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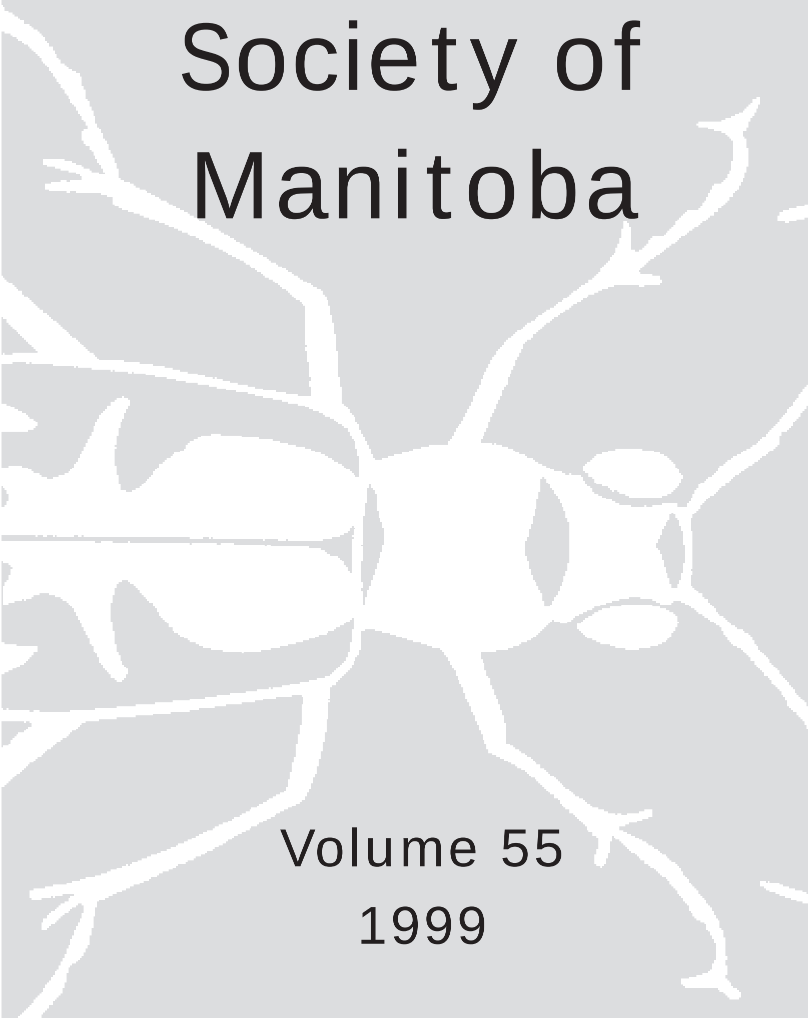

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Editor

Winnipeg, Manitoba

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In Memory:

Professor John Conroy

1939–2000

On February 25, 2000, we lost one of the most flamboyant and memorable entomologists in Manitoba. John Conroy died suddenly in Winnipeg, at the age of 61. John was born in Dublin, Ireland on July 27, 1939. He attended Xavier's School and Clongowes Wood College and later earned his B.Sc. from the National University of Ireland (Dublin) in 1961 and his M.Sc. from the National University of Ireland (Galway) in 1963. John and his wife, Mary, married in Limerick, Ireland on September 17,1963, and immigrated to Canada. They lived briefly in Vancouver, then settled in Winnipeg when John was hired as a lecturer in Biology at United College. He played an integral role in the Biology Department during the transition years as United College gained university status in 1967. John continued his role as the Chair of Biology in United College and became the first head of the Department of Biology in the new University of Winnipeg.

Along with several of his colleagues, John was encouraged to go back to university to study for his Ph.D. He was part of the limnology group working on Marion Lake, British Columbia, where he conducted research on water mites for his dissertation from the University of Manitoba (1974). He became a full Professor in 1982. John served on numerous department, university and senate committees, but the duty he most enjoyed was that of Chief Marshall for spring and fall convocations at the University of Winnipeg from 1990 to 1997.

At the University of Winnipeg, he taught a challenging variety of courses, including Human Biology, Human Anatomy and Physiology, Zoology of the Higher Invertebrates, and General Entomology. In his entomology course, he held high expectations for his students. He not only expected that they would have a grasp of the biology of insects, but that they have a good understanding of morphology, phylogeny and taxonomy. He also asked that his students make a collection for the course. To have a required collection is becoming a rarity in introductory courses, but this was something that John used to inspire his students. He always encouraged them to get out into the field to collect and study insects. His students acknowledged his confidence in them and were made to feel that they were capable of achieving more than they ever thought possible. John practiced a relaxed but dynamic style in the classroom, and he used a bottomless well of stories and anecdotes to enliven the facts as he developed one concept or another in his lectures. He made an effort to get to know his students and took a genuine interest in their welfare and future directions in biology. John's office door was always open, and he always made time for any student who cared to drop by.

John was a member of the Entomological Society of Canada (ESC), the North American Benthological Society, the Acarological Society of America, the Michigan Entomological Society, the Royal Irish Zoological Society, and the Entomological Society of Manitoba (ESM). He served an unprecedented two terms as Executive Secretary of the International Congress of Acarology; this position constituted the chief executive officer of the organization. John sat on the editorial board of the International Journal of Acarology and was a reviewer for many journals.

John brought valuable organizational and parliamentary skills to the table of many ESM meetings over the years. John was a staunch supporter of the rules of order at a meeting, and there was never a dull moment as he, Jock Guthrie and George Gerber debated the finer points of proper procedure. He served as president of the ESM in 1977-1978 and was the chair of the ESM Scholarship Committee from 1986 to 1997. He was the chair of the Entomological Society of Manitoba annual meeting on three occasions, and he was general chair and local arrangements chair for joint ESM/ESC meetings in 1977 and 1986, respectively. As a result of his experiences with joint annual meetings, John wrote a step-by-step guide to the process; this was used by ESC meeting organizers for two decades or so. He also participated in a 1983 ESC project to document entomological education in Canada. Perhaps the most notable of John's efforts on behalf of ESC was his service on the Philatelic Committee, which led the charge that resulted in Canada's first insect stamps, issued in time for the 1988 International Congress of Entomology in Vancouver.

The focus for John's research was the taxonomy and ecology of water mites (Acari: Hydrachnellae) and their host-parasite relationships with insects. John published more than 30 peer-reviewed papers on water mites, including descriptions of over 40 new species. John was a keen field biologist, and he spent many hours collecting the mites that became the basis for much of his taxonomic work. The resulting enormous collection of water mites has been transferred to the Canadian Collection of Insects, ECORC, in Ottawa. Although his primary interest was in the water mites, he did not neglect their hosts. So, with the recent increased interest in dragonflies, his 1979 paper with J.L. Kuhn on the Odonata of Manitoba will become the baseline reference for future studies. John was also a very willing collaborator, and his expertise on certain groups of water mites was much in demand. For other researchers, he identified mites from across Canada and into the high Arctic. It did not pass unnoticed by his students that he had a deep passion for his work, and that he believed strongly in the importance of what he was doing. He communicated his enthusiasm in frequent and entertaining seminars on water mites.

Another of John's passions was opera, and strains of his favourite operas could often be heard emanating from his office. He was a long-time member of the Manitoba Opera Association, and on one occasion played the non-singing role of King Duncan in Verdi's Macbeth. The final part of the appearance was when Duncan's body was carried across the stage on a stretcher. John later recounted that this was a very demanding part of the role: on opening night he was very nearly tipped off the stretcher and was not sure whether the slain king could have maintained the role, or whether, in front of an audience of 2000, a rich Irish brogue would have been heard berating the clumsiness of the bearers!

John was an active member of the community of St. Ignatius Church in Winnipeg, acting as a lector, co-ordinator, instructor of confirmation, and chair of the Parish Pastoral Council and the Liturgy Committee. He was also active at various levels in the Liberal Party. He is survived by his wife, Mary, two sons and a daughter, and three grandchildren.

John Conroy will be remembered by entomologists and former students for his sense of humour and his contributions to his scientific societies and his discipline. He had the ability to change the mood of a room just by entering. As a raconteur, he was irrepressible; his stories were pithy, witty, and often — like some arthropods — with a terminal sting. He had a story for every situation. We will miss the sound of his laughter.

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[1] John's curriculum vitae shows that he had returned the galley proofs of these papers.

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The Effects of Swathing on the Survival of Nymphs of *Lygus lineolaris* L. (Heteroptera: Miridae) in Canola

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Cutting canola and placing it into swaths had both immediate and long term effects on plant bug populations. About one-half of the plant bug nymphs on canola were dislodged from the crop when it was cut. Whether the displaced nymphs moved to the swath or not depended on the age of the nymphs and the stage of canola when it was cut. Very few nymphs moved to the swaths when crops were cut when 30-40% of seeds had begun to ripen but many nymphs moved to swaths if crops were cut at an earlier stage. Older nymphs readily fed and reached adulthood on swathed crops but fewer young nymphs completed their development on swathed than on standing crops. As a result plant bug populations decreased more rapidly on swathed crops than on standing crops. The likelihood that swathing could reduce plant bug feeding damage in canola is discussed.

INTRODUCTION

The nymphs of various plant bugs, *Lygus* spp, are known to feed on canola in southern Manitoba from July into early September (Gerber and Wise 1995). The survival of the nymphs in canola depends on the suitability of the crop for feeding. Canola in Manitoba is usually swathed, cut near the base of the plant and placed in windrows, in late August or early September to hasten crop maturity and to ensure uniform ripening of seeds. In most years, plant bug nymphs complete their development in canola before the crop is swathed (Gerber and Wise 1995, Leferink and Gerber 1997), but during years of adverse weather swathing may begin when nymphs are still developing. The objective of this study is to determine if swathing affects the development and survival of plant bug nymphs in canola.

MATERIALS AND METHODS

Canola cv. Excel was seeded at 5.6 kg/ha with a double disc press drill at Glenlea, Manitoba on 12 and 27 May, 1993 using seed treated with granular carbofuran insecticide and a lindane-fungicide (thiram and carbathiin) seed dressing to protect seedlings from flea beetles and diseases. Plots (4 m x 10 m) were separated by a 2 m cultivated strip. On 24 August, the plants in 2 plots at early (crop stage 5.1 of Harper and Berkenkamp 1975) and 4 plots at late (crop stage 5.3) stages of seed ripening were severed at a height of 20 cm and placed into 1 m-wide swaths with a front end swather. Crop stage 5.1 is the recommended stage for plant bug control in canola (Wise and Lamb, 1998a) and stage 5.3 is the recommended time to swath canola in Manitoba (Canola Council of Canada 1993). Three plots each at crop stages 5.1 and 5.3 were left standing. Ten plastic 15 cm-diameter dishes, partially filled with soapy water, were placed in the plots just before swathing, and were examined for plant bugs immediately after swathing.

Plant bugs were collected from 10 randomly selected areas and bulked to give one sample for each plot using a D-Vac sampler with a suction tube aperature of 285 cm^2. In the standing plots, samples were taken by passing the opening of the suction tube horizontally through the canopy to the ground for 15 sec. Swathed plots were sampled by pressing the opening of the D-Vac into the swath also for 15 sec. Samples were taken 1 to 2 h, and daily from 1 to 3, 6 to10, and 14 d after swathing, frozen within 4 h of sampling, and then assessed 2 to 3 days later. All plant bug nymphs and adults were counted, the nymphs were separated by instar (Schwartz and Foottit 1992) and the adults by sex and species (Kelton 1975). Counts of first and second instars were combined because damage to first instars during sampling made their identification difficult.

Nymphal counts in the swathed and standing crops 1 to 2 h and 1 to 2 d after swathing were transformed by $\log_{10}$ and then compared by 2-way ANOVA (SAS Institute Inc. 1990) to determine the immediate effects of swathing for the two seeding dates. The relative abundance of early (1-3) and later instars (4-5) and adults in swathed and standing plots 1 and 2 days after swathing were compared to those 10 and 14 days after swathing by contingency analysis (*G*-test, P=0.05) to determine whether swathing affects the survival of nymphs at different instars. Plant bug populations in swathed and standing crops 3 and 14 days after swathing were transformed as above and compared by 2-way ANOVA to determine differences in nymphal survival and adult development in swathed vs. standing crops for the two seeding dates.

RESULTS

The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois) comprised 98.8% of all adults collected in swathed and standing crops (*n*=592). *Lygus borealis* (Kelton) was the only other species of plant bug in the samples..

About 50% of the nymphs on crops of both seeding dates were dislodged when the crops were swathed but nymphal populations nearly doubled in the later seeded crops within 2 d (Table 1). The differences in nymphal densities in the swathed and standing crops within 2 h of swathing and 2 d later were not significant ($F_{1,21}$=0.16, *P*=0.69). The interaction of swathing and seeding date ($F_{1,21}$=2.66, *P*=0.12) on the density of plant bugs in the short term were also not significant, but plant bug populations on the crop were higher at the later seeding date ($F_{1,21}$=94.2, *P*<0.001).

In the standing crop of the early seeded test, the frequency of young (1-3 instars), old (4-5 instars), and adult stages of plant bugs was the same for samples taken 1 to 2 d and 10 to 14 d after plots had been swathed (^{2}=0.9, *P*=0.63). Swathing had no effect on the frequency of these stages 1 to 2 d after swathing (^{2}=2.2, *P*=0.34) but reduced the frequency of young nymphs 10 to 14 d after swathing (^{2}=17.5, *P*<0.01) when swathed crops were compared to standing crops (Table 2). The frequency of young nymphs also decreased for populations in swathed crops 1 to 2 vs. 10 to 14 d after swathing (^{2}=18.8, *P*<0.01). Swathing reduced the frequency of young instars in late seeded crops relative to standing crops after 1 to 2 d (^{2}=18.5, *P*<0.01) (Table 2). The frequency of young instars in swathed plants remained low for up to10 to 14 d (^{2}=31.0, *P*<0.001).

During the 3 to 14 d interval after swathing plant bug populations in plots decreased more rapidly in swathed crops than populations in standing crops ($F_{1,21}$=7.38, *P*=0.013) with the rate of decline being similar for the two seeding dates based on a non-significant interaction ($F_{1,21}$=0.45, *P*=0.51) (Table 3). In late seeded plots, plant bug populations remained stable in the standing crops but dropped nearly 4-fold in swathed crops. Populations in both the standing and swathed crops decreased in early seeded crops but the decline in swathed crops of >6-fold was over double that of the <3-fold drop in standing crops.

DISCUSSION

Swathing can have an immediate effect on plant bug populations on canola by dislodging the nymphs from the crop. About one-half of the nymphs fall to the ground during swathing, but most are able to crawl back to the crop. The nymphs ability to return to the crop in the swaths depends on the instar of the nymph and the crop stage of the canola when it is swathed. Young nymphs (1-3 instars) are less apt to return to swaths than older nymphs and fewer dislodged nymphs return to crops cut at the recommended 30-40% seed ripening stage than to earlier cut crops. Nymphs found on swathed canola can continue to feed and develop for at least 14 d after swathing and reach maturity.

The swathing of canola can affect plant bug populations, although the effects are marginal on later instars which continue to develop on both swathed or standing crops. However, young nymphs are more likely to die or migrate from swathed crops than young nymphs on standing crops. This effect of swathing on young nymphs is more pronounced when crops are swathed at a later crop stage because the crops quickly become unsuitable for feeding. The poor development of young nymphs on swathed crops causes plant bug populations to decrease more rapidly than on standing crops.

In conclusion, swathing will reduce plant bug populations on canola cut at the recommended 30-40% seed ripening stage but plants bugs can continue to develop within the swath. This reduction is more rapid than on crops cut at earlier crop stages, and may be sufficient to preclude the use of an insecticide when populations are near but below the economic threshold (Wise and Lamb 1998b). However, swathing would not likely sufficiently reduce feeding injury in crops cut at earlier crop stages or when plant bug populations far exceed the economic threshold. Further studies on whether feeding by plant bugs causes the same level of yield loss to canola in swathed versus standing crops are needed.

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Table 1. Mean±SD (*n*) densities (per m²) of plant bug nymphs in drop trays and swaths for canola swathed on the same date compared to densities in the standing crop.

Seeding	1 to 2 h after swathing			1 to 2 d after swathing	
date	Tray	Swath*	Crop	Swath	Crop
May 12	33±17(4)	33±18(4)	32±10(2)	25±10(4)	46±0(2)
May 27	114±62(2)	126±39(2)	225±40(3)	211±25(2)	199±110(3)

* Swathing effect on plant bug density not significant (2-way ANOVA, $F_{1,21}=2.66$, $P=0.12$) (SAS Institute Inc. 1990).

Table 2. Frequency (%) of young (1-3) and old (4-5) instars and adults of *Lygus lineolaris* on standing and swathed canola sampled 1 to 2 d and 10 to 14 d after swathed plots were cut.

Seeding date	Days after swathing	Swathed crop				Standing crop				χ^2
		1-3	4-5	A	*n*	1-3	4-5	A	*n*	
May 12	1-2	14	56	30	86	18	61	21	82	2.2
	10-14	0	29	71	35	16	56	28	50	17.5*
May 27	1-2	33	59	8	213	49	47	4	444	18.5*
	10-14	11	53	36	154	16	70	14	374	31.0*

*Frequencies of plant bug stages in swathed vs. standing crops are significantly different (*G*-test, $P<0.01$).

Table 3. Mean±SD (*n*) densities (per m²) of plant bugs on swathed and standing crops taken 3 d and 10 to 14 d after crops were swathed.

Seeding	3 days		10 to 14 days	
date	Swathed*	Standing	Swathed	Standing
May 12	39±15(4)	73±13(3)	6±5(4)	26±6(3)
May 27	243±54(2)	249±77(3)	63±39(2)	230±60(3)

* Swathing effect on plant bug density significant ($F_{1,23}$=7.38, *P*=0.013) and independent of seeding date ($F_{1,23}$=0.45, *P*=0.51) (2-way ANOVA, SAS Institute Inc. 1990).

Biology of *Phygadeuon fumator* Gravenhörst (Hymenoptera: Ichneumonidae), a pupal parasitoid of house and stable flies (Diptera: Muscidae) in Manitoba

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We examined the preferred stage of host attacked, seasonal dynamics, and methods for laboratory rearing for *Phygadeuon fumator* Gravenhörst, a potential biological control agent of house flies and stable flies in Manitoba. Of 50,842 live sentinel house fly pupae retrieved at two Manitoba dairies in 1996, *P fumator* parasitized 1,998. A total of 4,691 naturally occurring house fly and stable fly pupae were collected, of which 9.4% were parasitized by *P. fumator*. *Phygadeuon fumator* attacked only pupae in the field. When individual females were exposed to pupae and 3rd instar house fly larvae in the laboratory, 52.2% and 5.8% of observations were taken when females were in contact with containers of the pupae and larvae, respectively. At 22°C, males of *P. fumator* had significantly shorter development times (24.8 ± 0.1 days, 14 to 35 days; n=615) than females (26.5 ± 0.2 days, 18 to 35 days; n=147). Some *P. fumator* did not emerge immediately and entered a state of larval diapause. A greater proportion of *P. fumator* in sentinel pupae entered larval diapause (75.8%) than those in naturally occurring pupae (29.5%). *Phygadeoun fumator* has considerable potential as a biological control agent of house flies and stable flies, but factors influencing diapause induction and laboratory rearing must be determined.

INTRODUCTION

The genus *Phygadeuon* is a large one, most species of which parasitize pupae of cyclorrhaphous Diptera. There are some inconsistencies in the literature about the species of *Phygadeuon* which attack various filth flies, and the stage of host attacked. Legner and Olton (1968) examined parasitoids of the house fly, *Musca domestica* L., the stable fly, *Stomoxys calcitrans* (L.) and species of *Fannia* Robineau-Desvoidy, *Muscina* Robineau-Desvoidy and *Ophyra* Robineau-Desvoidy (Diptera: Muscidae) throughout the Palaearctic. A species of *Phygadeuon* parasitized *S. calcitrans*, *Fannia* and a species of Syrphidae (Diptera) in Ireland. *Phygadeuon* was also found in the Ethiopian and Pacific regions. Depner (1968) reared a *Phygadeuon* sp. from field-collected horn fly, *Haematobia irritans* (L.) (Diptera: Muscidae), pupae in Alberta. Floate *et al.* (1999) also found a *Phygadeuon* sp., presumably *Phygadeuon fumator* Gravenhörst (Hymenoptera: Ichneumonidae), attacking house flies and stable flies in Alberta feedlots. A species of *Phygadeuon* has also been reported to attack *M. domestica* in Denmark (Mourier 1972), and in the US (Legner *et al.* 1967; Miller and Rutz 1990; Smith and Rutz 1991*b*). Legner and Olton (1968) concluded that the activity of *Phygadeuon* sp. is greatest at higher latitudes in the Northern Hemisphere where other parasitoids are scarce or absent.

In a previous study, McKay and Galloway (1999) found that *P. fumator* was an important parasitoid of naturally occurring house fly pupae collected in two eastern Manitoba dairy barns. Although there is substantial information on the distribution of *Phygadeuon* spp., little is known about their biology, and there is confusion about what host and life stages it prefers. For example, Müller (1971) stated that *P. fumator* attacked the larval and pupal stages of *Delia brassicae* Bouché, but also attacked the pupae of the onion and turnip flies. Legner *et al*. (1976) and Rueda and Axtell (1985) concluded that *Phygadeuon* spp. attacked the larval stages of filth flies. Blanchot (1988), who was the first to describe the biology of *P. fumator*, found this species to attack pupae of *M. domestica*. Floate *et al.* (1999) reared a *Phygadeuon* sp. from puparia of sentinel house flies that had been placed in feedlots in Alberta. Of the 22,401 freeze-killed sentinel pupae retrieved from eight dairies in Manitoba, only one pupa was parasitized by *P. fumator* (McKay and Galloway 1999). It was not known if *P. fumator* rejected sentinel pupae because they had been freeze-killed or if it was because it was a larval parasitoid. Therefore, the main objective of this study was to determine if *P. fumator* in Manitoba was a larval or pupal parasitoid.

As secondary objectives, we wanted to investigate the basic biology of *P. fumator* in the field and under laboratory conditions, and to determine whether a laboratory colony could be established. In 1995, many *P. fumator* that were present in naturally occurring pupae had entered what was assumed to be a larval diapause and did not emerge from house and stable fly puparia after 60 days (McKay and Galloway 1999). Smith and Rutz (1991*a*) also found *P. fumator* frequently entered larval diapause. It is critical to understand the nature of this larval diapause to be able to assess the potential of *P. fumator* as a biological control agent of house flies and stable flies in Canada.

MATERIALS AND METHODS

Locations. Two farms, the Stengel and Staerk dairies, located near Beausejour (50 04'N, 96 30'W) and Whitemouth (49 58'N, 95 59'W), Manitoba, were chosen to examine the biology of *P. fumator*. The Stengel and Staerk dairies, with approximately 40 and 20 milking cows, respectively, had similar manure management and were selected on the basis of the numbers of *P. fumator* found in parasitoid surveys conducted in 1994 and 1995. Of eight dairies examined in 1995, *P. fumator* made up the majority of parasitoids reared from house and stable fly pupae at these two locations (McKay and Galloway 1999).

Sentinel pupae and larvae. Live sentinel pupae, reared from a laboratory house fly colony, were used to determine the presence of *P. fumator*. Three 450 ml plastic containers, each holding a minimum of 100 live one-day-old house fly pupae and two containers (450 ml) holding at least 100 third instar lab-reared house fly larvae were placed twice weekly at each farm from the 13 May to 17 October, 1996. Containers were nestled into the surface of known fly breeding sites (calf pens, under feed troughs) and protected from livestock. Adult *P. fumator* frequently penetrated deeply into the medium in the containers. After larvae and pupae were exposed in the barns for 4 days, containers were covered before being taken to the lab to prevent adult *P. fumator* from escaping. Each container was then carefully examined and all *P. fumator* found were placed into a plastic cage (16.5 x 16.5 x 16.5 cm) with access to a dilute honey solution and water to establish a laboratory colony. House fly pupae and larvae remaining were held in separate cages (32 x 32 x 32 cm) at 22 ± 1 C (16 hours light:8 hours dark) until all adult flies had emerged. Empty and intact puparia were then counted. Individual puparia were placed in single wells in Falcon® 96-well Micro Test III tissue culture plates and incubated at 25 ± 1 C (16L:8D), then examined each day for the emergence of *P. fumator*. The sex of all emerged *P. fumator* was determined and adults were transferred to the colony. After 60 days, intact puparia were dissected and the per cent parasitism of *P. fumator* determined. If an unemerged *P. fumator* was found, the stage of development (larva, pupa or adult) was recorded. A ^{2} statistical test was used to determine if the proportions of *P. fumator* in the various developmental stages were the same for both locations.

Naturally occurring pupae. House fly and stable fly puparia found in accumulated manure were also sampled for parasitoids. Five locations at each farm were sampled twice weekly from 13 May to 17 October. Each location within a barn was searched for 10 minutes or until at least 50 puparia were collected. Pupae were taken to the lab and placed in the tissue culture plates and incubated as described above. The species, sex and prevalence of parasitoids that emerged from each pupa was recorded. *Phygadeuon fumator* adults were added into the colony as described above. After a minimum of six weeks, all intact puparia were dissected. Data on parasitoid species, sex, prevalence and stage of development were recorded. A ^{2} statistical test was used to determine if the proportions of *P. fumator* in the various developmental stages were the same for both locations. This test was also used to determine if the proportions of *P. fumator* in various developmental stages were the same for naturally occurring and sentinel pupae.

Choice experiment. A choice experiment was conducted to determine if *P. fumator* prefers to oviposit in house fly pupae or larvae. Individual females were placed in each of two clear plastic cages (16.5 x 16.5 x 16.5 cm) and each was offered 10 one-day-old house fly pupae and 10 third instar house fly larvae. Two dishes, one for pupae and one for larvae, were placed on opposite sides of the cage. Cages were placed side by side and an incandescent light (100 watts) was positioned 10 cm behind the cages allowing light to be equally dispersed. The location of the female wasp in each cage was recorded every 60 seconds (one observation) for one hour. Observations on the location of female wasps (in pupal dish, in larval dish or in neither) were recorded. Since two cages were monitored at the same time, the recording of activity was alternated between cages every 30 seconds. After 30 minutes, the positions of the cages were reversed, allowing each cage to have the same light exposure. At the end of the experiment, pupae were removed from the cages and placed in tissue culture plates and incubated as described above. Larvae were allowed to pupate before placing them in the plates. If nothing had emerged after approximately three months, they were dissected to see if they had been parasitized. Twenty-seven females were used in this experiment. Of the 27 females, 16 females were field-collected (unknown age) and 11 were lab-reared (one day old) with no previous exposure to pupae or larvae. All females had been caged with males and were assumed to have mated. A ^{2} statistical test was used to determine if there was a difference between females from the field and colony and if there was a preference for larvae or pupae. A Mann-Whitney test was performed to determine if there were differences in oviposition between the two categories of females.

Laboratory Colonization. A colony of *P. fumator* was established by combining adults found in containers of sentinel pupae, and those that emerged from live sentinel and naturally occurring pupae. Since it appeared that females were affected by light, the colony was covered with black cloth and kept at 22 ± 1 C with a photoperiod of 18L:6D. One-day-old house fly pupae were mixed with 250-300 ml of fly-medium retained after larvae had pupated, and exposed to female *P. fumator* for 3 d. After exposure, the pupae were removed and placed in plastic cages (16.5 x 16.5 x 16.5 cm) to allow flies to emerge from unparasitized pupae. After the flies had emerged and died, the tray containing the remaining parasitized pupae was placed into a new cage to allow *P. fumator* to emerge. The puparia were incubated for 60 days at 22 ± 1 C (18L:6D) during which time any emerging adult wasps were recorded, removed and sexed. After 60 days, remaining puparia were dissected and the developmental stage of all *P. fumator* was recorded. Development times for males and females were compared using a two-sample t-test.

RESULTS

Sentinel pupae and larvae. At the Staerk farm, 22,075 live sentinel pupae were recovered. Of the 633 that were parasitized, *P. fumator* parasitized 597 (94.3%). *Phygadeuon fumator* was first collected from sentinel pupae placed in the field from 13-17 June and last collected from 5-9 September, 1996 (Fig. 1A). At the Stengel dairy, 28,767 sentinel pupae were recovered. Of the 1,419 pupae that were parasitized, *P. fumator* emerged from 1,401 (98.7%). *Phygadeuon fumator* was first collected from sentinel pupae placed in the field from 3-10 June and last collected from 2-5

September, 1996. No *P. fumator* parasitized pupae in October on either farm (Fig. 1A). For a list of other parasitoids collected, see McKay and Galloway (1999). None of the 5,426 and 6,950 sentinel larvae recovered from Staerk's and Stengel's, respectively, were parasitized.

Of the total 1,998 sentinel pupae parasitized by *P. fumator*, 298 adults emerged. The remaining 1,700 sentinel pupae were dissected. Most (75.8%) of *P. fumator* were in the larval stage (Fig. 1A). Since these larvae were alive after being incubated for a minimum of 60 d, it is presumed that they had entered a state of diapause. Emerged adults and pupae accounted for 14.9% and 9.3%, of the stages of *P. fumator*, respectively. It is not known whether pupae would have continued to develop into adults in the next several days, or whether there is a pupal diapause as well. At the Staerk farm, 92.1% of *P. fumator* were in the larval stage after 60 d, with pupal and adult stages accounting for 5.9% and 2.0%. At the Stengel farm, only 68.9% *P. fumator* were in the larval stage and more *P. fumator* emerged as adults (20.4%) than were in the pupal stage (10.7%). The proportion of individuals in each stage of development for live sentinel pupae varied between farms (^{2} = 135.5, $P < 0.001$).

Naturally occurring pupae. At the Staerk farm, adult house flies were first seen on 10 June, but house and stable fly pupae were not collected until 13 June and 15 July, 1996, respectively. *Phygadeuon fumator* first emerged from naturally occurring pupae collected on 8 July (Fig. 1B). Pupae were collected until 17 October when no fly larvae or adults could be found. At the Stengel farm, adult house flies were first seen 30 May. Two adult *P. fumator* were first collected on 17 June. The first stable fly pupa was collected on 8 July, while house fly pupae were not found until 22 July. *Phygadeuon fumator* first emerged from naturally occurring pupae collected on 22 July. Pupae were collected at the Stengel dairy until 17 October after which no larvae, pupae or adult flies could be found (Fig. 1B). Of the 2,753 fly pupae collected at the Staerk farm, 332 (12.1%) were parasitized by *P. fumator* (Table 1). Of the 1,938 fly pupae collected at Stengel's, 110 (5.7%) were parasitized (Table 1).

The proportion of individuals in each stage of development for naturally occurring pupae was similar for both farms (^{2} = 5.44, $P = 0.07$). More *P. fumator* emerged as adults (64.6%) than remained in the larval (29.5%) and pupal (5.9%) stages (Fig. 1B). The proportion of individuals in each stage of development varied among naturally occurring and sentinel pupae (^{2} = 428.3, $P < 0.001$). For sentinel pupae, more *P. fumator* were in the larval stage after 60 d.

Choice experiment. *Phygadeuon fumator* spent more time in containers with pupae than with larvae, but females from the colony and the field differed in their responses (^{2} = 189.32, P<0.001). For females from the colony, of the 660 observations, 401 (60.8%) were made when females were away from either the larval or pupal dishes. Two hundred and fifty-seven (38.9%) observations were taken while females were in the pupal dishes, and only 2 (0.3%) were made when females were in the larval dishes. For females collected from the field, of the 957 observations, 587 (61.3%) were taken when females were in contact with the pupal dishes. Two hundred and seventy-eight (29.1%) observations were made when females were away from both dishes, while 92 (9.6%) observations were taken from females in the larval dishes. For both categories of females, of the 1,617 observations made, 844 (52.2%) were taken when females were in contact with the pupal dishes, 679 (42.0%) away from both dishes and 94 (5.8%) in the larval dishes.

Fifty-two pupae were examined by the 16 females from the field, of which 24 were accepted and drilled. Twenty-one pupae were examined by the 11 females from the colony, but only 5 were drilled. No significant difference in oviposition behaviour was observed between females with known and unknown histories (Mann-Whitney U test = 53.0, P<0.08). Of all the pupae which were drilled, only three were parasitized and had been drilled by two females with unknown histories. All three *P. fumator* died in the larval stage.

Laboratory Colonization. At 22 ± 1 C, males of *P. fumator* have significantly shorter development times (t=7.03,P< 0.001, =0.05) than females. Mean ± SE development time was 24.8 ± 0.1 days (14.0 to 35.0 days; n=615) for males and 26.5 ± 0.2 days (18.0 to 35.0 days; n=147) for females, a difference of 1.7 days. Of the 1,256 parasitized house fly puparia examined, adult *P. fumator* emerged from 44.8%, while 50.2% and 4.9% remained in the larval and pupal stages, respectively.

DISCUSSION

In assessing the potential of *P. fumator* as a biological control agent of house flies and stable flies, it is essential that the stage or stages of the hosts attacked be clearly determined. Legner *et al.* (1976) and Rueda and Axtell (1985) considered *Phygadeuon* spp. attacking house flies and stable flies to be larval parasitoids, while Blanchot (1988) and Floate *et al*. (1999) reported *Phygadeuon* spp. attacking house fly pupae. In Manitoba in 1995, *P. fumator* did not parasitize freeze-killed sentinel pupae (McKay and Galloway 1999), therefore it was a consideration that *P. fumator* might be a larval parasitoid. However, in the present study, *P. fumator* was found to attack only live pupae in the field. Of all the live sentinel larvae recovered, none were parasitized by *P. fumator* or by any other parasitoid. In a choice experiment in the laboratory, female *P. fumator* clearly spent more time investigating pupae. For all observations, females were in contact with the pupal and larval dishes 52.2% and 5.8% of the time, respectively. No larvae were attacked during the choice experiment. We conclude that *P. fumator* is a pupal parasitoid of house and stable flies in Manitoba.

Having determined the stage of host attacked, it is also important to understand the dynamics of *P. fumator* in the field. In previous studies, *Phygadeuon* spp. accounted for 11.0% of the parasitism of house flies in central New York (Smith and Rutz 1991*c*), 6.1% and 2.9% of parasitoids reared from fly pupae in Alberta (Lysyk 1995; Floate *et al.* 1999) and 1.0% in Denmark (Mourier 1972). Results from the current study are the first in which *P. fumator* was the most abundant parasitoid. Smith and Rutz (1991*a*) examined microhabitat associations of parasitoids and found that *P. fumator* preferred sheltered sites primarily in moist bedding and feed. Legner and Olton (1968) concluded that the activity of *Phygadeuon* sp. was higher when other parasitoids are scarce or absent. Small populations of pteromalids and a suitable microhabitat in this study might have contributed to the greater prevalence of *P. fumator*.

Smith and Rutz (1991*c*) found that *P. fumator* was most abundant in June in New

York, while Floate *et al.* (1999) found that *Phygadeuon* sp. was present from spring through until fall, but was most abundant in late summer in Alberta. In Manitoba, the majority of *P. fumator* attacked sentinel pupae from 6 June to 15 July (Fig. 1A) and naturally occurring pupae from 19 August to 17 October (Fig. 1B). Naturally occurring hosts were unavailable in early June, thus sentinel pupae were the only hosts available inside the barns. After 15 July, when naturally occurring fly pupae became available, parasitism by *P. fumator* was lower in the sentinels and increased in naturally occurring pupae. When given the choice, *P. fumator* may prefer to parasitize naturally occurring pupae in moist areas to dry sentinel pupae in plastic containers.

Phygadeuon fumator is a major parasitoid of house flies and stable flies in some Manitoba dairy operations. It is important to know whether this species could be cultured for detailed study and perhaps for innoculative or inundative releases. Blanchot (1988) determined that *P. fumator* males and females developed in 21 and 22 days, respectively at 22 C (14L:10D). Differences in development times from Blanchot's study were 3.8 and 4.5 days for males and females. Photoperiod was longer in our study which may have contributed to the difference in development times, but there maybe differences in host factors, or even inherent differences between populations of parasitoids. Of all pupae parasitized from the colony and dissected after 60 days, the majority of *P. fumator* were in the larval and pupal stages. We assumed that these individuals were in diapause, as observed by Smith and Rutz (1991*a*).

In most instances, extrinsic factors such as temperature and photoperiod induce diapause and affect the generation entering diapause (Schneiderman and Horwitz 1958). However, factors which influenced diapause of *P. fumator* in this study were not determined. Like *Nasonia vitripennis* (Hymenoptera: Pteromalidae) and the egg parasitoid, *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae), diapause might be maternally influenced (Godfray 1994). Most sentinel pupae in our study were parasitized by *P. fumator* from June to July. When intact sentinel pupae were dissected, the majority of *P. fumator* were in the larval stage (Fig. 1A). However, for naturally occurring pupae, most were parasitized by *P. fumator* from August to October with the majority emerging as adults (Fig. 1B). Schneiderman and Horwitz (1958) found a correlation between host deprivation and the incidence of diapause for *N. vitripennis*. Per cent diapause increases from 0 to 97.3% when *N. vitripennis* experienced 1 to 5 days of host deprivation, respectively. Blanchot (1988) stated that *P. fumator* overwinters in fly puparia. We hypothesize that when female *P. fumator* emerged, there was a low probability of finding live pupae in the field since there was no substantial house fly or stable reproduction observed until July. The parasitoids may have eventually moved inside the facilities where there were sentinel pupae. Having been deprived of hosts, females parasitized sentinel pupae and produced a greater proportion of diapausing offspring. When naturally occurring hosts became available, females were no longer deprived of hosts, and the majority of the offspring developed to maturity and emerged as adults.

Temperature and photoperiod regimes were unlikely to have had an affect on developing parasitoids since there were differences in the proportion of individuals in each stage of development between naturally occurring and sentinel pupae. The proportions of larvae that developed through to adult were similar for the colony. However, it is not known if temperature and photoperiod triggered the female to illicit a diapause response in her offspring or if these factors influenced the developing larva. Research is required to determine if *P. fumator* larvae may enter a true diapause at any time in the season, or if some larvae have a period of extended development which might be unique to this species. More information is needed on the factors that induce and terminate diapause.

A colony of *P. fumator* was difficult to establish in the laboratory. Female production was low, so the colony slowly declined to the point where it consisted of predominantly males. Since the factors that affect sex ratios of *P. fumator* have never been examined, it is not known why the colony became predominantly male. However, if the factors that affect sex ratios of *P. fumator* are similar to other parasitoids that attack house and stable flies (e.g. Pteromalidae), a number of variables could have contributed. The proportion of *P. fumator* to hosts might have influenced sex ratio. Female *N. vitripennis* produce a smaller percentage of female progeny at high parasitoid:host ratios (Wylie 1966). The pupae exposed in the lab might not have been suitable for parasitism. King (1994) reported females of *Spalangia cameroni* Perkins (Hymenoptera: Pteromalidae) lay a greater proportion of daughters than sons in large hosts rather than small hosts. Before this parasitoid can be mass produced for biological control, the factors which affect sex ratios must be understood.

Though there was a preference for pupae, females from the colony versus females collected in the field were different. Females from the colony spent less time investigating containers of pupae and larvae. However, these females were only one day old, and may not have been mated and it is unlikely that they were ready to lay eggs. There were no differences in oviposition behaviour between the two categories of females. To understand factors which effect oviposition behaviour, host seeking strategies should first be addressed with more research conducted with regards to the mating system and reproductive development of *P. fumator*.

Phygadeuon fumator was relatively abundant in barns included in our study. It appears that *P. fumator* may have potential as a biological control agent in some parts of Canada. However, there are several important fundamental aspects of its life history and interaction with other parasitoids that must be determined. In addition, before *P. fumator* can be mass reared and its full potential assessed, factors regulating larval diapause and sex determination must be examined.

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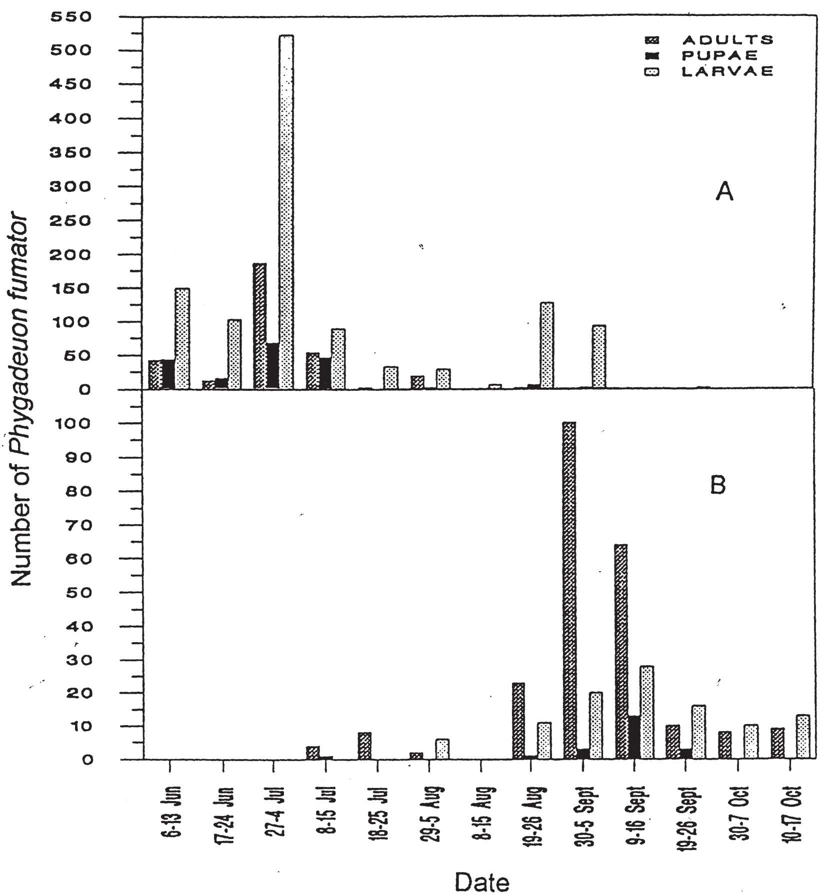

Figure 1. Numbers of *Phygadeuon fumator* Gravenhörst that developed through to larval, pupal and adult stages collected from two Manitoba farms from 6 June to 17 October, 1996. (A) Sentinel house fly pupae. (B) Naturally occurring house fly pupae.

Table 1. Proportions of house fly and stable fly pupae parasitized by *Phygadeuon fumator* in collections from two Manitoba dairy farms from 13 May to 17 October, 1996.

Farm	House fly pupae	Parasitized house fly pupae		Stable fly pupae	Parasitized stable fly pupae		Total fly pupae	Total parasitized pupae	
		No.	%		No.	%		No.	%
Staerk	2,431	284	11.7	322	48	14.9	2,753	332	12.1
Stengel	1,707	108	6.3	231	2	0.9	1,938	110	5.7
Total	4,138	392	9.5	553	50	9.0	4,691	442	9.4

Overwintering of the Native Elm Bark Beetle, *Hylurgopinus rufipes* (Coleoptera: Scolytidae), in Siberian Elm, *Ulmus pumila*

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At three sites near Winnipeg, Manitoba, Siberian elm, *Ulmus pumila*, and American elm, *U. americana*, trees were examined for the entrance holes of the native elm bark beetle, *Hylurgopinus rufipes*. At weekly intervals in September and October 1992, entrance holes were counted in the basal 30 cm of the trunks of ten trees of each species at each site. The density of new holes accumulated was calculated from the difference between the initial and final hole count. Densities of accumulated entrance holes in Siberian elm were 31–51% of those in American elm in the same site. Densities of holes in Siberian elm trunks were inversely related to the distance to the nearest American elm. The following spring, living *H. rufipes* were collected from overwintering tunnels in Siberian elm. We conclude that in Manitoba adult *H. rufipes* overwinter in both common species of elm.

INTRODUCTION

Dutch elm disease is the most important disease of elm trees in the northern hemisphere. The causal pathogen of the disease is the fungus *Ophiostoma ulmi* (Buismann) Nannf., which is spread from tree to tree by elm bark beetles. In North America, the major vectors of Dutch elm disease are the introduced European elm bark beetle, *Scolytus multistriatus* (Marsham), and the native elm bark beetle, *Hylurgopinus rufipes* (Eichoff) (Strobel and Lanier 1981). In the prairie provinces, *H. rufipes* is the principal vector (Hildahl and Wong 1965). Although *S. multistriatus* are found in Manitoba (Buth and Ellis 1981), more than 99% of the vector population in Manitoba is *H. rufipes* (Westwood 1991).

Hylurgopinus rufipes overwinter in the outer bark of the lower trunk of elm trees (Strobel and Lanier 1981). In the northern Great Plains most *H. rufipes* overwinter as adults, and almost all of these overwinter within 30 cm of the ground (Landwehr *et al.* 1982; Anderson 1996). Adult *H. rufipes* that emerge from brood galleries in summer fly to healthy elm trees where they first feed on twigs in the canopy, then overwinter in the trunk (Swedenborg *et al.* 1988). The mechanism by which these trees are selected is not known. It appears that adults are attracted to vertical objects and that selection of a suitable tree may be a result of repeated trial and error (Lanier 1983). Distance from the brood tree may influence tree selection, as elm trees with overwintering beetles are more frequent close to wood from which new adults emerged (Becker 1935). Whether all elm species are equally utilized for overwintering is not known.

Both American elm, *Ulmus americana* L. and Siberian elm, *U. pumila* L. are widespread in southern Manitoba and southern Saskatchewan. Adults overwinter successfully in American elm (Anderson 1996), but it is unknown whether overwintering occurs in Siberian elm. Surveys in the area in the mid-1960s detected *H. rufipes* in 7 – 27 % of American elm samples, but none of the samples of Siberian elm contained beetles (Hildahl and Wong 1965). However, these samples were taken from dead or dying parts of elm trees, and so may represent beetles in brood trees, rather than beetles feeding or burrowing in trees in which they overwinter.

Information about the selection of overwintering sites by *H. rufipes* is of considerable economic and practical significance. The control of overwintering beetles by insecticide applications to the lower trunk of elm trees is a key component of Dutch elm disease management in Manitoba (Westwood 1991), and basal sprays are applied to both American elm and Siberian elm. A considerable reduction in pesticide use would be possible if it were shown that Siberian elm is not used by overwintering *H. rufipes*. The purpose of this study was to determine if *H. rufipes* overwinters in Siberian elms in Manitoba.

METHODS

In fall 1992, we selected three sites where both American elm and Siberian elm occur. All sites were within 5 km of the Winnipeg city limits. Site 1 was east of the city, site 2 was west of the city and site 3 was south of the city. At each site, ten Siberian and ten American elms were selected and the diameter at breast height (DBH) of each tree was estimated from the measurement of the trunk circumference with a tape measure. In addition, the shortest distance between Siberian and American elms was measured for each site. Also, for site 1, where trees of the two species were closest together, the distance between each of the 10 selected Siberian elm and their closest American elm neighbour was measured.

For each of the selected trees in each site, counts of bark beetle entrance holes were made at weekly intervals from 23 September 1992 to 30 October 1992. Counts were made only for the bottom 35 cm of each trunk. The accumulation of holes was calculated by subtracting the initial hole count from the final hole count. Accumulations of entrance holes were converted to densities per unit area, based upon the assumption that the sample unit was a cylinder of measured circumference and height 35 cm. Hole density was compared among tree species by unpaired *t* tests, and subjected to regression and correlation analysis using Systat (Systat 1999).

In April of 1993, the Siberian elm trees in site 1 were examined non-destructively to determine whether adult *H. rufipes* had survived the winter in them.

RESULTS

Tree sizes differed significantly between species for two of the three sites (Table 1), however, there was no consistent trend for one tree species to be bigger than the other. In contrast, the mean density of entrance holes accumulated during the observation period was invariably less for Siberian elm than for American elm although this difference was significant in only two of the three sites (Table 1). In all sites, density of entrance holes in Siberian elm was significantly different from 0 (one sample t test, d.f. = 9, site 1: $t = 4.9$, $P < 0.001$; site 2: $t = 5.2$, $P < 0.001$; site 3: $t = 4.4$, $P < 0.01$).

The density of entry holes accumulated in Siberian elm appeared to be related to the density of holes in American elm at the same site (Fig. 1). However, despite the high correlation coefficient ($r = 0.97$), this relationship was not statistically significant ($P = 0.2$), presumably because of the small number of sites contributing to the relationship. For three sites, only a near-perfect underlying relationship, giving an r 0.997, would generate statistically significance.

In site 1, where distance from each Siberian elm to its closest American elm neighbour was measured, that distance was inversely related to the accumulated number of entrance holes in the sampled Siberian elm (Fig. 2). This relationship was statistically significant ($F = 11.0$; d.f. = 1,8; $P < 0.05$). In April 1993, when Siberian elm trees were examined in site 1, two overwintering adult *H. rufipes* were removed from one tree and three adults were removed from a second tree. All five adult *H. rufipes* were alive.

DISCUSSION

Hylurgopinus rufipes adults entered overwintering galleries in Siberian elm in fall and at least some of them overwintered successfully there. However, in all sites, densities of accumulated entrance holes in Siberian elm reached no more than 51% of those in American elm in the same site. It appears that American elm is a more preferred overwintering host than Siberian elm. Indeed, the effect of distance of Siberian elm from American elm on hole density (Fig. 2) suggests that *H. rufipes* adults respond at relatively long range to cues specific to American elm, and that the subsequent choice of Siberian elm may be a result of low discriminatory power by the insect when close to the trees to which they have been attracted. However, mistaken identity at close range is probably not the only mechanism for utilization of Siberian elm as an overwintering site. If it were, then we would expect no *H. rufipes* entry holes in Siberian elm in site 3, where Siberian elm were far removed from American elm. Perhaps overwintering in Siberian elm that are distant from American elm is the result of response to the visual cue of a vertical object (Lanier 1983).

We conclude that programs of basal spraying for control of overwintering adult *H. rufipes* should include Siberian elm as well as American elm. Exclusion of Siberian elm from basal spraying is particularly unwise when trees of this species are close neighbors of American elm.

ACKNOWLEDGEMENTS

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Table 1. Diameter at breast height (DBH), seasonal accumulated density of beetle entry holes and minimum distance between American elm, *Ulmus americana*, and Siberian elm, *U. pumila*, at three study sites near Winnipeg, Manitoba.

Site	Tree species	DBH [cm]		Cumulative entry holes per $100 cm^2$		Minimum distance between species [m]
		Mean ± SEM	*t* test[a] (d.f. = 18)	Mean ± SEM	*t* test[a] (d.f. = 18)	
1	*U. americana*	25.6 ± 1.6	$t = -3.2$	1.19 ± 0.17	$t = 4.3$	1.3
	U. pumila	34.9 ± 2.4	$P < 0.01$	0.37 ± 0.08	$P < 0.001$	
2	*U. americana*	40.3 ± 2.1	$t = 9.8$	0.24 ± 0.05	$t = 2.8$	58.0
	U. pumila	16.2 ± 1.2	$P < 0.001$	0.09 ± 0.02	$P < 0.05$	
3	*U. americana*	22.8 ± 2.2	$t = 1.6$	0.35 ± 0.07	$t = 2.0$	185.0
	U. pumila	18.1 ±2.0	$P = 0.1$	0.18 ± 0.04	$P = 0.06$	

[a] Unpaired two-tailed t-test of hypothesis that means for the two species in the site are the same.

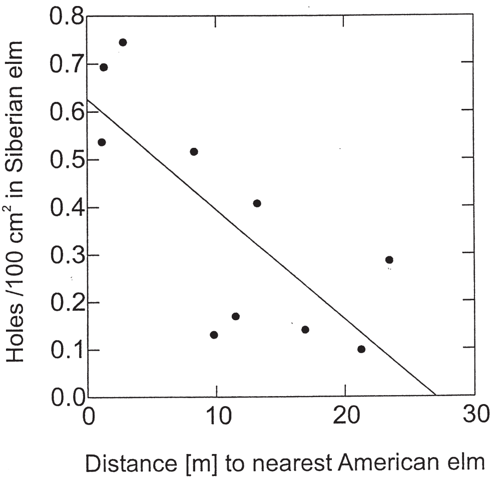

Figure 1: Relationship between the mean density of accumulated entrance holes in *U. pumila* and *U. americana* at three sites near Winnipeg. Manitoba. Vertical and horizontal bars represent standard errors for *U. pumila* and *U. americana* samples respectively. The diagonal lines are portions of the Gaussian ellipse bounding the region within one standard deviation of the mean of the bivariate normal distribution. Note that the scales of the two axes differ.

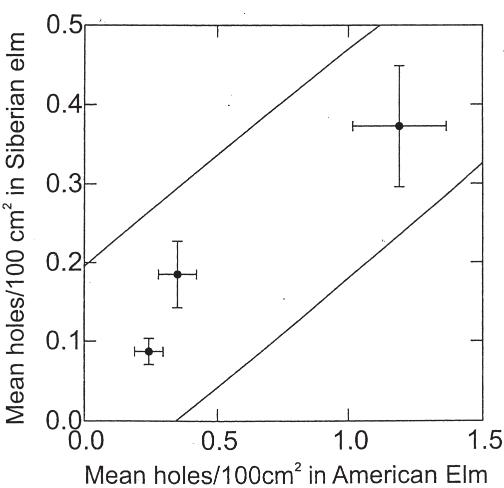

Figure 2: Relationship between the density of accumulated entrance holes in *U. pumila* trees and the distance of these trees from the nearest *U. americana* for site 1 near Winnipeg, Manitoba.

Scientific Program Abstracts for the 1999 Annual Meeting of the Entomological Society of Manitoba

November 5-6, 1999
Winnipeg, Manitoba

Keynote Address

AGRICULTURE AND INSECTS IN EUROPE: THE ROLE OF FIELD MAGINS. Wilf Powell, IACR-Rothamsted, Harpenden, Hertfordshire, AL5 2JQ, UK.

Over the last 20-30 years, agriculture in the United Kingdom and other parts of northern Europe has undergone a number of changes, particularly in the growing of arable crops. Specialized arable farms concentrating on cereal production with a few break crops such as oilseed rape, potatoes, and sugar beet have largely replaced traditional mixed farms, which reared livestock and grew a wider variety of crops. Field sizes have increased, with the accompanying loss of thousands of miles of field boundaries, many of which consisted of botanically diverse hedgerows. In addition, there has been a significant shift from the cultivation of spring-sown to winter-sown crops. As a result, winter stubble fields, which were important feeding sides for farmland birds, have almost disappeared from many farming regions. Intensification of arable crop production has also involved increased use of chemical inputs in the form of inorganic fertilizers and pesticides.

Over the same period there has been an alarming decline in biodiversity on farmland and an increase in some insect pest problems on arable crops. More intensive, mechanized crop production methods, especially in the application of fertilizers and herbicides, have impoverished the botanical diversity of surviving field margins with knock-on effects on insect diversity. This is also thought to have contributed both to the decline in many farmland bird species and to increased problems with pests such as cereal aphids. Dramatic declines in groups with high public profiles such as butterflies, bumble bees, birds, and wild flowers have led to growing public concern over the perceived impact of intensive agriculture on the rural environment. This concern, coupled with government commitments to global efforts to halt declines in biodiversity, has led to the introduction of incentive schemes to encourage farmers to diversify natural habitats on their farms. Much of this is aimed at field margin diversification, including the sowing of wild flower/grass strips. The potential of using field margins for the joint purposes of increasing biodiversity and enhancing natural pest control will be discussed, using recent research on the ecology and behaviour of aphid parasitoids. A strategy to enhance the impact of parasitoids on cereal aphids by manipulating their behaviour using aphid sex pheromones placed in field margins has been developed at IACR-Rothamsted.

Symposium: Effects of Recent Human Activity in Agriculture and the Environment on Insects

CONSERVATION BIOLOGY OF AQUATIC INSECTS. Rob Roughley, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

Most orders of insects have aquatic members; 10 to 15% of the Manitoba insect fauna is aquatic or semiaquatic. A review of aquatic habitats suggests that these are perhaps as varied as terrestrial habitats. Many classifications of aquatic habitats are available but one effective arrangement would include flow, salinity and pH. This classification is used for a review of habitat types. The economic value and human uses of aquatic environments creates an alteration of natural environmental processes which threatens the aquatic fauna. Human disturbance is the greatest threat to aquatic insects and it has a variety of different kinds of effects, such as acceleration or alteration of the direction of ecological processes. Targeting the specific kind of disturbance with a variety of conservation tools is seen as the most appropriate form of protection. Human exploitation of aquatic habitats is threatening certain kinds of aquatic insects but it also provides the mechanism for conservation and preservation. The kinds of problems associated with conservation of aquatic insects are illustrated using *Brychius* n.sp. (Coleoptera: Haliplidae) from the Duck Mountains in Manitoba.

EFFECTS OF FORESTRY ON INSECT FAUNA EFFECTS OF FORESTRY ON INSECT FAUNA. Richard Westwood, Dept. of Biology, University of Winnipeg, Winnipeg, MB.

A variety of forestry activities, including timber harvesting, forest renewal and pest management can significantly change the physical structure and biological makeup of forest stands. These activities can affect a wide range of biological processes, many of which can be observed by studying the successional pathways of forest ecosystems. Three examples of forestry activities in Manitoba affecting insects are discussed. These include the influence of forest harvesting and renewal methods on spruce budworm populations, the introduction of exotic tree species and root collar weevil and studies of the effects of harvesting activities on successional pathways in

Jack pine forests. The results of these investigations reveal that the length and intensity of spruce budworm outbreaks in Manitoba have changed considerably during the last 30 years due to forest management practices. Introduction of exotic tree species has elevated the root collar weevil from an occasional pest in isolated pockets to a major factor in preventing the continued growth of introduced species for plantation forestry in Manitoba and finally in Jack pine forest systems slight alterations in successional pathways due to forest management activities may not greatly affect overall diversity of selected groups studied.

INFLUENCE OF FARMING PRACTICES ON ARTHROPODS. Owen Olfert, Agriculture and Agri-Food Canada, Saskatoon, SK.

Arthropods are the most diverse group of organisms in most ecosystems. Many species, including beneficial and pest species, are well-suited to characterizing the ecosystems that they inhabit. Economic viability and soil degradation are major issues facing farmers in the grassland ecozone of the Northern Great Plains. Crop diversification, reduced fallow and reduced inputs are being promoted in an effort to address these issues. A systems approach can be applied as the experimental framework with which to monitor and assess alternate input and cropping strategies. The design, data collection, and evaluation are based on the collaborative efforts of crop, pest, economic, and soil scientists. This paper highlights studies in which the role of arthropods (insects, spiders, mites) are being assessed in redesigning farming systems that are economically viable and environmentally sustainable. Ecosystem-based, arthropod baselines are viewed as an integral component in evaluating farming systems.

MANAGEMENT OF INVERTEBRATE POPULATIONS IN WETLAND HABITATS. Dale A. Wrubleski, Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB, R0C 2Z0.

Aquatic invertebrates are one of the most diverse and abundant groups of organisms in freshwater wetlands. They perform a number of important functions in these habitats, but their most widely recognized value is their role in wetland food webs. A wide variety of wetland wildlife rely on invertebrates as important food resources. For this reason, management of these habitats often targets enhancement of invertebrate populations. This is particularly true of wetland management for waterfowl and shorebirds. Vegetation and water-level manipulations are the most common tools used to enhance invertebrate populations and to make them more accessible to these birds. At the same time however, wetland managers have made efforts to avoid increasing mosquito populations, particularly near major urban centers. Herbivory of wetland plants by insects is generally regarded as insignificant. An exception to this is the recent release of several European *Galerucella* beetles for the control of purple loosestrife (*Lythrum salicaria*).

THE IMPACT OF MODERN BEEKEEPING PRACTICES ON HONEY BEES. Don Dixon, Manitoba Agriculture, Winnipeg, MB, R3T 5S6.

Human interaction with honey bees (*Apis mellifera*) for the purpose of honey gathering and possibly other activities predates recorded history. The impact of "beekeeping" practices on the honey bee is reviewed under two general areas:

- the impact of technological developments related to colony management with particular reference to the development of the moveable frame hive,
- the impact of human assisted movement of honey bees into new geographical locations.

The development of the standardized moveable frame hive in the mid-19th century revolutionized the keeping of bees throughout the world. This simple innovation resulted from an improved understanding of the conditions which regulate wax comb production by honey bees and, in particular, the discovery of the "bee-space", the space of approximately 8 mm between finished combs by the European honey bee. The moveable frame hive promoted more systematic research into all aspects of honey bee biology, commercial honey bee management, the introduction of beekeeping into new areas and the development of secondary management activities such as queen rearing and package bee production.

Prior to 1600 AD, honey bees were found only in the Old World, where they had evolved. The first introductions of European honey bees into the western hemisphere occurred with the transport of several colonies of bees to North America during the mid-17th century. In recent years, honey bees have been introduced to virtually every part of the world that provides at least the potential for commercial honey production. Although these introductions have often resulted in important economic activities resulting from both honey production and pollination of commercial crops, there have also been several serious environmental and economic problems resulting from these introductions. For example, the introduction of the African honey bee to South America disrupted the occurrence of other bees in the region and also resulted in an important increase in stinging incidents involving both humans and livestock. Also, the international movement of bees has promoted the inter-species transmission of some diseases as well as facilitated the introduction of bee diseases into new areas.

Submitted Papers

INSECT POLLINATION OF THE ENDANGERED WESTERN PRAIRIE FRINGED ORCHID IN MANITOBA. Richard Westwood, Dept. of Biology, University of Winnipeg, Winnipeg, MB.

The Western Prairie Fringed Orchid (*Platanthera praeclara*) is found in several areas of remnant tall grass prairie in southeastern Manitoba. It is Manitoba's largest and one of the most impressive native orchids. Extensive agricultural activities throughout southern Manitoba have radically changed the landscape including areas once characterized as tall grass prairie. The orchid is now confined to isolated small patches within these last remnant tall grass prairie areas within the Tall Grass Prairie Reserve. The remaining population of a few thousand plants is the only one existing in Canada. The orchid has now been placed on Canada's list of endangered plants and its endangered status is recognized on a world-wide basis. Little is known about the many aspects of the biology of the Western Prairie Fringed Orchid in Canada and it has been recognized that a clear understanding of the orchid's biology is needed to prevent its extinction. Recent studies indicate that the orchids' ability to set seeds seems very low and this phenomenon may be a threat to attempts to conserve the remaining plants. Beginning in 1997 a series of experiments and surveys were initiated to determine the role insects played in pollination of the orchid and this paper reports on the progress of those studies.

ALTERNATIVES TO METHYL BROMIDE FUMIGATION OF EMPTY SHIP HOLDS. Paul Fields, Agriculture and Agri-Food Canada, Cereal Research Centre, Winnipeg, MB, R3T 2M9.

Methyl bromide is an ozone depleting substance, and most developed countries will phase-out its use by the year 2005. The pre-shipment uses of methyl bromide are exempt, but this is under review. This test was conducted on a lake-going ship. There were four treatments, control, methyl bromide with recapture, phosphine at 500 ppm, and phosphine at 1000 ppm. The phosphine was produced either by using Eco_2Fume™, 2% phosphine with 98% carbon dioxide in pressurized cylinders or by using the Horn generator which produces phosphine by mixing magnesium phosphide powder with water.

Four insects were used in the bioassay: rusty grain beetle, *Cryptolestes ferrugineus* (Stephens); rice weevil *Sitophilus oryzae* (L.); red flour beetle, *Tribolium castaneum* (Herbst); and the lesser grain borer, *Rhyzopertha dominica* (Fabricus). Twenty-five mixed-aged adults were placed in plastic vials with screen tops containing 10 g of wheat, and females allowed to lay eggs for several days before the treatments. Insects were removed from the treatments after 32, 48, and 72 h into the fumigation.

After 32 h, none of the adult insects survived in any of the three fumigation treatments. In the untreated hold there was over 98% adult survival for all species. There was less than 7% survival of eggs after 32 h in the fumigated holds and less than 1% survival after 48 h and no survival after 72 h.

OBSERVATIONS ON LICE (MALLOPHAGA: *BRUEELIA*, *MENACANTHUS*) INFESTING HOUSE SPARROWS (*PASSER DOMESTICUS* L.) IN MANITOBA AND NEW ZEALAND. Terry Galloway, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

In Manitoba, 64 house sparrows, *Passer domesticus* L., were examined for ectoparasites during 1995 to 1998; in Christchurch, New Zealand, 10 were examined from May, 1998 to March, 1999. Birds were salvaged from the Manitoba Wildlife Rehabilitation Organization at Glenlea, and collected following fatal window strikes on the University of Canterbury Campus in New Zealand. Birds were frozen for a variable length of time before being thawed and washed in warm soapy water. Ectoparasites were strained from wash water using a 200µ or 50µ brass screen. For Manitoba sparrows, 19 (29.7%) were infested with lice; 17 (27.0%, mean intensity = 8.0, range 1-31) were infested with *Brueelia subtilis* (Nitzsch, 1874), 5 (7.8%, mean intensity = 54.8, range 3-205) were infested with *Menacanthus eurysternus* (Burmeister, 1838), and 3 of the 19 were infested with both species. In New Zealand, 7 of the 10 birds examined were infested with *Brueelia cyclothorax* (Burmeister, 1838) (mean intensity = 23.8, range 2-96). The two *Brueelia* spp. were compared and appear to be the same species. Problems with synonymies in the Mallophaga are briefly discussed.

THE IMPACT OF A PALEARCTIC SPECIES, *COCCINELLA SEPTEMPUNCTATA*, ON THE RELATIVE ABUNDANCE OF INDIGENOUS COCCINELLIDS IN SOUTHERN MANITOBA. Ian L. Wise, W.J. Turnock, and F. Matheson, Agriculture and Agri-Food Canada, Cereal Research Centre, Winnipeg, MB, R3T 2M9.

The 7-spotted lady beetle, *Coccinella septempunctata* (C7), was intentionally introduced into the eastern United States on several occasions from 1956 to 1971. It became established in New Jersey in 1973, and has since spread naturally in the U.S. and into Canada. In anticipation of its arrival into Manitoba, annual collections of lady beetles by sweep net sampling in alfalfa were initiated in 1983. C7, subsequently, was found in Manitoba in 1988, and resulted in the ongoing annual collections being expanded in 1989 to include lady beetles from many annual and perennial plants and from the shores of Delta Beach of Lake Manitoba. While a total of 16 lady beetle species have been found to date ($N > 50{,}000$), a measure of the impact of C7 on indigenous lady beetle populations has been limited to the five most abundant species encountered before the arrival of C7. After 1988, C7 rapidly increased in numbers, becoming the most abundant lady beetle in field and beach collections in 1992. Since 1993 ($N = 39{,}544$), the relative abundance of C7 has remained below one-third of all beetles collected each year. *Hippodamia tredecimpunctata* (H13), a holarctic species, was the most common lady beetle in Manitoba before the arrival of C7 ($N = 1143$). Its relative abundance declined from over 50% before 1989 to less than 25% from 1989-1992, but since 1993 H13 has been the dominant species every year, comprising about 70% of all beetles collected. Two species *C. transversoguttata,* and *H. convergens* accounted for over 30% of lady beetles collected before and for 4 years after the arrival of C7. However, since 1993 the relative abundance of these species in all collections has dropped to <5%. Two other species *H. parenthesis* (HP) and *C. trifasciata* (C3) have also declined steadily in relative abundance since the arrival of C7. HP has gone from about a 6% relative abundance before 1993 to below 0.5% since 1996 ($N = 13{,}052$), and C3 has gone from being about 2% of all field collected beetles to near total absence (0.03%) during the same time.

THE TIGER BEETLES OF MANITOBA. William B. Preston, Robert E. Wrigley, James Duncan, and Colin R. Hawkins (deceased).

We are reporting on the status of a publication on the tiger beetles (Cicindela) of Manitoba. Twenty species have been reported from the province, but one of these has been taken only occasionally, and no Manitoba specimens have been located. We will include up-to-date information on the known distribution of Manitoba species, with Manitoba and North American distribution maps. In addition to coloured plates of specimens there will be coloured life photographs of most species, and of habitat types. The text will include: a brief introduction to Cicindela; a key to Manitoba species; a description of each species; a list of Manitoba collection localities; a discussion of the activity period of the adults; Manitoba collection dates; a discussion of the habitat; and additional remarks.

DIVERSITY, ABUNDANCE AND SOURCES OF CADDISFLIES IN AND AROUND HYDROELECTRIC GENERATING STATIONS ALONG THE WINNIPEG RIVER. Stacie Stiege, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

Hydroelectric generating stations along the Winnipeg River are subjected to the emergence of large numbers of aquatic insects. Among these insects are caddisflies which have been shown to cause work-related allergies. Light traps were used to capture caddisflies during the 1997 and 1998 field seasons at generating stations at Great Falls and Seven Sisters. The light traps worked incredibly well with the estimated number of caddisflies caught of the two-year period being 543,934; 285,772 in 1997 and 258,162 in 1998. The entire caddisfly season, from first capture to last, differed by only 1 week in the 2 years. In 1997, caddisflies were collected from 1 June to 16 October, and in 1998 from 26 May to 8 October. Peak flight activity began 1 week earlier at Great Falls than at Seven Sisters. During 1997, approximately 75% of caddisflies were captured during the 5-week period from the last week of June to the end of July. The 1998 peak flight activity occurred from mid-June to mid-July (4 weeks), when approximately 80% of the yearly total caddisflies were captured. The caddisflies identified to date belong to 13 families, 21 genera, and 57 species.

Large numbers of these were captured inside the generating stations. To determine the mode of entry of the caddisflies, four nights were spent in the stations. Through personal observations and the use of emergence traps, it was established that caddisflies get into the buildings through various openings and by emerging from the gate openings inside the gaterooms. Fine nylon filters were attached to the turbine caps in the powerhouses and we collected insect bits being blown into the generating stations through the air cooling system.

THE EFFECT OF TEMPERATURE AND DOSE OF FORMIC ACID ON EFFICIENCY OF CONTROL OF *VARROA JACOBSONI*. Robyn Underwood and

Robert Currie, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

Varroa jacobsoni is an economically important mite which is an ectoparasite on honey bees, *Apis mellifera*. Cultural and chemical controls have been employed to minimize the damaging effects of this pest. Formic acid is an inexpensive, readily available, natural chemical control agent which is used in many parts of the world. Its efficiency for *Varroa jacobsoni* control varies depending on factors such as time of year, ambient temperature, and mode of application. Bioassays were conducted to: 1) quantify the variability due to temperature and dose; and 2) determine the dose necessary to kill *Varroa jacobsoni* that will, at the same time, not harm honey bees. Cages containing 300 worker honey bees and 30 *Varroa jacobsoni* were exposed to continuous fumigation with formic acid doses of 0 (control), 5, 10, 20, 40, and 80 ppm at either 5, 15, 25, or 35°C (24 treatments). Mite and bee mortalities were assessed at hours 6, 12, 24, and every 24 hours thereafter until day 12. Temperature and formic acid dose affected mortality, although results were inconsistent among replicates, even under controlled conditions.

A BIOLOGICAL BASED INTEGRATED PEST MANAGEMENT PROGRAM FOR COLORADO POTATO BEETLE, *LEPTINOTARSA DECEMLINEATA*. Carl Jorgensen and Denise L. Olson, North Dakota State University, Entomology Dept., Fargo, ND, 58185.

Ten potato plants of either a susceptible variety (Russet Burbank) or a resistant clone (ND 5873-4) with elevated glycoakaloids were planted in 2 x 2 meter cages. The cages were inoculated with five egg masses of the Colorado potato beetle (CPB) per cage and five 2nd instar CPB larvae on every other plant. The cages were treated with the entomopathogens, *Beauveria bassiana* or *Bacillus thuringiensis*, a conventional insecticide (Furadan), or water. The predatory two-spotted stinkbug, *Perillus bioculatus*, was also evaluated in combination with the entomopathogens. Three replications were set-up in a randomized complete block design. The number and stage of the CPB, the number and size of *P. bioculatus*, and the defoliation level of the plants were recorded every four days. Yield parameters including weight, rating, and specific gravity were recorded and evaluated to determine differences between treatments.

The control and insecticide treatments received heavier defoliation than the *B. bassiana* or *B. thuringiensis* plots. he CPB appeared resistant to Furadan. During the summer of 1999, two storms may have compounded the results.

EVALUATION FOR RESISTANCE IN DURUM WHEAT TO THE ORANGE WHEAT BLOSSOM MIDGE, *SITODIPLOSIS MOSELLA* (GEHIN). Kirk M. Anderson, P.A. Glogoza, and M.J., Weiss, North Dakota State University, Dept. of Entomology, Fargo, ND, 58105.

The orange wheat blossom midge has been an incidental pest throughout the wheat growing regions of the United States and Canada since the early 19th century. In recent years, severe reductions in wheat yields have occurred in North Dakota when conditions promoted increases in the wheat midge population. Midge infestations were also significant in neighbouring areas of Minnesota, Manitoba, and Saskatchewan.

During the summers of 1998 and 1999, wheat varieties, evaluated in greenhouse choice tests, were evaluated in field trials under natural conditions. The experiments were conducted as a completely randomized design with 10 replications, and three planting dates in 1998 and two planting dates in 1999. Following natural infestation, wheat heads were collected, air dried, and processed. Head lengths, number of spiklets per head, larvae per variety, and the percent parasitism were recorded. In 1999, plant heights were also recorded. Despite differences in planting dates and wheat midge infestation pressure between 1998 and 1999, trends in infestation levels of varieties remained the same between the two years. Some durum varieties have consistently lower infestation levels and other varieties have consistently higher infestation levels.

RESEARCH ON PERISTENUS (HYMENOPTERA: BRACONIDAE) PARASITOIDS OF PLANT BUGS IN EUROPE. Heather White, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

In 1998 an M.Sc. program was initiated between CAB International, Agriculture and Agri-Food Canada, and the University of Manitoba to investigate European parasitoids of plant bugs in their native habitat. The main goal of this research is to provide information necessary for evaluating these species of parasitoids as potential biological control agents for pest *Lygus* in Canada. The objectives of the research in 1998 were to study seasonal succession of *Peristenus* species, determine parasitoid host instar preferences and examine *Peristenus* host specificity as well as to document *Lygus* population dynamics. In 1999 the main objectives of the research programme were to: examine plant bug seasonal use of agriculture crops, rear parasitoids from these mirids in several crops; and examine the host range of *Peristenus* species in agricultural and non-agricultural habitats.

THE IMPLICATIONS OF SPRUCE BUDWORM MANAGEMENT FOR DIVERSITY OF CARABID BEETLES AND MOTHS IN THE BOREAL FOREST. Carla M. Wytrykush and N.J. Holliday, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

Spruce budworm is an economic pest that can kill entire stands of trees during an outbreak period. Aerial applications of insecticide are used to protect the foliage, but this affects successional processes in the boreal forest. This study examined how pest management affects subsequent ecological diversity of moths and carabid beetles in eastern Manitoba. Unsprayed sites have a greater number of individuals and species of moths compared to sprayed sites. Carabid beetles are more abundant in unsprayed sites, but compared with sprayed sites, there are not more carabid species. The unsprayed sites seem to favour certain species of carabid beetles, allowing them to become very abundant. Vegetation differences may be the most significant factor influencing these responses.

POPULATIONS OF *DELIA RADICUM* ON CANOLA IN MANITOBA. Amy K. Hawkins-Bowman, N.J. Holliday, University of Manitoba, Winnipeg, MB, R3T 2N2.

Delia radicum, the cabbage maggot, is a growing concern for canola growers across Manitoba; this pest feeds on the roots of canola crops and may have an impact on crop yield. In 1999, in large field plots at Carman Research Centre in Manitoba, two generations of immatures completed development on canola. There was also a marked edge effect: root ratings were higher within the first 10 m of canola adjacent to a roadway, hedgerow, or fence. We will discuss the details and implications of these results.

WEEDS AND GROUND BEETLES (COLEOPTERA: CARABIDAE) AS INFLUENCED BY CROP ROTATION TYPE AND CROP INPUT MANAGEMENT. Shauna M. Humble, M.H. Entz, N.J. Holliday, and R. VanAcker, University of Manitoba, Winnipeg, MB, R3T 2N2.

In 1992, a long-term cropping systems study was initiated near Winnipeg, Manitoba to address concerns surrounding sustainability of commercial agriculture. Three, four-year rotations (annual crops only; annuals plus one green manure crop; annuals plus two-year alfalfa hay crop) were subdivided into four subplots based on fertilizer (f) and herbicide (h) use (all four combinations: +f+h, +f-h, -f+h, -f-h in each rotation type). A restored native prairie grass control plot is included in each of 3 replicates. A common test crop (flax) is seeded in all plots at the end of each rotation cycle (1995; 1999). Plant growth, weed and insect populations, and crop yield data collected from all years, with special emphasis on the test crop years, will be used to determine how cropping system diversity and input use affect populations of weeds and carabids, and whether carabid populations are related to change in weed populations.

NATURAL PARASITISM OF *HYBOMITRA NITIDIFRONS NUDA* AND *CHRYSOPS AESTUANS* (DIPTERA: TABANIDAE) EGG MASSES BY *TELENOMUS EMERSONI* (HYMENOPTERA: SCELIONIDAE) AND *TRICHOGRAMMA SEMBLIDIS* (HYMENOPTERA: TRICHOGRAMMATIDAE) IN MANITOBA. Muhmood Iranpour and Terry Galloway, University of Manitoba, Winnipeg, MB, R3T 2N2.

In the summer of 1998, horsefly and deerfly egg masses were collected from two locations southeast of Winnipeg. In the first location, 93 multi-layered egg masses of *Hybomitra nitidifrons nuda* were collected. Dissections showed 98.90% and 34.52% parasitism by *Telenomus emersoni* among egg masses and within individual egg mass, respectively. In addition, 36.28% of all eggs were unparasitized but failed to hatch. In the second location, 153 single-layered egg masses of *Chrysops aestuans* were collected. Results showed 121 egg masses (79.085) parasitized by both parasitoids, *T. emersoni* and *Trichogramma semblidis*, 17 egg masses (11.11%) only by *T. emersoni*, 6 egg masses (3.92%) only by *T. semblidis*, and 9 egg masses (5.88%) unparasitized. Percent parasitism within egg masses was 44.05% for *T. emersoni* and 9.91% for *T. semblidis* when they co-occurred and 40.82% for *T. emersoni* and 11.06% for *T. semblidis* when they occurred alone. Also, 18.61% of all eggs produced neither deerfly larvae nor parasitoids. Data analysis indicated significant interaction between these two parasitoids in *C. aestuans* eggs.

THE EFFICACY OF PEA PROTEIN ON THE CONTROL OF THREE STORED-PRODUCT INSECTS. Xingwei Hou Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2, and Paul Fields, Agriculture & Agri-Food Canada, Cereal Research Centre, Winnipeg, MB, R3T 2M9.

Pea protein was repellent, toxic to stored-grain insects, and reduced the F_1 progeny. Rice weevil was the most sensitive insect, followed by red flour beetle which was more tolerant than rusty grain beetle. In a simulated bin test, there were fewer insects in wheat treated with pea protein than in untreated wheat. Field experiment will be discussed.

INTRINSIC RATES OF INCREASE OF FOUR CEREAL APHIDS IN RELATION TO THEIR PEST STATUS. Sam M. Migui and Patricia A. MacKay, Dept. of Entomology, University of Manitoba, Winnipeg, MB, R3T 2N2.

Each year, several species of aphids migrate from the south and invade cereal crops in the northern Great Plains of North America. In Manitoba, aphids arrive in late spring and early summer. Because of the short growing season in these areas, we hypothesized that the pest status of the aphids would be associated with the intrinsic rate of increase of the population. A comparative study of four aphid species that commonly occur in Manitoba, i.e., *Rhopalosiphum maidis, R. padi, Schizaphis graminum* and *Sitobion avenae*, was conducted in the laboratory to test the hypothesis that species with the highest intrinsic rate of increase have the highest pest status. Aphids of each species were reared from birth until death on leaf pieces of barley. Data recorded on individual aphids include, time length of larval instars, total development time, daily fecundity, and longevity. The four species differed in their developmental rates and reproductive capacities. Aphid reproduction within the first

12 days of adult life appeared to adequately characterize the contribution of an individual aphid to the population increase of a species. *Rhopalosiphum paid* had the highest rate of development, the highest fecundity at 12 days of adult life and the highest intrinsic rate of increase. The original hypothesis was not supported by the data, since the most abundant and probably almost most pestiferous aphid species in Manitoba, is *S. avenae*. Other factors, such as production of winged dispersers and field survival of aphids might be involved in determining their pest status.

The Entomological Society of Manitoba gratefully acknowledges the following organizations, which provided financial support to the 55th Annual Meeting

Agrevo

Bayer, Inc.

Canadian Grain Commission

City of Winnipeg - Insect Control

Dow Agro Sciences

Gustafson

Louisiana Pacific Canada LTD

Manitoba Agriculture

Manitoba Natural Resources

North South Consultants

PCO Services Inc.

Pine Falls Pulp & Paper

Poulins Exterminators

SWAT Team Pest Services Inc.

Minutes of the 55th Annual Meeting of the Entomological Society of Manitoba

2:10 h, November 6, 1999
Freshwater Institute
Winnipeg, Manitoba

The President M. Smith presided.
With a quorum being present, the President called the meeting to order.

Attendance

Executive: M. Smith, President
P. MacKay, President-Elect
R. Lamb, Regional Director to the ESC
J. Gavloski, Member-at-Large

Executive Staff: R. Gadawski, Treasurer
B. Elliott, Editor - Newsletter
I. Wise, Secretary
D. Vanderwel, Proceedings Editor.

Executive members absent from the meeting were J. Buth, Past-President.

Members:	N. White	R. Roughley	W. Preston
	R. Underwood	S. Migui	B. Timlick
	P. Fields	T. Galloway	N. Holliday
	C. Wytrykush	D. Wytrykush	

1. Agenda (Appendix A).

Motion: Galloway/Roughley. That the proposed agenda of the 55th Annual General Meeting of the Entomological Society of Manitoba be accepted. CARRIED

2. Acceptance of the minutes of the last Annual Meeting (17 October, 1998)**.**

Motion: White/Gavloski. That the minutes of the 54th Annual General Meeting of the Entomological Society of Manitoba be accepted. CARRIED

3. Business arising from the minutes.None.

4. Executive Reports

Motion: Holliday/MacKay. That all Executive Reports be received.

CARRIED

Reports - Executive:

President	M. Smith
Treasurer	R. Gadawski
Regional Director to the ESC	R. Lamb
Editor of the Proceedings	D. Vanderwel
Endowment Fund Board	B. Timlick

President (Appendix B). Smith thanks all Committee Chairs for their work and support. Merge of the two student awards committees with new guidelines to be in place for the new Chair.

Treasurer (Appendix C). Gadawski absent. Report given by Timlick. No report submitted. Smith states she will provide report through Newsletter.

Regional Director to ESC (Appendix D). Lamb mentions the ESC meeting will be held in Manitoba in 2002.

Motion: Lamb/Galloway That the ESM hold a joint meeting the ESC when the national meeting is held in Manitoba in 2002.

Holliday inquires about the financial arrangements with the ESC. Lamb states the guidelines are available but not binding. The basic principles are the ESC is willing to bear the major burden of the losses if they can share the profits. This would part of the negotiations for joint funding and initial funding from the ESC. Motion CARRIED.

Editor of the Proceedings (Appendix E). Vanderwel states she will be publishing the Proceedings earlier (February) because of ease for her schedule. Only problem she sees is for individual wishing to submit manuscripts..

Endowment Fund Board (Appendix F). Timlick mentions that one certificate was renewed. Interest return of ~$1850 which is about $150 lower than past year because of lower interest rates. Smith states that at last Executive meeting the Endowment Fund principal was increased $3000 at the recommendation of the Treasurer and a new certificate will be taken out next year. Holliday inquires about whether should be locking into a plan of action before an idea of financial requirements needed for joint meeting. Timlick mentions the society has access to T-bills that are readily accessible.

5. Reports - Committees:

Finance	B. Timlick
Publicity / Newsletter	B. Elliott
Social	C. Wytrykush
Youth Encouragement / Public Ed.	R. Underwood
Archives	R. Roughley
Student Awards	B. Gallaway
ESM Scholarship	P MacKay
Scientific Program	N. White
Fundraising	J. Gosselin

Finance (Appendix G). Timlick states he did not deviate in his assessments for revenue and expenses in next fiscal year despite the Society's past surpluses. Lamb agrees with financial prudence but inquires about possible expenses to assume, i.e. student travel to 2000 ESC meeting.

Roughley states the Executive should think of ways for the Society to spend surpluses. Action to be taken by the Executive.

MacKay states that Gosselin received less in donations but still higher than in past years.

Motion: White/Timlick. That the Society express its appreciation to Joel Gosselin by presenting a certificate of appreciation to him. CARRIED

Motion: Underwood/ Timlick. That the Society have a volunteer appreciation night for some members as determined by the Executive. CARRIED

Publicity/Newsletter (Appendix H). Elliott states that he has stepped down as Chair. Smith thanks Elliott for his efforts especially for instigating email as a means of distribution.

Social (Appendix I). Wytrykush states that a luncheon is tentatively scheduled for the new year and asks members to submit possible names for presenters.

Education/Youth Encouragement (Appendix J). Underwood states that 15 members gave about 50 talks and got 2 years for funding from ESC. Used money to acquire living insects (walking sticks, hissing cockroaches), maintain insect colonies and slides. A form has been used to submit to teachers for donations to the Society. Forms were submitted.

ESC Common Names/Archivist (Appendix K). Roughley states archives have been moved to the basement of the ASB and new material has been acquired. Roughley requests that the Society purchase More filing cabinet space be purchased for archive material

Student Awards (Appendix L). MacKay submits report in W. Gallaway's absence.

ESM Scholarship (Appendix M).

Scientific Programme (Appendix N). 52 REGISTERED and 50 at banquet. 900 raised. Deficit of ~$1000

Fund Raising (Appendix O).

Honourary Members (Appendix P). No report submitted.

Membership (Appendix Q). No report submitted.

6. **Election Results**.- scrutineer S. Migui

   Motion: Holliday/Mackay. That the ballots be destroyed. CARRIED

7. **Web page proposal.** Smith states that the Society has been offered to have a web page set up by N. Grenkow at no cost. Smith states the Executive has been concerned about the upkeep needed and whether a web page is feasible. Gavloski asks whether N. Grenkow would be willing to upkeep. Timlick and Holliday states it is more practical to have someone closer. Smith asks whether it can be maintained as separate or included within a existing committee. Roughley states that potential linkages with other committees should be handled by the Executive. Lamb states the Society should advertise in the Newsletter for someone willing to take on this responsibility. Holliday states that if the web page is placed on the UM server the university might restrict who could maintain the web site. Fields states that other servers are available at a reasonable cost.

   Motion: Lamb/Holliday. That the executive investigate the proposal to set up a web site. CARRIED

8. **Transfer of Office**.

   M. H. Smith calls upon P. MacKay to assume the office of President Transfer of office.

9. Other Business.

Motion: Gallaway/Lamb. That D. Nicholson be reappointed as auditor for the Entomological Society of Manitoba. CARRIED

Underwood requests that guidelines be made available to Committee Chairs. MacKay states that there are guidelines and updates will be made and new guidelines will be sent to Chairs. Lamb states that one advantage of web site would be a source of Committee guidelines. Roughley states that Society should seek a more suitable site for the storage of the Society's archival material. Smith states that activities common to all committees will be added to the guidelines.

10. Adjournment.

Motion: Holliday/Lamb. That the meeting be adjourned. CARRIED

Appendices

Appendix A: Agenda of the Entomological Society of Manitoba 55th Annual Business Meeting 6 November, 1999

1. Acceptance of Agenda.

2. Acceptance of the minutes of the last Annual Meeting (17 October, 1998).

3. Business arising from the minutes.

4. Reports - Executive:

President	M. Smith
Treasurer	R. Gadawski
Regional Director to the ESC	R. Lamb
Editor of the Proceedings	D. Vanderwel
Endowment Fund Board	B. Timlick

5. Reports - Committees:

Finance	B. Timlick
Publicity / Newsletter	B. Elliott
Social	C. Wytrykush
Youth Encouragement / Public Ed.	R. Underwood
Archives/Common Names	R. Roughley
Student Awards	B. Gallaway
ESM Scholarship	P. MacKay
Scientific Program	N. White
Fundraising	J. Gosselin

6. Election Results - scrutineer. S. Migui

7. Web page proposal.

8. Transfer of office. M. Smith

9. Other business.

Appendix B: Reort of the President

The Entomological Society of Manitoba continues to be healthy and productive. Membership has remained stable for several years now and is up slightly this year. Registrations at the Annual General Meeting, the highlight of our year's activities, were up from the previous year. The committees, whose reports are to follow, worked hard to organize many activities, and all of us ensured their success by our participation. On behalf of all members, I'd like to thank the Executive and Committees for their interest, energy and commitment to the Society. A special round of thanks is due to the Secretary and Treasurer, who contribute a lot of time and organizational skill to making all our activties run smoothly. We are also in a good position financially, having had budget surplusses over the past six years, with an average of over $2,000.00 per year. This enabled us to continue building the principal in the Endowment Fund, to help offset the decreasing income generated by the Fund as interest rates declined.

There have been some significant changes in committees over the past year. Blaine Timlick has ably assumed the responsibilities of the Finance Committee and the Endowment Fund Board, which had been chaired by George Gerber. Robyn Underwood became the new chair of the Youth Encouragement and Public Education Committee when Don Henne stepped down. A recent decision by the Executive will see the Student Awards Committee and the Scholarship Committee merge to become one committee. Pat MacKay steps down as chair of the Scholarship Committee to assume the duties of President. Once a chairperson is appointed, the new committee will revise the committee guidelines.

The process of transferring the ESM exchange journals to the University of Manitoba Science Library is now well under way, after being initiated two years ago with an Executive decision to transfer ownership of the collection to the University. Once again, I'd like to thank Mike Malyk, Cereal Research Center librarian, for having maintained the collection for the past two decades and organizing the transfer. These publications will continue to be accessible to ESM members. Part of the collection will be catalogued and the remainder likely available at the Department of Entomology. We will keep you informed of the final decisions.

I think we can all be proud of our Society's accomplishments. The participation of all members will ensure that the Society remains an active contributor to the scientific community in Manitoba. I have enjoyed my year as President and look forward to working with the new Executive and Staff in the coming year.

Marjorie Smith, President

Appendix C: Report of the Treasurer

DOUG NICHOLSON & CO.,

Certified General Accountant

AUDITOR'S REPORT

To the Members of the
Entomological Society of Manitoba Inc.

I have examined the balance sheet of the **Entomological Society of Manitoba Inc.** as at **August 31, 1999** and the statement of income, expenses and surplus 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 many 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 whether any adjustments for unrecorded receipts from these sources might be necessary to income or surplus balances.

In my opinion, except 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 the above, these financial statements present fairly the financial position of the society as at August 31, 1999 and the results of it's operations and the changes in it's financial position for the year then ended in accordance with generally accepted accounting principles.

Doug Nicholson & Co.

Winnipeg, Canada
September 23, 1999

Doug Nicholson & Co.,
Certified General Accountant

ENTOMOLOGICAL SOCIETY OF MANITOBA INC.
BALANCE SHEET
AS AT AUGUST 31, 1999

ASSETS

	1999	1998
CURRENT		
Cash in bank	$ 4,655	$ 5,057
Cash advances (note 2)	225	225
Canadian T-Bill fund (note 4)	3,302	3,174
Investments (note 3)	35,000	33,004
	43,182	41,460

LIABILITIES

LIABILITIES	nil	nil

SURPLUS

SURPLUS	43,182	41,460
	$ 43,182	$ 41,460

APPROVED BY THE BOARD:

____________________ President ____________________ Treasurer

The accompanying notes form an integral
part of these financial statements

ENTOMOLOGICAL SOCIETY OF MANITOBA INC.
STATEMENT OF INCOME, EXPENSES AND SURPLUS
YEAR ENDED AUGUST 31, 1999

	1999	1998
REVENUE		
Annual meeting	$ 1,765	$ 1,583
Donations	1,360	1,000
Fundraising committee	–	108
Interest income	2,166	2,251
Members fees	1,698	1,888
Miscellaneous	110	121
Proceedings	203	377
Youth encouragement & public education	400	100
	7,702	7,428
EXPENSES		
Awards and scholarships	1,200	1,200
General	1,026	723
Meetings	2,331	2,351
Newsletter	97	324
Proceedings	770	707
Social committee	122	–
Youth encouragement & public education	434	19
	5,980	5,324
EXCESS (DEFICIT) OF INCOME OVER EXPENSES	1,722	2,104
Add: Surplus, beginning of the year	41,460	39,356
SURPLUS, END OF YEAR	$ 43,182	$ 41,460

The accompanying notes form an integral part of these financial statements

ENTOMOLOGICAL SOCIETY OF MANITOBA INC.
NOTES TO THE FINANCIAL STATEMENTS
AUGUST 31, 1999

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 year end. Capital assets are written off when acquired and, therefore, there are no annual depreciation allowances.

2. CASH ADVANCES:

Editor – Newsletter	R. Lafreniere	200
Advance	R. Westwood	25
		$ 225

3. INVESTMENT CERTIFICATES:

Certificate	Interest Rate	Maturity Date	
25723170	4.800%	Apr 5, 2004	2,000
960006276-3	5.150%	Sep 16, 2003	4,000
960006276-4	4.800%	Dec 11, 2003	3,000
25703249	5.250%	Feb 26, 2002	3,000
25723236	8.000%	Nov 12, 2002	9,200
960006276-1	4.500%	Oct 31, 2002	3,000
960006276-2	5.300%	Feb 10, 2003	10,800
			$ 35,000

4. INVESTMENT – T-BILL FUND:

The Canadian T-Bill fund was opened February 28, 1997 with a principal balance of $3,000. Investment income earned to August 31, 1999 was $302.

Appendix D: Report of the ESC Regional Director

On September 25 and 29, 1999 I attended the Entomological Society of Canada Governing Board Meetings, as the representative of the ESM. The Board Meetings were held in conjunction with the Joint Annual Meeting with the Entomological Society of Manitoba in Saskatoon. The Presidency of ESC was transferred from Linda Gilkeson to Dan Johnson. My chief duties for ESC were to prepare and present reports as Regional Director and as chair of an ad-hoc committee on the content of ESC Bulletin and Web Site, which can be read in the ESC Bulletin. The ESM was well represented at the meeting, and a number of our members presented papers. Two ESM student members, Jason Diehl and Carla Wytrykush, were awarded President's Prizes for outstanding student papers in their sessions, which comprised two of the four sessions for student papers. Of special interest to ESM members were the following issues. The ESC is considering an electronic version of The Canadian Entomologist, and the Editor, Jean Turgeon has been charged with preparing a feasibility study, and possible timetable for changes in format of the journal. The next Annual General Meeting of ESC in 2000 will be held in conjunction with the Entomological Society of America and Société d'Entomologie du Québec, Dec 3-7, 2000 in Montreal. In 2001 the Entomological Society of Ontario is hosting the joint meeting in Niagara Falls. The following year, 2002, is the turn of ESM if the usual sequence is followed. We should soon make the decision to invite ESC to hold a joint meeting in Manitoba in 2002, and form the appropriate committee, if that is the wish of the members.

Bob Lamb,
Regional Director

Appendix E: Report of the Editor of the Proceedings

Two hundred and twenty-five copies of Volume 53 (1997) of the *Proceedings of the Entomological Society of Manitoba* were printed and mailed in June, 1999. Volume 53 was 39 pages long. In June, 114 copies were mailed to Society members, 30 copies were mailed to subscribing institutions, and 60 copies were mailed to institutions that exchange their journal with ours or receive the Proceedings as a gift. (The Titles that we receive in exchange are listed on the inside front cover of recent volumes.) The price charged to subscribers was $10.00, as in the previous year.

Two hundred and twenty-five copies of Volume 54 (1998) of the *Proceedings* were printed and mailed in October, 1999. Volume 54 was 48 pages long, and contained one refereed scientific paper. One hundred and thirteen copies were mailed to Society members. I am currently preparing the mailing to outside institutions (those that subscribe, exchange their journal with ours, or receive the *Proceedings* as a gift). The number of copies involved should be comparable to that for Volume 53.

As mentioned at the last AGM, I plan to alter the publishing schedule of the *Proceedings*, starting this year (Volume 55, 1999). The traditional late summer date is a difficult time both for me and for the print shop that I use. An earlier publishing date would alleviate our time problems and, as an added bonus, should reduce the amount of correspondence with outside institutions. (Many write in early summer and on to determine why their purchase order for the previous year has not yet been filled). A publishing date of late February, early March would be ideal, if the membership does not object.

In closing, I would like to thank everyone involved with Volumes 53 and 54 for their efforts — particularly the authors, the anonymous reviewers, Ian Wise (secretary of the ESM), Randy Gadawski (Treasurer of the ESM), Marj Smith (past-Treasure of the ESM), Warren Schuetz (graphic designer, U of W print shop), Murielle Corriveau (Administrative Assistant, U of W), and Rob Currie (envelope stuffer, MH).

Désirée Vanderwel
Proceedings Editor

Appendix F: Report of the Endowment Fund Board

The endowment fund provides the resources which supports the Student Scholarship, publication of the *Proceedings* and part of the costs associated with the Annual General Meeting of the Society. In the past, this support is in the range of $2000.00.

At the 1998 Annual General Meeting, the Society raised the cap of the endowment fund from $35,000.00 to $40,000.00, as the amount of money invested in the fund had increased to $35,000.00 and thus reached the limit. The fund has generated $2046.00 in the 1998-99 financial year. This level of funding is currently just adequate to provide the resources necessary for the Society to maintain its activities as they currently exist. One of the certificates will be renewed in November and the endowment fund provisions will decrease by approximately $200.00 per annum.

To ensure that activities remain at a level desirable to the Society, it is suggested that more funds from the general revenues be placed into the fund. In general, if the content of the fund is approximately $40,000.00, current interest rates will provide the Society with approximately $2000.00.

If the Society believes that the capital allocated to the fund is sufficient, it is recommended that a decrease in spending be undertaken so that a deficit financial position is avoided.

Guaranteed Investment Certificates

Certificate No.	Principle	Interest Rate(%)	Maturity Date	Annual Interest
25723170	$2000.00	4.8%	Apr. 05, 2004	$96.00
25723236	$9200.00	8.0%	Nov. 12, 1999	$736.00
25723324	$3000.00	4.8%	Dec. 11, 2003	$144.00
25723368	$4000.00	5.15%	Sept. 16, 2003	$206.00
960006276-1	$3000.00	4.5%	Oct. 31, 2002	$135.00
960006276-2	$10800.00	5.3%	Feb. 10, 2003	$572.40
25703249	$3000.00	5.25%	Feb. 26, 2002	$157.50
	$35000.00			$2046.90

Appendix G: Report of the Finance Committee

The finance committee met in October, 1999 to review the annual budget and to assess potential revenues and expenditures.

In 1998-99, revenue exceeded expenses by $1,722.00. Expenses were approximately $700.00 less than anticipated, while revenues were approximately $400.00 greater than expected.

The finance committee reviewed the submitted budgets and prepared an overall budget for the society. An accounting of the revenues and expenses for the 1998-99 with projections for the current and next financial year are included. In general, the budget for the current year shows that the society is in a break even position. However, it should be stated that previous budgets are conservative in that they consistently underestimate revenue and overestimate expenditures. In general, the items which are least predictable are the donations on the revenue side and general society expenses on the expenditure side. It is thought that if the society can generate a consistent or increasing income from donations coupled with an addition to the endowment fund, the society should be in a break even position.

The society may also wish to consider membership due increases as they have not changed over the past several years.

October 31,1999
Blaine Timlick (Chair)
Marjorie Smith
Randy Gadawski

Entomological Society of Manitoba Inc.
Budget

Budget Item October 30, 1999	1998-99 Actual	1999-00 Actual & Proposed	2000-01 Projected
Endowment Fund	$35,000.00	$35.000.00	$38,000.00
REVENUE			
Membership Dues	$1,698.00	$1,700.00	$1,700.00
Proceedings	203.00	400.00	200.00
Social Committee	0.00	0.00	
0.00			
Youth/Education Committee	400.00	200.00	200.00
Donations	1,360.00	1,000.00	1,000.00
Fund Raising Committee	0.00	1,000.00	100.00
Student Awards and Scholarship	100.00	100.00	100.00
Meeting:ESM / AGM	1,765.00	1,700.00	1,700.00
Miscellaneous	110.00	150.00	150.00
Investment Income	2,166.00	1,900.00	2,000.00
Totals	**7,802.00**	**8,150.00**	**7,050.00**
EXPENSES			
General Society Expenses	$1,026.00	$1,100.00	$1,100.00
Proceedings	770.00	1,400.00*	700.00
Newsletter	97.00	150.00	150.00
Social Committee	122.00	200.00	200.00
Youth/Education Committee	434.00	250.00	250.00
Fund Raising	0.00	775.00	50.00
Student Awards and Scholarship	1,200.00	1,200.00	1,200.00
Meetings:ESM / AGM	2,331.00	2,500.00	2,500.00
Other Committees	0.00	50.00	50.00
Representation at ESC	0.00	350.00	350.00
Totals	**$5,980.00**	**$7,975.00**	**$6,550.00**
Net Gain/Loss for Year Ending August 31, 1999	$1,722.00	$175.00	$500.00

* Is the cost associated with producing 2 issues of the Proceedings

Appendix H: Report of the Publicity/Newsletter Committee

Three issues of the ESM newsletter were produced in the past year. The format remained consistent with the previous year and the cost per issue remained the same. Approximately $40.00 copying cost per issue. Mailing costs are approximately $45.00. Newsletters are e-mailed to 26 members of the ESM.

Effective as of November 06, 1999, I officially resign my post as editor and recommend Jason Diehl as the new editor of the Entomological Society of Manitoba Newsletter.

Brent Elliott (Editor)
Jason Diehl
Rhéal Lafréniere

Appendix I: Report of the Social Committee

This year the social committee organized the New Member's Social. A successful Ethnic Potluck Dinner was hosted at the Wytrykush home. Members brought a food dish representing their ethnic background, or a culinary tradition close to their heart/stomach. Several new members attended the event, and a good time was had by all.

Expenses	
Mailing costs 1998	$54.98
Mailing costs 1999	$37.19
New Members Social	$ 0.00
Totals	$92.17

Carla Wytrykush
Debra Wytrykush
Social Committee Co-Chairs

Appendix J: Report of the Youth Encouragement and Public Awareness Committee

With a committee of approximately 15 people, we talked to about 50 groups of young people this year. We spent about $500 ($400 was from a grant from the ESC, the rest was from donations taken in as a result of giving talks). The money was spent on books (children's field guides, teaching aids, etc.), new insect cultures (Milkweed Bugs, Giant Prickly Stick Insects from Australia, Brazilian Cockroaches, and Madagascar Hissing Cockroaches), adding slides to our collection, transportation, photocopies, and hand-made entomology games. Our biggest success was recruiting new committee members. I would like to thank them all!! I hope they will continue to be excited about teaching Winnipeg's youth about entomology.

Robyn Underwood

Appendix K: Report of the Common Names Committee / Archivist

There have been no applications from ESM members for changes in old common names nor additions of new common names of insects and related arthropods during the last year. Therefore there are no local activities to report.

The main holdings of the ESM archives are housed in Room 107, Entomology and Animal Science Building. Additions to the archives continue sporadically. Members are reminded that material of historical significance will be accepted by the archivist.

Rob Roughley

Appendix L: Report of the ESM Student Awards Committee

The Committee reviewed the nominations received for the Student Achievement Award and the SWAT StudentAward. Wayne Campbell was selected as the recipient of the Student Achievement Award. This is a book award valued at $150.00. David Wade was selected for the SWAT Student Award of $100.00.

J. Conroy
D. Currey
J. Hare
B. Gallaway (Chair)

Appendix M: Report of the ESM Scholarship Committee

The Entomological Society of Manitoba Scholarship Committee reviewed five applications for the ESM postgraduate award. The ESM Scholarship Committee unanimously recommends that the ESM postgraduate award be made to Ms Robyn Underwood, Department of Entomology, University of Manitoba. Ms Underwood is currently working on her M.Sc. degree under the supervision of Dr. Rob Currie in the Department of Entomology at U. of M. Her thesis is on the development of a control technique for the varroa mite, a pest of honey bees.

Patricia A. MacKay (Chair)
Dave Rosenberg
Désirée Vanderwel
Noel White

Appendix N: Report of the Scientific Program Committee

The meeting budget is given in this report. The 55th Annual meeting was held 5 - 6 November, 1999, at the Freshwater Institute. The theme of the meetings was “Effects of recent human activity in agriculture and the environment on insects.”

Our guest speaker was Dr. Wilf Powell of Rothamsted, U.K., presenting a talk on “Agriculture and insects in Europe : the role of field margins.” The symposium consisted of talks by R.E. Roughley, R. Westwood, O. Olfert (Saskatoon), D. Wrubleski, and D. Dixon. There were 16 submitted papers. Forty-eight people attended the meeting.

The organizing committee consisted of Joel Gosselin (Fundraising), Bob Lamb, Pat MacKay, Dave Rosenberg, Rob Roughley, Carla Wytrykush (Social) and Noel White (Chair)

I wish to thank everyone who helped to make the meeting a success by serving as program chairs, student competition judges, and at the registration desk.

Joel Gosselin
Bob Lamb
Pat MacKay
Dave Rosenberg
Rob Roughley
Carla Wytrykush
Noel White (Chair)

Appendix O: Report of the ESM Fundraising Committee

The Fundraising Committee received donations in the amount of $1,200 for the Annual General Meeting. Additional revenues of $160.00 from the sale of sweatshirts and ESM pins provided for a total of $1,360.00.

Joel Gosselin, Chair

Final Budget

Expenses		Receipts	
Mixer (Pat MacKay)	345.77	Sponsors	900.00
½ Airfare (Owen Olfert)	130.00		
Partial Airfare (Wilf Powell)	720.17		
Hotel (Wilf Powell) (3 nights)	270.72		
		Banquet:	
Photocopy		26 x $25	650.00
Programs	19.38	18 x $12	216.00
Abstract	14.40	6 x $0	0.00
			866.00
Dinner (Nov. 4) (Wilf Powell)	30.85		
Lunch (Nov. 5) (invited speakers)	25.71	Registration:	
		28 regular x $20	560.00
Lunch (Nov. 6) (invited speakers)	39.73	18 students x $5	90.00
(Applebees)			650.00
Coffee	116.96		
(Freshwater Institute)			
Banquet	1297.25		
Total Expenses	3010.94	Total Receipts	$2416.00
Deficit	(594.94)		
Authorized line of credit	$2500.00		

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 Proceedings 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 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.

Manuscript Submission and Review. Typed manuscripts must be submitted for review purposes. After final acceptance all manuscripts should be submitted in both typed form and on floppy disk. The name(s) of the file(s) on the disk, name of the word processing language, and the type of computer used must also be included. All manuscripts are reviewed by at least two reviewers. The Editor selects those reviewers and does not disclose their names. The Editor decides to accept, reject or return for revision, manuscripts after reviewer evaluation

Abstract. Articles greater than two typewritten pages, except scientific notes, must 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 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 recent Volumes (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 recent Volumes. 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

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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:

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