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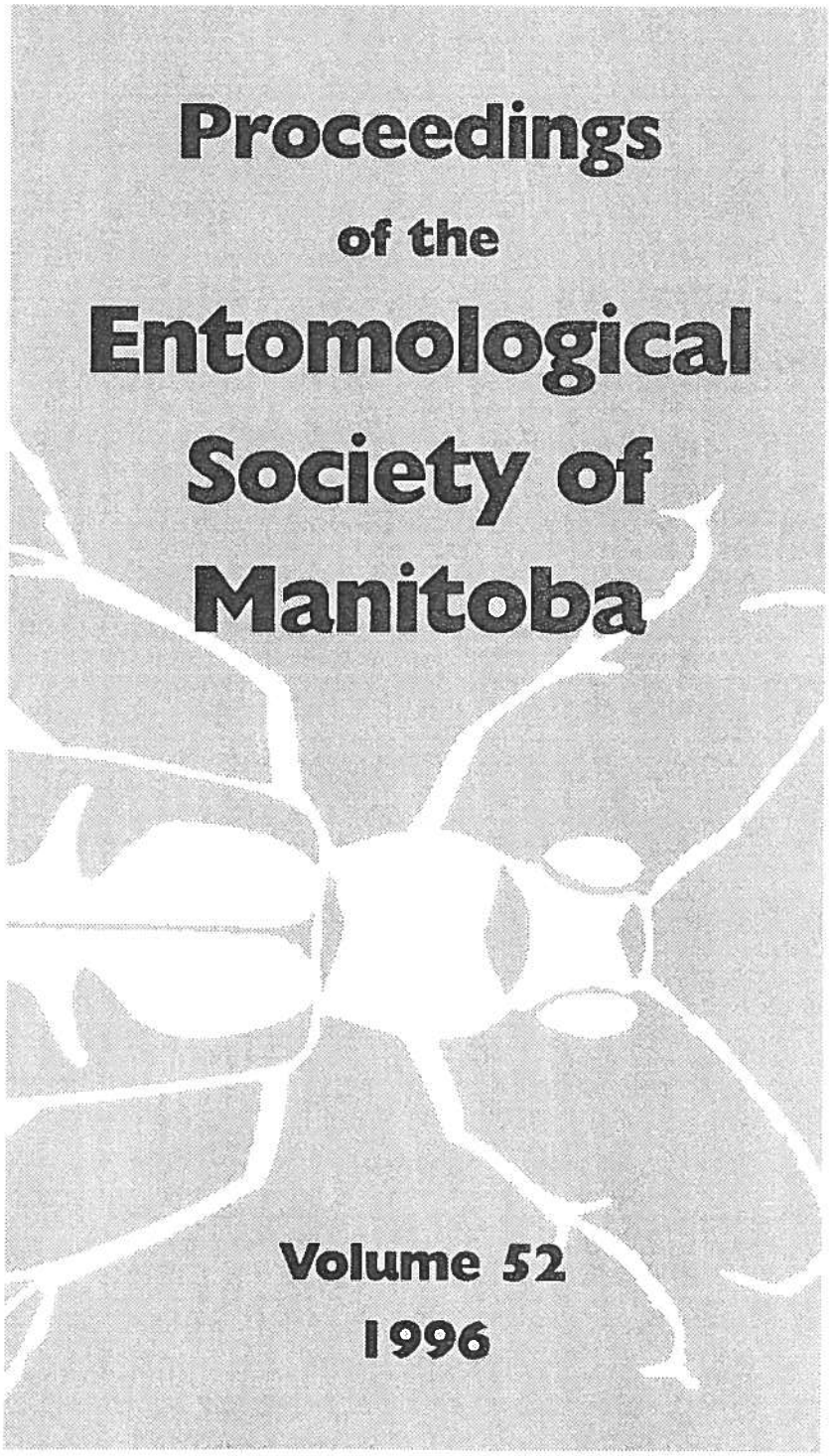

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Seasonal Abundance of Stable Flies, *Stomoxys calcitrans* (L.) (Diptera: Muscidae), at Glenlea, Manitoba

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Seasonal abundance of stable flies, *Stomoxys calcitrans* (L.) was studied at Glenlea, Manitoba in 1988 and 1989, using modified Williams traps with Tanglefoot® as an adhesive. Flies were trapped at an animal confinement facility and on the beef pasture at the Glenlea Research Station. There were 7.5X more stable flies trapped at the animal confinement site than at the pasture in 1988, and 2.1X more in 1989. Trap catches exceeded 50 flies/trap from 16 June to 30 August, 1988 and 23 June to 15 September in 1989 at the animal confinement site. Trap catches on pasture exceeded 50 flies/trap on only 4 occasions during the same period in 1988, and 8 occasions in 1989.

INTRODUCTION

The stable fly, *Stomoxys calcitrans* (L.), is one of the major livestock pests world-wide (Steelman 1976; Morgan *et al.* 1983). This fly was introduced into North America from Europe by 1776 and was commonly found in south-

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ern Canada by 1900 (Brues 1913). Stable fly infestations are typically severe in and around animal confinement facilities (McNeal and Campbell 1981; Hall *et al.* 1983; Scholl *et al.* 1985). The fly breeds in spilled feed, soiled bedding and manure which often accumulate in such situations (Meyer and Petersen 1983).

Stable fly populations have been monitored using various techniques, *e.g.* visual counts on cattle legs (Mullens and Meyer 1987), animal-baited traps (Harley 1965), suction traps (Semakula *et al.* 1989) and alsynite panels covered with adhesive (Williams 1973; Broce 1988). Sticky traps have generally proven superior for sampling the stable fly (Ruff 1979; Patterson 1981). Trapping efficiency using fibre glass traps was reported to vary with changes in weather (Berry *et al.* 1981; Agee and Patterson 1983). Temperature, solar radiation and relative humidity seem to have a major influence on the trap effectiveness (Berry *et al.* 1986).

Despite the occurrence of the stable fly in large numbers during the summer in Canada, there are few published accounts on its activity in the field. Hearle (1938) discussed stable flies in general as pests of livestock, and Teskey (1960) briefly considered its status and abundance in Ontario. The only detailed studies to date are those of Lysyk and Schaalje (1992) and Lysyk (1993, 1995). In contrast, in the United States, the stable fly has been the subject of numerous field studies (*e.g.* Berry and Campbell 1985; Scholl 1986; Mullens and Meyer 1987; Skoda *et al.* 1991). Our objective was to describe and compare the seasonal abundance of stable flies in an animal confinement facility and a beef cattle pasture at Glenlea, Manitoba.

MATERIALS AND METHODS

This research was conducted in the University of Manitoba's Glenlea Research Station (49° 38′N, 97° 08′W), *ca.* 20 km south of Winnipeg. The farm lies in the Red River flood plain, where drainage is poor as a result of the fine textured Osborne clay soils and topography (Economic Atlas of Manitoba 1960; Barto and Vogel 1978). Cultivated cropland is dominant, with extensive deciduous vegetation along the river margins, and where planted as shade trees or shelter belts.

Two study sites were chosen on the research station: the animal confinement facility, with barns and open sheds which housed 133 dairy cattle, 10-20 beef cattle, five horses, >600 pigs, and 30-60 sheep and the beef cattle pasture. The pasture covered *ca.* 310 ha and was divided into 12 paddocks, 19-72 ha each. Beef cattle (184 cows and calves in total) were held in at least three

paddocks throughout the study. Cattle were held in the paddock where traps were placed from May to 8 July in 1988 and from May until the termination of the study on 15 September, 1989.

Trapping Regime. Flies were sampled from 17 May to 16 September, 1988 and from 29 May to 15 September, 1989. Modified Williams Sticky Traps were used to sample adult stable flies at both study sites. Each trap consisted of four 34 X 30 cm alsynite panels. The four panels were fastened to a 4 X 4 cm wooden stake with screws and washers. The lower edges of the panels were 50 cm above the ground.

Tanglefoot Paste® was used as an adhesive. The adhesive was pre-thinned with 95% ethanol (4 parts Tanglefoot Paste to 1 part alcohol) and applied directly on each face of the panel using a paint brush. At the end of each trapping day, the panels were removed and cleaned in the laboratory using 95% ethanol. Grass was trimmed as needed around the traps. Twelve traps were used: six traps were placed in the animal confinement site and six were used in the pasture. Traps were set for nine hours (0700h-1600h) on each sampling occasion.

Traps were placed in the confinement area according to the classes of animals housed. In the pasture, all six traps were placed on two sides of one of the paddocks. Traps were placed 120 m apart along the edge of the pasture.

Trapped stable flies and other insects were removed from the traps with a pair of forceps at the end of a predetermined exposure period of one hour or more. Stable flies were put into labelled plastic vials, and stored on ice in a cooler until transported to the laboratory. Flies were stored at -15°C±1C° until sexed (based on frontal distance between the compound eyes and on genitalia) using a dissecting microscope and counted.

Statistical Analyses. Statistical analyses were done using The System for Statistics (Wilkinson, Leland. SYSTAT: The System for Statistics. Evanston, IL: SYSTAT INC. 1988). Seasonal abundance data were subjected to a Chi square test to determine if there were any differences in attractance to the traps based on sex of the flies.

RESULTS AND DISCUSSION

Seasonal Abundance, 1988. Numbers of adult stable flies collected using the Williams sticky traps were consistently greater in the animal confinement site compared to the pasture (Figs. 1 vs 2, respectively). A total of 38,051 adult stable flies was collected during 1988. The first flies were collected during the week ending on 4 June and the last were collected on 14 Septem-

ber. The experiments were terminated on 16 September when no flies were captured on the traps located at the pasture. The traps had been in place two weeks (from 17 May) prior to the collection of the first flies. Totals of 33,577 (>88%) and 4,474 (<12%) stable flies were collected at the animal confinement site and at the pasture, respectively. Although the animal confinement area and pasture were within two km of each other, stable flies differed in abundance and in duration of relative peak numbers. Peak captures occurred from 16 June through 30 August at the animal confinement site when daily mean number of flies per trap exceeded 50. The largest number of flies, 138 flies/trap/h, was collected on 28 June at the animal confinement site. Peak numbers of flies were collected from 17 June through 26 August at the pasture when the daily mean capture per trap was more than 15 flies. On 28 July, 18 flies/trap/h were collected at the pasture. There was a single peak in abundance at both animal confinement and pasture sites in 1988.

Seasonal Abundance, 1989. Seasonal distribution patterns of stable flies at the animal confinement site for the 1989 season (Fig. 3) were different from those in 1988 in terms of duration and occurrence of peak abundance. Traps were set on 29 May and the first adult flies were collected on 2 June. Trap catches were comparable to the 1988 season except that the highest capture rate was observed two to three weeks later (28 July) than in 1988. Daily catches were low until the end of June and then a considerable increase occurred from 7 July attaining the highest level on 28 July. Daily trap catches averaged >50 flies per trap from 23 June through 15 September. From the animal confinement site, 26,747 (68% of seasonal total) were collected. In total, 12,610 stable flies (32% of seasonal total) were caught at the pasture site in 1989, more than 3.5-fold the 1988 total catch at the pasture when one takes into consideration the total number of hours of sampling for both years.

The pattern of seasonal abundance at the pasture was similar for both years. Peak numbers of stable flies occurred during the last week of July (Fig. 4), as in 1988. However, 76 flies/trap/h were obtained in 1989 compared to 18 in 1988.

Stomoxys calcitrans occurred from May to September at Glenlea. The seasonal abundance is similar to that observed in the western part of the United States by Petersen and Greene (1989) in that seasonal peak abundance occurred in summer. The duration of the stable fly season in southern Manitoba is shorter than in the United States. For example, in eastern Nebraska, the fly season lasted from late March to late November (Scholl *et al.* 1985). There was a single peak in abundance in June and July, depending on the spring weather conditions, particularly temperature and precipitation. Peak stable fly populations in southern Manitoba were similar to those of the central United States, *e.g.* Missouri (Hall *et al.* 1983), Nebraska (McNeal and Campbell 1981; Scholl 1986) and Iowa (Dahm and Raun 1955), except that a second

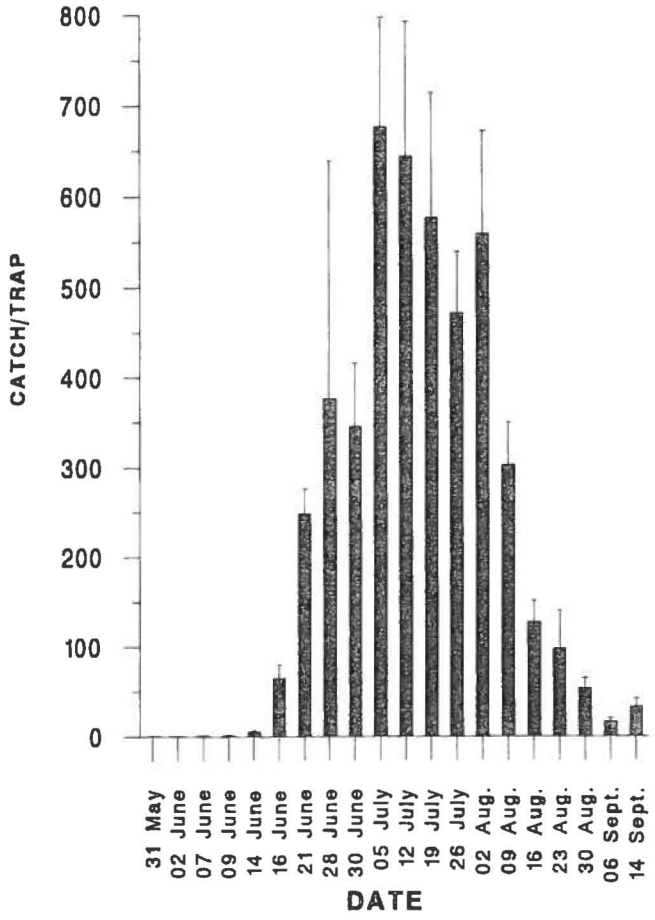

Fig. 1. Mean (± standard error) numbers of stable flies caught per sticky trap per day (n=6) at the animal confinement site in 1988, Glenlea Research Station.

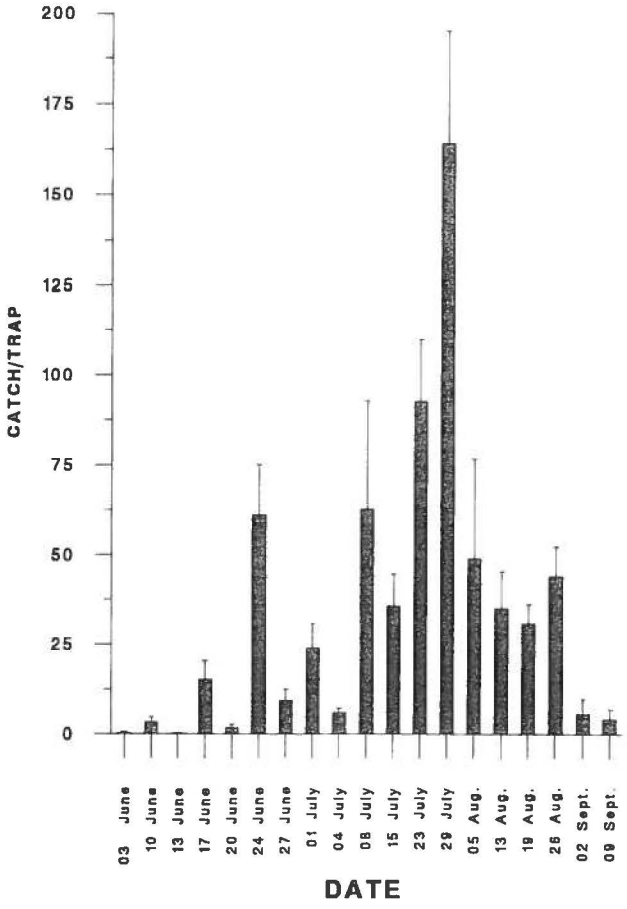

Fig. 2. Mean (± standard error) numbers of stable flies caught per sticky trap per day (n=6) at the pasture site in 1988, Glenlea Research Station.

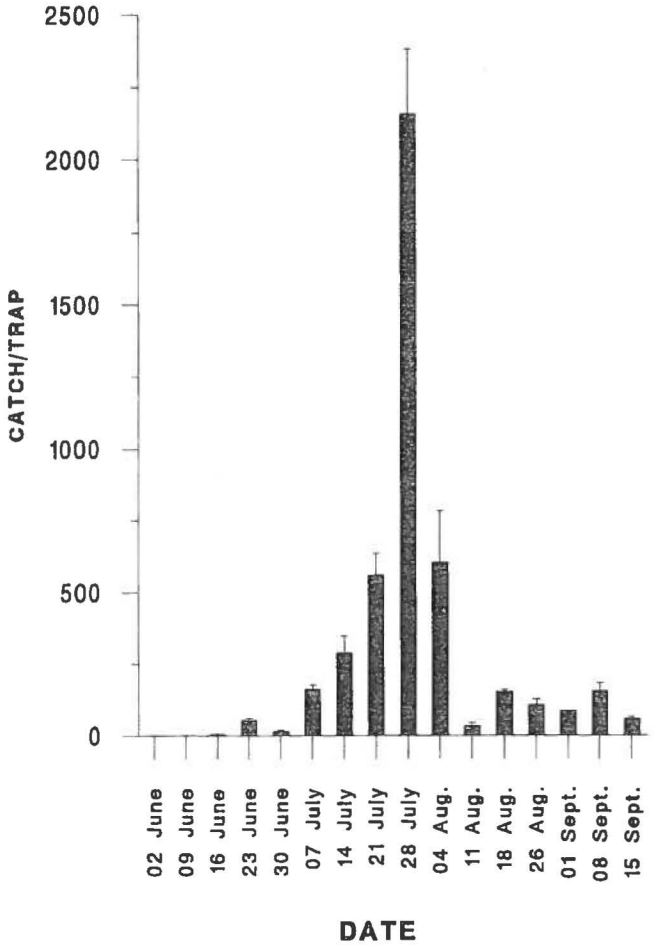

Fig. 3. Mean (± standard error) numbers of stable flies caught per sticky trap per day (n=6) traps at the animal confinement site in 1989, Glenlea Research Station.

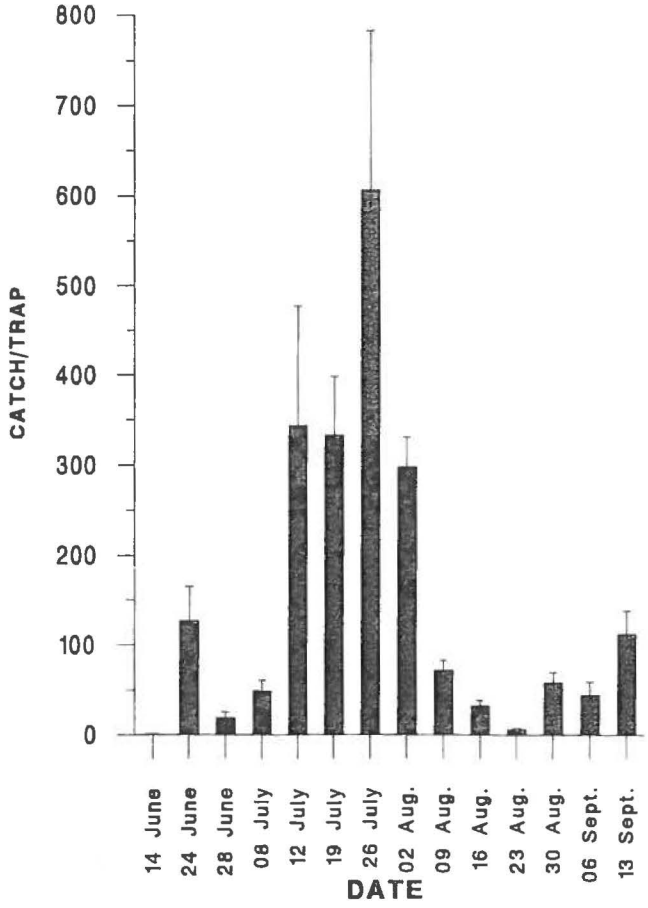

Fig. 4. Mean (± standard error) numbers of stable flies caught per sticky trap per day (n=6) at the pasture site in 1989, Glenlea Research Station.

peak abundance occurred in Nebraska in early September (Stage and Petersen 1981). In Alberta, stable flies were collected May to October around dairy barns, reaching peak abundance later in the season, in August and September (Lysyk 1993).

Thomas *et al.* (1989) reported a seasonal abundance pattern in southwest Nebraska very similar to the one reported here. Peak abundance occurred during the last week in June to the second week in July. It is interesting that, unlike eastern Nebraska, no second peak in abundance was observed in autumn in the southwest region of Nebraska (Thomas *et al.* 1989). Even though two peaks in seasonal abundance occur in some U.S. states, *e.g.* California and eastern Nebraska, the autumn peak is inconsistent and dependent on moisture availability (Mullens and Meyer 1987). Stable fly numbers decreased substantially in August, 1988, even though temperatures remained high, probably because of the lack of moisture in the breeding sites. Temperatures declined sharply in September, 1988 and stable flies virtually disappeared, especially at the pasture. Since the pasture was an open site, flies were exposed more to wind and cold conditions which resulted in a sharp decline in numbers of flies compared to the animal confinement site which was surrounded by trees and buildings.

Numbers of trapped flies differed considerably at the animal confinement site and pasture between years of this study. In 1988, catches of stable flies at the animal confinement site were 7.5-fold greater than on pasture, and in 1989 were 2.1-fold greater than the pasture catches. More flies were trapped on pasture in 1989 than in 1988, perhaps because of changes in animal management or differences in climatic conditions. The cattle were fed silage in addition to pasture grass, and hence spent most of the time closer to the traps, resulting in higher numbers of flies captured on average than in 1988. In 1989, no beef cattle were kept in the barn and all beef cattle were held at the pasture. It has been shown that stable fly abundance at a location may be a reflection of host activity and abundance, and availability of oviposition sites (Gersabeck and Merritt 1983).

The differences in abundance between the two Glenlea sites supports the hypothesis that pasture populations are comprised mainly of dispersers. Flies dispersed to the pasture, probably to procure blood meals from the cattle kept in the pasture. Hall *et al.* (1983) observed that in a year with above-average rainfall, populations of flies were higher on pastures than during a dry year. Stable fly breeding sites were also found around large round hay bales (Hall *et al.* 1982). Unlike in the studies referred to here, no breeding sites were found at the pasture site, even in 1989 in our study. On the other hand, many breeding sites were located in both years at the animal confinement site, particularly along fences, below waterers and feed bunkers.

Sex Ratios. The proportions of males from both collection sites were higher than those of females (Table 1). The average male/female ratio of trap-collected flies was 2.6:1 at the animal confinement site and 1.3:1 for the pasture. The male/female ratios increased slowly (from 1.9:1 in June) over the season and was at its highest (3.8:1) in September for traps at the confinement site. Ratios of males/females were generally lower on pasture. In June and September, 1988, there were occasions when females were equal or more abundant than males in the collections (0.8:1 and 0.9:1, respectively) (Table 1).

The average proportion of males/females for traps at the animal confinement was 1.9, and 1.5 at the pasture in 1989 (Table 1). Males were predominate in traps at the animal confinement site. Females were equally represented in trap catches on the pasture site only during June, 1989.

These observations are consistent with previous observations made in the United States by Buschman and Patterson (1981). Females apparently avoid prominent spots such as light-coloured walls or traps, and also, males use such sites for basking while waiting for females. Gravid females may spend most of the time searching for oviposition sites. Once the females are inseminated, they tend to avoid male harassment near mating sites (Harris *et al.* 1966; Buschman and Patterson 1981). The male/female ratios were slightly lower in pasture trap samples compared to animal confinement samples and there was no clear increase as the season progressed. Pasture populations may have consisted primarily of dispersing flies. As in other insect populations, dispersers may be predominantly females (Johnson 1966; Hogsette and Ruff 1985). The observed overall average sex ratios (Table 1) were similar to ratios observed by other workers; for example, a 60:40 (M:F) sex ratio was reported on traps by Buschman and Patterson (1981); Scholl *et al.* (1985) reported a sex ratio of 55:45 (M:F).

Stable flies are a serious pest of livestock in Manitoba, despite the relatively short season for adult activity. With their late appearance in sticky traps, it is conceivable that many flies disperse into the province from the south, or from isolated overwintering sites in Manitoba. Research needs to be conducted on potential for overwintering and origins of stable flies in Manitoba.

Table 1. Observed monthly sex ratios (male:female) for stable flies collected using Williams sticky traps at the animal confinement and pasture sites at the University of Manitoba Glenlea Research Station during 1988 and 1989.

		Animal Confinement Site			Pasture Site		
		No. of Males	No. of Females	Sex Ratio	No. of Males	No. of Females	Sex Ratio
1988	June	8052	4216	1.9:1.0*	244	304	0.8:1.0*
	July	9879	4270	2.3:1.0*	1388	924	1.5:1.0*
	August	4740	2119	2.2:1.0*	995	559	1.8:1.0*
	September	238	63	3.8:1.0*	28	32	0.9:1.0
1989							
	June	250	256	1.0:1.0*	429	456	0.9:1.0
	July	13283	5831	2.3:1.0*	4985	3002	1.7:1.0*
	August	3522	1838	1.9:1.0*	1644	1151	1.4:1.0*
	September	1216	551	2.2:1.0*	602	341	1.8:1.0*

*Sex ratios are significantly different ($X^2_{1, 0.05}$) from 1:1.

ACKNOWLEDGEMENTS

We would like to thank Rosaire Menard and the staff at the Glenlea Research Station for their co-operation during this study, and Daryl Wright for technical assistance. Dr. N.J. Holliday offered helpful advice on statistical analysis. This research was supported by a Commonwealth Scholarship awarded to the senior author, and by a grant from the Manitoba Department of Agriculture to TDG, through the Faculty of Agricultural and Food Sciences.

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On the Occurrence of *Chaetopsylla lotoris* (Stewart) (Siphonaptera: Vermipsyllidae) on Raccoons, *Procyon lotor* (L.), in Manitoba.

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The flea, *Chaetopsylla lotoris* (Stewart), is primarily associated with the raccoon, *Procyon lotor* (L.). This ectoparasite was previously known only from southern Ontario in Canada, and is here reported from Manitoba for the first time. Specimens were collected from a red fox, *Vulpes fulva*, from La Broquerie, and raccoons from Miami and Morris.

Most species of *Chaetopsylla* Kohaut, 1903 are found in the Palaearctic Region, but there are six species represented in North America (Lewis and Lewis 1994). In Canada, Holland (1985) recorded five species: *Chaetopsylla (Arctopsylla) tuberculaticeps* (Bezzi), *C. (Chaetopsylla) globiceps* (Taschenberg), *C. (C.) setosa* Rothschild, *C. (C.) floridensis* (I. Fox) and *C. (C.) lotoris* (Stewart). They are most often found on carnivores, including some of the most formidable hosts of fleas, the grizzly bear and black bear. Females may be neosomic, where the abdomen undergoes considerable enlargement during egg development.

Chaetopsylla lotoris is most often collected from the raccoon, *Procyon lotor*, but the gray fox, *Urocyon cinereoargenteus* is also a common host (Benton 1980). Although the raccoon is very widely distributed in North America, and in Canada, being found from Prince Edward Island and Nova Scotia to Alberta and southern British Columbia (Banfield 1974), the range of *C. lotoris*

is relatively restricted. Lewis and Lewis (1994) summarized the known distribution for this flea: it is recorded primarily from the northeastern United States, but as far west as southern Minnesota and Iowa. It is also known from North Dakota, just south of the Manitoba border (Woods and Larson 1970). Holland's (1985) records for Canada are restricted to southern Ontario.

Research on fleas in Manitoba has been limited, and Buckner (1964) and Buckner and Blasko (1969) apparently did not examine raccoons for ectoparasites, nor did they include *C. lotoris* in their records. As a result of our collecting efforts over the years, *C. lotoris* has been encountered on several occasions, and we report this species from Manitoba for the first time. Collection records are as follows:

NEW RECORDS: **Manitoba:** La Broquerie, 23.ii.1986, from red fox, *Vulpes fulva*, 1 male; Miami, 30.x.1990, from raccoon, *P. lotor*, 1 male, 5 female; 1.xi.1990, from racoon, *P. lotor*, 23 male, 33 female; Morris, 11.iv.1997, from raccoons, *P. lotor*, 3 male, 9 female .

All specimens have been prepared onto miscroscope slides and deposited in the J.B. Wallis Museum of Entomology, Department of Entomology, University of Manitoba and in the Canadian National Collection, Agriculture and Agri-Food Canada, Ottawa, Ontario.

It is likely that the distribution of *C. lotoris* is more extensive than indicated by the available records. Considering that raccoons and humans are often closely associated, it is rather surprising that we know so little about this interesting flea. Additional collecting will undoubtedly expand its known range.

Specimens were collected at Miami during a survey for the Lyme Borreliosis vector, *Ixodes scapularis* Say, funded by the Manitoba Health Research Council. We also thank Dr. Omer Larson (University of North Dakota, Grand Forks) for information on *C. lotoris* in North Dakota.

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New Records of Melandryidae (Coleoptera) From Manitoba

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New Manitoba collection records are given for seven species of Melandryidae (false darkling beetles), increasing the species known from the province from nine to sixteen.

The Melandryidae are a relatively small family in the large, diverse superfamily Tenebrionoidea. There has not been a comprehensive taxonomic study of the species of North America; this one of my long-term goals. LeSage (1991) provided a checklist of the species of Melandryidae of Canada and Alaska, with nine species recorded from Manitoba. In examination of specimens of Melandryidae from many North American museums, I discovered new records of the family from Manitoba. These are presented below, in the same order as the species appear in LeSage (1991). For each species, the previous known distribution is given (taken from LeSage 1991), followed by the new record(s). Each new record consists of the locality, date(s), collector(s), collecting technique (if any), the collection, and the number of specimens examined. Standard acronyms are used to denote the collections: **CARR**, John and Bert Carr Collection, Calgary, AB; **CASC**, California Academy of Sciences, San Francisco, CA; **CMNC**, Canadian Museum of Nature, Ottawa, ON; **DAPC**, Darren A. Pollock collection, University of Manitoba, Winnipeg, MB; **JBWM**, J.B. Wallis Museum of Entomology, University of Manitoba, Winnipeg, MB.

Hallomenus serricornis LeConte — Previous Canadian records: BC, AB, ON, PQ. **New Manitoba record**: Sandilands Provincial Forest, 10-12 km E. Marchand, 14-21.vi.1987, H. & A. Howden, flight intercept trap, (CMNC, 2).

Emmesa connectens Newman — Previous Canadian records: ON, PQ, NS, LB, NF. **New Manitoba record**: Victoria Beach, 9.vii.1924, L.H. Roberts, (JBWM, 1).

Melandrya striata Say — Previous Canadian records: BC, AB, SK, ON, PQ, NB. **New Manitoba records**: Aweme E., 28.vi.1920, N. Criddle, (JBWM, 1); Bakers Narrows, 20.vi.1964, M.M. Collins, (CASC, 1); Grass River Provincial Park, 16 km W. Iskwasum Lake, 54°38'N, 101°00' W, 25-30.vi.1981, Ashworth, Schwert, & Keller, window trap in *Populus tremuloides* upland, (DAPC, 1); Whiteshell Provincial Park, Falcon Lake, 30.v.1987, D.A. Pollock, coll. on surface of lake, (DAPC, 1); Winnipeg, 20.v.1919, L.H. Roberts, (JBWM, 1).

Zilora nuda Provancher — Previous Canadian records: PQ. **New Manitoba records**: Manitoba Agricultural College [=Winnipeg?], 12.v.1921, N. Pankiw, (JBWM, 1); same locality, vi.1921, F. Pankiw, (JBWM, 1).

Scotochroa buprestoides (Kirby) — Previous Canadian records: ON, PQ, NB, NF. **New Manitoba records**: Sandilands Provincial Forest, 10-12 km E. Marchand, 14-21.vi.1987, H. & A. Howden, flight intercept trap, (CMNC, 1); Sandilands Provincial Forest, 17 km N. Woodridge on Hwy 210, 26.vii-2.viii.1987, flight intercept trap, (JBWM, 1).

Serropalpus coxalis Mank — Previous Canadian records: BC, ON, PQ, NB, NS, NF. **New Manitoba records**: Sandilands Provincial Forest, 10-12 km E. Marchand, 10-13.vi.1987, H. & A. Howden, flight intercept trap, (CMNC, 1); same locality and collectors, 14-21.vi.1987, flight intercept trap, (CMNC, 2).

Dircaea liturata (LeConte) — Previous Canadian records: AB, SK, ON, PQ, NB. **New Manitoba records**: Aweme, 14.vii.1922, N. Criddle, (JBWM, 1); Winnipeg, University of Manitoba campus, D.A. Pollock, suction trap, on following dates: 3-10.viii.1984, (CARR, 1; DAPC, 1); 20-29.vii.1984, (DAPC, 1); same locality, 3.vi.1988, D.A. Pollock, at uv. light, (DAPC, 1).

ACKNOWLEDGEMENTS

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Scientific Program Abstracts for the 1996 Annual Meeting of the Entomological Society of Manitoba

October 25-26, 1996, Winnipeg, Manitoba

In Celebration of the
50th Anniversary of the Entomological Society of Manitoba
and the
75th Anniversary of the Department of Entomology
at the University of Manitoba

Symposium: Stored Products Entomology and Apiculture

Lead Speaker

PHYSICAL CONTROL OF STORED PRODUCT INSECTS. P. Fields, Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg, Manitoba, R3T 2M9.

I will give an overview of the use of low temperatures to control stored-product insects. In addition, I will present work on the physiology of cold acclimation of *Sitophilus granarius* and *Cryptolestes ferrugineus*. Unacclimated *S. granarius* had a LT_{50} (lethal time for 50% of the population)

of 12 d at 0C compared with 40 d after the full cold acclimation schedule. At -10C, unacclimated *C. ferrugineus* had a LT_{50} of 1.4 d compared with 24 d after the full acclimation schedule. Trehalose, as well as the amino acids proline, asparagine, glutamic acid and lysine were highest in cold acclimated insects for both species, whereas tyrosine was lowest in cold acclimated insects.

Diatomaceous earth (DE) has gained interest as a grain protectant as it is nontoxic to mammals, and it does not affect baking, malting, or pasta production. However, DE use has been limited because it reduces grain bulk density and must be used at high concentrations, 500 to 3500 ppm, to be effective. In conjunction with Hedley Technologies, Inc., a new diatomaceous earth-based insecticide, Protect-It, that is approximately 2-3 fold more effective than currently available diatomaceous earth grain protectants, was developed. In field trials, *C. ferrugineus* populations were consistently controlled by treatments at 75 ppm or greater. *Tribolium castaneum* populations were reduced by 100 ppm dust application, and controlled at 300 ppm. Grain bulk density was reduced by DE application, but the grain grade in treated wheat was not reduced due to bulk density reduction.

Submitted Papers

APPLYING HIGH POWER MICROWAVE RADIATION TO CONTROL HIDDEN INFESTATION IN WHEAT. S.L. Halverson[1], R. Plarre[2], W.E. Burkholder[2], T.S. Bigelow[3], M.E. Misenheimer[4] and E.V. Nordheim[5], [1]Micro Grain Inc. Clinton, Wisconsin, 53525, [2]USDA-ARS Madison, Wisconsin, 53706, [3]Oak Ridge National Laboratory, Oak Ridge, Tennessee, 37831, [4]NORAN Instruments Inc. Middleton, Wisconsin, 52562, [5]Department Forestry University of Wisconsin, Madison, Wisconsin, 53706, USA.

Applying high power microwaves in the millimetre wave range and frequencies above 10 GHz is attractive because of the availability of recently developed high power gyrotron oscillators with continuous, efficient, and reliable power outputs. Proof-of-principle experiments indicated that selective heating of stored product insects and their resulting mortality is a nonlinear function of frequency and increases at frequencies above 2.45 GHz in the vicinity of increasing relaxation processes associated with free water. Tests were conducted at 12, 15, 17.9 GHz (SHF-band) and at 55 GHz (EHF-band) on samples of soft white wheat, *Triticum aestivum*, infested with adults and two larval stages of the maize weevil, *Sitophilus zeamais*. This sought to investigate the predicted phenomenon of a maximum in selective heating of the insects without affecting the product due to the disparity of free water in insects and

grain and their associated loss factors. The samples were exposed to microwave radiation in an untuned cavity to determine mortality as a function of input energy and resulting product temperature. 15 GHz produced a greater mortality among adult weevils than 12 and 17.9 GHz. However, 55 GHz produced the greatest mortality for the three developmental stages studied. Because the power levels for these tests varied for each frequency subsequent tests were performed at a fixed frequency of 14.25 GHz. A constant input energy was achieved by applying four distinct input power levels and their corresponding exposure times to determine the dependency of mortality on these factors. Mortality appears to be a nonlinear function of energy input and shorter exposure times are critical and result in a larger variability of mortality. Germination of uninfested wheat samples was affected only slightly by the treatments. A minimum value of 84% germination occurred at 12 GHz and a maximum of 89% occurred at 17.9 GHz. Longer exposure times at constant energy input resulted in decreased germination. Further studies are necessary to verify these findings for Industrial Scientific and Medical (ISM) frequencies which can be applied for curative treatment of stored grain and would help reduce the use of agrochemical protectants.

FUMIGATION OF AN OAT MILL WITH CO_2 AND PHOSPHINE AT HIGH TEMPERATURES. Colin J. Demianyk and Noel D.G. White, Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Rd., Winnipeg, Manitoba, R3T 2M9.

New approaches are required to control pests in cereals and cereal-based products, as a result of limitations on the use of methyl bromide, a widely used fumigant that depletes atmospheric ozone. A commercial-scale, alternative method for control of insects was assessed by placing 10 vials each of 10 live confused beetle adults and 10 eggs on each of nine floors of a cereal milling and processing facility in Peterborough, Ontario. The building has its window and doors sealed and the temperature raised to an average of 37C. Liquid carbon dioxide was gasified and piped in to provide a 4-36 hour treatment average concentration of 4.3% by volume in air, and magnesium phosphide Fumi-Strips® were distributed on several floors to provide 29.3 ppm phosphine; fumigation was conducted for 36 hours. Adults were examined within two days after fumigation completion and showed 0% survival (n=900); the unexposed controls had 99% survival (n=100). Vials with eggs were incubated at optimum developmental conditions for one month; only 1.7% of treated eggs (n=900) hatched into larvae compared to 51% of control eggs (n=100). This combined fumigation exceeded the 95% kill rate that is con-

sidered successful under traditional methyl bromide treatments, even under adverse conditions that included low ambient humidity and several leaks in door seals. The potential of this new technique as an adequate replacement for methyl bromide structural fumigation appears high.

INDIVIDUAL VARIATION OF TASK PERFORMANCE AND ONTOGENY OF AFRICANIZED AND EUROPEAN HONEY BEES (*Apis mellifera* L.). T. Pankiw, Department of Zoology, Arizona State University, Tempe, Arizona, 85287-1501, USA.

Africanized colonies have higher growth rates than European colonies, shorter intervals between colony-level reproduction, smaller adult population sizes at reproduction, and higher post-reproductive colony mortality rates. This set of life-history characteristics is analogous to classical "r-selected" strategies on the r/K continuum. Differential within-hive task performance and ontogeny related to colony growth were examined among Africanized and European workers co-fostered in both Africanized and European colonies. Africanized workers preferentially performed tasks related to colony growth such as pollen collection and storage, whereas European workers preferentially performed tasks involving nest building such as comb building, nectar collecting and foraging. In general, the average age at which Africanized workers performed tasks was significantly younger than European workers. Interindividual worker behaviour and ontogeny will be discussed with respect to life-history variation among the two races of honey bees.

A STRATEGY FOR PREVENTING AGRICULTURAL INSECTICIDE DAMAGE TO HONEY BEES. D. Dixon, J. Buth and R. Lafrenière. Manitoba Agriculture, Soils and Crops Branch, Apiculture Section, 204-545 University Crescent, Winnipeg, Manitoba R3T 5S6 and Manitoba Agriculture, Carman, Manitoba.

The possibility of insecticide damage to managed honey bees is a perennial concern for Manitoba beekeepers. Some beekeepers have reported serious reductions in honey production associated with insecticide applications on some agricultural crops. These losses have usually been associated with insecticide applications made during the early afternoon on nectar-producing crops.

In an effort to prevent insecticide damage to honey bees, several cooperative initiatives have been undertaken between the Manitoba Beekeepers' Association and Manitoba Agriculture. This prevention strategy followed two basic

initiatives: 1) improving the understanding of, and appreciation for, the contribution that bees make to the agricultural economy through provision of pollination, and 2) promoting the safe use of insecticides near bees by publicising several damage prevention activities that may be undertaken by pesticide applicators, crop producers and beekeepers.

THE INFLUENCE OF COLONY STATE ON POLLEN FORAGING BEHAVIOUR IN HONEY BEE (*Apis mellifera* L.) WORKERS. Stephen F. Pernal and Robert W. Currie, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Three-frame observation colonies of honey bees were established indoors, with entrance tubes leading to the outside. Experienced and naive pollen foragers were marked and colonies were then manipulated to modify the information that pollen foragers received about the quantity or quality of stored pollen in the hive. After manipulation, the proportion of foragers collecting pollen, the types of pollen collected and the nutritional value of the pollen returned to the colony were assessed. Results suggest an interplay between colony level processes and individual pollen foraging behaviour in honey bees.

Symposium: Aquatic Entomology and Environmental Sciences

Lead Speaker

ROLLING STONES GATHER NO BUGS, OR DO THEY? Donna J. Giberson, Department of Biology, University of Prince Edward Island, Charlottetown, Prince Edward Island, C1A 4P3.

Catamaran Brook, New Brunswick, is the site of a large, multidisciplinary project designed to determine the effects of clear-cut logging on a small salmon stream in Atlantic Canada. Since 1991, I have been looking at the aquatic insects in this brook. My objective is to evaluate insect responses to natural disturbances in order to determine a "natural variability template" against which to compare logging responses (as logging begins in 1996). Floods are a natural disturbance, and affect stream insects by scouring them from the stream bottom and washing them downstream. Insects can be dislodged directly from the surface of rocks, but the effect is much greater when the current moves the rocks on the

stream bottom. In recent years, a great deal of effort has been directed towards quantifying the relationship between floods, rock movement, and aquatic insect response in streams. In Catamaran Brook, I have looked at these responses in 6 erosional and 6 depositional sites along the length of the stream. In this presentation, I will review what is known about flood responses of stream insects, and present some of the data I have been collecting for Catamaran Brook

Submitted Papers

COMPARISON OF THE PREDACIOUS WATER BEETLE FAUNA OF AUSTRALIA AND CANADA (Coleoptera: Dytiscidae). R.E. Roughley, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Similarities and differences in the species richness of Dytiscidae between Australia and Canada are investigated in an attempt to discover the underlying reasons for the disparity in the faunas. Australia, with a land mass of 7.68 x 10^6 km^2, has about 180 recorded species, whereas Canada, with a land mass of 9.98 x 10^6 km^2, has 262 species. A series of factors will be examined in an attempt to provide testable hypotheses for the observed differences. Among these are island versus mainland situations, since it would be predicted that an island fauna should be reduced due to isolation. Australia has a more tropical versus Canada's more temperate physical location and dytiscids have their greatest abundance in temperate areas, perhaps due to respiratory constraints. The amount of historical glaciation and the predictability of rainfall may be important in providing available habitat for water beetles consistently over time. Of the factors considered so far, the methods and the degree of intensity of collecting might provide the best rationale for the observed differences in the respective faunas.

REDISCOVERY OF *Amphizoa davidi* (Lucas) (Coleoptera: Amphizoidae). W.Xie and R.E.Roughley, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Amphizoa davidi is a member of the small family, Amphizoidae, belonging to the suborder Adephaga (Coleoptera). This family consists of a single genus, *Amphizoa*, and contains only five described species. *Amphizoa davidi* was rediscovered by Dr. Roughley, Prof. Yu Peiyu, and W. Xie in August, 1995. It is exciting news for entomologists. The family Amphizoidae is considered to represent an intermediate evolutionary stage between Geadephaga and Hydradephaga. The rediscovery of *A. davidi* not only confirms its existence,

but also presents valuable material for the study of relationships of amphizoid species to each other, as well as the phylogenetic position of Amphizoidae in Adephaga. There are three species occurring in western North America, and two in China. *Amphizoa davidi* was discovered for the first time from Baoxing County, Sichuan Province in 1870, and was described as a new species from only a single specimen, a male, in 1882. Many workers considered that *A. davidi* might well be extinct, since it was not collected for over one hundred years. Fortunately, the species was rediscovered as adults, and second and third instar larvae in the Fentong Zhai Nature Reserve and a nearby area. The habitat is in the range of 2300 to 3100 meters elevation along the bank of the Qing Yi River.

MONITORING MERCURY AND CADMIUM IN LAKE WINNIPEG AND THE RED AND WINNIPEG RIVERS USING MAYFLIES. G. Arnold[1], W.L. Lockhart[1], D.G. Cobb[1], B.E. Townsend[1], C. Smith[1] and T.D. Galloway[2]. [1]Department of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba, R3T 2N6, and Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Adult *Hexagenia* spp. and *Ephemera simulans* Walker (Ephemeroptera: Ephemeridae) were collected from 24 sites on Lake Winnipeg and the Red and Winnipeg Rivers in 1995 and 1996 to evaluate their usefulness as biomonitoring tools for contaminants. Total mercury concentrations ranged from 0.02 to 0.2 µg/g (dry weight), decreasing from the South to North Basin of Lake Winnipeg. Cadmium concentrations ranged from 0.2 to 2.9 µg/g (dry weight), the highest values in the Red River upstream from Winnipeg. Although spatial trends in contaminant loadings were consistent, annual site-specific variation occurred. Many of the field collections of mayflies were conducted by volunteers who lived or were stationed near the sampling sites. The value and problems associated with the use volunteers will be discussed.

ANALYSIS OF THE EFFECTS OF THE PINE FALLS PULP MILL ON THE BENTHIC INVERTEBRATES IN THE WINNIPEG RIVER, MANITOBA. P.L. Wong[1], L. Armstrong[2], C.L., Betze[3], P. Wilkinson[4], and W.L. Lockhart[4]. [1]Environmental Sciences Co-_o, Ltd., Winnipeg, [2]Statistical Advisory Service, University of Manitoba, Winnipeg, Manitoba, R3T 2N2, and Department of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba, R3T 2N6.

Benthic invertebrates were examined in sediment dredge samples from the Winnipeg River upstream and downstream from the Pine Falls pulp mill in efforts to

describe the effects of mill effluent on these animals. Considerable organic enrichment was evident in sediments for 2-3 km below the mill outfall along the south shore of the river, as judged by ratios of organic carbon to total nitrogen. The zone below the outfall along the south shore had the highest densities of benthic animals; however, the animals there were almost all oligochaetes and chironomids, species often noted to be tolerant to pollution. In this reach below the outfall, we found 67% oligochaetes and 20% chironomids while mayflies and caddisflies together comprised only 3%. In contrast, at reference sites upstream, oligochaetes comprised only 18%, chironomids 23% and mayflies and caddisflies 44%. The statistical analysis indicated 5 groups of sites: sites on the south shore within 0.5 km downstream from the outfall, sites on the south shore within 2.5 km downstream from the outfall, sites on both shores at least 6.5 km downstream from the outfall, one site on the south shore 4 km downstream from the outfall, all of the north shore sites (except one) and all the upstream sites. Visible deformities were evident in the mentum and mandibles of chironomids (genus *Chironomus*) from below the outfall and these tended to decrease with increasing distance downstream from the mill. It is concluded that there is serious organic pollution of the south shore of the river for at least 2.5 km below the outfall, but that this is no longer evident in the benthic community after a distance of 6.5 km downstream from the outfall.

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE, *Lythrum salicaria* L. WITH *Galerucella* spp.: DISPERSAL AND POPULATION DYNAMICS OF THE INSECTS AND IMPACT ON PLANTS UNDER PRAIRIE CONDITIONS. J.K. Diehl and N.J. Holliday, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

During the summer of 1995, four sites containing *Galerucella* spp. were sampled using a 1 m quadrat. Two sites were located at Delta beach, and two at Libau, Manitoba. One site at each location received an introduction of *Galerucella* spp. in 1993, and the other site in 1995. During the period of peak egg mass density, a series of transects radiating from a central release point was used to sample plants and egg masses at predetermined distances. Distribution and abundance of egg masses within sites and estimates of the total population will be presented.

SYNTHESIS OF PHENOLOGY MODELLING AND GEOGRAPHIC ANALYSIS TO EVALUATE A CANDIDATE (*Altica carduorum*, Coleoptera: Alaticidae) FOR BIOLOGICAL CONTROL OF CANADA THISTLE (*Cirsium arvense*, Asteraceae) ON THE CANADIAN PRAIRIES. D.J. Lactin, Dan. L. Johnson, Peter Harris and Fang-Hao Wan, Agri-

culture and Agri-Food Canada Research Centre, Lethbridge, Alberta, T1J 4B1.

Phenology modelling and spatial analysis were combined to assess the potential of a leaf-feeding beetle (*Altica carduorum*, Alticidae) to control the noxious weed Canada thistle, *Cirsium arvense* (Asteraceae) on the Canadian prairies. We developed two phenology models to estimate the potential geographic range of *A. carduorum*. One model included developmental rate functions to simulate phenology in detail; the second merely accumulated degree-days above 10C. Each model was run with and without a submodel of adult thermoregulation.

All simulations suggest that *A. carduorum* can complete at least one generation in each year over much of the Canadian prairies, and thus may establish permanent populations in these areas. Inclusion of thermoregulation submodels approximately doubles the geographic area in which establishment of permanent populations is predicted (the modelled potential range), compared to models which disregard thermoregulation. Output of linear and nonlinear models (*i.e.*, phenology vs. degree-day) did not differ, possibly because most phenological processes in this species are well approximated by linear models over the range of temperatures encountered.

We assessed the potential of *A. carduorum* to control Canada thistle by comparing the modelled potential range against the distribution of the host plant. The modelled potential range covers much of the range of the thistle, particularly where beetle thermoregulation is considered, missing only peripheral thistle populations (*i.e.*, the Peace River area, the Aspen parkland and the Rocky Mountain Foothills). Thus the beetle has potential to control the weed over this extensive region of overlapping distributions.

Symposium: Crop Protection

Lead Speaker

COLD TOLERANCE IN ANHOLOCYCLIC CLONES OF APHIDS AND ITS APPLICATION TO APHID PEST MANAGEMENT ON THE PRAIRIES. Richard A. Butts, Agriculture and Agri-food Canada, Lethbridge Research Station, Lethbridge, Alberta, T1J 4B1.

Russian wheat aphid is a devastating pest in winter wheat, but only becomes

a problem in spring cereals in years when it overwinters. Studies have been done to determine the role of cold tolerance in overwintering of Russian wheat aphid in Alberta. This aphid's supercooling point ranges from -25 to -29C; however, aphid populations decline rapidly below -10C in the field. In laboratory studies, life expectancies of aphids held at -1, -5, -10 and -20C were 26.5, 20.8, 6.8, 4.8 and 3.2 days. There appears to be recovery after exposure to cold. Aphids populations exposed to -1C for up to 25 days showed complete recovery when mortality and natality were examined. In studies with *Rhopalosiphum padi*, aphids survived longer when exposed in association with plant material than aphids that have no contact with their host plant. The difference in survival was most pronounced at -10C. Exposure on excised leaves also enhanced aphid survival at low temperature but was less effective than the intact plant. This suggests that plant quality as well as the presence or absence of plants is important in the cold tolerance of aphids on cereals. The combination of all these factors are discussed in relation to pest monitoring and management of aphids on the Prairies.

Submitted Papers

SEASONAL MORPHOMETRIC VARIATION OF SEXUAL AND ASEXUAL POPULATIONS OF PEA APHID. P.A. MacKay[1], M.A.H. Smith[2] and R.J. Lamb[2]. [1]Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2, and [2]Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Rd., Winnipeg, Manitoba, R3T 2M9.

There are large numbers of studies relating body size or weight in aphids and other insects to temperature or other environmental influences. However, there are few showing the influence of environment on morphometric variables such as appendage length and on allometry (variation in morphometric variables associated with variation in body size). The purpose for this study was to investigate morphometric variability within and between sexual and asexual populations of *Acyrthosiphon pisum*.

Samples of wingless females were collected from a population with a sexual phase at Glenlea, Manitoba, approximately weekly from May to September, 1988 to 1990, and from asexual populations at two locations in southern Australia about every 3-4 weeks from July, 1992 to June, 1993. The body length and 11 appendages were measured on a selection of intact aphids from each sample. Regression and analysis of variance techniques showed that there was high variability in body and antenna lengths within samples and

populations. Between-population comparisons showed that there was a common allometry for all summer-season aphids, but winter-season aphids in Australian populations were morphometrically different. These findings will be discussed from environmental and taxonomic perspectives.

TED RADCLIFFE'S GOPHER STATE IPM SITE: INTEGRATED PEST MANAGEMENT TEXTBOOK ON THE WORLD WIDE WEB. E.B. Radcliffe[1], W.D. Hutchison[1], and G.A. Schaefers[2]. [1]Department of Entomology, University of Minnesota, St. Paul, Minnesota 55108, USA, and [2]Consortium for International Crop Protection, Cornell University, Geneva, New York, USA.

Ted Radcliffe's Gopher State IPM Site, URL:.http://www.ent.agri.umn.edu/academics/classes/ipm/, is a rapidly expanding Integrated Pest Management (IPM) textbook on the World Wide Web featuring chapters contributed by internationally acclaimed experts. This project, initiated and maintained by the University of Minnesota, is co-sponsored by the Consortium for International Crop Protection (CICP) and National IPM Network (NIPMN). Our concept in creating this web page is to provide an electronic alternative or complement to printed textbooks for communicating information on integrated pest management. Our objectives are to provide: **1)** a venue for easily maintaining and up-dating "state of the art" information from the world's leading experts on all aspects of IPM, **2)** a resource economically deliverable anywhere in the world that can be freely downloaded and used by students, teachers, and IPM practitioners, **3)** a forum for the international presentation of practical information and theory on IPM and **4)** links to the vast and rapidly growing IPM resources available on the Internet including photographs and decision-support software. Our goal is to expand the coverage of this textbook and make it truly multidisciplinary and international in scope. We invite the contribution of articles on all aspects of IPM, theoretical or applied, general or highly specific.

WHEAT MIDGE (*Sitodiplosis mosellana* Gehin) MANAGEMENT IN NORTH DAKOTA. T. M. Nowatzki, P. A. Glogoza and M. J. Weiss, Department of Entomology, North Dakota State University, Fargo, North Dakota, 58105, USA.

The wheat midge has been a serious problem for wheat producers in the prairie provinces of Canada, and more recently in North Dakota. Until 1995, no outbreak of the pest had been reported in North Dakota and wheat producers had no experience in managing this insect. In 1995, fall soil sampling for cocoons in wheat fields on a 10 mile grid was conducted to determine the range of the wheat midge in the state. The data were used to produce a map to

identify the abundance of cocoons in the soil and prevalence of parasites parasites, and to prepare producers for control strategies in regions with high populations. The next step was to determine when producers should be scouting their wheat fields and applying insecticide for control. The degree-day model developed in Saskatchewan for predicting adult emergence was verified for North Dakota in 1996 using emergence traps, suction traps, and intensive field scouting. State-wide educational meetings were organized for producers to learn about the wheat midge, when to be scouting, and recommendations to control the insect. The degree-day model used in Saskatchewan was consistent for wheat midge populations in North Dakota. Fall soil sampling for cocoons will be conducted again in 1996 to determine if the range of the wheat midge population has changed.

DISTRIBUTION OF WIREWORMS (Coleoptera: Elateridae) IN THE GROWING SEASON IN MANITOBA. Xin Hou[1], N.J. Holliday[1] and C. Shaykewich[2]. [1]Department of Entomology and [2]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

This study was conducted to characterize how horizontal distribution patterns of wiremorms change and how their vertical distribution is related to soil environment during the growing season. To characterize how the horizontal distribution changes, a flax field near Carberry, Manitoba, was sampled at the beginning and the end of the season using a hexagonal sampling pattern. The distribution patterns of the wireworms at each time were analyzed with geostatistics and compared.

To study the relationship between wireworm vertical distribution and soil temperature and soil moisture, a potato field near Carberry, was sampled once a week during the growing season. At each sample time, five 30 x 30 x 30 cm holes were dug and the soil from each hole evenly subdivided into three vertical layers (10 cm each) and bagged separately. Soil temperature and moisture of each layer were measured, and wireworms in the soil were collected in the laboratory. The relationship of wireworm numbers and the environmental factors was analyzed with a regression procedure.

SHORT-RANGE DISPERSAL OF APHIDS WITHIN CEREAL CROPS. S.M. Migui and P.A. MacKay, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Dispersal of four cereal aphids, *Rhopalosiphum maidis* Fitch, *Rhopalosiphum padi* L., *Schizaphis graminum* Rondani and *Sitobion avenae* Fabricius was monitored on barley under laboratory and field conditions. In the laboratory,

studies were done on movements of adults and juveniles between leaf pieces of barley in petri dishes and between barley plants established in pots and flats. Aphid movement in open field plots was monitored from a central infestation point.

Adults contributed to spread of infestations by their movements between plants, and leaving their offspring on the plants. Different aphid species deposited different group sizes of offspring per natal location. Small larval group sizes were associated with a high rate of dispersal, while large group sizes were associated with a low rate of dispersal. Larvae exhibited movement behaviour after each moult. *Rhopalosiphum padi* moved most frequently under laboratory and field conditions. Because of their high dispersal capacity, *R. padi* and *S. avenae* had widespread distribution within the crop in the field. *Rhopalosiphum maidis* and *S. graminum* were least dispersive and exhibited an aggregated distribution.

LEVELS OF TOLERANCE IN *Brassica napus* SEEDLINGS TO HERBIVORY BY A DIVERSE INSECT FAUNA. J.E. Gavloski and R.J. Lamb., Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Rd., Winnipeg, Manitoba, R3T 2M9.

Levels of plant tolerance to herbivory were assessed for bertha armyworm, *Mamestra configurata* Walker, diamondback moth, *Plutella xylostella* L., green peach aphid, *Myzus persicae* Sulzer, turnip aphid, *Lipaphis erysimi* Kaltenbach, red turnip beetle, *Entomoscelis americana* Brown, and flea beetles, *Phyllotreta* spp. feeding on canola, *Brassica napus* L. Insects were caged on *B. napus* seedlings for 5-7 days in a controlled environment chamber. Tolerance was assessed as a ratio of the loss in plant material due to insect feeding and the simultaneous weight gain by the insects. Levels of tolerance showed much variation, with *B. napus* being most tolerant to feeding by red turnip beetles and bertha armyworms, and least tolerant to feeding by flea beetles. The trend displayed by these levels of tolerance matched those shown in studies of levels of compensation and yield loss by *B. napus* in response to insect damage.

AN ECONOMIC THRESHOLD FOR *Lygus* spp. ON CANOLA. I.L. Wise and R.J. Lamb, Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg, Manitoba, R3T 2M9.

Three species of mirid bugs are now recognized as pests of canola in western Canada. In Manitoba, *Lygus lineolaris* (Palisot de Beauvois) is usually most

abundant in the crop, but two other species are probably equally damaging when abundant. Field cages with artificial infestations and larger field plots with natural infestations were used to assess the impact of lygus bugs on canola between 1989 and 1993 in southern Manitoba. Insecticide applications at various crop growth stages were used as replicated treatments to cause variation in the levels of lygus bugs in the field plots. At high densities, lygus bugs reduced yield in field cages by up to 40% and at realistic field densities of 70 lygus per 10 sweeps, the yield loss was 20%, or 0.74 g per m^2 per lygus per 10 sweeps. Insecticidal control of lygus bugs in field plots increased yield, but not always significantly. Adequate precipitation from late in the bud stage to the early pod stage allowed the crop to compensate for lygus bug damage. At current prices, the economic threshold is 15 lygus bugs per 10 sweeps if precipitation is less than 70 mm during flowering. Lygus bug populations should be assessed at the end of flowering and controlled immediately if the threshold is exceeded.

WHEAT MIDGE IN MANITOBA: DEVELOPING RESISTANCE IN SPRING WHEATS. R.J. Lamb, I.L. Wise, R.I.H. McKenzie and P.S. Barker, Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg, Manitoba, R3T 2M9.

Wheat midge has been a serious pest in spring wheat in Manitoba since 1990. The pest was widely distributed in the wheat growing areas of the province in 1995 and caused yield losses of 30% in some fields. Recent research shows that populations remained high in 1996. Insecticidal control is now widespread and can be effective, but assessing midge populations and timing insecticide applications are not easy. Crop resistance could provide an effective alternative control. Resistance has been transferred from a few winter wheat sources to spring wheats. The resistance is effective in the field and adapted spring cultivars are being developed. Both antibiotic and antixenotic resistance have been identified in laboratory tests. To speed the development of resistant cultivars, field and laboratory methods for screening for resistance and studying the inheritance of resistance are used. These methods are described.

PARASITOIDS OF SPRUCE BUDWORM, *Choristoneura fumiferana* (Clemens) (Lepidoptera: Tortricidae), IN MANITOBA. D.A. Zebrowski and N.J. Holliday, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Parasitoid assemblages attacking spruce budworm populations in eastern Manitoba were assessed. Patterns of occurrence of the fourteen parasitoids col-

lected were analyzed with regards to abundance, host location and guild structure in endemic versus epidemic spruce budworm populations. The analyses were performed using contingency tables and correspondence analysis.

INSECTS ASSOCIATED WITH THE SASKATOON BERRY, *Amelanchier alnifolia.* Lloyd Harris, Saskatchewan Agriculture and Food, Regina, Saskatchewan, S4S 0B1.

Saskatoon berry, *Amelanchier alnifolia*, is native to the Canadian Prairies. In Saskatchewan, approximately 600 acres have been planted and growers are recognizing that insects and plant disease may be serious factors limiting the economic viability of the crop. Ten years of surveying native saskatoon berry stands for insects has provided a list of the insects most commonly associated with "saskatoons" and their relative importance as pests. Of the more than 56 different species of insects and mites associated with saskatoons, only the saskatoon bud moth, shadbush sawfly, hawthorn weevil, apple curculio, cherry stem borer and woolly elm aphid appear to be serious and persistent pests. The biology of most of these insects appears to have been neglected and could provide an opportunity for additional research.

Symposium: Medical/Veterinary Entomology and Urban Entomology

Lead Speaker

THE HISTORY OF LYME BORRELIOSIS RESEARCH IN ONTARIO: DEFINING THE RISK. Lindsay, L.R.[1], I.K. Barker[2], G.A. Surgeoner[1], S.A. McEwen[3] and J.D. Heal[3], [1]Department of Envionmental Biology, Ontario Agricultural College, [2]Department of Pathology, Ontario Veterinary College and [3]Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, Ontario, N1G 2W1.

The causative agent of Lyme borreliosis, *Borrelia burgdorferi*, is a bacterium transmitted by the tick, *Ixodes scapularis*, in Ontario. Since the initial discovery of an enzootic cycle of tick-borne transmission of *B. burgdorferi* among various reservoir hosts on the Long Point peninsula, Lake Erie, Ontario in 1987, research on the epidemiology of Lyme borreliosis in Ontario has pro-

gressed along several fronts. On the Long Point peninsula, investigations have focused on defining the life history and population dynamics of *I. scapularis* within various habitats and determining the influence of various abiotic and biotic factors on abundance of *I. scapularis*.

The primary objective of this research was to determine the factors which limit *I. scapularis* in the only locality in Canada where this tick is known to be endemic. Outside of the Long Point peninsula, research has aimed to define the competence of other ticks (*i.e.*, *Ixodes cookei* and *Dermacentor variabilis*) to act as vectors, as well as the role of certain mammals (*i.e.*, groundhogs and meadow voles) to act as reservoirs of *B. burgdorferi*. Active surveillance campaigns have been conducted in >30 localities outside of Long Point in search of additional foci of *I. scapularis* and *B. burgdorferi*. Lastly, the survival and development of *I. scapularis* at three localities outside of Long Point was determined to verify hypotheses concerning the potential distribution of this tick. Lyme borreliosis research in Ontario has demonstrated that because *I. scapularis* has a scattered distribution within Ontario, residents have a low but persistent risk of exposure to *B. burgdorferi*.

Submitted Papers

ECOLOGY OF THE *Aedes australis* COMPLEX IN AUSTRALASIA.
R.A. Brust, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

Aedes australis is a saline, rockpool mosquito of the Australasian region. Its sibling species, *Aedes ashworthi*, occurs on the southwest coast of Western Australia. It is clear from biological crosses, viability of the F1 hybrids and the unusual habitat occupied by both species that they have diverged recently. New South Wales populations of *Ae. australis* were 100% autogenous, but South Australia, Tasmania and New Zealand populations were anautogenous or only partially autogenous. Environmental conditions affected the per cent autogenous females and the number of eggs developed by females in autogenous populations. Low temperatures during the larval and pupal stages were most favourable for maximum autogenous egg production in the adults. Neither mating nor carbohydrate diet in adult females was necessary for maximum autogenous egg development. About 50% of autogenous females took a blood meal when females were placed on a host, but blood-fed females developed no more eggs than females fed water only.

FIRST ATTEMPT ON THE STUDY OF THE BIOLOGY AND MASS REARING OF TWO IRANIAN PARASITOIDS OF HOUSE FLY PUPAE *Muscidifurax raptor* Gireault & Sanders AND *Nasonia vitripennis* Wlk. (Hymenoptera: Pteromalidae). M. Iranpour[1] and S. Tirgari[2], [1]Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2 and [2]Department of Medical Entomology, School of Public Health, Tehran Medical Sciences University, Iran.

General annoyance and the danger of disease transmission by house flies are well known throughout the world. Biological control of house flies had been practised before the Second World War and has come into focus again in the past two to three decades. This type of control is becoming increasingly popular and practised in the foci of fly production such as garbage dumps and poultry houses in different countries. In the course of the study of arthropods associated with the wastes of domestic animals and poultry houses in different parts of Iran, three species of parasitoid wasps of house fly pupae were found, *Muscidifurax raptor, Nasonia vitripennis* (Pteromalidae) and *Spalangia subpunctata* (Spalangidae). The first two species were usually found in the poultry houses and the third in animal husbandry-refuse. The rate of their natural parasitism varied from 1% to 100%. In laboratory studies on the biology of these species, we used frozen house fly pupae as hosts, which were accepted by the females but not as well as fresh pupae. The life span of female and male *M. raptor* at 27C. was 13.33 and 5.66 days, respectively and that of *N. vitripennis* 8.25 and 2.5 days. Female *M. raptor* laid 25 eggs, but *N. vitripennis* was polyembryonic. The full grown larvae of *M. raptor* remained inside the puparia at 2C to 10C with no significant mortality for 90 days.

SURVEY AND RELEASE OF PARASITIC WASPS (Hymenoptera: Pteromalidae, Ichneumonidae) FOR CONTROL OF HOUSE FLIES AND STABLE FLIES IN DAIRY OPERATIONS IN MANITOBA. T. McKay and T.D. Galloway, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

House fly and stable fly puparia were collected at eight dairies in Manitoba from July, 1995 to September, 1995 and examined for pupal parasites. Six species, *Muscidifurax zaraptor* Kogan and Legner, *Spalangia cameroni* Perkins, *S. subpunctata* Först, *S. nigra* Latrielle, *Urolepis rufipes* (Ashmead) and *Phygadeuon fumator* Gravenhörst were collected. Approximately three million *Nasonia vitripennis* (Walker) were also released over ten, weekly intervals at four of these dairies. Prevalence and intensity of parasitism of filth fly pupae using naturally occurring and freeze-killed sentinel pupae were estimated and compared among release and non-release farms.

LICE (Phthiraptera) AND FLEAS (Siphonaptera) ASSOCIATED WITH ENDANGERED SPECIES OF BIRDS AND MAMMALS IN CANADA: DO THEY DESERVE CONSIDERATION? T.D. Galloway, Department of Entomology, University of Manitoba, Winnipeg, Manitoba, R3T 2N2.

With the progressive destruction and fragmentation of natural habitats in Canada, there is an ever increasing number of species for which continued survival is in jeopardy. The Committee on the Status of Endangered Wildlife in Canada has listed 3 species of birds which are extinct, one bird and two mammals that have been extirpated from Canada, 14 taxa of birds and one species of mammal that are endangered, nine species of birds that are threatened and 21 birds and 14 mammals that are considered vulnerable in Canada and which are conceivably hosts to a wide variety of fleas and lice. Although considerable attention has been drawn to the status of birds and mammals, little consideration has been given to their ectoparasites. For example, the Passenger Pigeon had disappeared from the wild by 1900, and there are no published Canadian records for the two species of Mallophaga known to have occurred on this host. The status of fleas and lice known to occur on the listed birds and mammals in Canada is reviewed, and their status assessed. Ectoparasites may play a significant role in the long term fitness of their hosts' populations. Under such circumstances, wildlife managers should consider preservation of ectoparasite populations as well those of their hosts, and evaluate the potential for introduction of parasites into re-established host populations.

Minutes of the 52nd Annual Meeting of the Entomological Society of Manitoba

13:00 h, November 7, 1996
Round Table Restaurant
Winnipeg, Manitoba

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

ATTENDANCE

Executive:	R. Currie, President	
	T. Galloway, President-Elect	
	R. Roughley, Past-President	
	N. Holliday, Regional Director to the ESC	
Executive Staff:	M. Henderson Smith, Treasurer and Finance	
	R. Westwood, Editor - Proceedings	
	R. Lafreniere, Editor - Newsletter	
	B. Timlick, Secretary	
Members:	T. McKay	B. Preston
	G. Gerber	R. Gadawski
	P. MacKay	B. Webster
	N. Vanek	J. Gosselin
	R. Lamb	P. Fields
	S. Pernal	

1. **Agenda** (Appendix A).

   Motion: MacKay/Galloway. That the proposed agenda for the 52nd Annual General Meeting of the Entomological Society of Manitoba be accepted. CARRIED.

2. **Minutes of the 51st Annual General Meeting.**

Motion: Gerber/Gadawski. the minutes of the 51st Annual General Meeting of the Entomological Society of Manitoba be accepted.
CARRIED.

3. **Business arising from the previous minutes.** None.

4. Reports — Executive

President (Appendix B). R. Currie states that there are several vacant positions within the society and that it is difficult to provide the same level of service with fewer members. R. Currie asks those present to ask their colleagues not participating to become more active.

Treasurer (Appendix C). R. Currie thanks M. Smith for a job well done.

Regional Director to the ESC (Appendix D). G. Gerber indicates that all changes to the functioning structure of the ESC are complete and will be implemented next year. Most committees have been downsized significantly. The memoirs will no longer be published with the last issue being published in 1997. R. Lamb asks if there is ESC presence on the world wide web. G. Gerber responds noting that this service will be run out of the University of Alberta.

Editor of the Proceedings (Appendix E). T. Galloway asks if there is a list of the journals that are reciprocated for. R. Westwood states that there is. G. Gerber indicates that these are available from the Agriculture Canada library. R. Roughley asks when the deadline for submissions in the Proceedings is. R. Westwood states that the cutoff date for accepting submissions is in late March or early April. R. Currie thanks R. Westwood for the tremendous effort he has put into developing the Proceedings.

Endowment Fund Board (Appendix F).

5. **Reports — Committee**

Finance (Appendix G). R. Currie states that there is monies available from the University of Manitoba and others for the joint anniversary (ESM and Dept. of Entomology) meeting. T. Galloway notes that money will be made available for invited speakers to cover travel costs. P. MacKay asks if the society will suffer a loss. M. Smith indicates that it will not at this time.

Motion: Gerber/Mackay. That the budgets for the 1996-97 be approved.
CARRIED

Publicity / Newsletter (Appendix H). R. Lafreniere indicates that he is in the process of setting up a web site and will address linking with the ESC and others at a later date.

Social (Appendix I).

Education and Youth Encouragement (Appendix J).

ESC Common Names (Appendix K).

Archivist (Appendix L).

Student Awards (Appendix M). R. Currie states that there were very few applicants for these awards and states that there should be more encouragement for potential candidates and that we should possibly consider allowing a broader range of applicants to apply.

ESM Scholarship (Appendix N).

Scientific Programme (Appendix O).

Membership Committee (Appendix P).

Fund Raising (Appendix Q).

Honorary Members (Appendix R).

6. **Election Results:**

Results: President Elect. J. Buth
Member at Large I. Pines

Congratulations are extended to both incumbents.

Motion: MacKay/Roughley. That the ballots for the 1996-97 election be destroyed. CARRIED.

7. **Transfer of Office:**

R. Currie calls upon T. Galloway to assume the office of President

8. **Other Business:**

Motion: Smith/Gerber. That the Entomological Society of Manitoba appoint D. Nicholson as auditor. CARRIED.

APPENDICES

Appendix A: Agenda of the Entomological Society of Manitoba 52nd Annual Business Meeting

November 7, 1996

1. Acceptance of the agenda

2. Acceptance of the minutes of the last Annual Meeting (November 4, 1995)

3. Business arising from the last minutes.

4. Reports - Executive

President	R Currie
Treasurer	M. Smith
Regional Director to the ESC	N. Holliday
Editor of the Proceedings	R. Westwood
Endowment Fund Board	M. Smith

5. Reports - Committees

Finance	M. Smith
Publicity / Newsletter	R. Lafreniere
Social	D. Zebrowski
Education / Youth Encouragement	N. Vanek
ESC common names / Archivist	R. Roughley
Student Awards	B. Gallaway

ESM Scholarship	P. McKay
Scientific Program	T. Galloway
Fund Raising	J. Gosselin
Honorary Members	R. Currie
Membership	T. Galloway

6. Election Results — D. Dixon

7. Transfer of Office — R. Currie

8. Other Business

Appendix B: President's Report

This has been an eventful year for the Society. The composition of the Society's membership has been changing dramatically in recent years. With the combination of retirements and cutbacks by governments and universities the numbers of professional entomologists employed in our Province has declined. Despite this the Entomological Society of Manitoba continues to be a very active in stimulating communication between entomologists and promoting entomology in the community.

This year the executive of the E.S.M. conducted a membership survey. The purpose of the survey was to assess the relative importance of Society activities to members and to ensure that the Society continues to meet the needs of its members. The survey results were published in the Society's newsletter.

In general, there was a high level of satisfaction with Society activities. Members highly valued our guest speakers which are brought in each year for the Scientific Program at the Annual General Meeting. The most popular function by far (mean score of 4.6/5) was funding for the Keynote speaker, but support was also high for external symposium speakers. This year we held a Joint meeting with the Department of Entomology to celebrate the 50th Anniversary of the Society and the 75th anniversary of the Entomology Department at the University of Manitoba. We were able to bring in three speakers from outside the Province and a number of students and alumni from the U.S. and western Canada were able to attend. The meeting was a tremendous success thanks to the efforts of Terry Galloway and his organizing committee.

Ranking second in "popularity" in our survey was the newsletter, with a mean score of 4.5. In recent issues our Editor, Rheal Lafreniere, has added many

new features and the news and information that is communicated continues to serve the diverse interests of our membership.

The Social Committee activities were of intermediate to high priority in the survey. A few members highly valued Society luncheons but commented that a more centrally located venue would be appreciated. The current venue for the AGM was selected in response to that request. Recent chairs of the Social Committee have changed the format of the New Members Social during the past several years. Our members have abandoned the traditional wine and cheese/speaker format and taken to the curling sheets and bowling alleys of Winnipeg. The response to these activities has been good. Deirdre Zebrowksi, our current social committee chair has been very busy and effective at keeping us entertained during the past year.

The Proceedings, under Richard Westwood's direction, the activities of the Youth Encouragement Committee, chaired by Norman Vanek, and funding of Scholarships and awards all continue to rank highly in terms of their importance to members. These functions will continue to be valuable in allowing the Society to promote entomology and encourage the development of the discipline.

The only Society activity that had an average score of less than 50% (2.3/5) in our survey was support for a distinguished speaker lecturer. This event does not appear to be a priority for most members since 75% of respondents preferred that funding be directed towards providing symposium speakers for the Scientific Programme at the Annual General Meeting. Given the current inability of the Society to fund both of these activities the Executive will disband the committee associated with selecting speakers and eliminate the annual commitment of funds associated with this event unless otherwise directed by the membership.

I would like to extend my thanks to all of the committee chairs and to the members of the executive for their guidance and support during the year.

R.W. Currie
President

Appendix C: Treasurer's Report

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, 1996 and the statement of income and expenses for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I consider necessary in the circumstances.

In common with 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, 1996 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.

Original signed by

Winnipeg, Canada — Doug Nicholson & Co.,

October 15, 1996 — Certified General Accountant

ENTOMOLOGICAL SOCIETY OF MANITOBA INC.
BALANCE SHEET
AS AT AUGUST 31, 1996

ASSETS

CURRENT	1996	1995
Cash advances (note 2)	$ 250	$ 50
Cash in bank	5,100	7,203
Investments (note 3)	30,004	27,997
	35,354	35,250

LIABILITIES

Liabilities	nil	nil

SURPLUS

Surplus	$ 35,354	$ 35,250

APPROVED BY THE BOARD:

_____Director

The accompanying notes form an integral part of these financial statements

ENTOMOLOGICAL SOCIETY OF MANITOBA INC.
STATEMENT OF INCOME
YEAR ENDED AUGUST 31,1996

REVENUE	**1996**	**1995**
Annual meeting	$ 1,517	$ 2,661
Fundraising committee	212	721
Interest income	2,214	2,678
Members fees	2,047	1,255
Miscellaneous	966	149
Proceedings	431	402
Youth encouragement & public education	--	200
	7,387	8,066
GENERAL EXPENSES		
Awards and scholarships	$ 1,200	$1,500
Donations	500	--
General	965	1,057
Meetings	2,524	100
Newsletter	167	76
Other committees	49	--
Proceedings	1,426	1,686
Social committee	154	253
Youth encouragement & public education	298	70
	7,283	4,742
EXCESS (DEFICIT)		
OF INCOME OVER EXPENSES	**$ 104**	**$ 3,324**
Add: Surplus, beginning of year	35,250	31,926
SURPLUS, END OF YEAR	**$ 35,354**	**$ 35,250**

The accompanying notes form an integral part of these financial statements

ENTOMOLOGICAL SOCIETY OF MANITOBA INC., NOTES TO THE FINANCIAL STATEMENTS AUGUST 31, 1996

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:

Treasurer	M. Smith	$ 25.00
Editor- Proceedings	R. Westwood	25.00
Editor - Newsletter	R. Lafreniere	200.00
		$250.00

3. INVESTMENT CERTIFICATES:

Certificate	Interest Rate	Maturity Date	
7053706	8.00%	Dec 15, 1997	3,024.33
7053805	7.25%	Apr 5, 1999	2,000.00
7053871	8.00%	Nov 12, 1999	9,200.00
7058436	5.25%	Dec 11, 1998	3,000.00
7058513	6.375%	Sep 16, 1998	2,003.96
7053937	9.75%	Oct 2, 1996	2,000.00
8421072	7.5%	Jan 26, 1998	1,775.67
14577420	5.0%	Dec 19, 1996	4,000.00
18105406	7.5%	Oct 31, 1997	3,000.00
			$30,003.96

E.S.M. Financial Committee Meeting - 26 October, 1996

Treasurer's Supplement to the Auditor's Report

REVENUES:

Interest Income:

G.I.C. interest was $2175.68. Interest from the bank account was $38.40.

Miscellaneous:

This includes $100.00 Awards income (SWAT award) and $866.28, which was the GST rebate. The GST rebate was much greater than usual because of the expenses incurred for the ESC-ESM Joint Annual Meeting in the previous fiscal year.

EXPENSES:

Donations

A donation of $500-00 which was made to the A.G. Robinson Memorial Scholarship Fund. This completes our commitment, made in 1993, to donate $1,000.00 to the Fund.

General Expenses:

Auditor	$829.25
Secret., Treas. Postage & Photocopying	99.32
Bank Charges	8.33
Corporations Fee	15.00
Other Office Supplies	13.30

The auditor's fees include costs to audit the ESC-ESM Joint Annual Meetings financial statements in addition to the Society's regular audit.

Other Committees:

This amount is the cost of printing and mailing the membership list.

Appendix D: Report of the ESC Regional Director to the Annual Business Meeting

In 1996, the Entomological Society of Canada's annual meeting was in Fredericton, NB and about 170 people attended. Members of the Entomological Society of Manitoba achieved two distinctions at these meetings: Steve Pernal won a prize in the student paper competition, and a team consisting of Jason Diehl, Brent Elliott, Steve Pernal, and Deirdre Zebrowski won the Linnean Games. The next annual meeting of ESC is scheduled for Edmonton, AB, (4-8 0ctober 1997). A joint meeting with the Entomological Society of America is planned for 2OOO in Montreal.

The 1995-6 president of the ESC is Dr Steve Marshall. The Society's secretary is Dr Peggy Dixon and Dr Gary Cummings is treasurer. The Bulletin Editor is Dr Hugh Barclay. Dr Peter Kevan is currently scientific editor of Canadian Entomologist and intends to resign in late 1997; a search has begun for a replacement.

The ESC is in the midst of some major restructuring initiatives to reduce costs increase membership, and streamline operations. Among the consequences of this process are that the Memoirs of the Entomological Society of Canada will be discontinued. Long manuscripts can be submitted for publication as special issues of the Canadian Entomologist, but full costs for special issues will be borne by the authors. Financial incentives will be in place to encourage submissions of final versions of manuscripts to Canadian Entomologists to be in electronic form, and to encourage submission of abstracts in both official languages. Effective for the 1997-8 society year several ESC committees will be restructured. The regional directors from affiliate societies will serve on the Science Policy and Public Education Committee, which is a fusion of two former committees. The Common Names Committee will no longer require representation from each affiliate society. The Scholarship Committee and Graduate Research - Travel Grants Committee will be replaced by a Student Awards Committee, and this Committee will not require representation from each affiliate society. The reduction in the required representation of affiliate societies on committees has been done because of difficulties of getting those societies to nominate committee members, it still hoped that members of affiliates will be put forward for membership on ESC committees. Full details of changes will be published in the ESC Bulletin for December.

The Bulletin of ESC will, henceforth, have a section on activities of the regional affiliates. Consequently, the newsletter editor of ESM should routinely forward a copy of the newsletter to the ESC Bulletin editor.

The ESC, and several regional affiliates have established home pages on the

World Wide Web. The Entomological Society of Manitoba might wish to consider whether it should follow suit.

N. J. Holliday
Regional Director

Appendix E: Report of the Proceedings Editor

Volume 51 (1995) of the Proceedings of the Entomological Society of Manitoba was completed on August 31, 1996 and mailed to Society members, subscribers and as gifts or exchange to selected institutions in October and November 1996. A total of 205 copies of Volume 51 were printed. The format was reduced from the current 8.511 X 11", to 6.5" X 8.51' to reduce mailing costs and save costs on printing. As the cost savings were substantial, the price charged to subscribers for Volume 51 of the Proceedings was $8.00 Canadian, the same as previous years.

Approximately 125 copies were mailed to society members, 40 to subscribing institutions and 50 were mailed to institutions that exchange their journal with ours or receive the Proceedings as a gift. Volume 51 was 55 pages in length.

Volume 51 contained 2 referred scientific papers which made up 20 of the 55 pages. Publishing authors paid only for reprints, as the Society does not charge page costs for papers printed in the Proceedings. The funds that the Society sets aside to help authors unable to fund their own papers has not been utilized since 1994/5. The peer review process worked well and I am indebted to the reviewers for their time and expertise to ensure the scientific content of the Proceedings is of the highest quality. Three papers were submitted for Volume 51, two being accepted and one found not suitable. I continue to seek new ideas and methods to improve the quality of our publication and any Society member who wishes to comment on the content or format of the current publication should do so in writing attention to myself.

Richard Westwood,
Proceedings Editor

Appendix F: Report of the Endowment Fund Board

The Endowment Fund provides a basis for funding the Student Scholarship ($1,000.00) and the publication of the Proceedings ($1,500.00). Also, the Fund contributes approximately $500.00 toward the costs associated with the Annual General Meeting of the Society. Therefore, the Endowment Fund is committed to about $3,000.00 annually.

In 1995-96 fiscal year, $2,175.68 of investment income was generated from a principal amount of $30,000.00. An additional $38.40 of interest was earned from our chequing-savings account. Membership fees are expected to cover a greater part of the Society's expenses.

We continue to combine our smaller G.I.C.'s into several larger ones. In the past year, a G.I.C. for $2,006.48 (matured 28 Aug., 1995) was combined with $1,993.52 (matured 19 Dec., 1995) and re-invested for one year. A G.I.C. for $2,000.00 (matured 2 Oct., 1996) will be combined with $4,000.00 (matures 19 Dec., 1996), and was to be re-invested for five years. In view of the currently very low interest rates, we recommend that the term be only one year.

Next year, a G.I.C. for $3,000.00 (matures 31 Oct., 1997) will be combined with $2,000.00 of a G.I.C. for $3,024.33 (matures Dec. 15, 1997) and reinvested. The balance of $1,024.33 will be combined with a G.I.C. for $1,775.67 maturing on 26 Jan., 1998.

Guaranteed Investment Certificates With Royal Trust

Cert. No.	Amount ($)	Interest Rate(%)	Maturity Date	Annual Interest($)
7053937	2,000.00	9.750	Oct. 2, 1996	195.00
14577420	4,000.00	5.000	Dec. 19, 1996	200.00
18105406	3,000.00	7.500	Oct - 3 1, 1997	225.00
7053706	3,024.33	8.000	Dec. 15, 1997	241.95
8421072	1,775.67	7.500	Jan. 26, 1998	133.18
7058513	2,003.96	6.375	Sept. 16, 1998	127.75
7058436	3,000.00	5.250	Dec. 11, 1998	157.50
7053805	2,000.00	7.250	Apr.5, 1999	145.00
7053871	9,200.00	8.000	Nov. 14, 1999	736.00
TOTAL	30,003.96			2,161.38

October 26, 1996:
Richard Westwood
Marjorie Smith
Rob Currie

Appendix G: Report of the Finance Committee

The committee met on 26 Oct., 1996. Lynn Manaigre resigned her position as chair of the Finance Committee in early September. She was unable to complete her term due to personal commitments. In the absence of a committee chair Richard Westwood, Editor of the Proceedings, sat as acting chair.

In 1995-96 revenue exceeded expenses by $103.44. The large surplus of $5,200.00, accumulated largely in 1994-95, is expected to be reduced gradually over the next few years with anticipated losses, as interest generated by the Endowment Fund investments continues to decline.

In view of the Society's general finances, the committee recommends that the Distinguished Speaker Series, as an annual item, be dropped; therefore, this item is no longer listed in the budget. In last year's survey the membership expressed a high interest in funding speakers associated with the Annual General Meeting, and a low interest in funding speakers at other times of the year.

The finance committee reviewed each of the committee budgets and prepared an overall budget for the Society. An accounting of the revenue and expenses for 1995-96 and projections for the next two fiscal years is attached.

Richard Westwood
Marjorie Smith
Rob Currie

Entomological Society of Manitoba

Budget Items

Revised 26 Oct, 1996	1995-96 Actual	1996-96 Actual & Projected	1997-98 Projected
Endowment Fund	$30,000.00	$30,000.00	$30,000.00
REVENUE			
Membership Dues	$2.047.15	$2,000.00	$2,000.00
Proceedings	430.79	400.00	400.00
Social Committee	0.00	0.00	0.00
Youth/Education Committee	0.00	0.00	0.00
Donations	200.00	650.00	500.00
Fundraising Committee	12.00	900.00	200.00
Student Awards and Scholarships	100.00	100.00	100.00
Meetings: ESM AGM	1,517.00	1,944.00	1,500.00
Investment Income	2,214.08	2,100.00	2,000.00
Miscellaneous: GST Rebate	866.28	126.00	150.00
Other Committees	0.00	0.00	0.00
TOTALS	7,387.30	8,420.00	7,050.00
EXPENSES			
General Society Expenses	965.20	900.00	1,000.00
Proceedings	1,426.37	1,600.00	1,600.00
Newsletter	166.76	250.00	250.00
Social Committee	154.50	300.00	300.00
Youth/Education	298.05	200.00	200.00
Fundraising Committee	0.00	650.00[1]	50.00
Student Awards and Scholarships	1,200.00	1,500.00[2]	1,350.00
Meetings: ESM AGM	2,523.77	3,500.00	2,500.00
Other Committees: Membership	49.21	50.00	50.00
Representation at ESC	0.00	350.00	350.00
Grant Robinson Scholarship Fund	500.00	--	--
TOTALS	$7,283.86	$9,500.00	$8,150.00
Net gain (Loss), year ending Aug.31	$ 103.44	(1,080.00)	(600.00)

Notes:

[1] Includes cost of sweatshirts printed for ESM and Dept. of Entomology Anniversary

[2] Includes student book award of $150.00 for 1995-96 not yet reimbursed.

Appendix H: Report of the Newsletter and Publicity Committee

The ESM Newsletter committee has published 3 issues of the society newsletter, (Volume 23, 1-3) and will be publishing the fourth issue in November 1996. The newsletter has gone through some minor layout changes, which includes several new feature articles such as: "Inter-net", "Cook-a-roach", and "Research".

The newsletter is now available via the Internet as an e-mail document or attachment file. The committee also plans to post the newsletter on the world wide web and will be announcing the web site in an upcoming issue.

In order to keep postage costs down, when ever possible the newsletter was mailed in conjunction with the membership list, social announcements, and the proceedings. My thanks to Jason Diehl and Brent Elliott for their assistance in gathering information and helping to piece together the newsletter on a regular basis.

Rhéal Lafrenière, Chair
Jason Diehl
Brent Elliott

Appendix I: Report of the Social Committee

The New Members' Social was held at the Coronation Bowling Lanes on May 4th, 1996. The event was attended by 28 people, including three new members: Tanja Mackay, Anbeka Tiwari and Ginger Gill. The evening consisted of a Bingo Bowling tournament followed by prizes for everyone!

The banquet for the Annual General Meeting was held on Oct. 25, 1996 at the Oceana Restaurant in Winnipeg. The banquet was attended by 56 people. Dinner music was provided by a flute and cello duo. After the dinner, "An Evening at the Improv..." took place. This was a seminar contest which tested the ingenuity and quick thinking of students and Faculty. The contest was won (by a narrow margin) by the Faculty team. "An Evening at the Improv..." proved to be quite entertaining and judging by audience response, was enjoyed by all.

Deirdre Zebrowski, Chair

Appendix J: Youth Encouragement and Public Awareness Committee

The aim of this committee is to expose the youth of this province to the diversity and importance of insects in our environment through education and awareness. Presentations, field trips to the department of entomology, and loans of YEPAC materials were made to introduce youth to the morphology and ecological significance of various insects. Funding for operations is provided by the Entomological Society of Manitoba.

A total of ten presentations were made either by myself or by various volunteers. The committee wishes to thank John Gavioski, Ginger Gill, Tanja Mackay, Dr. R. E. Roughley, and Carla Wytrykush for contributing their time and enthusiasm. Presentations typically involved the use of slides, posters, pamphlets, live demonstration materials and animated discussion! These were made to groups of children ranging from approximately 5-10 years of age at elementary schools within the Winnipeg area. Presentations were also made at schools in Sprague and Oak Bluff.

Future goals include the production of lapel pins to give out at talks with the word "YEEC" ("Youth Enjoying Entomology Campaign") embossed over a picture of an insect. Lastly, YEPAC activities require that ESM members be involved to insure continued public service.

Norman A. Vanek, Chair

Appendix K: Report of the Common Names Committee

There have been no applications from ESM members during the past year for new common names, nor has there been any requests for changes in old common names, and therefore there are not local activities to report. Members should be aware that there is a list of the "Common names of Insects in Canada" edited by E.M. Belton & D.C. Eidt. This list is available on diskette from the Entomological Society of Canada.

R.E. Roughley, Chair

Appendix L: Report of the Archivist

The archival materials of the Entomological Society of Manitoba are held in Room 213 of the Animal Science and Entomology Building, Department of Entomology, University of Manitoba. Two copies of the ESM Newsletter and a copy of the Proceedings are added to the Archives subsequent to their

publication. Any donation of any other material for the Archives will be considered at any time.

R.E. Roughley, Chair

Appendix M: Report of the Student Awards Committee

The committee reviewed the nominations received for the Student Achievement Award and the SWAT Student Award. Ms Ginger Gill was selected as the recipient of the Student Achievement Award. No candidate was selected for the SWAT Student Award.

J. Conroy
J. Hare
S. Pernal
W.J. Gallaway (Chair)

Appendix N: Report of the ESM Scholarship Committee

The Entomological Society of Manitoba Scholarship Committee met and discussed two applications for the ESM postgraduate award. The ESM Scholarship committee unanimously recommends that the ESM postgraduate award be made to Ms Tanja McKay, Department of Entomology, University of Manitoba. Ms McKay is currently working on her M. Sc. degree under the supervision of Dr. Terry Galloway in the Department of entomology at U. of M. Her thesis topic is "Survey and release of parasitic wasps (Hymenoptera:Pteromalidae, Ichneumorfidae) for control of house flies and stable flies in dairy operations in Manitoba".

R. Bodnaryk
P. MacKay

Appendix O: Report of the Scientific Programme Committee

The Annual Meeting this year was rather special in that we celebrated the 50th anniversary of the Entomological Society of Manitoba and the 75th anniversary of the Department of Entomology. The meeting was held on 25 and 26 October, 1996 in the Freshwater Institute. There were 36 regular members, 15 students and I nonmember who registered over the two day period.

Four symposia were held, each one to reflect *areas* of past activity and research among Manitoba entomologists. Each symposium was introduced by in invited speaker who delivered the lead address. On Friday morning,, the scientific program began with the symposium of Stored Products Entomology and Apiculture. Paul Fields, Agriculture and Agri-Food Canada, Winnipeg, presented a paper on "Physical control of stored product insects", and this was followed by five submitted papers. The afternoon session, Aquatic Entomology and Environmental Sciences, was introduced by Donna Giberson, Department of Biology, University of Prince Edward Island, with her paper, "Rolling stones gather no bugs, or do they?", where audience participants had the unique opportunity to experience what it was like to be a rock. There were six submitted papers following Donna's presentation. On Saturday morning, attendants were treated to the symposium on Crop Protection, led by Richard Butts, Agriculture and Agri-Food Canada, Lethbridge. Rick presented his paper on "Cold tolerance in anholocyclic clones of aphids and its application to aphid pest management", followed by ten submitted papers covering a wide variety of topics. Robbin Lindsay, Department of Environmental Biology, University of Guelph, led off the symposium on Medical/Veterinary Entomology and Urban Entomology, with his paper on "The history of Lyme borreliosis research in Ontario". There were four submitted papers to close out the scientific program. In addition to the four lead speakers' presentations, there were 25 submitted papers, 12 of which were presented by student members who participated in the student paper competition. The difficult job of selecting a winner among so it)any excellent presentations fell to the judges for the competition, Brent Elliott, Randy Gadawski. and Rob Roughley. The winner will be announced at the Annual Business Meeting, held on 6 November, 1996. Joel Gosselin had a beautiful sweat shirt designed especially for this anniversary meeting, featuring *Cicindela formosa manitoba* prominently on the front. These were a popular item during the coffee breaks.

The banquet held on Friday evening at the Oceana Restaurant was a great hit. Apart from the excellent meal and dinner music, Deirdre Zebrowski (Social Committee Chair) arranged for a seminar competition, with current Faculty members from the Department of Entomology (Rob Roughley, Rob Currie and Rick Butts), versus past and current graduate students from the Department (Donna Giberson, Robbin Lindsay and Steve Pernal). All the speakers were dealt a series of previously unseen slides, around which they were to construct an earlier titled seminar. The speakers did a superb job, to the delight of those in the audience. Pat MacKay and Bob Lamb once again hosted an informal mixer in their home on Saturday night. It was a relaxed atmosphere in which to renew acquaintances and visit with friends, a fitting way to bring the events of this year's anniversary celebrations to an end.

The Committee would like to thank all the speakers who contributed to the success of the scientific component of the meeting, Deirdre Zebrowski and her committee who were responsible for the social activities, and to Pat and Bob for hosting the mixer. Special thanks go to the Faculty of Agricultural and Food Sciences and the Department of Entomology for their financial support, and to the sponsors for their support of various meeting activities. There were many additional people who donated their time. to help out. Marjorie Smith and her crew did a superb job on the registration desk, and Al Wiens' assistance with arrangements around the Freshwater Institute was indispensable. The efforts of the judges for the student paper competition were very much appreciated. We would also like to acknowledge those who helped with projectors, the room lights and general running around when disaster struck.

Joel Gosselin *Richard Westwood*
Bob Lamb *Noel White*
Pat MacKay *Deirdre Zebrowski*
Dave Rosenberg *Terry Galloway (Chair)*

Appendix P: Report of the Membership Committee

The membership of the Entomological Society of Manitoba stands at I */* 5 members, with 6 Honorary Members, 5 Lifetime Members, and 105 Regular and Student Members. In the past year, we have gained 9 new members, and 7 members have renewed their membership. Membership has declined since the early 1990's (e.g. 138 in 1991; 140 in 1992), but our numbers have held remarkably well.

Terry Galloway

Appendix Q: Report of the ESM Fundraising Committee

(Sept. 95 to Aug. 96)

Donations in the amount of $200.00 for the Annual General Meeting were received. A total of 20 insect drawers were sold, generating a revenue of $5.00 per drawer for the Society. A $100.00 donation for this will be made during the next fiscal year.

Joel Gosselin

Appendix R: Report of the Honourary Members Committee

The honourary members committee put out a call for nominations in 1996 in the fall edition of the Society's newsletter. One nomination was received by

the secretary prior to the 30 October 1996 deadline. In order to obtain Honourary Member status each nominee must be approved by the membership through secret ballot. Currently, the Society has six honourary members. The number of openings for the status of honourary membership is limited to 10% of the active members.

R.W. Currie, Chair

Notice to Contributors

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

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

Text. Articles should be typed, double spaced and on one side of the paper. Margins should be 25 mm on all sides. One original and two copies of text should be submitted to the Editor. Spelling should conform to usage recommended in either the Oxford or Webster's New International dictionary. Except in tables, figures, or quotations, dates should be written in the form of 15 July, 1992, etc. Reference to illustrations should be in the form 'Figure 2' or 'Fig. 2', and references to tables should be in the form 'Table 2', etc. Citation references in the text should be in the form 'Wilson (1992) stated', '(Smith 1990)', '(Brown 1985, 1990a,b)' or '(Wilson and Brown 1984; Smith 1990)' in chronological order for multiple citations within one set of parentheses.

Footnotes should be kept to a minimum and typed at the bottom of the page to which they apply. Abbreviations should be kept to a minimum and only those that are generally recognized, or defined within the text for the sake of brevity should be used. Units of measurement should be metric and abbreviated according to the Canadian national standards.

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 be preceded by a brief but informative abstract.

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

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

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

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

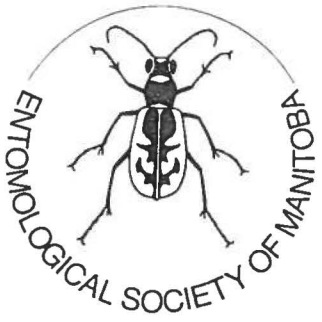
Acknowledgements

The editor wishes to acknowledge the efforts of the anonymous reviewers asked to review the research papers appearing in this Volume. Special thanks to Warren Schuetz of The University of Winnipeg Printing Services for the graphic design of this journal.

Entomological Society of Manitoba

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

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



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