D. Inglis, R. P. Feniuk, M. S. Goettel and D. L. Johnson

Monday, 17 October con't.

Poster Session con't.

Temporal dynamics of diamondback moth, *Plutella xylostella* L. on crambe, *Crambe abyssinica* Hochst. P. Kmec and M. J. Weiss

The biological control of purple loosestrife, *Lythrum salicaria*. An overview of the University of Guelph project. (CFBC) J. E. Laing, G. Bowles, C. d. R. Medina and J. E. Corrigan

Pollen cones enhance survival of jack pine budworm. V. G. Nealis and P. V. Lomic

Effect of soil compaction on digging of prediapause Colorado potato beetle. C. Noronha and C. Cloutier

Interaction of several pesticides and adjuvants with *Chondrostereum purpureum* -- A bioherbicide agent for control of forest weeds. (CFBC) R. Prasad

Structure of the suboesophageal ganglion of *Neobellieria bullata* (Parker), (Diptera: Sarcophagidae). M. Rivet

Velocity detection and its relationship to filter feeding in the mayfly nymph *Ametropus neavei* (Ametropodidae). P. J. Schouten

Morphological and molecular variation in lygus bugs. M. Schwartz and R. Foottit

A decision support system for management of mountain pine beetle infestations in lodgepole pine stands in British Columbia. T. L. Shore, W. G. Riel and L. Safranyik

Biological control of common ragweed using insects. (CFBC) M. Teshler, S. Briere, R. Stewart and A. Watson

European parasitoids under evaluation for introduction to control of hemlock looper. R. West, M. Kenis and K. Herz

The effect of galeal ablation on feeding behavior of the Colorado potato beetle. Z. Zhang and B. K. Mitchell

Monday, 17 October con't.

19:00 - 21:00

**Workshop: "Insect Biodiversity" -
Organizers: R. Roughley and T. Galloway**

19:00 - 23:00

President's Reception

Tuesday, 18 October

**Symposium: "Insect-Host Interactions and Insect Pest Management" -
Organizer: P. Palanaswamy**

08:30 - 09:10 Plant-pest insect-parasitoid interactions and innovative insect pest management strategies. **W. J. Lewis**

09:10 - 09:50 Chrysomelid-crucifer interactions and chemical control. **J. K. Nielsen**

09:50 - 10:30 Inducible resistance in plants and insect pest management. **R. Karban**

10:30 - 10:50 COFFEE - Sponsor: Repap Manitoba

10:50 - 11:30 Insect resistant transgenic plants: boon or bane for pest management? **R. Roush**

11:30 - 12:10 Immunology of the animal host-arthropod interface: development of anti-arthropod vaccines. **S. K. Wikel**

**Symposium: "Advances in Forest and Urban Tree Pest Management" - Organizer:
R. Westwood**

08:30 - 09:10 Experimental studies of spruce budworm population dynamics. **W. J. A. Volney**

09:10 - 09:50 Spruce budworm decision-support system: a tool to integrate insect control and impact into mainstream forest management planning. **D. A. MacLean**

09:50 - 10:30 Augmenting natural enemies for forest pest control. **S. M. Smith**

Tuesday, 18 October con't.

10:30 - 10:50 COFFEE - Sponsor: Repap Manitoba

10:50 - 11:30 Urban forest pest management in Winnipeg. R. M. Gadawski

11:30 - 12:10 Impact of ambrosia beetles on lumber values in coastal British Columbia. J. A. McLean

12:10 - 13:30 LUNCH

Submitted Papers: "Insect-Host Interactions" Room: Chairperson: Y. Pelletier

13:30 - 13:45 Induction of host plant feeding preference in larvae of bertha armyworm *Mamestra configurata*. L. M. Dosdall

13:45 - 14:00 Are some birch trees, *Betula papyrifera* resistant to birch leaf miners, *Fenusa pusilla*? Y. Prévost and D. Kentner

14:00 - 14:15 Distinguishing categories of hybridizing plants by their associated insects: tests and considerations. K. D. Floate, G. W. Fernandes, J. A. Nilsson and T. G. Whitham

14:15 - 14:30 Aphid-ant interaction reduces chrysomelid herbivory in a cottonwood hybrid zone. K. D. Floate and T. G. Whitham

14:30 - 14:45 Are parasitized hosts more vulnerable to predation than non-parasitized hosts? J. Brodeur

14:45 - 15:00 COFFEE - Sponsor: Pine Falls Paper Company

15:00 - 15:15 Mass rearing of *Galerucella californiensis* and *G. pusilla* (Coleoptera: Chrysomelidae), biological control agents of purple loosestrife, *Lythrum salicaria*. C. d. R. Medina and J. E. Laing

15:15 - 15:30 Release and recovery of *Galerucella californiensis* and *G. pusilla* (Coleoptera: Chrysomelidae), biological control agents of purple loosestrife, *Lythrum salicaria*. J. E. Laing, G. Bowles, C. d. R. Medina and J. E. Corrigan

15:30 - 15:45 The use of a seasonal greenhouse for rearing biological control agents for purple loosestrife in Manitoba. C. Lindgren

Tuesday, 18 October con't.

Submitted Papers: "Forest Entomology"

Chairperson: J. Turgeon

13:30 - 13:45 Impact of *Choristoneura occidentalis* in multi-layered, interior Douglas-fir ecosystems of southern British Columbia. L. MacLauchlan

13:45 - 14:00 Factors affecting survivorship of the spruce cone maggot (*Strobilomyia neanthracina*). J. Sweeney and G. Gesner

14:00 - 14:15 Effects of larval food quality on *Choristoneura fumiferana* reproductive biology. J. Delisle and M. Hardy

14:15 - 14:30 Predicting defoliation by the jack pine budworm. P. V. Lomic and V. G. Nealis

14:30 - 14:45 Staphylinid beetle diversity in aspen forests in Alberta. G. R. Pohl

14:45 - 15:00 COFFEE - Sponsor: Pine Falls Paper Company

15:00 - 15:15 Forest structure influences herbivore abundance. D. P. Ostaff

15:15 - 15:30 Spatial distribution of the Eucalyptus leaf beetle, *Chrysopharta bimaculata* (Olivier) (Coleoptera: Chrysomelidae). A. R. Clarke, J. L. Madden and M. P. Zalucki

15:30 - 15:45 Mitochondrial DNA variation in the *Pissodes strobi* species group (Coleoptera: Curculionidae) in western Canada. D. W. Langor and F. A. H. Sperling

Submitted Papers: "Behaviour and Physiology" Chairperson: T. Galloway

13:30 - 13:45 Comparison of mating disruption between spruce budworm and oriental fruit moth in a wind tunnel. C. J. Sanders and G. S. Lucuik

13:45 - 14:00 Field tests of mating disruption for blackheaded fireworm of cranberries. S. Fitzpatrick, J. Troubridge, C. Maurice and S. May

14:00 - 14:15 Sex pheromone-mediated mating disruption for controlling *Endopiza viteana* (Clemens) in Niagara peninsula, Ontario vineyards. R. M. Trimble

Tuesday, 18 October con't.

14:15 - 14:30 The importance of alternative strategies to territoriality in the water strider *Limnoporous notabilis* (Heteroptera: Gerridae). **A. J. Tyre**

14:30 - 14:45 Development of the actin cytoskeleton in the telotrophic ovaries of *Rhodnius prolixus*. **K. Yeow and E. Huebner**

14:45 - 15:00 COFFEE - Sponsor: Pine Falls Paper Company

15:00 - 15:15 A new artificial feeding technique for *Rhodnius prolixus*. **E. Huebner, R. Harrison and K. Yeow**

15:15 - 15:30 Germ cell ontogeny in *Rhodnius prolixus* Stål embryos (Hemiptera: Reduviidae). **B. S. Heming**

15:30 - 15:45 Effect of maternal age on pteridine content, size, development time and fluctuating asymmetry in tsetse flies. **G. S. McIntyre and R. H. Gooding**

15:45 - 16:00 Form and function of net-winged midge gall pupal gills (Diptera: Blephariceridae): implications for respiration. **G. D. W. Pommen and D. A. Craig**

16:15 - 16:45

Heritage Lecture: "Manitoba's Six-legged Pests and Two-legged Pioneers" - S. Loschiavo

16:45 - 18:00

Entomological Society of Canada Annual General Meeting

19:00 Banquet

Wednesday, 19 October

Submitted Papers: "Biological Control"

Chairperson: R. Bouchier

08:45 - 09:00 Prey discrimination in *Coleomegilla maculata* (Coleoptera: Coccinellidae) towards parasitized and unparasitized *Trichoplusia ni* (Lepidoptera: Noctuidae) eggs. **C. Roger, G. Boivin and D. Coderre**

Wednesday, 19 October con't.

09:00 - 09:15 Using fitness to predict productivity of *Trichogramma* and *Trichogrammatoidae* species/strains of *Ephestia kuehniella*. F. Fournier and G. Boivin

09:15 - 09:30 Genetic variation and correlation of some quantitative traits related to biocontrol in *Trichogramma minutum* Riley. F. Liu and S. M. Smith

09:30 - 09:45 Influence of rearing method and host concealment on the host-finding ability of *Trichogramma minutum*. B. Van Hezewijk

09:45 - 10:00 Ovarian development and reproductive mode in *Trichogramma minutum*. Z. Wang and S. M. Smith

10:00 - 10:30 COFFEE - Sponsor: AgrEvo

10:30 - 10:45 Arrestment response of *Trichogramma minutum* to host scales and host plant extracts. Vijaychander and S. M. Smith

10:45 - 11:00 Optimal sex allocation in *Anaphes victus* (Hymenoptera: Mymaridae). G. Boivin

11:00 - 11:15 The use of a kairomone by *Aleochara bilineata* to locate *Delia radicum* larvae. L. Royer and G. Boivin

11:15 - 11:30 Development of guidelines for release of *Amblyseius fallacis* in fruit crops. H. Thistlewood and D. Pree

Submitted Papers: "Agriculture"

Chairperson: N. White

08:45 - 09:00 A North Dakota wheat growers insect pest survey: results, management implications and new research directions. P. J. Boeve, M. J. Weiss and P. A. Glogoza

09:00 - 09:15 Pesticide protestors, public officials, and public relations. B. Beirne

09:15 - 09:30 Stage specific economic thresholds and sequential sampling for *Macrosiphum euphorbiae* (Thomas) in oilseed flax. I. L. Wise and R. J. Lamb

Wednesday, 19 October con't.

09:30 - 09:45 Biomass conversion ratios for aphids on some annual crops. **R. J. Lamb and P. K. MacKay**

09:45 - 10:00 Low temperature control of *Plodia interpunctella* in a seed warehouse. **B. Timlick and P. G. Fields**

10:00 - 10:30 COFFEE - Sponsor: AgrEvo

10:30 - 10:45 The control of stored-product insects using diatomaceous earth. **Z. Korunic, P. G. Fields and B. Timlick**

10:45 - 11:00 Evaluation of insecticidal activity of plant extracts against stored-product insects. **Y. Xie, P. G. Fields and M. B. Isman**

11:00 - 11:15 Effects of application rates and spray volumes on persistence of *Bacillus thuringiensis* in raspberry field. **S. Li, S. Fitzpatrick and S. Bryant**

11:15 - 11:30 *In vivo* binding detection of *Bacillus thuringiensis* cryI toxins in Lepidopteran midgut epithelium. **S. Yi and K. van Frankenhuyzen**

11:30 - 11:45 Isolation and characterization of midgut epithelium. **L. Braun and B. A. Keddie**

11:45 - 12:00 The midgut as a barrier to pathogen invasion. **B. A. Keddie**

09:00 - 12:00

Workshop: "Biological Control of Purple Loosestrife"

Organizer: C. Lindgren

09:00 - 17:00

Workshop: "Semiochemical Workshop"

Organizer: C. Sanders

12:00 - 13:00 LUNCH

12:00 - 15:00 E.S.C. Governing Board Meeting

E.S.C. Norman Criddle Award Recipient: Dr. William B. Preston

The Entomological Society of Canada Norman Criddle Award recognizes the contribution of an outstanding non-professional entomologist to the furtherance of entomology in Canada. The award may be given for outstanding work in teaching or research, community projects, publicity, popular writing, preparation of slide sets or films or any other activity that enhances the image of entomology. The recipient is selected by the affiliate society that hosts the annual meeting of the Entomological Society of Canada.

This year the Criddle Award goes to Dr William B. Preston. Bill is a native of the Okanagan Valley, where he first began collecting insects at about the age of 12. He completed his B.Sc. and M.Sc. degrees at the University of British Columbia, and his Ph. D. at the University of Oklahoma; both his graduate degrees involved the biology of snakes. He joined the Manitoba Museum of Man and Nature in 1970 and since then has been Curator of Herpetology and Ichthyology. From 1970-76 he also acted as Curator of Invertebrates — his only professional appointment where he had responsibility for insects.

Bill is an accomplished and enthusiastic entomologist with a large personal collection of insects and spiders; he has a special interest in Coleoptera, but also has a fondness for Orthoptera, Hymenoptera — particularly ants, Lepidoptera — particularly moths, and arachnids. Bill pioneered shopping mall exhibits of insects in Manitoba, and has a formidable talent for photography of insects and spiders. He has published papers on the insect fauna of Manitoba, and is a co-author of "The Butterflies of Manitoba", which was published in 1989. Bill has served the Entomological Society of Manitoba on several committees and as President of the Society. Bill's current entomological activities include collaborating on a publication on the ants of British Columbia, updating the list of ants of Manitoba, and collaborating on research on the moths of Manitoba. He is looking forward to retirement, when he can devote more time to the study of insects and arachnids.

The Criddle Award perpetuates the name of Norman Criddle, who has strong associations with entomology in Manitoba. Criddle was a distinguished natural historian who meticulously observed and documented the biology of plants and animals in the area of the family home at Aweme, Manitoba. He performed pioneering work in economic entomology, and from 1913 until his death in 1933 was in charge of the Dominion Entomological Laboratory at Treesbank, Manitoba.

SCIENTIFIC PROGRAM ABSTRACTS FOR THE 1995 JOINT ANNUAL MEETING

Anderson, P. Dept. of Entomology, University of Manitoba, Winnipeg MB R3T 2N2. Overwintering of native elm bark beetles, *Hylurgopinus rufipes*, (Coleoptera: Scolytidae) in American elm in Manitoba. (Student Paper Award)

In riverbank stands near Dauphin, Manitoba, entrance holes of bark beetles were counted in trunks of American elm trees in fall of 1992 and 1993. In April and November 1993, trees were felled and tunnels and beetles in the bark counted. Densities were greatest within 25 cm of the ground, and within this zone densities increased as tree size increased. Other factors had little effect.

Beirne, B. Simon Fraser University, Burnaby BC V5A 1S6. Pesticide protestors, public officials, and public relations.

Examples illustrate how protest campaigns against pesticide programs in British Columbia often were incited, intensified, or prolonged unnecessarily by the rudeness, condescension, or secretiveness of officials.

Belloq, I. and S. Smith. University of Toronto, 33 Willcocks St., Toronto ON M5S 3B3. Can we increase natural mortality of the white pine weevil? (CFBC - Poster)

Mammalian predation significantly reduced overwintering survival of the white pine weevil in jack pine. More weevils survived in a seeded than in planted stand. Treatment of slash, duff depth and presence of weeds showed no significant effect on winter mortality of weevils.

Bichon, R. T. School of Forestry, Lakehead University, 955 Oliver Rd., Thunder Bay ON P7B 5E1. Influence of dispersing late instar spruce budworm (*Choristoneura fumiferana*) on conifer natural regeneration. (Student Paper Award)

Spruce budworm population densities and dispersal of late instars were measured in four 10-hectare plots established in a boreal mixedwood near Black Sturgeon Lake, Ontario. Natural regeneration within each plot also was assessed for feeding damage by dispersing budworms. Budworm population at the canopy level, dispersal numbers, and resulting damage to regeneration were consistently greater at white spruce trees than at black spruce or balsam fir.

Bjornson, S. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Microsporidia and *Phytoseiulus persimilis*: biological control of a biological control agent? (Student Paper Award)

Microsporidian parasites were recently discovered in *Phytoseiulus persimilis*, a predatory mite used to control pest mites in commercial greenhouses. These spore-forming protozoa may affect the longevity and performance of *P. persimilis*. Quality control may be required to maintain healthy predatory mites in future mass rearings.

Blatt, S. E. Dept. of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. Alarm pheromone system of the western conifer seed bug, *Leptoglossus occidentalis*, Heidemann. (Student Paper Award)

Volatiles from agitated adults and nymphs of *L. occidentalis* were captured on Porapak Q. Gas chromatographic analysis disclosed hexanal, hexanol, hexyl acetate, heptyl acetate and octyl acetate from adults, and trans-2-hexenal and 4-oxo-2(E)-hexenal from nymphs. Laboratory and field bioassays examining the biological response to synthetic blends are currently underway.

Boeve, P. J., M. J. Weiss, and P. A. Glogoza. Department of Entomology, North Dakota State University, Fargo ND 58105 USA. A North Dakota wheat growers insect pest survey: results, management implications, and new research directions.

A mail survey was sent in March 1994 to 2248 wheat growers in three regions of North Dakota, the Red River Valley, the Glaciated Plains, and the Missouri Plateau. The usable response rate was 22%. Regional differences were found in pest species importance, scouting practices, and control methods used.

Boivin, G. Station de recherche, Agriculture Canada, 430 Boul. Gouin, St-Jean-sur-Richelieu QC J3B 3E6. Optimal sex allocation in *Anaphes victus* (Hymenoptera: Mymaridae).

Under local mate competition, female parasitoids allocate only enough males to fertilize all their daughters. When exploiting a patch alone, female *A. victus* allocated an average of one male every four females. This cycle was unaffected by host abundance but the presence of other females increased the frequency of male allocation. Measure of the male capacity to fertilize females indicates that the female evaluates the sexual performance of her sons adequately.

Braun, L. and B. A. Keddie. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Isolation and characterization of midgut epithelium.

Enzymatic removal of the basal lamina-connective tissue layer from Lepidopteran midgut produces a flat sheet preparation of epithelial tissue. Tissues can be maintained in bathing media for up to 24 h. Cell changes *in situ* can be monitored using a variety of staining and microscopic techniques.

Braybrooks, A. V. Faculty of Forestry, University of Toronto, Toronto ON M5S 3B3. Impact of ants on the survival of the egg parasitoid, *Trichogramma minutum*. (Student Paper Award)

Heavy predation by ants was observed on mass-released *Trichogramma minutum* in parasitized flour moth eggs. To quantify the impact of ants, species composition, foraging rates and foraging locations were compared on the ground (pitfall trapping) and in the trees (beating) in young and mature red pine and white spruce plantations.

Brockerhoff, E. Forestry Canada, FPMI, P. O. Box 490, Sault Ste. Marie ON P6A 5M7. Potential for biological control of the spruce seed moth in Canada by introducing European parasitoids. (Student Paper Award)

The parasitoid complex of the holarctic spruce seed moth, *Cydia strobilella* L. (Lepidoptera: Tortricidae), was investigated at several sites in Europe. One egg parasitoid and six larval parasitoids were found during the study. Comparison of species complexes in Europe and North America indicate two promising candidates for introduction into Canada.

Brodeur, J. Département de Phytologie, Université Laval, Faculté des Sciences de L'Agriculture et de L'Alimentation, Cité universitaire QC G1K 7P4. Are parasitized hosts more vulnerable to predation than nonparasitized hosts?

Hosts parasitized by insect parasitoids are ecologically different from nonparasitized hosts. However, it is suggested that parasitized hosts are similar to nonparasitized hosts in their vulnerability to insect predators. Components of parasitoid strategy to reduce predation pressure on the host are reliance on host defensive mechanisms and manipulation of host behaviour.

Brodeur, J., G.¹ Turcotte² and A. Bouchard.¹ ¹Département de Phytologie, Université Laval, Faculté des Sciences de L'Agriculture et de L'Alimentation, Cité universitaire QC G1K 7P4; ²Les Settes du St-Laurent Inc., Portneuf QC G0A 2Y0. Potential of *Amblyseius fallacis* for biological control of tomato russet mite. (CFBC - Poster)

As a first step towards developing a biological control strategy for the tomato russet mite TRM, we tested the potential of different mite predators. Voracity of *Homeopronematus anconai*, *Amblyseius fallacis*, *Amblyseius cucumeris* and *Phytoseiulus persimilis* was determined. The first three species fed on each of the life stages of the eriophyid mite. Furthermore, *A. fallacis* was able to develop and reproduce when feeding on the TRM.

Bueglas, J. Department of Environmental Biology, University of Guelph, Guelph ON N1G 2W1. An ecological study of *Acanthoscelides tenuis* (Coleoptera: Bruchidae) on purple loosestrife (*Lythrum salicaria*). (Student Paper Award)

Acanthoscelides tenuis is an uncommon endemic bruchid beetle associated with the seeds of two native *Lythrum* species in the United States. Numerous populations on *Lythrum salicaria* have been discovered in southern Ontario. *A. tenuis* larvae bind seeds within the capsules resulting in reduced dissemination and germination.

Cárcamo, H. A. Department of Biological Sciences, University of Calgary, Calgary AB T2N 1N4. Effect of sulphur/lime contamination on carabid beetles. (Student Paper Award)

A pitfall-trapping study was initiated in 1994 to investigate the effect of sulphur/lime contamination on soil invertebrates in pine forests near sour gas processing plants in south-west central Alberta. Preliminary data suggest that activity of common carabids and species diversity are not affected by pollution.

Challoner, C. Department of Entomology, 2-27 Earth Sciences Building, University of Alberta, Edmonton AB T6G 2E3. Biochemical analysis of the white eye colour mutant of the tsetse fly, *Glossina morsitans submorsitans*. (Student Paper Award)

Compound eyes of the white mutant contain less than 2 percent of the xanthommatin found in those of wild type flies. Analysis of intermediates and enzymes in the tryptophan to xanthommatin pathway indicates that the lesion occurs late in that pathway, possibly at the level of transportation of pigment precursors.

Chen, W. and M. B. Isman. Department of Plant Science, University of British Columbia, Vancouver BC V6T 1Z4. Growth inhibitory effects of toosendanin on the variegated cutworm, *Peridroma saucia*. (Poster)

Using a diet-shift bioassay, both pure (98%) toosendanin and a refined extract of *Melia toosendan* bark (containing 75% toosendanin) were shown to inhibit larval growth of the variegated cutworm. On a weight basis, the refined extract is more active than pure toosendanin, indicating the presence of minor constituents with pronounced bioactivity. A mixture of 75% toosendanin with a neem extract containing 25% azadirachtin was particularly effective in inhibiting larval growth.

Clarke¹, A. R., J. L. Madden² and M. P. Zalucki.³ ¹CRC for Temperate Hardwood Forestry, Locked Bag No. 2, P.O. Sandy Bay, 7005, Tasmania, Australia; ²Department of Agricultural Science, University of Tasmania, Box 252C, GPO Hobart, 7001, Tas., ³Department of Entomology & CRC Tropical Pest Management, University of Queensland, 4072, Queensland Australia. Spatial distribution of the Eucalyptus leaf beetle, *Chrysopharta bimaculata* (Olivier) (Coleoptera: Chrysomelidae).

Chrysopharta bimaculata (Olivier) is a native chrysomelid species which can cause chronic defoliation of *Eucalyptus* forests in Tasmania. Population monitoring is difficult as adult populations appear to be temporarily and spatially patchy and, at least locally, highly mobile. In order to quantify the spatial patchiness of *C. bimaculata*, season-long flight-trap and on-tree sampling of beetle populations were undertaken. Analysis of data confirms that beetle populations are highly patchy at a number of geographic scales; including between trees (0.5ha), within a forest coup (12ha) and between forest coups (500ha).

Cloutier, C. Département de biologie, Université Laval, Québec QC G1K 7P4. Gregarious feeding improves performance of stinkbug used for biocontrol. (CFBC - Poster)

Perillus bioculatus often feeds gregariously on caterpillars and chrysomelid larvae. Opportunity to interact with large (N5) nymphs feeding on L4 colorado potato beetle promoted survival and development of small (N2) predators. It may be advantageous to release mixed age classes to exploit communal feeding in augmentative releases of *P. bioculatus*.

Craig, D. A. Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E9. Accelerative escape motions and swimming in *Baetis tricaudatus* larvae (Baetidae: Ephemeroptera).

Highspeed digital video recordings were used to examine the escape behaviour of *Baetis tricaudatus* larvae. Extreme body contortions commenced the locomotion sequence. Body undulations were cetacean. Analysis of the recordings showed that accelerations of up to 26.0 m/s² were achieved by 8.0 mm larvae.

Day, S. and C. Hodgson. Department of Biological Sciences, Wye College, Wye, Ashford, Kent, TN25 5AH UK. Factors affecting the dispersal of *Rhopalosiphum padi* (L.) on winter barley.

Dispersal of *Rhopalosiphum padi* (L.) apterae from their natal winter barley plants began on Day 9, coinciding with the start of the second generation and with a significant decrease in plant growth rate. The Hampshire and Essex clones of *R. padi* used did not vary significantly in the timing or pattern of dispersal.

DeClerck-Floate, R., E. Kokko and F. Leggett. Agriculture & Agri-Food Canada, Box 3000, Main, Lethbridge AB T1J 4B1. Comparison of *Altica* spp. consumption of Canada thistle leaf disks using image analysis. (CFBC - Poster)

Image analysis of fresh leaf disks was useful in comparing consumption by the leaf beetles, *Altica cirsiicola* and *A. carduorum*; the former being considered for Canada thistle biocontrol. Quantification of eaten leaf material through image analysis was objective, precise and rapid. *Altica cirsiicola* has a greater rate of leaf consumption.

Delisle, J.¹ and M. Hardy². ¹Canadian Forestry Service, Sainte-Foy QC, ² Université Laval, Sainte-Foy QC. Effects of larval food quality on *Choristoneura fumiferana* reproductive biology.

Choristoneura fumiferana is known to be a polyandrous species. In this study, we examined whether the probability that females resume calling (the emission of sex pheromone) and remate following the first mating is influenced by the quality of food consumed by males and females during their larval development. These results would be also discussed in relation with the migratory strategy of this species.

Delisle, J.¹, N. M. M. de Lima², and R. J. West³. ¹Canadian Forestry Service, Sainte-Foy QC, ²Université Laval, Sainte-Foy QC, ³Canadian Forestry Service, St. John's NF. Intersexes in the geometrid, *Lambdina fiscellaria fiscellaria*. (Poster)

The flight activity of the hemlock looper, *Lambdina fiscellaria fiscellaria*, was monitored during an epidemic in Quebec, using several different types of traps (pheromone, light, pheromone + light). More than 300 intersex moths were captured, representing 0.2% of adults caught. A detailed description of the varying types of intersexes captured, and their appearance during the flight period, will be discussed.

Digweed, S. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. The role of competition in the community ecology of birch leafminers (Hymenoptera: Tenthredinidae) in Alberta. (Student Paper Award)

Competition may affect birch leafminers, since they occur at high densities, and predation and parasitism levels appear low. I examined competitive interactions involving two exotic birch leafminers, *Fenusa pusilla* and *Profenusa thomsoni*: intraspecific competition within, and interspecific competition between, *F. pusilla* and *P. thomsoni*; and interspecific competition between *P. thomsoni* and the native birch leaf skeletonizer, *Bucculatrix canadensisella*.

Dosdall, L. M. Alberta Environmental Centre, Bag 4000, Vegreville AB T9C 1T4. Induction of host plant feeding preference in larvae of bertha armyworm, *Mamestra configurata*.

Bertha armyworm, *Mamestra configurata*, is a polyphagous noctuid moth of economic importance in the production of canola in western Canada. Host plant feeding preference induction studies were conducted with seven host species representing five plant families for both fourth- and sixth-instar larvae of bertha armyworm.

Elliott, B. G. Department of Entomology, University of Manitoba, Winnipeg MB R3T 2N2. Influence of regeneration techniques on biodiversity of forest Lepidoptera. (Student Paper Award)

Differences in species diversity and ecosystem diversity of Lepidoptera in plantations and naturally regenerated stands of jack pine in Manitoba were investigated. Results from 1993 indicate butterfly species diversity peaks earlier in planted stands but overall, planting reduced species diversity. Results for butterflies in 1994 and for moths in both years will be presented.

Fidgen, J. G. University of New Brunswick, Bag Service #44555, Fredericton NB E3B 6C2. Brood size and sex ratio in the spruce budworm parasitoid, *Elachertus cacoeciae* (How.) (Hymenoptera: Eulophidae). (Student Paper Award)

Host instar and host density effects on brood size and brood sex ratio were investigated for the parasitoid, *Elachertus cacoeciae* (How.) (Hymenoptera: Eulophidae), attacking experimental spruce budworm populations in New Brunswick. Larger broods and female-biased sex ratios appear to be produced from older hosts instars. Results from this study will be discussed.

Fidgen, L. L. University of New Brunswick, Bag Service # 44555, Fredericton NB E3B 6C2. Influence of cone length on oviposition of *Strobilomyia* sp. (Diptera: Anthomyiidae) on spruce. (Student Paper Award)

Spruce cones with and without eggs of cone maggots, *Strobilomyia* sp. were compared to determine if females were selecting the larger cones in which to oviposit. Cones with eggs were significantly longer than cones without eggs for four of six samples. When mature, infested cones were smaller than healthy cones.

Fitzpatrick, S., J. Troubridge, C. Maurice and S. May. Pacific Agriculture Research Centre, 6660 N.W. Marine Drive, Vancouver BC V6T 1X2. Field tests of mating disruption for blackheaded fireworm of cranberries.

Polyvinyl chloride dispensers containing either the main component of fireworm pheromone (Z 11-14:acetate) or a three-component synthetic pheromone blend (Z 11-14:acetate, Z 11-14:alcohol and Z 9-12:acetate) were placed, at a rate of 500 dispensers per ha, in 0.7 ha plots on cranberry farms. Mating in treatment plots was significantly reduced compared to control plots (0-3% of females vs. 60-75%). Pheromone trap catches in treated plots were also significantly lower than those in control plots. Practical aspects of this technology are discussed.

Floate, K. D. Agriculture and Agri-Food Canada, Lethbridge AB T1J 4B1. Non-target effects of ivermectin residues in cattle dung. (CFBC - Poster)

Ivermectin is a parasiticide widely used by the cattle industry. Most of the dose is ultimately excreted in the feces of the treated animal. Here we report preliminary results examining the effect of ivermectin residues in dung on non-target insects which include predators and parasites of livestock insect pests.

Floate, K. D.¹ and T. G. Whitham². ¹Agriculture and Agri-Food Canada, Lethbridge AB T1J 4B1, ²Northern Arizona University, Flagstaff AZ 86011-5640, USA. Aphid-ant interaction reduces chrysomelid herbivory in a cottonwood hybrid zone.

In a cottonwood (*Populus*) hybrid zone, *Chaitophorus* aphids attract aphid-tending ants which exclude the leaf-feeding beetle, *Chrysomela confluens*. Although aphid colonies are ephemeral, their presence resulted in a 2-fold reduction in beetle herbivory. Genetic variation in tree phenology likely alters the significance of this interaction on the host plant.

Floate, K. D.¹, G. W. Fernandes², J. A. Nilsson³ and T. G. Whitham⁴. ¹Agriculture and Agri-Food Canada, Lethbridge, AB T1J 4B1; ²ICB/Universidade Federal de Minas Gerais, Belo Horizonte MG Brazil 30161-970; ³Apache Junction AZ 85219, USA; ⁴Northern Arizona University, Flagstaff AZ 86011-5640, USA. Distinguishing categories of hybridizing plants by their associated insects: tests and considerations.

Discriminant analyses of associated insects can be used to segregate sympatric categories of hybrid plants from one another and their parental species. This was demonstrated with an accuracy of 99% and 95% in hybrid zones of rabbitbrush (*Chrysothamnus*) and cottonwood (*Populus*), respectively. Considerations for the application of this method are discussed.

Fournier, F.¹ and G. Boivin². ¹Services Bio-Contrôle Inc., ²Agriculture Canada, 430 boul. Gouin, St-Jean-sur Richelieu QC J3B 3E6. Using fitness to predict productivity of *Trichogramma* and *Trichogrammatoidae* species/strains of *Ephestia kuehniella*.

Parameters used to evaluate the performance of parasitoid species in mass rearing should include measures of fitness. Fecundity, host adequation, longevity and progeny sex ratio were evaluated over time for 43 species/strains of Trichogrammatidae reared on *E. kuehniella*. When the mean number of females produced in the first six hours of oviposition at 25°C is used, we obtain a good segregation between species/strains. While *Trichogramma embryophagum* and *Trichogrammatoidea bactrae* produced from 18.7 to 20.4 females, *Trichogramma confusum* and *Trichogramma cacoeciae* produced only 3.9 to 4.7.

Gadawski R. M. City of Winnipeg, Insect Control Branch, 2799 Roblin Blvd., Winnipeg MB R3R 0B8. Urban forest pest management in Winnipeg. (Symposium)

Dutch elm disease (DED) is the single most important threat to Winnipeg's urban forest. Since its appearance in Winnipeg in 1975, DED has claimed several thousand trees, and it puts at risk more than 200,000 others. To defend against this risk, the City has developed an integrated

approach to disease management. The strategy is based on the experiences of eastern North America, but considers many regional initiatives. One of the important components of this management strategy is the control program for the native elm bark beetle. This insect is considered the primary vector of DED in Manitoba and is the focus of this discussion. The beetle population is controlled by spraying the basal portion of elm trees. This effectively limits the size of the overwintering population. However, traditional spray methodologies have changed and new information has helped to define spray priorities. For the first time physical barriers are showing some promise of effectiveness, and research is already focused on comparisons between intensive versus conventional sanitation methods of DED management.

Gallo, A. Lakehead University, 955 Oliver Road, Thunder Bay ON P7B 5E1. Ground beetles near a kraft paper mill. (Student Paper Award)

It was found that the carabid fauna near a kraft paper mill in Thunder Bay, Ontario changed in composition between 1971 and the present time. Impact of flue stack fallout appears to be the main anthropogenic cause.

Gavloski, J. Agriculture Canada, 195 Dafoe Road, Winnipeg MB R3T 2M9. The response of *Brassica napus* and *Sinapis alba* to different types of herbivory. (Student Paper Award)

Seedlings of *Brassica napus* and *Sinapis alba* were damaged by different insects or mechanically to test the hypothesis that plants have a generalized response to herbivory. Measurements of leaf, stem, and root growth indicate that the rate that plants compensate for herbivory is herbivore dependent.

Glozoza, P. and M. Weiss. North Dakota State University, Box 5346, Fargo ND 58105-5346. Influence of crop cover on oviposition site selection by *Phyllophaga implicita* (Horn).

After feeding on tree foliage, *Phyllophaga implicita* (Horn) females return to the soil to oviposit eggs. This study was conducted to determine if crop cover influences the oviposition site selected. Treatments were corn, soybean, wheat and oats. Significantly more eggs and larvae were found in soybean and corn plots than small grains.

Hamel, M. C.R.B.F. Pavillion Abitibi-Price, Université Laval, Québec QC G1K 7P4. Feeding ecology of white pine weevil adult in the province of Québec. (Student Paper Award)

Results from field experiment, laboratory bioassays, and chemical analyses indicated that white pine weevil adult could detect host tree species as well as host tree vigor based upon the monoterpene profile of the bark. Feeding chemical stimuli could not explain the preference of the insect for the host tree leader.

Hammond, H. E. J. Department of Entomology, University of Alberta, Edmonton AB T6E 2E3. The arthropod biodiversity of *Populus* spp. coarse woody material in North and Central Alberta. (Student Paper Award)

The arthropods inhabiting coarse woody material is currently being studied in aspen-mixedwood stands in central and northern Alberta. Several wood decay classes from post-rotation and rotation age stands are the focus. Preliminary evidence suggests faunal differences between regions, age class stands, and in wood varying in state of decay.

Hansen, R. USDA-APHIS, Forestry Science Lab - MSU, Bozeman, MT 59717-0278, USA. Developing sampling protocols for *Aphthona* spp. flea beetles, leafy spurge biocontrol agents. (Poster)

USDA-APHIS coordinates a redistribution effort for leafy spurge biocontrol agents, involving five *Aphthona* spp. and 15 US states. An adult sampling strategy for *Aphthona* field insectary sites (FIS) was developed, using 80 net-sweeps per release. A mathematical relationship between net catches and beetle density was determined in order to estimate beetle populations at FIS. Using phenological models for *Aphthona* spp., three sampling dates are scheduled for each FIS. Sweep-sample data are then used to recommend harvest, continued sampling, or abandonment the following year.

Harrington, R., S. P. Foster and E. Hawkins. Rothamsted Experimental Station, Harpenden UK. Movement of apterous *Myzus persicae* in winter: requirements, restrictions and repercussions.

The aphid *Myzus persicae* is largely anholocyclic in Britain and to survive must avoid freezing and continue feeding. Individuals must move frequently to achieve this. Factors limiting movement, and hence survival will be discussed and the implications in terms of spring population levels and insecticide resistance status considered.

Harrison, R. Department of Zoology, University of Manitoba, Winnipeg MB R3T 2N2. Structural and functional characterization of microtubules in an insect ovary. (Student Paper Award)

The telotrophic ovariole of *Rhodnius prolixus* contains an extensive microtubule array that transports essential cellular components from nurse cells to developing oocytes. I have determined the polarity of the microtubules and the distributions of posttranslational modifications of tubulin by immunofluorescence and Western blotting. Functional assays for motility will also be discussed.

Heming, B. S. Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E9. Germ cell ontogeny in *Rhodnius prolixus* Stål embryos (Hemiptera: Reduviidae).

Although the physiology of reproduction in adults of *R. prolixus* is well understood, its germ cells (GC), are essentially unknown and I establish, for the first time, the details of GC origin, proliferation, allocation, and encapsulation in embryos of both sexes and provide a base for their experimental study.

Horton, D. R. USDA - ARS, 3706 W. Nob Hill Blvd. Yakima WA 98902, USA. Effects of sex ratio on interplant movement by pear psylla in small cage studies.

Male-biased sex ratios prompted movement off the original host plant and onto a newly introduced host in male pear psylla (Homoptera: Psyllidae) of the reproductive but not the diapausing generation. These effects were due apparently to mate-searching activities by males.

Huebner, E., R. Harrison and K. Yeow. Department of Zoology, University of Manitoba, Winnipeg MB R3T 2N2. A new artificial feeding technique for *Rhodnius prolixus*.

We report a simple cost effective method for experimental or routine culturing of the blood sucking bug *Rhodnius*. Insects gorged on blood-filled envelopes of stretched Nescofilm or Parafilm. Using heparinized rabbit blood gave growth and fecundity similar to rabbit fed bugs. Envelopes were warmed to 37°C on a slide warmer.

Inglis, G. D., R. P. Feniuk, M. S. Goettel and D. L. Johnson. Agriculture and Agri-Food Canada, Research Centre, Lethbridge AB T1J 4B1. Mortality in grasshoppers exposed to soil-borne *Beauveria bassiana*. (CFBC - Poster)

Beauveria bassiana conidia in sand killed grasshopper (*Melanoplus sanguinipes*) adults and nymphs. By 14 days, 95 to 100% of ovipositing females were dead. Male mortality was delayed relative to females. There was no effect on eggs, but 64% beauveriosis was observed in emergent nymphs. This study demonstrates that adults and nymphs, but not eggs, are susceptible to infection by soil-borne *B. bassiana*.

Karban, R. Department of Entomology, University of California, Davis CA 95616 USA. Inducible resistance in plants and insect pest management. (Symposium)

Many plant traits change following attack; some make the plant less suitable for subsequent herbivores. Resistance in grapevines against economically important Pacific spider mites can be reliably induced by inoculating plants early with less damaging, herbivorous, Willamette mites. Predators may be absent and the two mites need not overlap temporally or spatially for the negative interaction, indicating mediation through changes in host quality. For growers who have had chronic problems, inoculations of Willamette mites reduced populations of Pacific mites and increased yields. Such "vaccinations" can provide effective new pest control that could be used in many crops.

Keddie, B. A. 2-21 Earth Sciences, University of Alberta, Edmonton AB T6G 2E3. The midgut as a barrier to pathogen invasion.

The insect midgut is a complex organ composed of several tissue layers that represent potential barriers to pathogen invasion. During a successful infection by a baculovirus these barriers are penetrated although the pattern of systemic infection may be influenced by the arrangement of the midgut tissues.

Klingenberg, C. P. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Life history studies in the waterstrider *Gerris buenoi*. (Student Paper Award)

Studies of life history traits in the waterstrider *Gerris buenoi* contradicted current theory, as development time and final size are negatively, not positively correlated. I will report results of experiments on the quantitative genetic basis of life history traits and the possible role of protozoan parasites.

Kmec, P. and M. J. Weiss. Department of Entomology, North Dakota State University, Fargo ND 58105 USA. Temporal dynamics of diamondback moth, *Plutella xylostella* L. on cramble, *Crambe abyssinica* Hochst. (Poster)

The occurrence of diamondback moth was monitored in 1993-94. In 1993, the correlation coefficients for visual adult counts versus pheromone captures, egg counts versus pheromone captures, and pheromone captures at two locations in the state were $r=0.40$, $r=0.97$, and $r=0.65$, respectively.

Korunic Z.¹, P. G. Fields² and B. Timlick². ¹Hedley Pacific Ventures Ltd., Suite 1540, 800 West Pender St., Vancouver BC V6C 2V6, ²Agriculture and Agri-Food Canada, 195 Dafoe Rd., Winnipeg MB R3T 2M9. The control of stored grain insects using diatomaceous earth.

Diatomaceous earth has been used for thousands of years to control stored grain insect pests. Today it is gaining wider acceptance in the grain industry because it is non-toxic to mammals and gives long lasting protection. We present results from laboratory and field tests on an improved diatomaceous earth formulation.

Kukan, B. Department of Plant Science, University of British Columbia, Vancouver BC V5T 2A2. DNA hybridization for detection of NPV in tent caterpillars. (Student Paper Award)

Nuclear polyhedrosis viruses (NPV) are being used successfully as biological control agents, however, much is yet to be learned of the host-pathogen relationship. Viral disease could explain some of the characteristics of population cycling in forest Lepidoptera. I will describe the development and testing of DNA dot-blot hybridization assay to monitor variation in frequency of NPV infection in cyclic populations of tent caterpillars.

Laing, J. E., G. Bowles, C. D. R. Medina and J. E. Corrigan. Department of Environmental Biology, University of Guelph, Guelph ON N1G 2W1. The biological control of purple loosestrife, *Lythrum salicaria*. An overview of the University of Guelph project. (CFBC - Poster)

Field releases of *Galerucella californiensis* and *G. pusilla* (Coleoptera: Chrysomelidae) were made in the Guelph, Ontario area in the summers of 1992 and 1993. These species were released in southwestern and eastern Ontario in 1994. *Hylobius transversovittatus* (Coleoptera: Curculionidae) was released in the summers of 1993 and 1994 around Cambridge, Ontario. These species have been continuously reared in the laboratory for the past two years. A comparative laboratory study of the biology of the *Galerucella* species has been undertaken, and studies of the impact of *G. californiensis* on purple loosestrife in the field are in progress.

Laing, J. E., G. Bowles, C. D. R. Medina and J. E. Corrigan. Department of Environmental Biology University of Guelph, Guelph ON N1G 2W1. Release and recovery of *Galerucella californiensis* and *G. pusilla* (Coleoptera: Chrysomelidae), biological control agents of purple loosestrife, *Lythrum salicaria*.

Both species of *Galerucella* beetles were originally released in the Guelph area in August 1992. Further releases were made in Cambridge, Kitchener, Hamilton and Toronto in 1993 and in southwestern and eastern Ontario in 1994. In 1994, beetles were recovered from approximately 60% of the 1992 release sites and 75% of the 1993 sites. We failed to recover *G. californiensis* from a higher proportion of its release sites when compared to *G. pusilla*, and sites with running water appeared to be less favourable than those with standing water or dry sites in terms of establishment of the beetles.

Laitinen, A. M. Department of Biology, University of Victoria, Victoria BC V8W 2Y2. Genotypic variation in the nuclear polyhedrosis virus isolated from Douglas-fir tussock moth. (Student Paper Award)

Orgyia pseudotsugata is a native, periodic defoliator of Douglas-fir and true fir in British Columbia. Preliminary results, from restriction digests and Southern blots from six locations in B.C., show genotypic variation in the naturally occurring nuclear polyhedrosis virus (NPV) isolated from individual larvae. From these variants, a genetically unique strain of NPV may be selected for in use laboratory and field sprays to investigate increases in mortality as a result of the spray.

Lamb, R. J.¹ and P. A. MacKay². ¹Agriculture & Agri-Food Canada, 195 Dafoe Road, Winnipeg MB R3T 2M9, ²Department of Entomology, University of Manitoba, Winnipeg MB R3T 2N2. Biomass conversion ratios for aphids on some annual crops.

The conversion from plant to herbivore biomass was measured for seven aphids on wheat, barley and flax, to estimate a single quantitative value for the interaction between plants and insects. For all interactions, the biomass conversion ratio was approximately 3-4 mg of plant lost per mg of aphid gained.

Langor, D. W.¹ and F. A. H. Sperling². ¹Canadian Forest Service, 5320-122 St., Edmonton, AB T6H 3S5, ²Department of Biology, University of Ottawa, Ottawa ON K1N 6N5. Mitochondrial DNA variation in the *Pissodes strobi* species group (Coleoptera: Curculionidae) in western Canada.

A 1585-bp segment of mtDNA was sampled with restriction enzymes in four species of *Pissodes*. Estimated inter-specific sequence divergences were 0% to 28.7%. *Pissodes terminalis* and *P. nemorensis* were the most closely related species. Restriction site variation is sufficient to discriminate among most species. A diagnostic protocol using three restriction enzymes is recommended.

Lewis, W. J. USDA-ARS, Box 748, Tifton, GA 31793 USA. Plant-pest insect-parasitoid interactions and innovative insect pest management strategies. (Symposium)

Insect parasitoids are closely interwoven with multiple components of a cropping ecosystem. Thus, their foraging behavior is shaped by multi-trophic level influences. Parasitoids of herbivores rely on plants and associated organisms for reproductive food resources. The larval parasitoids, *Microplitis croceipes* and *Cotesia marginiventris*, have served as model systems to elucidate how chemical and visual cues from the plant aid the parasitoid in locating hosts and food. The studies show that plant chemicals induced by the host's feeding and by-products of the host derived from the plants are vital to the parasitoid's host-finding and assessment of the profitability of the habitat. Visual cues associated with the host are also important. Moreover, learning by the parasitoid serves a crucial role in their ability to exploit these chemical and visual cues. Learned use of plant-related chemical and visual cues are important also in the parasitoid's location of its adult food needs. Further, the parasitoid has a very sophisticated ability to associatively link, separately, the occurrence of arbitrary cues with either hosts or food and subsequently use the cues based on current needs of hosts versus food. These findings have been used to demonstrate, in small plots, ways to enhance parasitoids as biological control agents. Formulations of selected cues can be applied to the crop to lure the parasitoid and retain them in an effective behavioral state. Traps, using the cues as baits, have been developed for monitoring the presence and density of parasitoids. Behavioral and physiological state qualities of laboratory-produced parasitoids can be improved through the use of cues for pre-release conditioning. Also, technology to breed and agronomically manage plants and cropping systems so as to optimize their inherent attributes in support of the effectiveness of parasitoids together with other natural enemies are being developed.

Li, S., S. Fitzpatrick and S. Bryant. Pacific Agriculture Research Centre, 6660 N. W. Marine Drive, Vancouver BC V6T 1X2. Effects of application rates and spray volumes on persistence of *Bacillus thuringiensis* in raspberry field.

Effects of application rates and spray volumes on persistence of two formulations of *B. thuringiensis* (var. *kurstaki*) were determined in the raspberry field. Insecticidal activity against the obliquebanded leafroller at higher rates persisted significantly longer than at lower rates. Persistence of *B. thuringiensis* in lower spray volumes was significantly longer than in higher ones. Half-lives of *B. thuringiensis* under field conditions for each application rate and spray volume are compared.

Lindgren, C. Manitoba Purple Loosestrife Project, Oak Hammock Marsh, Box 1160, Stonewall MB R0C 2Z0. The use of a seasonal greenhouse for rearing biological control agents for purple loosestrife in Manitoba.

The purpose of this paper is to briefly examine how a greenhouse was modified for use to rear biological control agents for the control of purple loosestrife. Rearing techniques and equipment used will be discussed. Data will be presented on the rearing success of *Galerucella pusilla*, *G. californiensis*, as well as *Hylobius transversovittatus* obtained under greenhouse conditions.

Liu, F. and S. M. Smith. Faculty of Forestry, 33 Willcocks St., University of Toronto, Toronto ON M5S 3B3. Genetic variation and correlation of some quantitative traits related to biocontrol in *Trichogramma minutum* Riley.

Quantitative genetic studies showed that selected biological traits of *Trichogramma* varied genetically and phenotypically. When populations were allowed to inbreed over 90 generations, parasitism, longevity, sex ratio and emergence were reduced. Parasitism, number of females, number of males, and longevity were genetically correlated.

Lomic, P. V. and V. G. Nealis. Department of Biology, University of Waterloo, Waterloo ON N2L 3G1. Predicting defoliation by the jack pine budworm.

Pollen cones of jack pine (*Pinus banksiana*) have a significant influence on the population dynamics of the jack pine budworm (*Choristoneura pinus*). We developed equations to predict defoliation which incorporated budworm life stage and host-tree pollen cone data.

Lucas, P. Department of Biological Sciences, Brock University, St. Catharines ON L2S 3A1. Food density influences the number of head fan rays in black flies (Diptera: Simuliidae). (Student Paper Award)

Head fan ray number has been used as an aid to identifying larval black flies. There is, however, circumstantial evidence to suggest the number of rays is variable. By rearing larvae under three feeding regimes, low, medium and high, it has been possible to influence the number of head fan rays.

Macias-Samano, J. E. Department of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. Secondary attraction in *Pityokteines elegans* Swaine (Coleoptera: Scolytidae). (Student Paper Award)

Classical pheromone isolation and identification laboratory procedures, as well as GC-EAD analyses, disclosed production by and response of *P. elegans* to Ipsenol and Ipsdienol. Field experimentation confirmed the use of these semiochemicals as aggregation pheromones.

MacLauchlan, L. Ministry of Forests, 515 Columbia St., Kamloops BC V2C 2T7. Impact of *Choristoneura occidentalis* in multi-layered, interior Douglas-fir ecosystems of southern British Columbia.

Annual monitoring of 32 plots located in multi-layered Douglas-fir stands shows significantly less tree mortality in overstory than understory trees, particularly in plots with a recent harvesting history. 57.1% mortality of trees less than 5 cm diameter occurred in plots which had no history of budworm control. Annual defoliation is related to incremental growth and mortality of trees occupying different spatial locations in the canopy.

MacLean, D. A. Canadian Forest Service - Maritimes Region, Box 4000, Fredericton NB E3B 5P7. Spruce budworm decision support system: a tool to integrate insect control and impact into mainstream forest management planning. (Symposium)

Spruce budworm outbreaks must be taken into account in forest management planning, if plans are to be accurate. I will describe a spruce budworm and forest management decision support system (DSS) being developed in a 5 year multi-agency project supported by Canada's Green Plan. This system of computer models, running on a Unix workstation and using the ARC/Info GIS, integrates harvest scheduling and silviculture to minimize the need for protection (insecticide use), and sets priorities for forest protection, if desired, to increase forest yields. Models completed to date predict long-term stand- and forest-level development and timber supply under alternative pest/forest management scenarios; determine protection priority for stands based on marginal timber supply benefits of insecticide use; and project the forest inventory up to 30 years into the future, under user-specified assumptions about budworm outbreak occurrence, severity, and protection use. The DSS will be used in 3 ways: forest management planning (build budworm effects into timber supply, sustainable harvest level, and harvest schedule calculations), protection planning, and prevention (design harvest and silviculture schedules to minimize future budworm damage).

McDonald, R. S. Department of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. Host-seeking and upwind flight in *Delia antiqua* (Diptera: Anthomyiidae). (Student Paper Award)

The effects of sex, age, ovarian development and mating status on upwind flight to onion volatiles were measured in dual-port airflow olfactometer. Comparisons were made between combinations of females and males to test hypotheses that host-finding is attuned to changes associated with physiological status, and is sex specific.

McEntire, B. A. Seed Pest Management, BC Ministry of Forests, 7380 Puckle Road, Saanichton BC V8M 1W4. Life history and pheromone monitoring of the fir coneworm, *Dioryctria abietivorella* (Lepidoptera: Pyralidae), in British Columbia. (Student Paper Award)

The fir coneworm, *Dioryctria abietivorella*, is a serious pest of conifer cones in North America but very little is known of its biology. This study attempts to identify male flight period, sex pheromones, and other aspects of fir coneworm life history. Flight was monitored at two BC sites (coastal and interior) using four different synthetic pheromones. In the interior, male moths flew for at least 10 weeks beginning in late May; on the coast, male flight began in early July and continued through the summer. Fir coneworm may overwinter as late instar larvae in cones.

McIntyre, G. S. and R. H. Gooding. University of Edmonton, Edmonton AB T6G 2E3. Effect of maternal age on pteridine content, size, development time and fluctuating asymmetry in tsetse flies.

Male tsetse flies were examined for effects of maternal age on size, puparial duration, and head capsule pteridine content. Pteridine content was unaffected but offspring of old flies had shorter puparial periods and tended to be smaller. Effects of maternal age on fluctuating asymmetry are also discussed.

McKinnon, M. L. Faculty of Forestry, University of New Brunswick, Fredericton NB E3B 6C2. Influence of plant growth rate and foliar nutrition on performance of a specialist herbivore *Zeiraphera canadensis*. (Student Paper Award)

The influence of plant growth rate and foliar chemistry on herbivore performance was investigated using *Zeiraphera canadensis* Mutt. & Free. on white spruce. Overall, performance parameters were positively related to tree growth rate and foliar nutritive quality. These results support the plant vigour but not the plant stress hypothesis.

McLaughlin, L.¹ and F. F. Hunter² ¹Department of Zoology, Guelph University, Guelph ON N1G 2W1, ²Department of Biological Sciences, Brock University, St. Catharines ON L2S 3A1. Night-time resting sites of black flies (Diptera: Simuliidae).

Black flies were dusted with fluorescent powder and released at dusk into 4'X4'X7' (LxWxH) enclosures, each containing one 6' tree. At 2 a.m. the location of resting black flies was determined using a black light. Over 50% of flies were found in the leaf litter.

McLean, J. A. Department of Forest Sciences, University of British Columbia, Vancouver BC V6T 1W5. Impact of ambrosia beetles on lumber values in coastal British Columbia. (Symposium)

Loggers fell large volumes of trees in late summer and fall in preparation for yarding and milling the following year. This pattern sets up large quantities of suitably aged logs for attack by ambrosia beetles the following spring. Beetles are transported throughout the industrial milieu during the summer setting up secondary infestation sites for the following year. Degrade losses were shown to exceed \$11,000,000 for one company which suggests more than \$100,000,000 degrade annually throughout the coastal industry. The role of the logger in movements of ambrosia beetle populations will be contrasted with the natural dispersal methods employed by these beetles.

McNeil, J. N. Département de biologie, Université Laval, Ste. Foy QC G1K 7P4. Ecological and genetic aspects of long distance migration, with particular emphasis on Lepidoptera. (Symposium)

Long distance migration is an essential component in the life history of many insect species. In my presentation I will (i) consider the ecological cues that may serve to evaluate habitat quality and thus determine whether migration will ensue or not, (ii) examine the meteorological conditions affecting long distance movement, and (iii) discuss the physiological and genetic factors that may influence the time available to successfully complete migration.

McQueen, R. L. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Management of birch leaf miners in northern cities. (Student Paper Award)

Two species of leaf mining sawflies, *Fenusa pusilla* (Lepeletier) and *Profenusa thomsoni* (Konow) cause damage on birch trees in the City of Edmonton. The goal of my research is to develop a leaf miner management plan that meshes biological and horticultural control procedures and convey this information to a concerned public.

Medina, C. P. Department of Environmental Biology, University of Guelph, Guelph ON N1G 2W1. Coexistence strategies of two *Galerucella* species on purple loosestrife, *Lythrum salicaria* L. (Student Paper Award)

Biology and behaviour of two *Galerucella* species imported for release against purple loosestrife were studied. Under constant temperatures, *G. californiensis* developed slightly faster than *G. pusilla*. Survivorship of immatures as well as fecundity of adults was also higher in *G. californiensis* at lower temperatures (15°C). Differences in the oviposition sites of adults and feeding sites of larvae between the two *Galerucella* species will also be presented.

Medina, C. D. R. and J. E. Laing Department of Environmental Biology, University of Guelph, Guelph ON N1G 2W1. Mass rearing of *Galerucella californiensis* and *G. pusilla* (Coleoptera: Chrysomelidae), biological control agents of purple loosestrife, *Lythrum salicaria*.

Galerucella pusilla and *G. californiensis* have been in continuous laboratory culture since the summer of 1992. Larvae and adults of both species are maintained on host plant foliage. The culture methods are identical for the two *Galerucella* species. An average of 1,500 - 2,000 pairs of adults of both species have been produced per week during the field release season. Details of the rearing technique and problems encountered with the rearing program will be discussed.

Meyer, A. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Insects attacking wild saskatoons in the boreal forest. (Student Paper Award)

I surveyed wild saskatoons (*Amelanchier alnifolia*) for insects in north-central Alberta. An unidentified bud moth was ubiquitous, and devastated both reproductive and non-reproductive shoots. I will report on the phenology of the bud moth, the damage it caused, and its parasitoids.

Mondor, E. B. Departments of Psychology and Botany, Brandon University, Brandon MB R7A 6A9. Sphere sizes optimally attractive to the apple maggot fly (*Rhagoletis pomonella*) on crabapple and standard-apple trees. (Student Paper Award)

The apple maggot fly, *Rhagoletis pomonella* is a significant pest of apples in North America. The efficacy of four sizes of red spherical traps were tested on trees bearing crabapples and standard-apples. Flies attacking both fruit sizes responded most strongly to the same (supernormal) trap size, however the optimal stimulus differed for male and female flies.

Mulyk, D. S. Department of Zoology, University of British Columbia, Vancouver BC V6T 1Z4. DNA sequence variation in some members of the *Geocoris bullatus-pallens* species complex occurring in western Canada. (Student Paper Award)

Portions of both the mitochondrial (i.e., Cytochrome b, Cytochrome oxidase II) and nuclear (i.e., Internal transcribed spacers 1 and 2, the D3 loop of the 18S rDNA) genomes are being amplified and sequenced from *Geocoris bullatus* (Say), *G. discopterus* Stål, *G. pallens* Stål, and *G. uliginosus* (Say) (Heteroptera: Lygaeidae) to understand their phylogenetic relationships and biogeographic history.

Nealis, V. G. and P. V. Lomic Canadian Forest Service-Ontario Region, Box 490, Sault Ste. Marie ON P6A 5M7. Pollen cones enhance survival of jack pine budworm. (Poster)

We conducted laboratory and field experiments to quantify the effect that pollen cones of jack pine (*Pinus banksiana*) have on newly-emerged second-instar jack pine budworm (*Choristoneura pinus*). Pollen cones were found to enhance survival of the budworm in both the laboratory and field.

Nielsen, J. K. Chemistry Department, Royal Veterinary and Agricultural University, 40 Thorvaldsensvej DK-1871, Frederiksberg C. Denmark. Chrysomelid-crucifer interactions and chemical control. (Symposium)

All crucifer feeding Chrysomelidae seem to be stimulated to feed by glucosinolates, a group of sulphur containing glycosides which seems to be present in all crucifers. Specific responses to glucosinolates may explain how the beetles recognize crucifers from plants which do not contain these compounds. However, the beetles may need at least a simple mixture of compounds in order to distinguish between host and non-host crucifers. This mixture may be regarded as a chemical profile of the host plant. Inadequate knowledge of the whole mixture constituting a chemical profile may be one reason for the slow progress in the development of cultivars which are resistant to insect attack.

Noronha, C. and C. Cloutier. Département de biologie, Université Laval, Québec QC G1K 7P4. Effect of soil compaction on digging of prediapause Colorado potato beetle. (Poster)

Digging speed and depth of CPB decreased exponentially with soil compaction in laboratory tests. Sex and size did not affect digging, but beetles preferred to dig in loose soil and delayed digging in compact soil. Soil heterogeneity is probably an important factor in digging and overwintering depth under natural conditions.

Ostaff, D. P. Faculty of Forestry, University of New Brunswick, Fredericton NB E3B 6C2. Forest structure influences herbivore abundance.

The host plant populations's age structure appears to be important in determining the size and composition of some herbivore communities. With the support of data collected by the Forest Insect and Disease Survey, I discuss the role of tree age and density in determining the abundance of some forest herbivores.

Pelletier, Y. and C. D. McLeod. Agriculture and Agri-Food Canada, Research Centre, Box 20280, Fredericton NB E3B 4Z7. Obstacle perception by insect antennae during terrestrial locomotion.

Our results demonstrated, for the first time with insects, that antennae of walking adult Colorado potato beetles, *Leptinotarsa decemlineata* (Say), by their movements and their position ahead of the beetle, provide information on the presence of the obstacle necessary to initiate step-up behavior. Furthermore, the change in the body angle needed to increase the reach of the prothoracic leg and step on the obstacle, is proportional to the height of the obstacle.

Perlman, S. Department of Entomology, Royal Ontario Museum & University of Toronto, Zoology, 100 Queens Park, Toronto ON M5S 2C6. Definition and evolution of hyperparasitism, with special reference to the family Perilampidae (Hymenoptera: Chalcidoidea). (Student Paper Award)

A survey of "hyperparasitism", a vague concept developed from a biological control perspective, clarifies important differences between true hyperparasitism and secondary parasitism, based on timing and mode of attack. Behavioural experiments are discussed which test the hypothesis that diverse host associations in perilampids resulted from opportunistic hyperparasitism.

Pohl, G. R. Forestry Canada, Northern Forestry Centre, 5320-122 St., Edmonton AB T6H 3S5. Staphylinid beetle diversity in aspen forests in Alberta.

Staphylinid beetles were collected in pitfall traps in aspen (*Populus tremuloides* Michx.) forests at six locations in Alberta in 1992 and 1993. In total, 85 species were found, excluding the subfamily Aleocharinae. Communities at the six locations are compared, as are communities from stands of different age at one of the sites.

Poland, T. M. Department of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. Competitive interactions between the spruce beetle and two secondary bark beetle species. (Student Paper Award)

The spruce beetle, a major pest of mature spruce, often co-exists with two secondary species, *Ips tridens* and *Dryocoetes affaber*. Spruce beetle attraction to its pheromone is inhibited by pheromones of both secondary species. Attack density and progeny production were reduced when secondary beetles were induced to co-attack trees after spruce beetle establishment.

Pommen, G. D. W. Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E3. Chemosensory cues for larviposition behavior of the flesh fly, *Neobellieria* (= *Sarcophaga*) *bullata*. (Student Paper Award)

Chemical cues for oviposition and larviposition behavior for saprophagous flies have not been well studied. Factors affecting larviposition have been identified and preliminary work has begun to identify chemical cues from liver which stimulate larviposition. The role of chemosensory cells in mediating oviposition site selection will be discussed.

Pommen, G. D. W. and D. A. Craig. Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E3. Form and function of net-winged midge pupal gills (Diptera: Blephariceridae): implications for respiration.

Blephariceridae pupal gills show great variety in structure. Flow around gills produces vortices, known regions of low pressure. This probably assists the plastron of the gill. That high velocity produces low pressure sufficient to outgas water for respiration in the beetle *Potamodytes tuberosum* is used to support this conclusion.

Prasad, R. Pacific Forestry Centre, Natural Resources Canada, Victoria BC V8Z 1M5. Interaction of several pesticides and adjuvants with *Chondrostereum purpureum* -- A bioherbicide agent for control of forest weeds. (CFBC - Poster)

The basidiomycete fungus, *Chondrostereum purpureum* Fr. Pouzar, has been found to be a good potential bioherbicide candidate for control of hardwood vegetation in forests. However, its interaction with some agrochemicals that are normally employed in forest protection was not known. Employing two concentrations (0.01% v/v and 0.1% v/v) of several agrochemicals, a laboratory study was conducted to assess their impacts on the infective mycelia. Except for Bond, and Suntan get-2, most adjuvants, sunscreen agents, and pesticides (herbicides, fungicides, and insecticides) were fungitoxic at 0.1%. Fungitoxicity was concentration dependent and the

results indicate that the possibility of tank-mixing the basidiomycete with agrochemicals appears limited and the possibility of agrochemical residue effects on survival of the basidiomycete is implied.

Prévost, Y. and D. Kentner School of Forestry, Lakehead University, Thunder Bay ON P7C 5E1. Are some birch trees, *Betula papyrifera* resistant to birch leaf miners, *Fenusa pusilla*?

Birch leaf miners reduce the aesthetic value of birch throughout Canada. Serendipitously, while describing the seasonal progress of the damage to the leaves, we came across a tree that seemed to exhibit some resistance, in that both damage per leaf and number of leaves damaged were less, progress of damage and development of larvae was slower and there were fewer larvae per leaf.

Rankin, M. Department of Zoology, University of Texas, Austin TX 78712 USA. Physiological links between migration and reproduction. (Symposium)

Insect migration is said to involve various costs such as mortality on route, delayed reproduction, reduced energy reserves for reproduction. This, along with the oogenesis-flight syndrome suggest that there may be limits on the extent to which both increased migration and increased reproductive output could evolve. However, migration in insects is often used as a colonizing device, and an ideal colonist would display both adaptations for long flight and for rapid and prolific reproduction. Physiological controls have evolved in some insect species to link migration and reproduction such that the reproductive costs of migration are minimized or eliminated. Examples of three such control systems will be described in species that use migration as a colonizing mechanism.

Reid, M. L. Department of Biological Sciences, University of Calgary, Calgary AB T2N 1N4. Body size and breeding behaviour of bark beetles.

The biology of bark beetles (Coleoptera: Scolytidae) is characterized by breeding aggregations and protracted parental care. These features may result from limited dispersal prospects, which should be more severe for smaller individuals. As this hypothesis predicts, smaller beetles were more likely to join aggregations and remained longer with their mates.

Rivet, M. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Structure of the suboesophageal ganglion of *Neobellieria bullata* (Parker), (Diptera: Sarcophagidae). (Poster)

The suboesophageal ganglion (SOG) is the center of taste integration. The maxillary-labellar nerves convey information from the mouthparts to the SOG. Several features of the SOG were mapped using a modified Nissel stain and visualized on both a light and confocal microscope. The site of entry of the labro-frontal and maxillary-labellar nerves, the general location of cell bodies and a number of tracts are described. The structure of the SOG of *N. bullata* seems similar to that of *Musca domestica*.

Roger, C.¹, G. Boivin², and D. Coderre³ ¹Department of Natural Resources Sciences, McGill University, Montréal QC, ²Agriculture Canada Research Station, 430 Boul Gouin, St-Jean-sur-Richelieu QC J3B 3E6, ³Department of Sciences Biologiques, Université du Québec à Montréal, Montréal QC. Prey discrimination in *Coleomegilla maculata* (Coleoptera: Coccinellidae) towards parasitized and unparasitized *Trichoplusia ni* (Lepidoptera: Noctuidae) eggs.

Under the optimal foraging theory, predators should select prey that maximize their energy intake. If parasitized hosts are of lower quality, prey discrimination would be predicted. When *C. maculata* larvae were offered *T. ni* eggs either unparasitized or parasitized by *Trichogramma evanescens* (Hymenoptera: Trichogrammatidae), they consumed significantly more unparasitized eggs. Discrimination could be based on an external kairomone deposited by the parasitoid female or on internal modifications brought about by the immature parasitoid development.

Roitberg, B. D. Department of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. An evolutionary perspective of short range movement in insects. (Symposium)

I plan to talk about the relationship between within-habitat resource distribution and the evolution of movement. To accomplish this, I will introduce some new approaches (the use of structure functions) that allow one to describe resource availability from the insect's perspective. Then, I'll draw upon my own work on rosehip flies to compare three different habitats that vary significantly in terms of resource distribution but not necessarily in terms of their impact on movement-related behaviours of fruit flies nor on fly population dynamics. The example points out the dangers of making sweeping generalizations about the interaction between ecology and behaviour.

Roland, J., P. Taylor and G. McKinnon Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E9. Harmonic RADAR for remote tracking of individual flying insects.

Harmonic radar technology was adapted for use with flying insects, for the purposes of studying insect movement. Diodes and antennae were miniaturized to a combined weight of 0.4 mg, and were tested on sarcophagid flies, tent caterpillar moths and alpine butterflies. Range of detectability of the present configuration was 20 to 30 metres.

Roush, R. Department of Entomology, Cornell University, Ithaca NY 14850 USA. Insect resistant transgenic plants: boon or bane for pest management? (Symposium)

Transgenic cotton and potatoes significantly reduce the need for insecticide applications and thereby help to preserve beneficial and innocuous species. Thus, they may have considerable environmental and entomological advantages. Nonetheless, some entomologists and environmentalists have argued that insect resistant transgenic crops should not be used, due to the risk of spread of insect resistance genes into weedy plants and the potential for the evolution of *Bt* resistance in the targeted pests. However, the chances of increased weediness from the currently targeted crops seems remote. Further, if properly deployed, transgenic plants may manage resistance better than *Bt* sprays.

Royer, L.¹ and G. Boivin². ¹McGill University, St-Anne-de Bellvue QC H9X 1C0
²Agriculture Canada Research Station, 430 Boul Gouin, St-Jean-sur-Richelieu QC J3B 3E6.
The use of a kairomone by *Aleochara bilineata* to locate *Delia radicum* larvae.

Aleochara bilineata adults feed on cabbage maggot (*Delia radicum*) eggs and larvae. We studied the response of *Aleochara* adults to various olfactive cues in a Y-tube olfactometer. *Aleochara* adults were not attracted by the odour of rutabagas, but oriented towards roots infested by cabbage maggot larvae. The principal attractants originated from cabbage maggot larvae and larval frass. The use of chemical information may facilitate the location of prey by *A. bilineata*.

Sanders, C. J. and G. S. Lucuik Canadian Forest Service, Box 490, Sault Ste. Marie ON P6A 5M7. Comparison of mating disruption between spruce budworm and oriental fruit moth in a wind tunnel.

Male spruce budworm and male oriental fruit moth, exposed overnight to various concentrations of their respective sex pheromones in a wind tunnel and then presented with calling female moths, responded no differently from males kept in clean air, except at highest concentrations. There were no differences between the two species.

Schouten, P. J. Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E3. Velocity detection and its relationship to filter feeding in the mayfly nymph *Ametropus neavei* (Ametropodidae). (Poster)

Previous experimental evidence indicated that *Ametropus neavei* nymphs are capable of detecting water velocity. SEM micrographs revealed many sensilla types on the head and antennae including trichoid mechanoreceptors. Histological evidence shows that certain chordotonal organs are inside the antennae. Both sensilla types are probably involved in velocity detection.

Schwartz, M. and R. Footitt Centre for Land and Biological Resources Research, Agriculture and Agri-Food Canada, Ottawa ON K1A 0C6
Morphological and molecular variation in lygus bugs. (Poster)

Lygus presents many taxonomic difficulties both in phylogenetic analyses and routine identification due in large part to variable taxonomic characters. We have investigated ontogenetic and geographic components of character variation using multivariate morphometric techniques and combined with this molecular data to begin to develop a phylogenetic perspective for the genus.

Shore, T. L., W. G. Riel and L. Safranyik. Canadian Forest Service, Natural Resources Canada, Victoria BC V8Z 1M5. A decision support system for management of mountain pine beetle infestations in lodgepole pine stands in British Columbia. (Poster)

The mountain pine beetle is the most serious pest of mature lodgepole pine in western North America. Each year, infestations result in the death of millions of trees which seriously disrupts the forest management planning process. A decision support system is being developed by the Canadian Forest Service in cooperation with the British Columbia Forest Service which integrates GIS, forest inventory and mountain pine beetle databases, a risk rating system, a population dynamics and impact model and a management expert system.

Smith, J. L. Department of Biology, University of Victoria, Box 1700, Victoria BC V8W 2Y2. Factors affecting the survivorship of an oak gall wasp, *Neuroterus saltatorius* (Edwards). (Student Paper Award)

The parasitoid guild of an oak gall wasp, *Neuroterus saltatorius*, was investigated in *Quercus garryana* stands on Southern Vancouver Island. Sixteen parasitoid species (Chalcidoidea) were found to attack *N. saltatorius* galls. Overall parasitism rates were found to be low and additional factors may be important in regulating population levels.

Smith, S. M. Faculty of Forestry, University of Toronto, Toronto ON M5S 3B3. Augmenting natural enemies for forest pest control. (Symposium)

While historically a number of natural enemies have been augmented for control of forest pests, most recent work in Canada has focused on the egg parasitoid *Trichogramma minutum*. Over the past 10 years, *T. minutum* has been investigated for its use in inundative releases against a number of forest insect pests including the spruce budworm, forest tent caterpillar, black army cutworm, hemlock looper, pine false webworm, and spruce budmoth. Where results on host acceptance look promising in the laboratory, studies have been taken to the field to determine the feasibility and strategy for release. Key areas of research needed to make this approach commercial include mass rearing (alternative hosts and artificial diets), parasitoid quality, release technology and both long- and short-term strategies for suppression of pest populations.

Spence, J. Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E9. Movement and the structure of pondskater populations.

A ten-year study of gerrid populations dynamics on a single pond based on weekly census shows that populations are larger, regional units connected by both within- and between-season movement. Output-input ratios for all species are highly variable. New colonists fly in throughout the breeding season and most flying females carry chorionated eggs. Weekly disappearance was estimated experimentally at ca. 30%, with 25-50% of this loss attributed to emigration. These populations are dynamic breeding assemblages with little representation from the pond in the previous year.

Stuart, A. Department of Biological Sciences, Brock University, St. Catharines ON L2S 3A1. Phylogenetic analysis of cocoon spinning behaviour in black flies (Simuliidae). (Student Paper Award)

Historically, black fly phylogenies have been reconstructed using morphological and chromosomal data. The cocoon spinning behaviour of the pharate pupa also yields many characters for phylogenetic analysis. The behaviour is complex, innate, and highly conserved among individuals of the same species. This paper will describe the behavioural characters to be used. A preliminary phylogeny of the Simuliidae will be presented.

Sweeney, J. and G. Gesner Canadian Forest Service, Box 4000, Fredericton NB E3B 5P7. Factors affecting survivorship of the spruce cone maggot (*Strobilomyia neanthracina*).

Survivorship of *Strobilomyia neanthracina* was estimated in two white spruce seed orchards in New Brunswick in 1992 and 1994. Predation in the soil accounted for 40% and 65% mortality of larvae and pupae, respectively, and was due mainly to invertebrates. One half of pupae did not survive the winter.

Taylor, P. D. and J. Roland. Department of Zoology, University of Alberta, Edmonton AB T6G 2E9. Movement of forest tent caterpillar and parasitoids in fragmented forest.

We are investigating how movements of forest tent caterpillar (*Malacosoma disstria*) and of its natural enemies are differentially affected by forest fragmentation. Forest fragmentation may alter regional herbivore dynamics by altering fine-scale interactions with its natural enemies. These changes may be the cause of observed differences in patterns of outbreaks between continuous and fragmented forest.

Tenhumberg, B. Department of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. The role of prey availability on foraging behaviour of syrphid larvae.

A dynamic state variable model is used to calculate the optimal foraging behaviour of syrphid larvae. Prey availability determines the frequency of resting and foraging as well as the duration of the larval period and the pupal weight obtained. The results of the model are compared with experimental data.

Teshler, M., S. Briere, R. Stewart and A. Watson. Plant Science Department, McGill University, MacDonald Campus, 21,111 Lakeshore, Ste-Anne-de-Bellevue QC H9X 3V9. Biological control of common ragweed using insects. (CFBC - Poster)

Original comparative experimental data of biological and ecological peculiarities, feeding behaviour of 2 insects *Zygogramma suturalis* and *Galerucella natulata* (Coleoptera: Chrysomelidae) are presented. Some advantages and disadvantages of their use for biocontrol purposes, preliminary investigation of synergistic effects of the fungus (*Phyllosticta* sp.) and insecticide application are shown.

Thistlewood, H. and D. Pree Centre for Pest Management, Agriculture & Agri-Food Canada, Vineland ON L0R 2E0. Development of guidelines for release of *Amblyseius fallacis* in fruit crops.

A highly organophosphate insecticide-resistant strain of *Amblyseius fallacis* (Acari: Phytoseiidae) was selected for pyrethroid resistance and is being released on fruit crops for biological control of spider mites. Factors affecting the success and failure of inundative and augmentative releases since 1990 are discussed.

Timlick, B. and P. G. Fields. Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg MB R3T 2M9. Low temperature control of *Plodia interpunctella* in a seed warehouse.

The Indian meal moth (*Plodia interpunctella*, Pyralidae: Lepidoptera) is a major pest of food and seed warehouses and processing facilities. With the increasing resistance to contact insecticides and the curtailed use of the fumigant methyl-bromide because it depletes the ozone, we examined the efficacy of low temperature control of the Indian meal moth in the laboratory and a seed warehouse.

Tomlin, E. S. Dept. of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. Host selection by the white pine weevil in three types of laboratory bioassay. (Student Paper Award)

Feeding and oviposition preferences of the white pine weevil, *Pissodes strobi* (Peck), were studied using three types of laboratory bioassay. Three Sitka spruce clones consistently deterred feeding and oviposition; feeding preferences varied with sexual maturity and/or phenology of the host material. Experiments are being conducted to determine the nature of the deterrent stimulus.

Trimble, R. M. Pest Management Research Centre, Agriculture and Agri-Food Canada, 4902 Victoria Avenue North, Box 6000, Vineland ON L0R 2E0. Sex pheromone-mediated mating disruption for controlling *Endopiza viteana* (Clemens) in Niagara peninsula, Ontario vineyards.

Economic control of the grape berry moth, *Endopiza viteana* (Clemens) was achieved during five consecutive years in two vineyards using Isomate®-GBM pheromone dispersers. Pheromone-based control was equal to or better than insecticide-based control. There were no outbreaks of secondary pests associated with the elimination of insecticide from pheromone-treated vineyards.

Tyre, A. J. Department of Biological Sciences, Simon Fraser University, Burnaby BC V5A 1S6. The importance of alternative strategies to territoriality in the water strider *Limnoporus notabilis* (Heteroptera: Gerridae).

Territorial behaviour for mate and food acquisition has been observed in many different species of water striders. Alternative strategies for acquiring the same resources have also been observed. I use the results of a game theory model of territoriality to emphasize the importance of considering the costs and benefits of these alternative strategies when examining territorial behaviour in insects.

Van Hezewijk, B. Faculty of Forestry, University of Toronto, 33 Willcocks St., Toronto ON M5S 3B3. Influence of rearing method and host concealment on the host-finding ability of *Trichogramma minutum*.

In a field release, spruce budmoth eggs (*Zeiraphera canadensis*) were parasitised more effectively by field populations of *Trichogramma* spp. than by mass-reared *T. minutum*. Searching efficacy of field populations and mass-reared *T. minutum* were compared. Field strains were better at finding concealed eggs on spruce shoots than mass-reared parasitoids.

Vijaychander and S. M. Smith Faculty of Forestry, University of Toronto, 33 Willcocks St., Toronto ON M5S 3B3. Arrestment response of *Trichogramma minutum* to host scales and host plant extracts.

The influence of spruce budworm kairomones (scales: male and female) and synomones (balsam fir and white spruce) on the arrestment behaviour of female *Trichogramma minutum* was examined. Female parasitoids spent more time on filter paper patches treated with foliage extracts than control patches. The interaction of these infochemicals was compared to that of individual effects.

Vogel, S. Department of Zoology, Box 90325, Duke University, Durham NC 27708-0325 USA. Insects aren't airplanes: constraints and opportunities. (Symposium)

Insect wings are best viewed as helicopter blades--devices that produce lift but use it to get thrust, both upward and forward. Even as blades, though, they're peculiar. Since they beat rather than spin, they reverse their twist and restart their lift twice per stroke. Since they operate under somewhat different aerodynamic rules, they suffer more drag for their lift and beat faster relative to their forward movement. Since insects are so small and thus have high surface-to-weight ratios, they find it relatively easy to stay aloft (and so can hover cheaply) but more difficult to progress forward.

Volney, W. J. A. Northern Forestry Centre, Forestry Canada, 5320-122 St., Edmonton AB T6H 3S5. Experimental studies of spruce budworm population dynamics. (Symposium)

Forest pest management policies developed in eastern Canada to protect trees from defoliation by the spruce budworm do not apply to western Canada. The biological basis for a population suppression policy was examined experimentally and tested on white spruce stands in western Canada. Preliminary results of these and observational studies indicate that a new strategy has considerable merit. Furthermore, the treatments indicate that survival rates in the late instars are strongly associated with population trend.

Wang, Z. and S. M. Smith Faculty of Forestry, University of Toronto, 33 Willcocks St., Toronto ON M5S 3B3. Ovarian development and reproductive mode in *Trichogramma minutum*.

Ovarian development was compared in thelytokous and arrhenotokous *Trichogramma minutum* from the same host. Based on ovarian dissections and oviposition, the number of eggs in arrhenotokous parasitoids increased linearly with parasitoid age while a stable distribution was seen for thelytokous parasitoids. This, considered with other factors, suggests that thelytokous *T. minutum* tend to be synovigenic and arrhenotokous parasitoids tend to be proovigenic.

West, R.¹, M. Kenis¹ and K. Herz² ¹NRCan, Canadian Forest Service, Newfoundland and Labrador Region, Box 6028, St. John's NF A1C 5X8, ²International Institute of Biological Control, European Station, CH-2800 Delémont, Switzerland. European parasitoids under evaluation for introduction to control of hemlock looper. (Poster)

Among the 20 geometrid species recovered from annual surveys in coniferous forests in the Swiss Alps, three have been identified as sources for four parasitoids that might be suitable for introduction to Newfoundland to control the hemlock looper; *Epirrita autumnata*, *Agriopsis aurantiaria* and *Poecilopsis isabellae*. The biologies of two univoltine species of *Dusona* (Hymenoptera: Ichneumonidae), *D. contumax* ex. *A. aurantiaria* and *D. sp. ex. P. isabellae*, and two univoltine species of *Aleiodes* (Hymenoptera: Braconidae), *A. gastritor* ex. *E. autumnata* and *A. sp. ex. P. isabellae*, are discussed.

Wikel, S. K. Endowed Chair in Agricultural Biotechnology, 127 Noble Research Centre, Oklahoma State University, Stillwater OK 74078 USA. Immunology of the animal host-arthropod interface: development of anti-arthropod vaccines. (Symposium)

Development of vaccine based control strategies for ticks requires a thorough understanding of the immunological interactions at the tick-host interface. Tick feeding induces host resistance

to infestation involving cytokine, antibody and cell mediated immunity. Ticks can modulate host immune competence. These interaction pathways can be used to design strategies for the immunological control of ticks. Immortalized tick digestive tract cells grown in culture can be used to induce significant anti-tick immunity. Host immunosuppressive compounds isolated from tick salivary gland are being used to develop an anti-immunomodulatory factor vaccine designed to alter tick feeding and pathogen transmission.

Williamson, M. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. Impact of *Bacillus thuringiensis* (Btk) on non-target Lepidoptera of wetland gaps in the boreal forest. (Student Paper Award)

Btk has been aerielly applied in Saskatchewan to control the spruce budworm (*Choristoneura fumiferana* Clemens). Little is known about its effects on non-target Lepidoptera. I have (1) quantified the impact of Btk on Lepidoptera of wetland gaps embedded within the spray blocks and (2) studied the subsequent recovery of this fauna.

Winchester, N. N. Biology Department, University of Victoria, Box 1700, Victoria BC V8W 2Y2. Centinelan extinctions: extirpation of northern temperate old-growth rainforest arthropod communities. (Student Paper Award)

Arthropod biodiversity is being investigated in the Carmanah Valley on Vancouver Island, British Columbia. Examination of several species, many of which are not yet described, indicate that this structurally complex habitat acts as a reservoir for biological diversity. Removal of this habitat will forever change the structural and functional aspects of these ecosystems and initiate species extinctions.

Wise, I. L. and R. J. Lamb. Agriculture Canada, 195 Dafoe Road, Winnipeg MB R3T 2M9. Stage specific economic thresholds and sequential sampling for *Macrosiphum euphorbiae* (Thomas) in oilseed flax.

Sequential decision plans based on counts and binomial sampling were developed for *Macrosiphum euphorbiae* (Thomas) on flax at two stages. The relationship between variance (s^2) and mean density (x) was $\log_e s^2 = 0.79 + 1.649 \log_e x$ ($n=69$, $r^2 = 0.98$). Both methods gave similar decisions, but counting required a minimum of 25 plants at full flower and 20 at green boll vs. 40 and 65 for binomial sampling.

Xie, Y.¹, P. G. Fields¹ and M. B. Isman². ¹Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg MB R3T 2M9, ²Department of Plant Science, University of British Columbia, Vancouver BC V6T 1Z1. Evaluation of insecticidal activity of plant extracts against stored-product insects.

Repellency, toxicity and fecundity-reducing effects of azadirachtin and extracts from neem tree (*Azadirachta indica*) and chinaberry (*Melia toosendan*) on three stored-product beetles were investigated in the laboratory. All extracts repelled insects, caused mortality and reduced offspring in a dose dependent manner. This study indicated that a natural grain protectant based on the neem and *M. toosendan* extracts may be feasible.

Yeow, K. and E. Huebner Department of Zoology, University of Manitoba, Winnipeg MB R3T 2N2. Development of the actin cytoskeleton in the teleotrophic ovaries of *Rhodnius prolixus*.

Development of the extensive F-actin mesh characteristic of the adult tropharium was investigated during 5th instar to adult transformation. Prominent F-actin strands appear, concurrent with the formation of the microtubule core, during the last 2-3 days before the adult molt. The strands form from thickened F-actin rings of ring canals.

Yi, S. and K. van Frankenhuyzen. Forest Pest Management Institute, Canadian Forest Services, Department of Natural Resources Canada, Box 490, Sault Ste. Marie ON P6A 5M7. *In vivo* binding detection of *Bacillus thuringiensis* cryI toxins in Lepidopteran midgut epithelium.

The binding of two *Bacillus thuringiensis* insecticidal crystal proteins (ICPs) to the midguts of intoxicated *Lymantria dispar* and *Bombyx mori* was immunologically localized. Light microscopic observations showed that only CryIA(b) in *L. dispar* and both CryIA(b) and CryIE in *B. mori* bind to the microvilli of the midgut epithelial cells.

Zhang, Z. and B. K. Mitchell. Department of Entomology, University of Alberta, Edmonton AB T6G 2E3. The effect of galeal ablation on feeding behavior of the Colorado potato beetle. (Poster)

Feeding behaviours, on both potato and tomato, were observed in adult Colorado potato beetle. Compared with normal animals, operated ones with removed galea needed a much longer time to explore leaves before feeding. They bit more often during a meal, but consumed significantly less leaf and had a much lower feeding rate. This may indicate that chemosensilla on the galea of the beetle are important in feeding behavior and host recognition.

Minutes of the 50th Annual Business Meeting
of the Entomological Society of Manitoba

14:00 h, November 17, 1994

Travel Lodge Astoria
Winnipeg, Manitoba

The President, Dr. R. Roughley, presided. A quorum being present, the president called the meeting to order.

ATTENDANCE

Executive: R. Roughley, President
B. Fingler, President-Elect
R. Gadawski, Past-President
N. Holliday, Regional Director to the ESC

Executive Staff: M. Henderson Smith, Treasurer
B. Timlick, Secretary
R. Westwood, Editor - Proceedings
A. Robbie-Draward, Editor - Newsletter

Members: I. Wise G. Gerber
N. White P. McKay
T. Galloway B. Lamb
B. Turnock D. Dixon
J. Gosselin J. Conroy
P. Fields S.Pernal
I. Pines C. Jay
J. Gavloski B. Preston

1. Agenda (Appendix A) N. White notes that he is no longer involved with the distinguished lecture series and that this is the duty of the past president. Also add I. Wise report as representative to the Manitoba Environmental Council. Motion: Gadawski/Gerber. That proposed agenda with amendments be adopted. **CARRIED**

2. Minutes of the 49th Annual Meeting. Motion: N. White/B. Lamb. That the minutes of the 49th Annual Business Meeting of the Entomological Society of Manitoba, held 5 November 1993 and published in volume 49 of the Proceedings of the ESM, be accepted. **CARRIED**

3. Business Arising from the Previous Minutes: None.

4. Executive Reports:

- a. President. None.
- b. Treasurer. (Appendix C - Financial Statements).

Questions arise regarding the current auditor. G. Gerber stated that the society retained this particular auditor through a search conducted previously. Motion: P. McKay/M. Galloway. That the society engage the same auditor for next year. Motion: N. Holliday/ G. Gerber. That the previous motion be deferred until all reports from the agenda are accepted. McKay/Galloway accept to have motion deferred.

- c. Editor - Proceedings of the ESM (Appendix D).
- d. Regional Director to the Entomological Society of Canada (Appendix E).
- e. Endowment Fund Board (Appendix F).

5. Committee Reports

- a. Finance Committee (Appendix G).

Treasurer stated that there are surplus funds, but expects a deficit in the next year. R. Roughley opened floor to discussion regarding balancing budget. P. Fields noted that our profits this year should offset next years losses. N. Holliday stated that 'next year' is coming soon (August 31, 1995) and that the society is not charging as much as we could for membership. N. Holliday suggested that the society increase membership fees, because if this is not done, the society will likely not be able to continue inviting keynote speakers. B. Turnock suggested initiating page charges for the Proceedings. Motion: N. Holliday/T. Galloway. That full membership be raised to \$25 and that student fees raised to \$10. **CARRIED**

Motion: N. White/N. Holliday. That the society increase the cost of the Proceedings from \$8.00 to \$10.00 and that the editor initiate page charges based on cost recovery. **CARRIED**

b. Publicity, Newsletter (Appendix H).

N. White, on behalf of the society, expresses gratitude on a job that was very well done.

c. Social (Appendix I).

d. Education and Youth Encouragement (J).

e. ESC Common Names (Appendix K).

f. Archivist (Appendix L).

g. Scrutineers Report (Appendix V).

h. Honourary Members (No Report)

i. ESC Scholarship (Appendix O).

j. ESM Scholarship (Appendix P).

k. Scientific Program/Joint Annual Meeting (Appendix Q).

l. ESC/ESM Membership (Appendix R)

m. Fund Raising (Appendix S).

n. Manitoba Environment Council (Appendix M).

Motion: Conroy/Gosselin. That all reports from the chairs be accepted.

CARRIED

6. Election Results.

Congratulations to R. Currie, President-Elect for 1994/95 and A. Robbie-Draward Member-at-large. Motion: Roughley/Conroy. That the ballots be destroyed.

CARRIED

7. Transfer of Office.

R. Roughley called upon B. Fingler to assume office of the President.

8. Other Business.

Motion: P. McKay/M. Galloway. That the society engage the same auditor for next year.

CARRIED

Motion: R. Roughley/T. Galloway. That the society agree in principle to a joint celebration of events marking the Entomological Society of Manitoba's 50th and the Department of Entomology, University of Manitoba's 75th anniversaries as suggested by N. Holliday in September, 1994. (Appendix R).

CARRIED

9. Adjournment

APPENDIX A

ENTOMOLOGICAL SOCIETY OF MANITOBA
50TH ANNUAL BUSINESS MEETING

November 17, 1994

AGENDA

1. Acceptance of Agenda.
2. Acceptance of last Annual Meeting (Nov. 5, 1993).
3. Business arising from the minutes.
4. Reports - Executive
 - a. President R. Roughley
 - b. Treasurer M. Henderson Smith
 - c. Editor of the Proceedings R. Westwood
 - d. Regional Director to the ESC N. Holliday
 - e. Endowment Fund Board J. Buth
5. Reports - Committees
 - a. Finance J. Buth
 - b. Publicity, Newsletter A. Robbie-Draward
 - c. Social S. Pernal
 - d. Education/Youth Encouragement J. Gavloski
 - e. ESC Common Names R. Roughley
 - f. Archivist R. Roughley
 - g. Honourary Members None
 - h. Student Awards B. Galloway
 - i. ESC Scholarship J. Conroy
 - j. ESM Scholarship J. Conroy
 - k. Joint Annual Meeting D. Dixon
 - l. Scientific Program P. Fields
 - m. ESC Membership None
 - n. ESM Membership None
 - o. Fund Raising J. Gosselin

- | | |
|---------------------------------|------------------------|
| p. Distinguished Lecture Series | R. Gadawski |
| q. Environmental Council | I. Wise |
| 6. Election Results 1993-94 | R. Roughley |
| 7. Transfers of Office | R. Roughley/B. Fingler |
| 8. Other Business | |
| 9. Adjournment | |

APPENDIX B

PRESIDENT'S REPORT

Unavailable for this issue.

APPENDIX C

AUDITOR'S REPORT

To the Directors of the
Entomological Society of Manitoba Inc.

I have examined the balance sheet of the Entomological Society of Manitoba Inc. as of August 31, 1994 and the statement of income and expenses for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I consider necessary in the circumstances.

In common with any non-profit organizations, the organization derives some cash revenue, the completeness of which is not susceptible to conclusive audit verification. Accordingly, my verification of these revenues was limited to the amounts recorded in the records of the organization and I was not able to determine any adjustments for unrecorded receipts from these sources might be necessary to income or surplus balances.

In my opinion, accept for the effect of any adjustments, if any, which I might have determined to be necessary had I been able to satisfy myself concerning the completeness of the cash revenues referred to above, these financial statements present fairly the financial position

of the society as at August 31, 1994 and the results of its operations and the changes in its financial position for the year then ended in accordance with generally accepted accounting principles.

Winnipeg, Canada
October 25, 1994

Original signed by Doug Nicholson
Certified General Accountant

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.
BALANCE SHEET
AUGUST 31, 1994

ASSETS

	<u>1994</u>	<u>1993</u>
Cash advances (note 2)	\$ 250	\$ 350
Cash in bank	1,672	(67)
Investments (note 3)	30,004	30,000

LIABILITIES

Liabilities	nil	nil
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SURPLUS

Surplus	<u>\$31,926</u>	<u>\$30,283</u>
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APPROVED BY THE BOARD

_____ Director

_____ Director

The accompanying notes form an integral part of these financial statements.

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.
 NOTES TO THE FINANCIAL STATEMENTS
 AUGUST 31, 1994

1. SIGNIFICANT ACCOUNTING POLICIES:

Income and expenses are recorded on the cash basis of accounting. There are no accruals of receivables or payables at the end of the year. Fixed assets are written off when acquired and therefore, there are no annual depreciation allowances.

2. STANDING ALLOWANCES

Treasurer	M. Smith	\$ 25
Newsletter	A. Robbie-Draward	200
Editor	R. Westwood	25
		<u>\$250</u>

3. CASH IN THE BANK: \$1672

3. INVESTMENT CERTIFICATES:

7053937	\$2,000.00
7053706	3,024.33
8421072	1,775.67
7058513	2,003.96
7058436	3,000.00
7053805	2,000.00
12007930	2,000.00
7053871	7,200.00
18105406	3,000.00
7053893	2,006.48
14577420	<u>1,993.52</u>
	\$30,003.96

ENTOMOLOGY SOCIETY OF MANITOBA, INC.
STATEMENT OF INCOME AND EXPENSES
YEAR ENDED AUGUST 31, 1994

	<u>1994</u>	<u>1993</u>
REVENUE (note 1)		
Annual meetings	\$1,720	\$1,736
Donations	550	450
Fund raising committee	296	407
Interest income	2,794	2,950
Members fees	1,458	1,578
Miscellaneous	241	-
Other committees	169	-
Proceedings	2,359	576
Student awards	100	103
Social committee	39	314
Youth encouragement/ public relations	<u>200</u>	<u>200</u>
	<u>9,926</u>	<u>8,314</u>
EXPENSES (note 1)		
Awards and scholarships	\$1,287	\$1,287
Distinguished speakers	-	1,115
Fund raising committee	-	13
General	921	1,044
Meetings	2,388	4,172
Newsletter	269	620
Other committees	854	-
Proceedings	1,995	4,250
Representation at the ESC	-	425
Social committee	457	540
Youth encouragement/ public relations	<u>112</u>	<u>-</u>
	<u>8,283</u>	<u>13,466</u>
EXCESS (DEFICIT) INCOME OVER EXPENSES	\$1,643	(\$5,152)
SURPLUS, START OF YEAR	\$30,283	\$35,435
SURPLUS, END OF YEAR	\$31,296	\$30,283

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.
TREASURER'S SUPPLEMENT TO THE AUDITORS REPORT
FOR THE YEAR ENDING AUGUST 31, 1994

1. GST:

The GST rebate (Revenues: Miscellaneous) was 241.08.

2. ANNUAL MEETING:

Attendance at the November Scientific Program was up from the previous year. In 1993, 42 regular and 19 student members attended the meetings, and 30 regular and 8 student banquet tickets were purchased. Also, 3 out-of-province students attended the meeting and banquet. In 1992, 41 regular and 14 student members attended the meetings; 31 regular and 9 student members attended the banquet.

3. MEMBERSHIP:

For the year ending March 1, 1994, 24 members left, and 13 new members (8 student, 5 regular) joined, for a total of 118 members.

4. INTEREST INCOME:

Interest income is down from the previous fiscal year due to the continued decline in interest rates. G.I.C.'s previously held at 10.75% and 11.25% were renewed at 5.25% and 7.25% respectively.

5. BANK ACCOUNTS:

To simplify accounting and save on service charges, the chequing account at the Royal Bank and Savings Account at the Royal Trust (Grant Park) were closed on November 17, 1994, and a savings-chequing account opened at Royal Trust (Downtown). The Endowment Fund, invested in G.I.C.'s, remains at the Royal Trust (Grant Pk).

6. PROCEEDINGS:

Revenues from the sale of reprints from Vol. 49 (\$409.57) were not received until after the 1993-94 fiscal year. Costs for mailing (\$58.70) were not paid until after the fiscal year.

7. DISTINGUISHED LECTURE SERIES:

The Distinguished Lecture Series was not held for the 1993-94 fiscal year because the 1992-93 fiscal year ended with a deficit.

8. OTHER COMMITTEES:

The revenue amount of \$169.28 is the refund of accommodation expenses by Dr. Schwert (1992-93 Distinguished Speaker), because they had been paid for by the Graduate Students Association.

9. GENERAL EXPENSES:

Auditor	\$588.50
Secretary, Treasurer Postage	111.73
Secretary, Treasurer Photocopying	34.41
Bank Service Charges	57.17
New cheques	26.16
Corporations Fee (incl. 94-95 fee)	30.00
Office Supplies	78.02

10. RECOMMENDATIONS REGARDING AUDITOR

At the last executive meeting, the issue of the cost of having the E.S.M. financial records audited was raised. I was asked to obtain information on the costs involved and to make recommendations on how we might reduce this cost since it is a significant amount each year. It was suggested that I obtain some estimates from other accountants as to the cost of doing the audit. The following information was obtained:

- a. There are no ' association recommended fees' and the charge for doing a financial statement and audit are, within limits, up to each accountant. The procedure for getting an estimate from a particular accountant involves showing are record keeping system to the accountant and takes at least 2 weeks. JoAnne Buth had discussions with an auditor in Carman who indicated that audit costs would be similar to those charged by our current auditor. For this reason, and for those that follow, I felt it not-necessary to get some individual estimates.

b. The cost of preparing the financial statements accounts for only a minimal amount of the total cost of the audit. For this reason the use of the computer based accounting system does not save much money. Its main advantages are the time saving and simplified organization to the treasurer.

c. The best way to reduce the cost of an audit are to have well organized and well controlled books. A computer based accounting system can improve the organization and accuracy of the record keeping. The amount of control over the books is important. This means that the less cash handled and the bigger the paper trail, the better. It takes a lot less effort to audit books when everything is well documented and receipted.

I suggest that we stay with the firm which currently audits our books. I was impressed with the thoroughness of the audit and the level of knowledge in answering my questions. The auditor has made some recommendations in a letter accompanying her report that could reduce the cost of future audits.

Marjorie A.H. Smith
E.S.M. Treasurer

APPENDIX D

REPORT OF THE PROCEEDINGS EDITOR

Volume 49 (1993) of the Proceedings of the Entomological Society of Manitoba was completed on August 31, 1994 and mailed to the society members, subscribers and as gifts or exchange to selected institutions in September 1994. A total of 250 copies of Volume 49 were printed. The price charged to subscribers for Volume 49 of the Proceedings was \$8.00 Canadian and this cost has remained the same during the past ten years. The cost to produce Volume 49 was approximately \$8.50 per volume (the cost per volume for Volume 49 was \$10.00)

Approximately 130 copies were mailed to society members, 40 to subscribing institutions and 50 were mailed to institutions that exchange their journal with ours or receive the Proceedings as a gift. Volume 49 was 77 pages in length and remained in a 8.5 x 11 inch format.

Volume 49 contained 3 referred scientific papers which made up 36 of the 77 pages. Publishing authors paid only for reprints, as the Society does not charge page costs for papers printed in the Proceedings. The funds that the Society sets aside to help authors unable to fund their own papers was not utilized in 1993/4. The peer review process worked well and I am indebted to the reviewers for their time and expertise to ensure the scientific content of the Proceedings is of the highest quality. Four papers were submitted for Volume 49, three being accepted and one rejected. I continue to seek new ideas and methods to improve the quality of our publication and any Society member who wishes to comment on the content or format of the current publication should do so in writing attention to myself.

Richard Westwood
Proceedings Editor
November 1, 1994

APPENDIX E

**REPORT OF THE ESC REGIONAL DIRECTOR TO THE ENTOMOLOGICAL
SOCIETY OF CANADA**

The Entomological Society of Manitoba's annual meeting were in Winnipeg this year, so more than the usual proportion of ESM members had the opportunity to attend both the scientific and business meetings of the national society. Of potential interest to members of the ESM are the following items.

The book, *Diseases and pests of vegetable Crops in Canada*, was published this year. Copies are available from the ESC. The publication costs of the book have had a strong negative effect on the budget of the ESC this year, but it is hoped that these costs will have been recouped by the end of 1995.

The scientific editor of the *Canadian Entomologist* is now Dr. Peter Kevan, University of Guelph. The cover of both the *Canadian Entomologist* and the *Memoirs* will be changed; designs have been approved. Both journals will soon be able to accept final manuscript versions on disc.

The 1994-95 president of the RESC is Dr. L. Safranyik. The society's secretaryship will pass from Dr. R. West to Dr. P. Dixon on January 1, 1995. The Society is seeking a new Bulletin Editor and a new Treasurer for January 1996.

The ESC is greatly concerned about two potential items of legislation. The first would restrict the collection, possession and movement of insect specimens. Legislation restricting movement of insect specimens has recently been enacted in the U.S.A. and a Canadian version is in preparation. The U.S. act prevents the movement of insects across the border by mail, and impedes trans-border movement by other means. The second legislative area of concern is that which protects endangered species. Such legislation could prohibit collection of rare insect species and, since bulk sampling techniques do not allow rare species to be excluded, routine sampling techniques such as sweep netting, light traps and pitfall traps could be illegal.

The ESC has vacancies for Honourary Members (deadline 31 January, 1995) and is also seeking nominations for its gold medal and C. Gordon Hewitt Award (deadline 30 December 1994). The ESC has not been particularly active in putting forward nominees for these honours, and I recommend that the Society executive give some thought to putting forth nominations.

The ESC Membership Committee requires a representative from the ESM. The new executive should make an appointment and notify, Dr. Danks, chair of the ESC Membership Committee. The ESC recently received a report on the declining trend in membership, which appears to be linked to the reduced number of professional entomologists in Canada. The membership list of the ESC will be published on diskette henceforth. The electronic version will be available from the ESC office in 1995; a nominal fee will be charged. Available right now from the ESC office is a diskette containing the ESC list of common names of insects. Cost is \$15 plus shipping and handling.

Future Annual Meetings of the ESC will be in Victoria, BC (14-18 October 1995); Fredericton, NB (tentatively 5-9 October 1996); Edmonton (4-8 October 1997). A joint meeting with the Entomological Society of America in 2000 is being discussed; a possible venue is Toronto.

N. J. Holliday
Regional Director

APPENDIX F

ANNUAL REPORT OF THE ENDOWMENT FUND BOARD

The Endowment Fund continues to be a major source of revenue for the society. It provides a basis for funding the Student Scholarship (\$1,000.00), to the publication of the proceedings (\$1500.00) and the promotion of publication of scientific papers in the Proceedings (\$400.00). Also, the fund contributes approximately \$500.00 toward the cost associated with the Annual General Meeting of the Society. Therefore, the Endowment Fund is committed to about \$3,400.00 annually.

In the 1993-94 fiscal year, \$2,794.00 of investment income was generated from a principle amount of \$30,000.00. Although interest rates have now stabilized, income from the Endowment Fund continues to decline as G.I.C.'s at 10-11% are being renewed at 7-8%. Interest rates are not expected to rise to previous levels of 10-11%.

Marjorie Smith investigated other investment options for the Endowment Fund. As the purpose of the fund is to generate income, options like mutual funds which are meant for longer term are not suitable. Although money-market funds currently have a reasonable rate of return, there are minimum investment amounts and management fees associated with this option. At this time, G.I.C.'s will generate higher income than money-market funds.

The auditor suggested that certificates be consolidated into fewer larger investment amounts. This would decrease the paper work and simplify the audit. as a result, two certificates which recently matured (\$2,000.00 and \$7,200.00) have been combined. Interest will be paid semi-annually. Four other G.I.C.'s will be combined into two as they mature over the next two years.

A description of the Endowment Fund investments is as follows:

GUARANTEED INVESTMENT CERTIFICATES WITH ROYAL TRUST

<u>Cert. No.</u>	<u>Amount (\$)</u>	<u>Interest Rate (%)</u>	<u>Maturity Date</u>	<u>Annual Interest \$</u>
7053937	2,000.00	9.750	02.10.96	195.00
7053706	3,024.33	8.000	15.12.97	241.95
8421072	1,775.67	7.500	26.01.98	133.18
7058513	2,003.96	6.375	16.09.98	127.75
7058436	3,000.00	5.250	11.12.98	157.50
7053805	2,000.00	7.250	05.04.99	145.00
unavailable	9,200.00	7.750	14.11.99	713.00
7053893	2,006.48	11.500	28.08.95	230.75
14577420	1,993.52	10.750	19.12.95	214.30
18105406	3,000.00	7.500	31.10.97	225.00
Total	30,003.96	Avg. 8.16		2,383.43

Marjorie Smith
JoAnne Buth, Chair
 November 9, 1994

APPENDIX G

ANNUAL REPORT OF THE FINANCE COMMITTEE

The finance committee met on November 9, 1994 to review the societies financial status.

In 1993-94, revenue exceeded expenses by 1,643.00. In general, committee expenses were less than projected, especially the Proceedings and the Newsletter.

The finance committee reviewed each of the committee budgets and prepared an overall budget for the society. An accounting of the revenue and expenses for 1993-94 and projections for the next two fiscal years is attached. Of note is the projected revenue for 1994-95 which included 2,000.00 from the ESC-ESM JAM.

The 1,000.00 donation for the A.G. Robinson memorial scholarship which the society committed in principle in 1993 is not shown as an expense for 94/95 nor 95/96.

With the current income and expenses, net losses are projected for future years. This is due, in part, to reduced interest income from the Endowment Fund as interest rates have declined and increased costs of the Proceedings.

Reasonable annual expenses without a Guest Lecture are projected to be \$8,800.00. Current annual revenue for a typical year is \$7,200.00. This means an annual deficit of approximately \$1,600.00 which is clearly not suitable.

The society needs to consider increasing revenues through increased membership fees and Proceeding subscriptions and/or decreasing expenses and activities.

Entomological Society of Manitoba

BUDGET ITEMS	1993-94 ACTUAL	1994-95 ACTUAL & PROJECTED	1995-96 PROJECTED
Endowment Fund	\$30,000.00	\$30,000.00	\$30,000.00
REVENUE			
Membership dues	1,458.00	1,500.00	1,500.00
Proceedings	2,359.00 ¹	600.00	600.00
Social Committee	39.00	0.00	0.00
Youth/Education Committee	200.00	200.00	200.00
Donations	550.00	0.00	500.00
Fund Raising Committee	296.00	600.00	500.00
Student Awards and Scholarship	100.00	100.00	100.00
Meetings: ESM AGM	1,720.00	0.00	1,700.00
ESC-ESM (94-95)	0.00	2000.00	-
Miscellaneous Committees	169.00	0.00	0.00
Investment Income	2,794.00	2,383.00	2,100.00
Miscellaneous: GST Rebate	241.00	149.00	1,000.00 ²
TOTALS	\$9,926.00	\$7,532.00	\$8,200.00
EXPENSES			
General Society Expenses	\$ 921.00	\$1,200.00	\$1,300.00 ³
Proceedings	1,995.00	2,100.00	2,200.00
Newsletter	269.00	640.00	650.00
Social Committee	457.00	500.00	500.00
Youth/Education Committee	112.00	300.00	200.00
Fund Raising Committee	0.00	50.00	50.00
Student Awards and Scholarships	1,287.00	1,300.00	1,300.00
Meetings: ESM AGM	2,388.00	0.00	2,500.00
ESC-ESM (94-95)	500.00	0.00	-
Other Committees: Membership	30.00	50.00	50.00
Guest Lecture	0.00	1,000.00	0.00
Representation at ESC	324.00	350.00	350.00
TOTALS	\$ 8,283.00	\$ 7,490.00	\$9,100.00
Net Gain (Loss) for Year Ending August 31st	\$1,643.00	\$(42.00)	\$900.00

¹ Includes revenue from Volume 48 (1992) - A.G. Robinson Memorial article - \$1498.00

² Includes GST rebate from ESC-ESM Joint Annual Meeting

³ Includes audit for ESC-ESM Joint Annual Meeting

Marjorie Smith, Richard Westwood
JoAnne Buth, Chair, November 10, 1994

APPENDIX H

NEWSLETTER AND PUBLICITY COMMITTEE

Three issues of the Entomological Society of Manitoba Newsletter were published this year. The summer and spring issues were combined. The 1994 membership list was included with the distribution of the first issue of 1994. In addition, ballots for the election of President-Elect and Member-At-Large were mailed with the summer issue.

The total cost of the publication, which includes the cost of printing, postage and envelopes was \$269. The budget for the Newsletter was \$640.

Two copies of each issue were submitted to the ESM Archivist and the National Library of Canada in Ottawa.

A. Robbie-Draward
Chair

APPENDIX I

ANNUAL REPORT OF THE SOCIAL COMMITTEE

During the 1993-94 fiscal year, the Entomological Society of Manitoba met for three luncheons at the Travelodge Hotel Astoria. On September 15th, 1993, 43 people listened to Pat MacKay and Bob Lamb speak about their Australian adventures in "Pat and Bob Down Under". On January 19th, 1994, Buster Welch, from the Freshwater Institute, spoke to 23 members about "Research in Canada's Arctic". On June 7th, 1994, the luncheon schedule was completed by Pat Copps from PCO Services in Vancouver, B.C. Mr. Copps spoke about the challenges encountered while practicing "Urban Entomology and Pest Management in Saudi Arabia."

For the New Members' Social, held on March 5th, 1994, members and guests of the Society enthusiastically participated in Bingo Bowling at Academy Uptown Bowling Lanes in Winnipeg. Following bowling, an informal reception was graciously hosted by Robert Currie and Desiree Vanderwel. Thirty-six people were in attendance including five of the Society's 12 new members: Drew Craig, Paul Gatien, Sam Migui, Rob Rymerson and Tanya Zamzow.

Because of the Joint Annual Meeting between the Entomological Society of Canada and the Entomological Society of Manitoba during October 15-19th, 1994, the Social Committee was alleviated from planning events normally associated with the ESM's Annual Meeting. Normal activities will resume next year.

S.F. Pernal
Chair

APPENDIX J

YOUTH ENCOURAGEMENT AND PUBLIC AWARENESS COMMITTEE

Approximately 20 talks were given by either myself or volunteers during 1994. The majority of these were to grade schools, although talks were also presented to scout groups (twice), daycares (twice), and a series of five talks was presented to an old age home. With each talk was a presentation of live and preserved insects. Most of the talks were local, although two were presented in Morden.

Aside from talks, five displays were set up for schools and daycares. These displays were left for several days or weeks while the students studied entomology. A display was also set up for one evening at a science fair in Oakbank.

Expenses in 1994 included:

Discover Entomology video (\$50.00) - This was purchased from the Entomology Society of America (ESA) and is a 15 minute video explaining the different branches of entomology and how entomologists from each of these branches contribute to society. This video can be borrowed by any ESM member for personal viewing or to be used during a presentation.

ESA Calenders (\$35.00) - Six ESA calenders were purchased to create posters from insect pictures in these calenders. These posters can be used during presentations to daycares, schools etc.

Travelling expenses (\$25.00) - for travel to Morden (fuel costs).

In 1995 proposed projects and funding will be required for:

Enhancing the ESM Slide collection - Slides will be purchased from the Ries Memorial Slide Collection and I am planning to photograph local and tropical insects for the ESM collection.

Funding will also be required to purchase display cases for insects in the ESM collection.

John Gavloski, Chair

APPENDIX K

REPORT OF THE COMMON NAMES COMMITTEE

There have been no applications from Entomological Society of Manitoba members during the past year for new common names, nor has there been any requests for changes in old common names, and therefore, there are no local activities to report. The revised common names list "Common names of insects in Canada" (Edited by E.M. Belton & D.C. Edit) is available on diskette from the Entomological Society of Canada, 393 Winston Ave., Ottawa, Ont., K2A 1Y8

R.E. Roughley
Chair

APPENDIX L

REPORT OF THE ARCHIVIST

The Archives materials of the Entomological Society of Manitoba are held in Room 213 of the Department of Entomology, University of Manitoba. Two copies of the E.S.M. Newsletter at each publication and these are added to the Archives. Any donations of any other material for the Archives would be welcome.

R.E. Roughley
Chair

APPENDIX M

REPRESENTATIVE TO THE MANITOBA ENVIRONMENTAL COUNCIL 1994

As mentioned in the 1993 Annual Report, financial support for the Manitoba Environmental Council by the Province of Manitoba ended in April 1993. MEC members were not reappointed when their terms expired, and no new appointments were made. In August 1994, the Minister of Environment assembled 14 individuals, who were recommended by the

Executive Committee, to contribute to a reformed MEC. However, as of November, 1994, no appointments to the new MEC have formally been made by the Minister, who has continued to fail to comply with the requirements of the Environment Act since funding to the MEC was terminated.

Former members of the MEC, and other persons and groups interested in environmental matters, continue to encourage the Minister to reactivate the MEC. These groups have stated to the Minister that the MEC was an important source of nonpartisan and objective advice, and served as a moderating influence in disputes involving environmental concerns. No group has been able to fill this role or provide this type of advice to the Minister in the interim.

Ian L. Wise

APPENDIX N

ESM STUDENT AWARDS COMMITTEE

The Committee reviewed the nominations received for the Student Achievement Award and the SWAT Student Award. Mr. Paul Gatien was selected as the recipient of the Student Achievement Award. Mr. Jason Diehl was selected for the SWAT Student Award. The recipients were presented their awards at the banquet of the Joint Annual Meetings of the Entomological Societies of Canada and Manitoba.

*J. Conroy
S. Pernal
W.B. Preston
W.J. Gallaway, Chair*

APPENDIX O

ENTOMOLOGY SOCIETY OF CANADA SCHOLARSHIP COMMITTEE

The Entomological Society of Canada Scholarship Committee met and discussed six applications for the E.S.C. Postgraduate Awards.

As you are no doubt aware from the Joint Meeting last month, the E.S.C. Scholarship Committee recommended that the E.S.C. Postgraduate Awards be made to Ms. Julie Anne McCarthy and Ms. Duyen Nguyen.

Ms. McCarthy is from the University of Guelph and is supervised by Dr. Cynthia Scott-Dupre.

Ms. Nguyen is from McGill University. Her supervisor is Dr. M.F. Rau.

The ESC Scholarship Committee was disappointed with the continuing low number of applicants (six) which was down from 1993 (eight) and especially since we had seventeen applicants in 1991. There were no candidates nominated from Manitoba.

John C. Conroy,
E.S.M. Representative,
E.S.C. Scholarship Committee

APPENDIX P

ENTOMOLOGICAL SOCIETY OF MANITOBA SCHOLARSHIP COMMITTEE

The Entomological Society of Manitoba Scholarship Award Committee met and discussed four applications for the E.S.M. Postgraduate Award.

The E.S.M. Scholarship Committee unanimously recommends that the E.S.M. Postgraduate Award be made to Ms. Rene Harrison, Department of Zoology, University of Manitoba.

Ms. Harrison is currently working on her MSc. degree under the supervision of Dr. Erwin Huebner, Department of Zoology, University of Manitoba. Her thesis looks at "the extensive microtubule array found in the trophic cords of the telotrophic ovariole of the insect, *Rhodnius prolixus*".

The Committee members were Professor R.A. Woods and Professor Marianne Hardy, Department of Biology, University of Winnipeg.

John C. Conroy,
Chair, E.S.M. Scholarship Committee

APPENDIX Q

SCIENTIFIC PROGRAM COMMITTEE REPORT

Part of Appendix T.

APPENDIX R

E.S.M. MEMBERSHIP COMMITTEE

Report unavailable.

APPENDIX S

FUND RAISING COMMITTEE

Revenues up to August 31, 1994 include corporate donations of \$550.00 and the sale of insect drawers for \$215.00. Aphid T-shirt and ESM pins provided an additional revenue of \$81.00. The total revenue of \$846.00 surpasses the previous year's revenue of \$650.00.

*Joel Gosselin, Chair
Richard Westwood*

APPENDIX T

JOINT ANNUAL MEETING (ESC/ESM) COMMITTEE

The Joint Annual Meeting of the Entomological Societies of Canada and Manitoba were held October 16-19, 1994 at the Delta Winnipeg Hotel. The theme of the meeting was "Insect Movement" with several invited speakers making presentations on the subject as well as numerous presented papers during the concurrent sessions. There were also five workshops on the following subjects:

- "Silvicultural Approaches to Integrated Pest Management"
- "Employment Opportunities in Entomology - What You Should Know Before You Graduate"
- "Insect Biodiversity"
- "Biological Control of Purple Loosestrife"

- "Semiachemical Workshop"

There were two symposia held on the following subjects:

- "Insect-Host Interactions and Insect Pest Management"
- "Advances in Forest and Urban Tree Pest Management".

In addition, the Canadian Forum For Biological Control held their annual meeting on October 16. The meeting was well attended with approximately 255 registrants.

The Joint Annual Meeting Committee will submit to the Treasurer of the ESM a financial statement for the meeting after all financial transactions associated with the meeting have been completed. This statement should be audited as part of the 1994/95 year end audit of the ESM. The committee is currently projecting a surplus of about \$2,000.00 to be provided to the ESM during fiscal year 1994/95 to be followed by an additional approximately \$1,000.00 as a rebate on GST paid to be collected following the 1994/95 year end.

Following is the membership of the Organizing Committee which was formed as an ad hoc committee of the ESM in 1992:

General Chairperson	Don Dixon
Science Programme	Paul Fields (chair)
	Rob Anderson
	Rob Currie
	Swami Pachagounder
Fund Raising	Joel Gosselin (chair)
	Richard Westwood
Associates, Banquet and Tour Programme	Pat MacKay
Conference Photography	Roy Ellis
Finance	JoAnne Booth
Meeting Accommodation	Don Dixon
Printing	Barry Fingler
Publicity	Autumn Robbie-Draward
Registration	Neil Holliday
Visual Aids	Dave Holder

The Committee would like to extend thanks to the many volunteers who assisted during the meeting and to the corporate and government sponsors who made significant contributions to the meeting.

Don Dixon, Chair

APPENDIX U

DISTINGUISHED RESEARCH SCIENTIST LECTURE COMMITTEE

Report unavailable.

APPENDIX V

SCRUTINEER'S REPORT 1994-1995

Successful President-Elect	Rob Currie
Successful Member-at-Large	Autumn Robbie-Draward
Number of ballots returned	64
Number of spoiled ballots	0

R.E. Roughley, Chair

OTHER BUSINESS: Letter to the ESM concerning 75 Year Anniversary for the Department of Entomology, University of Manitoba.

Dr. R. Roughley
President, Entomological Society of Manitoba
Dept. of Entomology, University of Manitoba
Winnipeg, Manitoba, R3T 2N2

Dear Rob:

The department of entomology was founded, as far as can be determined from the University archivist, in 1921. This means that, in 1996, the Department will have been a separate entity for 75 years. This seems a suitable reason for celebration. The department has briefly discussed the idea of a symposium, or other scientific meeting, as a means of celebration, but no decisions have yet been made.

The Entomological Society of Manitoba and the Department of Entomology have enjoyed a close relationship for many years, and members of the Department feel that it would be appropriate if the Entomology Society was a partner in our celebrations. There are three reasons for this suggestion. Firstly, the Society held its charter meeting in March, 1945, so that its fiftieth anniversary is within one year of the Departments seventy-fifth. Secondly, for the Department to mount a major symposium might result in competition with the Society's annual meeting and reduce the attendance and impact of the meeting. Thirdly, a pooling of resources could produce a better product than each entity celebrating independently.

If the Society is in favour of a cooperative venture, it would seem reasonable to schedule some sort of celebration in 1996; this would mark the completion of the Society's 50th year and be the 75th year of the Department. Such a time frame would also give us sufficient time to develop a memorable and scientifically valuable form of celebration, and to explore opportunities for getting external funding to support the venture. Such funding could be used, for example, to bring in speakers who were formally associated with entomology in Manitoba, and have now moved elsewhere.

At this point, I am seeking the Society's agreement in principle that a joint celebration be held. If that is agreed, I suggest that the Department and the Society each appoint two members to a small planning committee, the duties of which are to draw a plan, and explore funding opportunities. Ultimately this committee might coopt others as it moved towards becoming an organizing committee for whatever form of celebration is ultimately agreed upon.

Yours Sincerely,
N.J. Holliday
Professor and Head, Department of Entomology

NOTICE TO CONTRIBUTORS

Research papers in the *Proceedings of the Entomological Society of Manitoba* are fully refereed. The *Proceedings* are published once a year and manuscripts are welcome any time. The research papers section of the *Proceedings* is primarily intended to highlight entomological research of local (Manitoba) or regional (prairie provinces) interest. The following guidelines should be followed in writing and preparation of manuscripts. Guidelines are adapted from *The Proceeding of the Entomological Society of Ontario*, Volume 117, 1986.

General. Articles are normally in English and should not be offered for prior or simultaneous publication elsewhere. The Editor should be informed if manuscripts have been refused elsewhere. Authors need not be members of the Entomology Society of Manitoba to submit articles.

Text. Articles should be typed, double spaced and on one side of the paper. Margins should be 25 mm on all sides. One original and two copies of text should be submitted to the Editor. Spelling should conform to usage recommended in either the Oxford or Webster's New International dictionary. Except in tables, figures, or quotations, dates should be written in the form of 15 July, 1992, etc. Reference to illustrations should be in the form 'Figure 2' or 'Fig. 2', and references to tables should be in the form 'Table 2', etc. Citation references in the text should be in the form 'Wilson (1992) stated', '(Smith 1990)', '(Brown 1985, 1990a,b)' or '(Wilson and Brown 1984; Smith 1990)' in chronological order for multiple citations within one set of parentheses. Footnotes should be kept to a minimum and typed at the bottom of the page to which they apply. Abbreviations should be kept to a minimum and only those that are generally recognized, or defined within the text for the sake of brevity should be used. Units of measurement should be metric and abbreviated according to the Canadian national standards.

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Abstract. Articles greater than two typewritten pages, except scientific notes, must be preceded by a brief but informative abstract.

Acknowledgements. Acknowledgements should be short and placed in a paragraph at the end of the text.

References. All references should be listed alphabetical order of authors at the end of the article. References not directly consulted by the author should be preceded by an asterisk. The full title for each reference must be given, plus complete pagination for all items, including books. The names of serials and periodicals should be written out in full.

Layout. The general layout of articles should follow the format for those appearing in this Volume (e.g. use of italics, use of bolding and capitals for wording etc.). Tables and figures should also follow the format for those articles appearing in this Volume. Two copies of each illustration for each reviewer should be submitted. Captions should be numbered consecutively and must be attached to each illustration.

Publication. There are no page charges for publication of articles in the *Proceedings of the Entomological Society of Manitoba*. Charges are applicable to article reprints on a cost recovery basis.

ACKNOWLEDGEMENTS

The editor wishes to acknowledge the efforts of the anonymous reviewers asked to review the research papers appearing in this Volume.

ENTOMOLOGICAL SOCIETY OF MANITOBA

The *Entomological Society of Manitoba* was formed in 1945 "to foster the advancement, exchange and dissemination of Entomological knowledge". This is a professional society that invites any person interested in entomology to become a member by application in writing to the secretary. The society produces a quarterly newsletter, the *Proceedings*, and has a variety of meetings, seminars and social activities. Persons interested in joining the society should contact:

The Secretary
Entomological Society of Manitoba
c/o Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba, R3T 2M9

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IN MEMORY

BARRY GORDON FINGLER
1954-1995

Members of the Society were greatly saddened by the passing of Barry Gordon Fingler on May 23, 1995 in Winnipeg, Manitoba. Barry is survived by his father and mother Gordon and Marion Fingler, his brother Derek and wife Leslie and their children, Daniel and Jane and by his sister Karen and husband Ward Karlberg and their daughter Robyn.

Barry was a native of Manitoba, being born in Winnipeg, June 9, 1954. He graduated from Churchill High School and received his B.A. in Agriculture and Masters of Science at the University of Manitoba. After graduation, Barry joined the Alberta Department of Agriculture, being stationed at the Alberta Special Crops and Horticulture Center, Brooks, Alberta, where he continued research and extension work in apiculture. Barry then joined the Manitoba Department of Agriculture as the extension Apiarist where he worked until the time of his passing.

Barry was the author of and assisted in several publications regarding the study of bees. He assisted in instructing "Beekeeping for the Hobbyist" evening course, at the University of Manitoba. Barry was an active participant in both the Entomological Societies of Manitoba and Canada, including being the current president of the Entomological Society of Manitoba. He was active in the Manitoba Forage Seed Association, the Canadian Alfalfa Seed Council, and was the Manitoba representative on the Technical Advisory Committee of the Canadian Leafcutter Bee Cocoon Testing Centre in Alberta. He also participated in the activities of the Manitoba Beekeepers Association, Canadian Association of Professional Apiarists and the Canadian Honey Council. Barry regularly attended and made presentations to two regional beekeepers associations, the Red River Apiarists Association and the Brandon Beekeepers Association.

Barry was an avid outdoors and sports enthusiast and an active member of the Grace Lutheran Church in Winnipeg. Barry will be sadly missed by his friends and associates in the Society.

Don Dixon, Richard Westwood
ESM