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H. Glenn Wylie*

October 15, 1927, Wingham, Ontario – December 1, 2015 Winnipeg, Manitoba

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H. Glenn Wylie had a long and productive career specializing in parasitoid biology and the biological control of insect pests. His interest in biology began on the family farm in southwestern Ontario, and in insects as a student assistant at the Canada Department of Agriculture laboratory at Belleville, Ontario in the summer of 1948. He graduated from the University of Toronto, Honours Zoology, in 1949, and was immediately hired by the Canada Department of Agriculture as a Technical Officer in the Entomology Laboratory at Belleville. From April 1950, Glenn was seconded to the Commonwealth Institute of Biological Control, Feldmeilen, Switzerland to collaborate in efforts to find biological control agents against the balsam woolly aphid in the Atlantic Provinces (Wylie 1958a, b). In addition to six months at Feldmeilen, Glenn was stationed in the Vosges Mountains of France for the summers of 1950 and 1951. The result of these efforts was "…a list of European predators and detailed information on the biology and life history of each species" (Bulletin of the Entomological Society of Canada 19 [1988]: 91–92). Six aphid predators that he identified were imported to eastern Canada, four of which established successfully.

Instead of the expected return to Canada in fall 1951, Glenn was encouraged to enrol in graduate studies at the University of Oxford. In his doctoral thesis, under the guidance of Professor George Varley, he described host-finding by the house fly parasitoid, *Nasonia vitripennis* (Walker). Professor Niko Tinbergen had recently arrived at Oxford, and stimulated Glenn's interest in animal behaviour. A condition of Glenn's Department of Agriculture support during his doctoral studies was that he be involved in Varley's research on the winter moth, *Operophtera brumata* (Linnaeus). This insect had become a major pest of broad-leafed trees in Nova Scotia, and Glenn was required to spend about six weeks each summer in 1952 and 1953 on studies that might lead to its biological control. Because of the workload, Glenn was initially reluctant to take on both thesis research and the winter moth project. Nevertheless, he successfully juggled these two responsibilities and additionally found time to court Jean Mary Hodges. Jean typed Glenn's D. Phil. thesis, which was submitted in May 1953, and in September 1953, they

* This article is also published in the Bulletin of the Entomological Society of Canada in an abbreviated form without citations or bibliography.

were married and moved to Belleville. So, from 1950–1953, by his 26th birthday, Glenn completed a major study of the biological control of balsam woolly aphid, completed a D. Phil. on the behaviour of a house fly parasitoid in 22 months, met and married Jean Hodges, and laid the ground work for biological control of winter moth.

Biological control of the winter moth was Glenn's full-time project from 1954–57. Between 1952 and 1956, over 182,000 winter moths were shipped to Belleville for parasitoid rearing and other studies. Although Glenn made some of the first collections, most were done by European collaborators with visiting entomologists from Belleville to coordinate: Harold Welch in 1954, Harold and Glenn in 1955, and James McLeod in 1956. Glenn's thorough knowledge of the European literature (Wylie 1955), and the work at Belleville, resulted in a catalogue of 63 parasitoids of the moth in its native range (Wylie 1960c), and improved understanding of geographic variation in the moth's phenology and population ecology (Wylie 1960a, b). As early as 1953, Glenn concluded that the tachinid, *Cyzenis albicans* (Fallén), and the ichneumonid, *Agrypon flaveolatum* (Gravenhorst), were promising candidate biological control agents, and Glenn and Jean, along with Glenn's assistant, Leon Chivers, made the first releases of *C. albicans* in Nova Scotia in 1954. Glenn was always quick to acknowledge the assistance of colleagues in Europe and North America (Wylie 1960c), but without Glenn's efforts, the declines in the population of winter moth that were documented by Embree (1965, 1966) would not have happened. The two parasitoids recommended by Glenn established quickly and went on to control the damage of winter moth in Nova Scotia and Prince Edward Island. Embree (1971) estimated that the total cost of the research leading to this result was $160,000 and saved, in Nova Scotia alone, a forest resource valued at $12,000,000 (current value $75,000,000). When winter moth was introduced to Victoria, B.C., Douglas Embree repeated the process, collecting parasites in Nova Scotia, and sending them to Victoria with similar rapid success (Lucarotti 2013).

After completion of the winter moth project, Glenn returned to the study of pteromalid parasitoids of muscid flies. First, he published his thesis research on *N. vitripennis* (Wylie 1958c), and followed this with studies of the effect of host age, size and density on this parasitoid. He also investigated the effects of intraspecific and interspecific interactions of pteromalid parasitoids within the same host. An early benefit of this research was its utilization "…by the USDA in developing mass rearing procedures for parasites released in inundative control programmes against house fly and other pest fly species" (Bulletin of the Entomological Society of Canada 19 [1988]: 91). From 1958 to 1979, Glenn published 21 papers reporting on his studies of pteromalid parasitoids and these have been cited more than 700 times. They continue to be important in the field of host-parasitoid interactions, with more than 50 citations since 2009, some 30–60 years after their publication dates.

In 1972, Agriculture Canada transferred Glenn and many of his colleagues at the Belleville laboratory to the Integrated Pest Management Section of the Winnipeg Research Station. In Winnipeg, Glenn quickly developed a research program on the parasites of key pests of oilseed rape or canola, then a rapidly expanding crop in Western Canada with many little known insect pests. With Gordon Bucher, Glenn used field surveys to assess the role of pathogens and parasitoids in the population dynamics of

bertha armyworm, *Mamestra configurata* Walker (Wylie and Bucher 1977). Glenn went on to document the prevalence and biology of armyworm parasitoids in a series of six papers produced from 1977 to 1979. By 1979 he had begun work on the life history of flea beetles in canola, in preparation for investigating opportunities for their biological control (Wylie 1979b, 1981a). He initially focussed on the biology of an already active parasitoid, *Microctonus vittatae* Muesbeck, and later studied other euphorine braconids, including the European *Microctonus bicolor* Wesmael. This work resulted in a series of 10 papers from 1980 to 1985. From 1978 to 1983, the European parasitoid, *Townesilitus bicolor* Wesmael, was released for biological control of flea beetles, but this species apparently did not establish (Wylie 1988). By 1985, Glenn was working with his technician and graduate student, Frank Matheson, on the parasitoids of aphids that infest alfalfa and field peas (Matheson and Wylie 1985; Wylie and Bisdee 1987). As part of this programme, over 100,000 *Aphidius smithi* Sharma *et* Subba Rao were released against pea aphid, *Acyrthosiphon pisum* (Harris), between 1983 and 1987; assessments in 2001 indicated that this parasitoid had become established (Wylie *et al*. 2005).

Besides his many contributions to biological control of insect pests, Glenn contributed in other ways to entomology. He was a quiet man, not given to self-promotion, but was a valued and willing reviewer and source of expertise and advice for his colleagues. He was Secretary of the Entomological Society of Canada (1982–1984), and chaired the ESC's By-Laws Committee. For the Entomological Society of Manitoba, Glenn chaired the Annual Meeting Committee and Publicity Committee at various times, and was President of the Society in 1976–1977. Glenn was an Adjunct Professor in the Department of Entomology, University of Manitoba from 1982 to 1988. Reflecting the respect he was given by the entomological community in Canada, he was named an Honorary Member of the Entomological Societies of Canada (1988) and Manitoba (1987).

Glenn retired in January 1987 after 37 years working at Agriculture and Agri-Food Canada. He was an active retiree. He volunteered his time at the Fort Whyte Alive Environmental Education Centre, and was a member of the Friends of the Delta Marsh Research Station. He continued to take an interest in entomologists and entomology and, until shortly before his death, encounters with Glenn and his dog were welcome punctuations for some of his former colleagues on their walk home.

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George H. Gerber*

March 19, 1942, St. Walburg, Saskatchewan
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George H. Gerber began his entomological career at the Saskatoon Research Station of what is now Agriculture & Agri-Food Canada. He spent three summers working there on soil insects while studying towards his Bachelor of Science in Agriculture at the University of Saskatchewan. Upon graduation in 1964, George stayed in Saskatoon enrolled in a graduate program in biology and completed a Ph.D. thesis in 1968 entitled: "Structure, formation, histochemistry, fate and function of the spermatophore of the caragana blister beetle, *Lytta nuttalli* Say (Coleoptera: Meloidae)." George was hired in 1969 as a scientist at the Canada Department of Agriculture Research Institute in Belleville, Ontario, where he began a long career investigating the biology of insect pests of crops. In September 1972, George and four of his Belleville colleagues were transferred to the Canada Department of Agriculture Research Station in Winnipeg. He became Head of the Crop and Stored-Products Pests Section at what by then was named the Cereal Research Centre, from 1989 to 1991. George worked there until his retirement in 1996.

From the beginning, George focussed his research on the reproductive biology of insects, particularly the morphology, histology and physiology of reproduction in Coleoptera. His first published paper grew out of a course project in insect physiology on the regulation of the female reproductive cycle in *Tenebrio molitor* Linnaeus (Gerber 1967). His graduate research was a comprehensive description of blister beetle reproduction (*Lytta* spp.) (Gerber *et al*. 1970a; Gerber *et al*. 1971a, b; Gerber and Church 1972, 1973, 1976; Church and Gerber 1977a, b). He sometimes broadened his perspective to apply the insights from this work to insect reproduction in general (Gerber 1967, 1970b), and then moved on to repeat his detailed examination on other species of beetles, first *T. molitor* (Gerber 1973, 1975a, 1976), and then the sunflower beetle, *Zygogramma exclamationis* (Fabricius) (Gerber and Neill 1978, 1979). The latter project was done in collaboration with G. Bruce Neill, the first of four graduate students George advised while an Adjunct Professor at the University of Manitoba. In recognition of his early contributions to our understanding of insect reproduction, George was awarded the C. Gordon Hewitt Award

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for 1981 by the Entomological Society of Canada (Bulletin of the Entomological Society of Canada 13 [1981]: 72–73).

George believed strongly that basic research provides the best foundation for effective applied entomology. So, when he was transferred to an integrated pest management group in Winnipeg in 1972, he used his knowledge of insect reproduction as the starting point for contributing to the management of insect pests of canola. To broaden his expertise in pest management, George took a transfer of work to the Institute of Animal Resource Ecology at the University of British Columbia in 1979. In Winnipeg, he began working on a little known canola pest, red turnip beetle, *Entomoscelis americana* Brown, with investigations of egg survival, and egg and larval development (Gerber 1978, 1981, 1984 1985, 1987; Gerber and Lamb 1982; Lamb and Gerber 1985; Lamb *et al*. 1984). This background knowledge on the development of red turnip beetle was extended to host plant interactions (Gerber 1976; 1984; Gerber and Obadofin 1981a, b). He summed up the work on the life history of this native chrysomelid in reviews (Gerber 1989, 1994) and applied the insights he gained to pest management recommendations (Gerber 1982).

George also contributed his knowledge of insect reproduction to an important canola pest, bertha armyworm, *Mamestra configurata* Walker, and other Noctuidae (Bodnaryk and Gerber 1988; Gerber and Howlader 1987; Gerber and Walkof 1992; Howlader and Gerber 1986a, b; Gerber *et al*. 1991). George ended his research career with a series of papers from 1995 to 1998 on *Lygus lineolaris* (Palisot de Beauvois) in canola, beginning as usual with the reproductive aspects of the pest (Gerber 1995), but moving on to host plant relations and seasonal biology.

Besides maintaining an active research career, George contributed greatly to the Entomological Societies of Manitoba and Canada. In Manitoba, George served as Regional Director for the Entomological Society of Manitoba to the Entomological Society of Canada (1974), as editor of the Manitoba Entomologist (1981), as chair of the Scientific Program Committee (1983), and as Treasurer (1987–1989), as well as on Entomological Society of Manitoba committees. At the national level, George served as Secretary of the Entomological Society of Canada (1975–1978), as chair of the By-laws, Rules and Regulations Committee for many years, as Director-at-Large (1981–1984), and as President (1994). He always took his society responsibilities seriously, and gained a reputation as the person to ask about the intricacies of society business.

After 50 years as a bachelor, George's life took on a new dimension when he and Margaret Elliott were married in 1992. He and Margaret moved into a new house together and George enjoyed establishing another garden. Only four years later, George retired, sooner than he wished, at the time canola research was transferred from the Cereal Research Centre to the Saskatoon Research Centre. In retirement, George moved on from entomology, but maintained his interest in natural history and photographing nature. Through his whole adult life, he was an enthusiastic curler, and continued this passion to the end. He was one of the "Aggie-Row Curlers", a mix of players from the Agriculture Canada Research Station and the University of Manitoba, Faculty of Agriculture. George was one of the keenest supporters of this group almost from the time he arrived in Manitoba. His well-known organizational skills were sometimes tested, when he had to

combine his enthusiasm for arriving on time at the curling rink on a Friday afternoon, with his focussed attention to detail in his research life.

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Dipteran leafminers and an associated parasitoid in canola in Saskatchewan

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Abstract – Many species of insect herbivores feed on canola on the Canadian Prairies, but none have been reported to mine canola leaves. Mines were noted in canola leaves near Melfort, Saskatchewan in 2014, and near Prince Albert, Saskatchewan in 2015. Fly larvae were dissected from the mines and reared. Two adult *Scaptomyza flava* (Fallén) (Diptera: Drosophilidae), one adult *Liriomyza* sp. (Diptera: Drosophilidae) and two adult parasitoids *Halticoptera patellana* (Dalman) (Hymenoptera: Pteromalidae) emerged. The mines and lifecycles of the two species of flies are described. Based on experiences in other parts of the world, neither species is expected to become a significant pest of canola on the Prairies.

Virtually unknown as a crop on the Prairies sixty years ago, oilseed rape or canola (*Brassica napus* L.) (Brassicaceae) reached a high of 8.3 million ha harvested in Canada in 2014 (Canola Council of Canada 2016), rivalling wheat as the nation's leading agricultural commodity. A coterie of insect herbivores feeds on oilseed *Brassica* crops wherever they are grown. Many of these herbivores, both native and adventive, cause sufficient damage to achieve pest status (Lamb 1989). As the hectares of canola have increased on the Prairies, so has the number of insect pests of the crop (Altieri 1999). Insects known as pests early in *B. napus* production in Canada such as bertha armyworm, *Mamestra configurata* Walker (Lepidoptera: Noctuidae) (Turnock and Philip 1977), a native species, and flea beetles *Phyllotreta* spp. (Coleoptera: Chrysomelidae) (Burgess 1977), invasive alien species, have been joined by other species achieving pest status such as native and cosmopolitan *Lygus* spp. (Hemiptera: Miridae) (Butts and Lamb 1991), and diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae) (Dosdall *et al*. 2011). With time, other introduced species such as swede midge, *Contarinia nasturtii* (Kieffer) (Diptera: Cecidomyiidae) (Hallett and Heal 2001), have arrived, adding to the list of insect pests of canola in Canada. In 2014 and 2015, several oilseed *Brassica* accessions

were compared for their susceptibility to *C. nasturtii* (Diptera: Cecidomyiidae) and flea beetles (Coleoptera: Chrysomelidae) at the Agriculture and Agri-Food Canada Melfort Research Farm (N52°49′ lat., W104°36′ long.). Plots were grown on canola stubble surrounded by peas, *Pisum sativum* L. (Fabaceae), in an area adjacent and to the south of a mature Manitoba maple (*Acer negundo* L. var. *interius* (Britt.) Sarg.) shelterbelt. In 2014, seeding took place 21 May. On 5 July, the majority of *B. napus* plants were in the bud stage, with their inflorescence raised above the level of the rosette. Many *B. napus* plants had mines in their leaves, with Diptera larvae inside, whereas none were observed on the *Brassica juncea* L. (four accessions), *B. rapa* L. (two), *B. carinata* A. Braun (three), *Sinapis alba* L. (two), and *Camelina sativa* (L.) Crantz (three) accessions that were part of the same study. Mines were noted on all 17 accessions of *B. napus.* There was no apparent relationship between the level of infestation and distance from the shelterbelt, nor among *B. napus* lines. Some leaves contained more than one larva, and frass could be seen as dark areas within the mined area (Figure 1), which aids in distinguishing insect mines from white leaf spot, *Pseudocercosporella capsellae* (Ellis & Everh.) Deighton (Capnodiales: Mycosphaerellaceae), infection. A leaf with one mine was collected from each of 15 different *B. napus* plants, the larvae were removed and placed on moist sand one per vial, in a laboratory growth chamber at 22°C, 16:8 h light:dark conditions. Four adult insects emerged, which were sent to the National Identification Service (Entomology) in Ottawa for identification. Two specimens were of *Scaptomyza flava* (Fallén) (Diptera: Drosophilidae), one was a female *Liriomyza* sp. (Diptera: Agromyzidae), and one was *Halticoptera patellana* (Dalman) (Hymenoptera: Pteromalidae). In 2015 at Melfort, plots were seeded on 14 May similar to the protocol of 2014, but no leafminers were found on any brassicaceous lines. Similar mines were observed near Prince Albert on 16 July, 2015, in plots of *B. napus* at the Saskatchewan Conservation and Learning Centre (52°02′ N, 105°77′ W). Only three mines were evident and all three leaves bearing mines were collected and kept individually in mini BugDorm cages (MegaView Scientific). Only one yielded an adult insect: one female *H. patellana*. Larval survival to emergence of either adult flies or parasitoids was low and a change in rearing tactics to placing leaf-mined leaves onto damp filter paper in a Petrie dish (Martin 2012) might improve rearing success.

Scaptomyza flava is Holarctic, found in Eurasia from Siberia to the Mediterranean Sea region. In North America, *S. flava* adults are usually grey but a yellow form that may have been introduced from Europe is present as well (Hackman 1959). Earlier believed to

Figure 1. A *Brassica napus* leaf with *Scaptomyza flava* (Diptera: Drosophilidae) mining injury, Melfort Research Farm, Melfort, SK, Canada, 18 July 2014 (T. Wist).

be absent from the Canadian prairies (Stone *et al*. 1965), *S. flava* seems now to be widespread here; there are specimens of *S. flava* in the Biodiversity Institute of Ontario collected at Jasper National Park in 2012, and at many locations from Calgary to Winnipeg in 2015 (Ratnasingham and Hebert 2007). At this point, it is unclear whether or not *S. flava* is adventive to North America from Europe or Asia. The larvae pupate in leaves or soil. Most adult flies emerge from puparia, in the early hours of the photophase, and most mating occurs at the same time a day later (Shakeel *et al*. 2009). Incisions created by the female flies' ovipositors leak plant fluid that they consume. Eggs are laid in some of these incisions (Shakeel *et al.* 2009). Under laboratory conditions of 20±1°C, 60%±5 R.H. and 16:8 h light:dark, a female starts to lay eggs about three days after emerging, reaches her peak rate of oviposition by about day 10, and may continue to lay a decreasing number of fertile eggs for up to about 25 days, with a potential lifetime total of around 70 eggs (Shakeel *et al*. 2009). Adults are weak fliers, as inferred from their tendency to lay more eggs near artificial windbreaks in experimental field plots (Lewis 1966). Upon eclosion, most larvae create a narrow, serpentine mine in the direction of the midvein. There are three larval instars, delineated by measurements of the mandibles and skeleton made with illumination by transmitted light (Martin 2012). This illumination method also helps to differentiate *S. flava* from *Liriomyza spp*. larvae. The mine may follow the vein a short way and then it widens to form a blotch (Fig. 1). The blotch mine can be used to differentiate between infestation by *S. flava* and *Liriomyza* spp. on brassicas (Fig. 1). Several *S. flava* larvae may be in the same blotch mine (Whiteman *et*

al. 2011). About 21 days are required for development from eggs to new adults at 22°C (Whiteman *et al*. 2011). *Scaptomyza flava* is polyphagous; the range of hosts mined by *S. flava* larvae comprises species in nine plant families, and includes such crops as *P. sativum*, *Solanum tuberosum* L. (Solanaceae), and leafy *Brassica* vegetables (Martin 2004). Although multivoltine and frequently present in leaves of young plants, *S. flava* is not considered a pest of oilseed *Brassica* crops in Europe (Frey 1951; Stapel 1961; Alford 2011), with the possible exception of Ukraine (Sekun and Snezhok 2014). In New Zealand, *S. flava* is considered a serious enough pest of brassicas (Martin 2012) that research into the most effective insecticides was warranted (Martin *et al.* 2006).

Females of *Liriomyza* are usually unidentifiable at the species level (Spencer 1986). In the United States, *Liriomyza brassicae* (Riley), *L. sativae* Blanchard, and *L. huidobrensis* Blanchard, are all known to mine *Brassica* species as well as *Pisum* (Spencer 1986). However, only the cosmopolitan *L. brassicae* has been recorded on the Canadian prairies (Ratnasingham and Hebert 2007; Spencer 1969; Sehgal 1971), and so the specimen collected at Melfort may belong to this species. *Liriomyza huidobrensis* was discovered recently in southern Ontario, but is believed to winter there only in greenhouses (Bahlai *et al.* 2006), and *L. sativae* also is known in Canada only from Ontario (CABI 2006). *Liriomyza bryoniae* (Kaltenbach) is also associated with Brassicaceae hosts, but is known only from the Palearctic region (CABI 1999). Like those of *S. flava*, female *Liriomyza* pierce leaves with their ovipositors to deposit eggs and feed from the wounds (Parella 1989). Larvae feed on leaf mesophyll tissue in a serpentine pattern that gives this genus the common name of "serpentine leafminer" (Werner 1982) and will remain in leaves unless crowding forces them into the stem (Parella 1989). *Liriomyza* larvae usually pupate in the soil (Parella 1989). *Liriomyza* species are not considered pests of oilseed *Brassica* crops, except perhaps in Egypt (Sayed and Teilep 2013).

The Universal Chalcidoidea Database (Noyes 2016) lists various hosts of *H. patellana*, including at least seven *Liriomyza* species, and *S. flava*. The CABI (2008) datasheet does not list *S. flava*, as a host. Other *Halticoptera* species though are associated with agromyzid (Bahlai *et al*. 2006) and drosophilid hosts, including *S. flava* [as *S. apicalis* Hardy (Hoffman and Joliffe 2005)], and so the *H. patellana* collected in our study may have come from either host species. Parasitism frequently contributes to the maintenance of leafminer density below that at which economic damage occurs, particularly when the marketable portion of the crop is other than the leaf (Liu *et al*. 2009), as is the case here. The leafminers discovered first at Melfort are likely to cause negligible losses to prairie canola production, considering their significance or lack thereof elsewhere, and especially given that a parasitoid already has been found. However, the crop and area will be worth monitoring in the future to confirm that leafminer densities remain low.

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First Manitoba records of the non-native beetles, *Cantharis rufa* (Coleoptera: Cantharidae) and *Hippodamia variegata* (Coleoptera: Coccinellidae)

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Abstract – Here we present the first records of occurrence for two non-native beetle species in Manitoba, Canada: the soldier beetle *Cantharis rufa* and the lady beetle *Hippodamia variegata*.

Introduction

Cantharis rufa (Linnaeus) is a soldier beetle (Cantharidae) inadvertently introduced into Atlantic Canada from Europe. The first known record is from New Brunswick in 1901 (C. Majka, *personal communication*, 23 November 2015), and it was later found in Nova Scotia in 1914, insular Newfoundland in 1950, and Prince Edward Island in 1952 (C. Majka, *personal communication*, 23 November 2015). The known range of *C. rufa* in Canada includes the Maritime Provinces (excluding Labrador), Quebec, and southern Ontario (Brown 1950, Bousquet *et al*. 2013, Pelletier and Hébert 2014, C. Majka, *personal communication*, 23 November 2015). Records of occurrence from the United States include New York, Massachusetts, and the northern Appalachians (Pelletier and Hébert 2014). The habitat of this species is typically grasslands, softwood tree plantations, and young forests (Pelletier and Hébert 2014). Little appears to be known about the life history of *C. rufa*, with adults reported as short-lived beetles which feed on pollen, nectar, and aphids (Evans 2014).

The variegated lady beetle, *Hippodamia variegata* (Goeze), native to Europe, northern Asia (excluding China), and North Africa, has been successfully introduced to North America, South Africa, Australia, and Chile to control aphids on crops (Wheeler 1993, Franzmann 2002, Rebolledo *et al*. 2009). The species was first intentionally introduced to the USA from 1957–1958 (Gordon and Vandenburg 1991) but has not been released in Canada. It was first reported in Canada in the vicinity of Montreal, Quebec in 1984 (Gordon 1987). The species was detected in New Brunswick in 1987, Ontario in 1989, Prince Edward Island in 1991, insular Newfoundland in 1992, Nova Scotia in 1994, and

British Columbia in 2009 (Klimaszewski *et al*. 2015). The species became common in Ontario in the 1990s (Marshall, no year) and now occurs as far west as Manitoulin Island and Windsor (Klimaszewski *et al.* 2015). The British Columbia population likely represents a translocation of specimens from eastern North America (Klimaszewski *et al*. 2015). Although the species was widely released in the United States, *e.g*., from New Jersey to Florida, Texas to California, and Hawaii (Wheeler 1993), not all releases were successful. Wheeler (1993) recorded it surviving in eight New England states in 1992, and it had dispersed to western Wisconsin, Minnesota and South Dakota by 2009 (Williams and Young 2009, Hesler and Lundgren 2010, Heidel and Morey 2011). The dispersal of *H. variegata* may be augmented by high fecundity. In Greece, females may produce 960 eggs, with a mean generation time of 34 days (Kontodimas and Stathas 2005).

It is interesting that both *C. rufa* and *H. variegata* were found for the first time by a number of collectors in 2014 and 2015 in Winnipeg and surrounding areas. These localities had been frequently surveyed in previous years, with no sign of the beetles' presence. Surveys in a number of suitable natural habitats from Winnipeg to the United States' border by Wrigley failed to reveal their presence over the past two decades, and neither species was collected in recent crop surveys in southern Manitoba (J. Gavloski, Manitoba Agriculture and Rural Development, *personal communication*, 4 February 2016).

Here we provide the first records of occurrence for *C. rufa* and *H. variegata* in Manitoba. We will discuss the locations of specimens, potential source populations, and the future impacts of these species in the province.

Materials and Methods

Three specimens of *C. rufa* (Fig. 1) were collected by aerial net in Winnipeg, Manitoba, by staff of the Living Prairie Museum (LPM). Two specimens were found on 9 June 2015 in a tall grass prairie remnant in Assiniboine Forest (49.856307 N, 97.249187 W), one by E. Miller on dandelion (*Taraxacum officinale* F.H. Wigg.), and one by K. Morwick and H. Webb on three-flowered avens (*Geum triflorum* Pursh). A third specimen was collected by K. Morwick and H. Webb on 30 June 2015 in the remnant tall grass prairie habitat of LPM (49.89050 N, 97.27149 W) on beautiful sunflower (*Helianthus pauciflorus* Nutt.); however, pollinia on the meso tarsi indicate it had also visited milkweed (*Asclepias* spp.). Specimens were identified using Pelletier and Hébert (2014) and were verified by photograph by Georges Pelletier in October 2015. These three specimens are deposited in the LPM entomological collection.

Wrigley (2015) reported *C. rufa* from three additional locations in Manitoba. Two specimens were captured from Birds Hill Provincial Park (50.017835 N, 96.935951 W) on 11 June 2014 from roadside willows, and one specimen from Kenaston Boulevard in Winnipeg (49.86 N, 97.22 W) was collected on the night of 5 June 2015 from the wall of a building adjacent to a water-retention pond. Furthermore, *C. rufa* and *Cantharis aneba borealis* (Fender) were abundant on several kinds of flowers in Labarrière Park, south of Winnipeg (49.74 N, 97.15 W) on 21 June 2015 (Wrigley 2015). Specimens of *C. rufa*

were collected and deposited in the Wallis/Roughley Museum of Entomology (WRME), University of Manitoba, and the Manitoba Museum.

Semmler found one specimen of *H. variegata* (Fig. 2) in tall grass prairie habitat within Little Mountain Park, Manitoba (49.957278 N, 97.247553 W) on 27 June 2014, and a second specimen at LPM on 21 September 2014. She collected three specimens from the LPM's prairie seed plots located in St. Norbert (49.746077 N, 97.145501 W), one on 9 September 2014 and two on 22 September 2014. Specimens were identified using Marshall (2007) and Kits and Quinn (2015), and are currently held in the LPM entomological collection.

Wrigley collected 20 specimens of *H. variegata* on 16 May 2015 at Birds Hill Provincial Park, Manitoba (51.40 N, 97.03 W) on a patch of balsam poplar (*Populus balsamifera* Linnaeus) in the center of an abandoned gravel pit. No other species of beetles were observed. Three additional specimens were collected on 31 June 2015 on Ducharme Road north of Highway 15, 3 km NW St. Rita (49.86 N, 96.33 W) in a shrub-meadow opening within aspen-jack pine forest (deposited in WRME). Four other species of lady beetles were common in the same vegetation: the native three-banded lady beetle (*Coccinella trifasciata* Linnaeus), the parenthesis lady beetle (*Hippodamia parenthesis* Say), the non-native Halloween lady beetle (*Harmonia axyridis* Pallas) and the seven-spotted lady beetle (*Coccinella septempunctata* Linnaeus).

Figure 1. *Cantharis rufa*. Photos by S. Semmler.

Figure 2. *Hippodamia variegata*. Photos by S. Semmler.

Discussion

The means of arrival and abundance of *C. rufa* in Manitoba is unclear. The species is common in much of its eastern range (Pelletier and Hébert 2014, C. Majka *personal communication*, 23 November 2015). The nearest source population in Ontario reported by Pelletier and Hebert (2014) is Manitoulin Island, ~1200 km east of Winnipeg. Eight specimens in the WRME were collected on 30 June 1984 at Katharine Cove (47.44 N, 84.75 W) in Lake Superior Provincial Park, Ontario, indicating a source population ~947 km east of Winnipeg. While it is possible that *C. rufa* spread to Manitoba via North Dakota, the species is not yet known from that state based on examination of specimens at the University of Minnesota (R. Thomson, *personal communication*, 19 November 2015), University of North Dakota, Grand Forks (J. Vaughan, *personal communication*, 23 November 2015), and North Dakota State University, Fargo (G. Fauske, *personal communication*, 29 January 2016). However, both individuals from North Dakota reported that numerous *Cantharis* specimens in their collections had not been identified to species, so perhaps *C. rufa* may be represented there. Also, no records or specimens are

known farther west in the Minot, North Dakota area (G. Handley, *personal communication*, 29 January 2016). As the boreal forest is suitable habitat for *C. rufa*, and the closest known population in Canada exists in Ontario, it seems likely that *C. rufa* spread through boreal habitat from Ontario to Manitoba, either naturally or with human assistance.

The North Dakota-Minnesota population of *H. variegata* is the likely source of the Manitoba population. Heidel and Morey (2011) reported the first Minnesota records of *H. variegata* in soybean and sweet corn fields in the summer of 2009 at Evansville, St. Paul, and Rosemount. The expansion has been attributed to available prey such as the soybean aphid (*Aphis glycines* Matsumura) and the corn leaf aphid (*Rhopalosiphum maidis* Fitch) (Heidel and Morey 2011). The entomology collection of the University of Minnesota lists specimens from the state starting from 2009 (R. Thomson, *personal communication*, 5 February 2016). In North Dakota, the species was first noticed, and was already common, in 2013 in the Fargo area (G. Fauske, *personal communication* 29 January 2016). No specimens are currently known farther west in the region of Minot, North Dakota (G. Handley, *personal* comm*unication* 29 February 2016). Thus, Fargo represents the closest known population to Manitoba.

It is possible that one or both of these species represent recent range expansions through a combination of human activity and natural dispersal. Non-native beetles have been transported between provinces on seedlings, garden ornamentals, building materials, firewood, and food products (Polland and McCullough 2006, Majka and LaSage 2008, Haack *et al.* 2010, CFIA 2012). Also, Wrigley has found numerous species of cantharids and coccinellids occurring in the sedge-grass-shrub borders of roads, rail lines, and watercourses, which present suitable dispersal routes into new areas. For example, individuals could fly along the Red River riparian forest, or raft down the river from Fargo, 226 km away. Lady beetles are frequently found in large numbers along shores of rivers and lakes, and they may survive above the water surface for the several weeks it takes for driftwood or live trees to carry them to Winnipeg and Birds Hill Park. There is also evidence of range expansions linked to increased seasonal temperatures due to climate change for several species of insects in Canada (Kerr 2001, Carroll *et al.* 2003, Westwood and Blair 2010, Semmler and Westwood 2013).

In view of both species' apparent rapid expansion westward from eastern North America, we surmise that they arrived in southern Manitoba from Ontario, Minnesota and North Dakota. Manitoba's diverse natural and altered habitats provide suitable resources and the warm summer climate is conducive to establishment and persistence of populations.

It will be interesting to observe if *C. rufa* and *H. variegata* fit relatively innocuously into Manitoba's insect fauna, or become a threat to native biodiversity. Introduced lady beetle species have been found to have a negative impact on native aphidophagous insects through competition for prey (Roy *et al*. 2016). *Cantharis rufa* has yet to be designated as a pest species within Canada (CFIA 2015); however, larvae and adults are predatory so it is possible that this beetle species could affect other insects (Evans 2014, Pelletier and Hébert 2014). Further surveys in Manitoba are needed to better understand range, abundance, and interactions with native species.

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71st Annual Meeting Entomological Society of Manitoba, Inc.

Friday October 23, 2015
Freshwater Institute
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and
Saturday October 24, 2015
Room 219 Animal Science/Entomology Building
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Abstracts

KEYNOTE ADDRESS

INSECT CELL LINES: USEFUL MODELS TO STUDY THE MODE OF ACTION OF INSECTICIDES.

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The Coleoptera represent the most species-rich order within the class Insecta, with 387,100 described species. Yet in contrast to this species richness, the importance of beetles in ecosystem functions and as significant pests of agriculture and forestry, little more than 30 continuous beetle cell lines have been reported in the literature. In this presentation, I will summarize our effort toward the development of an emerald ash borer (*Agrilus planipennis* Fairemaire) cell line to study the molecular mode of action of azadirachtin. After numerous unsuccessful attempts, a single EAB attached cell line was obtained, and has now been passaged more than 100 times. The cell line is sensitive to the botanical insecticide azadirachtin, with 10^{-6}M concentrations triggering extensive cell death at 7d post treatment. Gene expression changes induced by azadirachtin were also studied by RNAseq. During our quest to obtain an EAB cell line, we also accidentally isolated and propagated a cell line from an unrelated beetle, the ash and privet borer (*Tylonotus bimaculatus* Haldeman). The latter cell line was studied for its response to ecdysone and diacylhydrazine insecticides. The benefits and limitations of cell lines in insecticide research will be discussed.

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SYMPOSIUM

Molecular Approaches to Fundamental and Applied Entomology

DIVERGENT TRANSCRIPTIONAL REGULATION AND SPECIATION IN *DROSOPHILA*.

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Hybrid male sterility resulting from crosses between closely related species is a common barrier to free gene flow. Several studies have conducted both gene-specific as well as genome-wide assays of gene expression in comparisons between parental species and male sterile hybrids to identify candidate speciation genes. Most studies have highlighted a potential role of late sperm developmental genes (spermiogenesis) in hybrid male sterility. However, in the absence of fully fertile control hybrids, it is impossible to differentiate between misregulation associated with sterility *vs.* misregulation driven by fast male gene evolution. In order to isolate sterility effects from evolutionary divergence in the absence of sterility, we have used both genetic introgression approaches to create fertile hybrids and species pairs that produce unidirectional male sterility (i.e. only one direction of the parental species cross produces sterile hybrid males). In gene specific assays that targeted spermatogenesis genes, we have identified several cases of misregulation of spermatogenesis genes in the absence of sterility and patterns that are lineage-specific. In a genome-wide assay, we identify more severe genome-wide misregulation in the sterile than the fertile male hybrids, with no prevalence for genome-wide under expression in the sterile condition relative to parental species. Proteases were the only male reproductive tract gene ontology class overrepresented among genes uniquely misexpressed in the sterile hybrids.

MARKER ASSISTED SELECTION FOR BREEDING RESISTANCE TO HONEY BEE PARASITES AND PATHOGENS.

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Honey bees are subjected to a variety of stressors related to parasites, disease, pesticides and the environment that collectively have resulted in high frequencies of colony

mortality over the past 7–8 years. Breeding bees to enhance traits associated with resistance to parasites and disease could reduce the impact of some of the major stresses and help to improve overall honey bee colony health. However, current methods that are used for selecting traits in honey bees associated with resistance involve time-consuming assays that are difficult for commercial beekeepers to use when making stock selection choices. We examined the potential for a unique approach using proteomic markers that were correlated with behavioural resistance mechanisms in selecting for resistance. After only three generations of selection using proteomic markers, results were equivalent to standard field-based assays currently used for selection. Bees selected using this method showed improvement in several parameters related to colony health and increased colony survival when compared to unselected bench mark populations.

PREVENTION OF ISRAELI ACUTE PARALYSIS VIRUS (IAPV) INFECTION IN HONEY BEES USING DSRNA

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Israeli acute paralysis virus (IAPV) is a serious pathogen of the honey bee, *Apis mellifera* L., vectored by the parasitic mite *Varroa destructor* Anderson and Trueman. Our objective was to assess the efficacy of different dsRNAs targeted to various regions of the IAPV genome in preventing IAPV infection in honey bees. Ten treatments were applied to different bioassay cages each containing fifty newly emerged adult bees that were held at 30°C in a temperature-controlled incubator. The overall aim of our study is to delay the development of resistance to RNAi by targeting stable regions of the virus. We focused on low variability (lower chances of developing resistance) and high variability (high chances of developing resistance) regions of IAPV as target areas. We fed IAPV to adult bees along with each double-stranded (ds) RNA construct in sugar syrup. Only one treatment that was from a region with low variability had lower IAPV concentration than the positive controls (GFP and IAPV). However, several constructs within low and high variability regions had higher bee survival than IAPV inoculated positive controls. There was selection of constructs from low variation regions, and other regions can provide control as effective or more effective than existing commercially designed constructs. IAPV-specific dsRNA could be an important tool for improving the healthy development of honey bee colonies.

MITOGENOMIC HYPOTHESIS TESTING IN *JUNONIA* BUTTERFLIES.

Jeffrey M. Marcus. Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

The New World species of buckeye butterflies (genus *Junonia*) is a recent diversification (less than 4 million years). Previous phylogenetic analysis of 658 bp *COI* DNA barcodes or short nuclear and mitochondrial coding sequences suggests that the New World *Junonia* contains three distinct lineages, which may form a monophyletic group, but with low bootstrap support. The genus *Junonia* clearly originated in the Old World, but it is not clear if the New World was colonized from Africa or the Asia-Pacific region. Two possible sister taxa were proposed: *J. orithya* (L.) (Africa and Asia) and *Junonia villida* (Fab.) (Asia-Pacific). Sequencing the 15.3 kb mitochondrial genomes of 19 *Junonia* specimens (both Old and New World forms) suggests that *Junonia* is not monophyletic and invaded the New World from the Pacific on 3 separate occasions. *Junonia villida* (Fab.) (or a similar Pacific ancestral taxon) is responsible for 2 invasions, while the third came from a taxon related to Asian *J. lemonias* (L.). After each invasion, the lineages diversified. The two lineages related to *J. villida* hybridize relatively frequently and undergo genetic exchange, while the lineage related to *J. lemonias* appears to be genetically distinct and appears to have given rise to only a single New World species: *J. vestina* C. and R. Felder. *Junonia vestina* differs from most other *Junonia* (which are lowland species) in that it occurs at elevations of 1800–4000 m. Comparing the mitogenome of *J. vestina* with other *Junonia* is an opportunity to test hypotheses for mitochondrial adaptation originally proposed based on sequences from high altitude-adapted mammal species.

A MOLECULAR APPROACH TO CONTROL POPULATIONS OF DENGUE VECTOR MOSQUITOES.

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With mosquito-borne pathogens threatening over half the world's human population, the need for environmentally-safe mosquito population control methods remains paramount. The sterile insect technique (SIT) is a biological control method that can reduce pest insect populations by releasing a large number of sterile males to compete with wild males for female mates to reduce the progeny produced. Typically, males are sterilized using radiation, but such methods can reduce their mating competitiveness. The method is also most effective if only males are produced, but this requires the development of effective sex-sorting methods. Recently, we have developed a non-transgenic, non-radiation method of generating fit sterile male *Aedes aegypti* (L.) that efficiently mate with females, preventing the production of offspring. Larval mosquitoes were fed double-stranded RNAs (dsRNAs) that induced an RNA interference (RNAi) mediated knockdown of both male fertility genes and a female sex determination gene to generate a male-biased sterile adult population, which overcomes the need to sex-sort insects before release. The sequence-specific gene-silencing mechanism of this RNAi technology renders it adaptable for species-specific application across numerous insect species. We envisage its use for traditional large-scale reared releases of mosquitoes and other pest insects, although the technology may also have potential for field-based production of

sterile males reared from oviposition traps, where females deliver eggs into a dsRNA-treated larval site from which only fit sterile males emerge as adults.

SUBMITTED PAPERS

SPECIES-SPECIFIC INSECT CONTROL USING RNA INTERFERENCE.

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The gene silencing mechanism RNA interference (RNAi) uses double-stranded RNA (dsRNA) to target and prevent translation of specific genes' mRNA transcripts within an organism. DsRNA reduces the expression of tubulin and vATPase genes when fed to several insect species, such as fruit flies, aphids and moths. Similarly, when larvae of the dengue vector mosquito, *Aedes aegypti* (L.) are soaked for a relatively short period of time in a dsRNA solution targeting *β-tubulin*, they subsequently showed reduced gene expression and increased mortality. RNAi may be used to reduce populations of disease vectors, as well as populations of agricultural pests, and the technology is currently being tested on pest insects of canola. Using various delivery methods for dsRNA, and targeting genes specific to insects, RNAi has potential as a species-specific insect control method, reducing or eliminating the use of broad spectrum chemical pesticides that may harm the environment and kill beneficial species.

CHARACTERIZING PUTATIVE CELLULAR MEDIATORS OF WEST NILE VIRUS INFECTIONS IN *AEDES AEGYPTI* AND *CULEX QUINQUEFASCIATUS* MOSQUITO CELLS.

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West Nile virus (WNV) is a mosquito-borne zoonotic arbovirus that arrived in North America in 1999 and subsequently spread quickly across the continent. This spread has been mediated by the large number of host organisms it infects, such as birds, reptiles, and mammals, and by its transmission vectors, mosquitoes. The virus infects mosquito species differently, with some species, including many within the genus *Culex* having high infection rates, while other species, such as those in the genus *Aedes*, show reduced competency for virus transmission. Differences in mosquito vector competence can be due to differences in the ability of WNV to enter mosquito cells. Using RNAi techniques, the role of two clathrin coat adaptor proteins in facilitating WNV infections in mosquito cells was examined, and the findings suggest that these proteins may act as susceptibility factors in *Culex quinquefasciatus* (Say), and as resistance factors in *Aedes aegypti* (L.). These findings will contribute to our understanding of the molecular basis of vector competence in different mosquitoes, and may help us determine whether other species could serve as potential vectors of this health-threatening virus.

CHARACTERIZING INNATE IMMUNE RESPONSE TO WEST NILE VIRUS IN THE MOSQUITO *AEDES AEGYPTI*.

Cassidy N.G. Erdelyan[1], M. Drebot[2], and Steve Whyard[1]. [1]Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; [2]Viral Zoonoses, National Microbiology Laboratory, Winnipeg, Manitoba, Canada R3E 3R2.

The Toll pathway is an immune signalling pathway present in insects, which when activated by pathogens, leads to the production of anti-microbial peptides (AMPs). While many of the intracellular signalling molecules of the Toll pathway have been characterized in *Drosophila melanogaster* Meigen and *Tenebrio molitor* L., considerably less is known of the signalling pathway in mosquitoes. Similarly, an extracellular serine protease cascade has been identified in both *Drosophila* and *Tenebrio* that serves to activate the Toll pathway, but no components of the corresponding pathway have been adequately described in mosquitoes, despite the fact that mosquitoes are frequent carriers of pathogens that can infect their blood-meal hosts. We have identified a putative modular serine protease (modSP) in the mosquito, *Aedes aegypti* (L.), that appears to interact with a non-structural protein (NS1) from West Nile virus. RNA interference (RNAi)-mediated knockdown of *modSP* in *A. aegypti* resulted in increased susceptibility to microbial challenge, which suggests that this serine protease plays a role in the mosquito Toll pathway. The functional validation of other proteins in the Toll pathway and interactions with NS1 could help us understand the range of the mosquito's immune responses and uncover the molecular basis of mosquito susceptibility to different viral pathogens.

DETECTION OF PATHOGEN SPILLOVER FROM MANAGED HONEY BEES (*APIS MELLIFERA* L.) TO NATIVE POLLINATORS (*BOMBUS* SPP.) THROUGH THE QUANTIFICATION OF RNA VIRUSES.

C. Robson-Hyska, R. Currie and S. Desai. Department of Entomology, University of Manitoba, Winnipeg, Manitoba Canada R3T 2N2.

Recent declines of bee species worldwide have raised concerns as to the fate of major commercial and wild flowering plants dependent on these bees for pollination. In North America, declines in native species have been attributed to pathogen spillover from imported pollinators used for greenhouse and crop pollination. Among these pathogens are a small group of RNA viruses that result in reduced survivorship of colonies. However, little is known about the distribution of these viruses in different habitats. This study focuses on seven of these viruses in commercial honey bees (*Apis mellifera* L.), and examines their prevalence and concentration in native bumble bees from different landscapes (*Bombus* spp.) (Hymenoptera: Apidae, Bombini). Sampling of bumble bees and honey bees occurred at sites both near and far from contact with managed honey bee colonies throughout the foraging season. RNA was extracted from each specimen and analysed for viral quantities using RT-qPCR. Comparisons of virus titres in bumble bees from both types of sites will shed some light on the extent to which pathogen spillover may occur and generate momentum for developing conservation strategies.

WAX AND WINGLESS FLIES: HONEY BEE VIRUSES IN UNEXPECTED PLACES.

M.J. Colwell[1], R.W. Currie[1], and S.F. Pernal[2]. [1]Department of Entomology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; [2]Agriculture & Agri-Food Canada, Beaverlodge, Alberta, Canada T0H 0C0.

Although there are many insect pollinators, European honey bees (*Apis mellifera* L., Hymenoptera: Apidae) are arguably the most economically important and recognizable of the commercial pollinators. However, higher than normal declines in the past decade have put the honey bee industry at risk. Viruses are likely one of the key factors in honey bee health. Little work has been done to explore the possible role of wax comb, the substrate on which all hive activities take place, as an element in virus transmission. The so called "bee louse", *Braula coeca* (Nitzsch) (Diptera: Braulidae), is a wingless fly inquiline in honey bee colonies. It is now established in University of Manitoba's apiary, possibly a first in Canada. Although considered a commensal in temperate regions, it can be a serious pest in warmer regions. We show the first detection and quantification of honey bee viruses on wax comb and in *B. coeca* from honey bee colonies. A modified TRIzol wash was used to test comb for viruses, and a standard RNA extraction kit was used for tissue samples from *B. coeca*. Upcoming experiments are planned to determine if viruses on wax comb are infective to bees, and the potential role of *B. coeca* in virus transmission.

SERIAL INFECTION OF *CULISETA INORNATA* (DIPTERA: CULICIDAE) WITH RIFT VALLEY FEVER AND CACHE VALLEY VIRUSES UNDER LABORATORY CONDITIONS

M. Iranpour [1,2], A. Dibernardo [1], and R. Lindsay [1,2]. [1]Zoonotic Diseases and Special Pathogens, National Microbiology Laboratory, Public Health Agency of Canada, 1015 Arlington St., Winnipeg, Manitoba, Canada R3E 3R2; [2]Department of Entomology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2

Cache Valley virus (CVV) and Rift Valley virus (RVFV) are members of the family Bunyaviridae and these viruses can cause illness in humans and livestock in North America. Based on previous studies, *Culiseta inornata* (Williston) has shown competence to acquire and transmit these viruses separately. However, it was unknown whether interaction between the viruses might result in competitive exclusion if both viruses were introduced into the same vector mosquitoes. This scenario is rather realistic given the widespread prevalence of CVV and the possible introduction of RVFV into North America. To test this hypothesis, five groups of 100 laboratory-reared *Cs. inornata* were inoculated with either: 1) CVV alone, 2) RVFV alone, 3) RVFV then one week later with CVV, 4) CVV then one week later with RVFV, and 5) a mixture of both CVV and RVFV. After an incubation period of 15 days, 284 mosquitoes survived in all five treatments and the bodies and saliva from these mosquitoes were tested for CVV and RVFV using Real-time PCR. The presence of RVFV or CVV infection in *Cs. inornata* mosquitoes did not appear to impair the ability of either virus to replicate in co-infected

mosquitoes. These preliminary findings suggest that pre-existing infection in competent vector mosquitoes would not be a barrier to RVFV incursion into North America.

WHY ARE SO MANY WINTER WHEATS FROM EASTERN NORTH AMERICA RESISTANT TO WHEAT MIDGE?

R.J. Lamb, M.A.H. Smith, I.L. Wise, and R.I.H. McKenzie. Agriculture and Agri-Food Canada, Cereal Research Centre, 101 Route 100, Unit 100, Morden, Manitoba, Canada R6M 1Y5.

Nine winter wheat cultivars (*Triticum aestivum* L.) were the source of the *Sm1* gene for resistance to wheat midge**,** *Sitodiplosis mosellana* (Géhin) (Diptera: Cecidomyiidae), in spring wheat. All nine showed antibiosis characteristic of *Sm1*, as expected. They also showed oviposition deterrence and reduced hatch which contributed to overall resistance. The overall level of resistance of the nine winter wheat cultivars was usually lower than that of resistant spring wheat lines in laboratory trials, but equally high in a field trial. Five of seven other North American winter wheat cultivars also showed resistance. Three of these were grown in the 1920's and earlier, before wheat varieties were officially registered. One of these, 'Mediterranean', came from Europe in the 1880's and may be the origin of *Sm1* in North America. Two of eleven Chinese winter wheat lines showed resistance to wheat midge but at a lower level than that characteristic of *Sm1*. Widespread resistance in North American winter wheat cultivars was unexpected because wheat midge has not been a pest of winter wheat for many decades. North American winter wheat cultivars can provide sources of resistance to wheat midge, particularly high levels of oviposition deterrence as exhibited by 'Goens' and 'Rawhide'.

THE EFFECTS OF CROWDING AND HOST-PLANT QUALITY ON SOYBEAN APHID WING INDUCTION.

Aldo Rios-Martinez and Alejandro C. Costamagna. Department of Entomology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

The soybean aphid, *Aphis glycines* Matsumura (Hemiptera: Aphididae), is an important agricultural pest in North America. Summer colonies of soybean aphids are composed of apterous and winged parthenogenetic individuals. Differences in the life cycle roles of these two morphs and their proportions within a population are essential factors for understanding the population dynamics of the soybean aphid and provide a good model for studying phenotypic plasticity from an adaptive perspective. Among some of the environmental factors known to influence the production of winged individuals in several other species of aphids are host-plant nutritional quality and crowding. A field cage experiment was conducted to determine the effects of these two factors on morph determination and development performance of soybean aphid nymphs. Plant nutritional quality impacts on aphids were tested by rearing nymphs in clip cages set on artificially aphid-infested versus un-infested soybean plants. Within-plant nutritional quality effects were tested by setting pairs of clip cages on top versus bottom nodes. Finally, tactile stimuli resulting from crowding were tested by comparing high versus low densities of aphids inside clip cages. Preliminary results suggest that plant infestation level, within-

plant nutritional quality and crowding result in combined cues for wing development in the soybean aphid.

DO NATURAL ENEMY MOVEMENTS AND AGRICULTURAL LANDSCAPE COMPLEXITY AFFECT SOYBEAN APHID SUPPRESSION IN MANITOBA?

K.G.L.I. Samaranayake and Alejandro C. Costamagna. Department of Entomology, Faculty of Agricultural and Food Sciences, University of Manitoba, Canada R3T 2N2.

Movement of transient generalist predators in soybean fields is crucial for controlling soybean aphid, *Aphis glycines* Matsumura (Hemiptera: Aphididae). We hypothesized that the structure and composition of agricultural landscapes affect the level of soybean aphid biological control observed in Manitoba. We studied soybean aphid suppression in 27 fields across a gradient of landscape complexity during 2013 and 2014. In each field, we infested potted soybean plants with soybean aphids (14 aphids/ pot) and treated them as either: 1) open to predation by ambient levels of natural enemies or 2) protected from predation by predator exclusion cages. This design was replicated five times in each soybean field. Surrounding habitats within a 2 km radius of each selected field were mapped and digitally quantified using ARC GIS 10 to characterize landscape complexity. Thirty bidirectional malaise traps were established between each selected soybean field and neighboring habitat to monitor natural enemy movements. We observed strong to moderate suppression of soybean aphids across the province during both years. Soybeans, cereals, and canola were the major land-cover types found across landscapes. Proportion of cereal crops and between-field movement of coccinellids and aphidophagous green lacewings had a negative relationship with soybean aphid survivorship in the open treatment at various scales. Naturally occurring aphid populations were negligible during both years. Our results suggest that incipient aphid colonies in soybeans may be subject to high levels of predation in landscapes dominated by cereal crops, where predators can find alternative aphid species to support their populations.

EFFECTS OF LANDSCAPE STRUCTURE ON ABUNDANCE OF CEREAL LEAF BEETLE *OULEMA MELANOPUS* AND ITS PARASITOID, *TETRASTICHUS JULIS*.

Arash Kheirodin[1], Alejandro Costamagna[1], and Hector Carcamo[2]. [1]Department of Entomology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; [2]Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada T1J 4B1.

The abundance and percentage parasitism of cereal leaf beetle was assessed in 35 wheat fields (14 spring wheat and 21 winter wheat fields) in southern Alberta during 15 June to 30 July, 2014. Fields were located within a wide range of agricultural landscapes ranging from simple to highly complex. Landscapes were characterized based on the percentage of the non-crop area (including pasture, native and cultivated grassland, and riparian vegetation) and percentage of cultivated area in proximity with the wheat fields sampled. Preliminary results from 13 fields suggest that the parasitoid positively responds to landscape complexity (semi-natural habitat). Higher proportion of semi-natural habitats in the landscape increased the percentage parasitism by *T. julis*, whereas incidence of crop

land decreased it. The response of the cereal leaf beetle to the landscape was inconsistent, and was not strongly affected by the area of wheat fields in the landscape. By contrast, the proportion of barley fields in particular, and cropland in general, had positive effects on beetle abundance.

DIATOMACEOUS EARTH TO CONTROL FOUR STORED-PRODUCT INSECTS.

A. Abdelghany and P. Fields. Cereal Research Centre, Agriculture and Agri-Food Canada, Department of Biosystems Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Diatomaceous earth (DE) is the most widely used inert dust to control stored-product insects. We examined the efficacy of DE (DE-cide™) in the laboratory on wheat, barley, corn and oats against; red flour beetle (*Tribolium castaneum* (Herbst)) rusty grain beetle (*Cryptolestes ferrugineus* (Stephens)), rice weevil (*Sitophilus oryzae* (L.)) and lesser grain borer (*Rhyzopertha dominica* (Fab.)). The order of sensitivity of the species tested from least to most resistant insect was: *C. ferrugineus* < *S. oryzae* < *T. castaneum* < *R. dominica*. The order of the amount of DE required to control *C. ferrugineus* for various grains from least to most DE was: wheat < barley < corn = oats. We also examined the efficacy of DE in simulated farm bins with 300 kg of wheat (500 and 1000 ppm), corn (3000 ppm) or barley (1000 ppm) infested with *C. ferrugineus* or wheat (3000 ppm) infested with *S. oryzae* during 4 months. There was 92 to 100% reduction in adults and 95 to 100% reduction in offspring production in the DE-treated bins. In the laboratory, DE at 50 ppm in wheat reduced test weight by 1.8 kg/hL and at 550 ppm reduced test weight by 4.1 kg/hL. In the simulated farm bins, test weight was reduced by as much as 4.6 kg/hL for wheat treated with 1000 ppm. The grain grade of Canadian Western Red Spring wheat #2, Canadian Western barley #1 and Canadian Western Corn #5 were not reduced with DE application.

DEFENSIVE SECRETIONS IN LARVAE OF A CARABID BEETLE: CHEMICAL COMPOSITION AND VARIATION.

A.E. Holliday[1], T.M Mattingly[1], and **N.J. Holliday**[2]. [1]Department of Chemistry and Biochemistry, Swarthmore College, Swarthmore, Pennsylvania, U.S.A. 19081; [2]Department of Entomology, University of Manitoba, Winnipeg, Canada R3T 2N2.

The carabid beetle, *Chlaenius cordicollis* Kirby, occurs on the beaches of lakes in southern Manitoba and of rivers in Pennsylvania. Adult beetles overwinter, and reproduce in mid-summer; larvae are abundant on some beaches in July and August. We have previously characterized the composition of the adult defensive secretion, which is sprayed from pygidial glands when the adult is threatened. Almost 70 years ago, it was noticed that larvae of *Chlaenius* have eversible glands located on the thoracic epimera of some segments, and it was suggested that these had a defensive function. Using solid-phase microextraction samplers and gas chromatograph-mass spectrometry, we sampled and analysed compounds in the head space above larvae that had been induced to evert the glands. Nine compounds were detected; they appear likely to deter attackers. Most of the compounds in the larval secretion are chemically related to, but different from

compounds in the adult secretion. There were two distinct patterns of composition of larval secretions, but the reasons for this dimorphism are unknown. So far, evidence suggests that geographic location, beetle sex, and larval stage of development are not associated with the dimorphism.

EVIDENCE FOR A FAR-POSTERIOR WING COMPARTMENT BOUNDARY IN INSECTS.

Roohollah Abbasi, and Jeffrey M. Marcus. Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

We evaluated the organizational effects of compartment boundaries in butterflies and fruit flies. First, Independent Contrast Analysis (ICA) analysis was applied to eyespot patterns in *Vanessa* butterflies (Lepidoptera: Nymphalidae). ICA of eyespot color elements revealed significant positive correlations between eyespots 2 and 5 and between eyespots 3 and 4 on all wing surfaces. Similar patterns of correlation between these eyespots are known from some wing surfaces in both *Junonia* and *Bicyclus* butterflies, suggesting that this nested pattern of symmetry on either side of vein M3 may occur across the family Nymphalidae. This line of symmetry is distinct from and posterior to the compartment boundary and wing organizer system defined by Engrailed expression and dpp signaling (between veins Rs and M1). Surveying the wing cell color patterns across all families of butterflies reveals a similar nested set of A-P color pattern symmetry in this region of the butterfly wing. Evaluation of spontaneous Lepidopteran mitotic clones reveals a peak abundance of clonal boundaries between wing cells 2 and 3, which is consistent to the presence of a compartment boundary in this vicinity. Finally, in FLP/FRT wing clones produced in *Drosophila,* there is a clonal boundary posterior to the L5 wing vein that is homologous to the M3 vein dividing wing cells 3 and 4 in butterflies. Collectively, these findings suggest the existence of both a previously undetected additional compartment boundary and a new A-P wing pattern organizer near vein M3 that is responsible for patterning the posterior portion of holometabolous insect wings.

THE BUCKEYE BUTTERFLIES (GENUS *JUNONIA*) FROM FLORIDA, USA, CAN BE USED AS A MODEL FOR STUDYING COLONIZATION, ESTABLISHMENT, AND INTROGRESSION OF INVASIVE INSECT SPECIES

Melanie M.L. Lalonde, and Jeffrey M. Marcus. Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Invasion biology focuses on understanding the arrival of non-native species into new habitats, including dispersal events, secondary contact zones, and hybridization. The buckeye butterflies (genus *Junonia*) of Florida, USA have experienced at least two invasion events during their history. It is thought that *Junonia coenia* Hübner was resident in Florida before the last glacial maximum, approximately 11,000 years ago. This species is polyphagous and distributed throughout the state. The first invasion event is thought to have occurred approximately 3,000 years ago when *J. evarete* (Cramer) (a monophagous mangrove-feeding species whose habitat is restricted to coastal areas) colonized Florida from the Caribbean. The second invasion event occurred approximately 50 years ago when *J. genoveva* (Cramer) (a polyphagous tropical species whose habitat in Florida is

restricted to the most southern frost-free zone where its larval hosts can persist) colonized Florida from the Caribbean. This has led to habitat overlap of all three species. Hybridization occurs readily in the laboratory, and occurs naturally at some frequency between these species in the wild. Specimens are available for all three species from Florida and the Caribbean for the last 100 years. Diagnostic morphological and molecular markers exist for determining what *Junonia* have Caribbean ancestry, allowing us to observe the invasion and creation of a secondary contact zone over time and space. Using biogeography and population genetics, we have tracked the most recent invasion of *Junonia* as it colonized Florida. Although *Junonia* is not an agricultural pest, it can be used as a predictive model for invasion events.

MOLECULAR MARKERS FOR DETECTION OF FLEA BEETLES (COLEOPTERA: CHRYSOMELIDAE) IN PCR-BASED GUT CONTENT ANALYSIS OF PREDATORS IN CANOLA.

A. Dal Molin, L. Peixoto, and B. Sharanowski. Department of Entomology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

We report on tests and development of molecular markers to detect the exotic flea beetles *Phyllotreta cruciferae* (Goeze) and *Phyllotreta striolata* (Fab.), and the native *Psylliodes punctulata* Melsh., in gut content of predators. DNA sequence analyses *in silico* were conducted based on sequences of Canadian populations of flea beetles from BOLD and GenBank with markers previously developed for European populations. These analyses predicted detection of *Phyllotreta* from Canadian populations, although they are not species-specific within that genus. In laboratory assays, available markers were used to detect the presence of *Phyllotreta* DNA in concentrations as low as 0.5ng/µL from adults and from larvae. However, both sequence analyses and laboratory tests indicated that the detection of *Psylliodes* requires the development and optimization of new markers. Our goal is to optimize these markers so that they can be used to conduct an extensive survey of natural enemies that can influence flea beetle populations, contributing to development of a sustainable approach to the control of these pests in canola.

POTENTIAL CAUSES OF AERIAL INSECTIVORE POPULATION DECLINES RELATED TO DIET.

A. Bass[1], B. Sharanowski[1], and K. Fraser[2]. [1]Department of Entomology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; [2]Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Aerial insectivores are birds that prey exclusively on insects collected during flight. The populations of these bird species have been declining more rapidly than other groups. We collected 54 bolus samples during summer 2015 from adult purple martins (*Progne subis* (L.)) as they returned to nests to feed offspring. Insects were identified to family, and the length and width of each insect was measured to estimate mass. Samples contained 34 insect families and 2 arachnid families. The most frequently collected insect orders were Odonata, Diptera, Hymenoptera, and Hemiptera. The average length of all insects, the average number of insects by order per bolus, and the average mass of insects by order

per bolus follow patterns relating to developmental stages of the chicks. Although purple martins appear to be opportunistic feeders, aquatic insects made up 55% of the total diet. If malathion causes a decline in the population numbers of non-target aquatic insects, it is a potential cause of decline of purple martins as well as other aerial insectivores.

POSTER

THE ROLE OF MICRORNAS IN OVARIAN DEVELOPMENT IN *DROSOPHILA MELANOGASTER*.

C. Dugray, A. Liu, N.J. Doughty, and S. Whyard. Department of Biological Sciences, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Epithelial to mesenchymal transition (EMT) is a biological process where epithelial cells lose epithelial characteristics and acquire a migratory phenotype. During ovarian development in *Drosophila melanogaster* Meigen, EMT is essential for follicular cells to dissociate from epithelium and move to surround the developing oocytes. The down-regulation of a protein associated with cell adhesions, Discslarge (Dlg), is required for EMT in *D. melanogaster* ovaries. In this study, the microRNAs, miR-34, miR-137, and miR-375, were examined for their possible role in down-regulating the expression of *dlg*. Using qRT-PCR, the relative transcript levels of the miRNAs and *dlg* were quantified in various tissues and during different stages of the fly's development. All genes were found to be expressed throughout development in all tissues examined. A microRNA binding assay was performed using human embryonic kidney (HEK) cells, and demonstrated that miR-34, miR-137, and miR-375 are capable of binding to the 3'UTR of *dlg*, and could therefore regulate the expression of *dlg*. The injection of female *D. melanogaster* with miR-34, miR-137, and miR-375 specific morpholino-like oligonucleotide resulted in altered levels of the associated miRNA transcripts, as well as perturbations in ovary development. This study confirms that miR-34, miR-137, miR-375 and *dlg* are important in ovarian development, and that the miRNAs can putatively down-regulate *dlg* expression. Identifying how microRNAs affect *dlg* and other proteins associated with EMT will not only help us understand how key developmental processes occur, but may also enhance our understanding of mis-regulating microRNAs in EMT, which has been associated with metastatic cancer.

The Entomological Society of Manitoba gratefully acknowledges the following organizations which provided financial support for the 71st Annual Meeting

Abell Pest Control, Inc.

Bayer Cropscience Canada Co.

Canadian Centre for Mosquito Management

Canadian Grain Commission

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Orkin PCO Services

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The Entomological Society of Manitoba

71st Annual Business Meeting

24 October, 2015
Department of Entomology, University of Manitoba

Attendance

President	Richard Westwood
Secretary	David Wade
President-elect	Paul Fields
Proceedings Editor	Terry Galloway

Pat Mackay
Steve Whyard
Ale Costamagna
Alberto Civetta
Rassol Bahreini
Rob Currie
Marjorie A. Smith
Sarah Semmler
Cole Robson-Hyska
Rhéal Lafrenière
Kateryn Rochon
Megan Colwell
Jordan Bannerman
Aldo Rios Martinez
Suresh Desai
Alison Partridge
Aditi Singh
Thais F.S. Guimaraes
Roohollah Abbasi
Lisa Capar
Blaine Timlick
Robbin Lindsay
Randy Gadawski
Robert Wrigley
John Gavloski
N.J. Holliday
Robert Lamb
Roman Kryuchkov
Jeffrey Marcus

Regrets

Barb Sharanowski
Desiree Vanderwel
Colin Demianyk
Joel Gosselin
Kathy Cano

1 **Acceptance of Agenda**

Motion: Holliday/Lamb – to accept the Agenda (Appendix A)…… .....Carried

2 **Acceptance of the Minutes of the Last Annual Business Meeting (1 November 2014)**

Motion: Currie/Galloway – to accept previous Minutes of the 71st Business Meeting.....Carried

3 **Business Arising from the Minutes**

a) Bylaw revisions to allow for electronic voting in the future

Wade presented the proposed changes to the bylaws to allow for the option of electronic voting in the future. Additional changes to the bylaws were also presented to the membership including the addition of a scholarship fund and some minor updates to some articles. The

membership had a number of change requests which will be brought back to the Executive for discussion. The Executive will then present the revised changes to the membership in 2016.

4 **Reports – Executive**

Motion: Holliday/Lamb – to receive the reports……..…… Carried

Appendix B – President

Westwood thanked Steve Whyard for chairing the 2015 Scientific Committee and he also thanked Paul Fields for volunteering to chair the 2017 JAM. He also thanked the Executive for their work on revising the bylaws.

Appendix C – Treasurer

Presented by Westwood. The Society currently has $54,900 in assets and ran a slight deficit last year.

Appendix D – Regional Director to the ESC

Presented by Wade. Sharanowski stepped down as Regional Director as she is moving to Orlando in January 2016. This year's ESC governing meeting has yet to occur so there was nothing to report. Highlights of her report included the upcoming meeting and the issues about QST reimbursement as well as mentioning that a letter is being drafted to the new government regarding restrictions of federal scientists. Holliday was able to provide further updates on both matters.

Appendix E – Editor of the *Proceedings*

Galloway reported that volume 70 (2014) was the first volume published exclusively in a digital format. There was one submitted scientific paper and an obituary for A.J. Thorsteinson. Galloway mentioned he has two manuscripts for 2015 but is always looking for submissions of scientific papers and notes to publish in upcoming volumes of the Proceedings. Fields asked if the abstracts of the joint meeting will be published and Galloway said they would be. Lamb asked that the obituary be forwarded to the ESC Archivist and be posted separately on the website.

Appendix F – Endowment Fund Board

Presented by Westwood. The committee reported the principal of the endowment fund stood at $45,000 as of August 31, 2015.

5 **Reports – Committees**

Appendix G – Finance

Presented by Westwood. The Finance committee reported that we are still in good financial shape.

Appendix H – Publicity/Newsletter

Smith reported that three issues were produced in the past year. She mentioned that all but three members received their copies via email. She thanked all members who contributed articles to the newsletter and encouraged all members to contribute.

Appendix I – Social
Capar reported that the New Members Social was held on April 22nd at the Round Table Steakhouse. 43 members and friends attended. Pat MacKay and Bob Lamb gave a talk of their trip to Antarctica. There was discussion about a new venue to host the New Members Social including the U of M or a community centre. Capar asked if the society could continue to pay for the new members and student's lunches. Westwood stated the Executive had no issues with continuing that practice.

Appendix J – Youth Encouragement/Public Education
Rios reported that this year's activities were attended by over 3000 people. The majority of the outreach was done at the Water Festival events. He also mentioned that the Youth Encouragement Chair was being taken over by Arash Kheirodin in the fall of 2015.

Appendix K – Archives
Presented by Westwood. There was no activity to report. As Sharanowski stepped down, the Executive will be looking for a replacement chair. Currie suggested combining the Archives committee with the Web Page committee as all current documents are created digitally. Holliday wanted the guidelines of the new committee to be updated to ensure preservation of archival material. The new Executive will review the proposal.

Appendix L – Common Names
Presented by Westwood. There was no activity to report.

Appendix M – Scholarship and Awards
Westwood presented his report. The winners were as follows: Student Achievement – Kaitlyn Watts; Orkin award – Erin McNally; ESM Graduate Scholarship – Aldo Rios Martinez.

Appendix N – Fundraising
Presented by Wade. $1600 was raised from September 2014 to August 2015.

Appendix O – Scientific Program
Whyard reported on the highlights of the 2015 program. He stated that there were 18 submitted papers, of which nine were part of the student paper competition. There was also one submitted poster. Thanks were given to the committee.

Appendix P – Membership
Presented by Currie. Membership is at 101, up from 96 last year.

Appendix Q – Web Page
Currie provided an overview of recent changes to the web page. He also mentioned that no further action had been taken about making the pages more mobile-friendly. There was continued discussion around this issue including costs and converting the pages to the new format. Westwood asked the committee to look further into the possibility and report back to the Executive.

6 **Election Results**
President Elect.....John Gavloski
Member-at-Large.....Randy Gadawski
Regional Director.....Rob Currie

Appendix R
Motion: Holliday/Mackay – to destroy the ballots

7 **New Business**
There was no new business discussed.

8 **Moment of Silence for Deceased Members This Year**
There was a moment of silence for current member Maurice Tauber and past member Amy Hawkins-Bowman.

9 **Transfer of Office** – Richard Westwood to Paul Fields

10 **Other Business** – None

11 **Adjournment** – 1:18 p.m.
Motion: Fields – to adjourn the meeting.....Carried

APPENDIX A

The Entomological Society of Manitoba, Inc.
Agenda of the Entomological Society of Manitoba
71st Annual Business Meeting

24 October 2015

1. Acceptance of Agenda

2. Acceptance of the Minutes of the Last Annual Meeting (1 November 2014)

3. Business Arising from the Minutes

4. Reports – Executive
   President – Richard Westwood
   Treasurer – Ian Wise
   Regional Director to the ESC – Barb Sharanowski
   Editor of the *Proceedings* – Terry Galloway
   Endowment Fund Board – Kathy Cano

5. Reports – Committees
   Finance – Kathy Cano
   Publicity/Newsletter – Marjorie Smith/Jordan Bannerman
   Social – Lisa Capar
   Youth Encouragement/Public Education – Aldo Rios
   Archives – Barb Sharanowski
   Common Names – Barb Sharanowski
   Scholarship and Awards – Richard Westwood
   Fund-Raising – Joel Gosselin
   Scientific Program – Steve Whyard
   Membership – Désirée Vanderwel
   Web Page – Rob Currie

6. Election Results – Scrutineer, Colin Demianyk

7. New Business

8. Moment of Silence for Deceased Members This Year

9. Transfer of Office

10. Other Business

11. Adjournment

APPENDIX B

Entomological Society of Manitoba
President's Report – Annual Business Meeting
24 October, 2015

The beginning of my term coincided with the second day of our 2014 scientific meeting (the 70th Annual meeting) which was a great success and included 20 submitted papers, 5 symposium presentations, the keynote address and 4 posters. In recent years the range of entomological expertise and areas of interest were very broad and the meeting was well attended. The success of our annual meetings and other initiatives is a testament to the hard work and keen interest our membership (both students and regular members) have in keeping the ESM front and center for those interested in entomology in Manitoba.

The executive met three times in the 2014/15 year and in addition to many of smaller matters also addressed three major action items during this period which included planning for the 2017 JAM ESM/ESC in Manitoba, the process to find a scientific chair for the 2015 ESM Annual Meeting and a review of the Society by-laws.

We have been very fortunate that Dr. Steve Whyard agreed to chair and plan our 2015 fall meeting. Steve has been ably assisted by Dr. Suresh Desai and Ms. Aditi Singh. The theme of the meeting is to be "Molecular approaches to fundamental and applied entomology". The invited keynote speaker is Dr. Daniel Doucet from the Canadian Forest Service. At the time of writing there were 16 paper presentations, one poster and five symposium presentations scheduled for the two day meeting on Oct 23 and 24, 2015. On behalf of the Society, I would like to thank Steve, Suresh and Aditi for all their efforts in ensuring we will have an excellent meeting. Once again Joel Gosselin has been our fund raising chair for the Society and he has continued to be very successful in raising funds to assist in the delivery of our annual meeting.

In regard to the planning for the JAM ESM/ESC the society is grateful that Dr. Paul Fields (our incoming President for 2015/16) has kindly agreed to be the scientific program chair for the 2017 meeting in place of Dr. Barb Sharanowski who will be taking a university faculty position in the U.S. at end of 2015.

A third major initiative for the executive has been a detailed examination of the Society by-laws in an effort to update or remove items in the by-laws that appear to be out-dated or in need of modification. The executive spent considerable time reviewing all the by-laws and recommended changes/additions/deletions which will be tabled for the general membership at the business meeting on Oct 23, 2015. The review of the Society by-laws was prompted by discussion at the previous annual business meeting regarding voting procedures which prompted this full review of the by-laws (many of which have not reviewed for several decades). Overall it has been quite a busy year for the executive and I would like to thank the executive members and other society members who have contributed to the smooth functioning of the society in 2015.

Richard Westwood
President, Entomological Society of Manitoba

APPENDIX C

Report of the Treasurer

THE ENTOMOLOGICAL SOCIETY OF MANITOBA INC.

Financial Statements

Year Ended August 31, 2015

Note: These Financial Statements have not been audited. The Accounts, Bank Statements and Receipts were provided by the Treasurer and reviewed by the President to prepare these summary financial statements.

President: Richard Westwood Date: 22 October 2015

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.

Statement of Financial Position

August 31, 2015

		2015		2014
ASSETS				
CURRENT				
Cash	**$**	**6,145**	$	7,294
Money market fund		**3,755**		3,740
		9,900		11,034
TERM DEPOSITS	**$**	**45,000**	$	44,000
	$	**54,900**	$	55,034
LIABILITIES				
CURRENT	**$**	**NIL**	$	NIL
NET ASSETS				
Unrestricted net assets		**9,900**		11,034
Internally restricted		**45,000**		44,000
	$	**54,900**	$	55,034

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.

Statement of Financial Position

August 31, 2015

		2015		2014
REVENUES				
Annual meeting	**$**	**900**	$	845
Donations		**1,616**		1,600
Interest income		**984**		991
Membership fees		**1,564**		1,554
Miscellaneous		**82**		68
Proceedings		**82**		152
Youth encouragement & public education		**425**		70
		5,653		5,280
EXPENDITURES				
Awards and scholarships		**2,600**		1,500
Donations		**0**		0
General		**362**		395
Meetings		**1,868**		2,025
Newsletter		**0**		385
Proceedings		**651**		969
Social committee		**307**		191
Youth encouragement & public education		**0**		0
		5,788		5,465
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENDITURES	**$**	**(135)**	$	(185)

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.
Statement of Financial Position
August 31, 2015

	Unrestricted net assets	Internally restricted	**2015**	2014
NET ASSETS – BEGINNING OF YEAR	$ 11,034	$ 44,000	**$ 55,034**	$ 55,219
Excess of revenues over expenditures	(135)		**(135)**	(185)
Fund transfer	(1000)	1000	-	-
NET ASSETS – END OF YEAR	$ 9,900	$ 45,000	**$ 54,900**	$ 55,034

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.
Statement of Financial Position
August 31, 2015

TERM DEPOSITS

Certificate Number	Interest Rate (%)	Purchase Date	Maturity Date	Par Value ($)	Interest 2014 ($)
900055611-0013	2.10	12 Dec 2010	16 Nov 2015	9,000	189.00
900055611-0014	1.85	16 Nov 2011	16 Nov 2016	9,000	166.50
900055611-0015	2.05	9 Nov 2012	9 Nov 2017	9,000	184.50
900055611-0016	2.10	12 Dec 2012	12 Dec 2019	9,000	189.00
900055611-0017	2.00	17 Nov 2014	17 Nov 2019	9,000	240.00
			Total	**45,000**	**969.00**

ENTOMOLOGICAL SOCIETY OF MANITOBA, INC.

Statement of Financial Position

August 31, 2015

Memberships and Meeting Registrations

Membership: Regular - $25, Student - $10
Registration: Regular - $20, Student - $5, 1-day - $10

	Membership			Registration	
	Regular	Student	Life	Regular	Student
Number	51	29	6	39	24
Income ($)	1,274	290	-	780	120
Total	$1,564*			$900	

*Note: Exchange rate on US$ checks reduced actual totals slightly, and members who made a donation are excluded.

APPENDIX D

Entomological Society of Manitoba
Report of the ESC Regional Director

I will be stepping down as Regional Director as of the end of the ESC meeting in 2015 and will be replaced by Dr. Rob Currie from the University of Manitoba. I am moving to Orlando in January and will miss everyone greatly. I hope to see you all at ICE in Orlando in September 2016. Thus, I will also be stepping down from the Common Names Committee and Archive Committee – official replacements will be needed.

The 152nd Annual meeting of the Entomological Society of Canada will be held in Montreal, QC from November 8-11, 2015.

Taxes are being collected this year (GST and QST) on registration fees for ESC. The taxes have been included in the price. Government of Canada and Province of Quebec department employees are **not** exempt from QST, effective April 1, 2013, however, departments and agencies of Canada's other provinces and territories are exempt from QST. The ESC is still looking into the process for potential individual reimbursements for QST.

The ESC Science Policy and Education Committee is working on a new letter to send to a possible new government regarding restrictions to federal government scientists.

Barbara Sharanowski
Regional Director

APPENDIX E

Entomological Society of Manitoba
Report of the *Proceedings* Editor

This year marks a leap into the electronic age for the *Proceedings.* Volume 70 (2014) of the *Proceedings of the Entomological Society of Manitoba* was produced exclusively in electronic format for the first time this year. It has been sent to all members of the ESM and posted on the ESM website. Printed, unbound copies will be sent to members of the society who do not have e-mail. This new process will result in a considerable savings to the Society, as set-up, printing and mailing costs have been all but eliminated. Volume 70 consists of 59 pages, with one Scientific Paper, the abstracts from the Annual Meeting of the Entomological Society of Manitoba held at the Freshwater Institute and in the Department of Entomology on 31 October-1 November, 2014, and the Minutes of the 70th Annual Business Meeting of the Entomological Society of Manitoba held on 1 November,

in the Department of Entomology. There is also a belated obituary for Professor A.J. Thorsteinson, former head of the Department of Entomology. Thor died in 1998, but this was not generally known in the entomological community until recently when his daughter, Julian, and I collaborated to prepare this obituary.

If you have a manuscript of relevance to entomology in Manitoba, I encourage you to consider submitting it to the *Proceedings*. Scientific Notes as well as full Scientific Papers are welcome. I think the *Proceedings* is an excellent place to publish new distribution records and faunal lists for insects and related arthropods in Manitoba. I have two manuscripts in hand for the 2015 *Proceedings*, something I take as a positive sign for submissions in the future. All submitted manuscripts are peer-reviewed; all published papers are available as PDF reprints on the web. Thanks very much to Rob Currie who posts the *Proceedings* so efficiently. Issues of the *Proceedings* are fully accessible using on-line search engines. There are no page charges to authors for published manuscripts, and with our electronic format, there should be no limits on manuscript length. The *Proceedings* are freely available to entomologists around the world, so your papers are only the click of a button away.

Terry Galloway
Proceedings Editor

APPENDIX F

ENTOMOLOGICAL SOCIETY OF MANITOBA
Report of the Endowment Fund Board for 2014-2015

The endowment fund board met on October 16, 2015.

A summary of investments and projected interest income for the fiscal year is attached (Table 1). Interest generated by the Endowment Fund provides a basis for funding the publication of the Proceedings and other Society activities. The Endowment Fund principal was $45,000 as of August 31, 2015.

Kathy Cano, Chair
Ian Wise
Richard Westwood

Certificate No.	Principal	Interest Rate (%)	Maturity Date (Purchase Date)	Annual Interest
900055611-0013	9,000.00	2.10	Nov 16, 2015 (Dec 12 2010)	189.00
900055611-0014	9,000.00	1.85	Nov 16, 2016 (Nov 16 , 2011)	166.50
900055611-0015	9,000.00	2.05	Nov 9, 2017 (Nov 9 2012)	184.50
900055611-0016	9,000.00	2.10	Dec 12, 2019 (Dec 12 2012)	198.00
900055611-0017	9,000.00	2.00	Nov 17, 2019 (Nov 17, 2014)	240.00
Total	**$45,000.00**			**$969.00**

APPENDIX G

ENTOMOLOGICAL SOCIETY OF MANITOBA
Report of the Finance Committee for 2014-20145

The Finance committee met on October 16, 2015 and all was found to be in order. The financial statement and the budgets for the current and next fiscal years are attached. The Society continues to be in good financial shape.

Kathy Cano, Chair
Ian Wise
Richard Westwood

Income and expenses for fiscal year ending 31 August 2015

BUDGET ITEMS	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**
REVISED 31 August 2015	**Actual**	**Actual**	**Actual and Projected**	**Projected**
ASSETS				
Cash	7,294	6,145	7,500	7,500
Money Market fund	3,740	3,755	3,500	3,500
TOTAL (Cash + Money Market Fund)	11,034	9,900	11,000	11,000
Term Deposits (Endowment fund)	44,000	45,000	45,000	45,000
NET ASSETS (Cash+ Money Market fund + Term)	**55,034**	**54,900**	**56,000**	**56,000**
REVENUE				
Membership Fees	1,554	1,564	1,500	1,500
Proceedings	152	100	100	100
Social Committee	0	0	0	0
Youth Encouragement & Public Education Committee	70	425	500	500
Donations	1,600	1,616	1,600	1,600
Meetings: ESM/AGM	845	900	800	800
Interest income:	991	984	1,100	1,100
Miscellaneous	68	82	500	500
TOTALS	**5,280**	**5,653**	**6,100**	**6,100**

EXPENSES				
General Society Expenses	395	362	1,000	1,000
Proceedings	969	651	500	500
Newsletter	385	0	100	100
Social Committee	191	307	200	200
Youth Encouragement & Public Education Committee	0	0	200	200
Fundraising Committee	0	0	0	0
Student Awards and Scholarships	1,500	2,600	1,500	1,500
Meetings: ESM/AGM	2,025	1,868	1,700	1,700
Donations	0	0	0	0
Representation at ESC	0	0	600	600
TOTALS	**5,465**	**5,788**	**5,800**	**5,800**
Net gain (loss), year ending Aug. 31	**(185)**	**(135)**	**300**	**300**

APPENDIX H

Entomological Society of Manitoba
Report of the Newsletter Committee

The Newsletter Committee produced three issues of Volume 41 of the ESM Newsletter in the past fiscal year. Issue 41.1 was published in October 2014, issue 41.2 in March 2015 and issue 41.3 in August 2015. The three issues were distributed via e-mail. Three members who have not provided an e-mail address received their Newsletter by regular mail. These nine issues were mailed through the Department of Entomology. The costs will be reimbursed in the 2015-2016 fiscal year.

The budget of the ESM Newsletter committee is expected to be minimal in future fiscal years due to the use of e-mail to distribute issues.

Thank you to those members who have contributed articles to the Newsletter. We encourage all ESM Members to contribute items of interest to the membership.

Marjorie Smith
Jordan Bannerman
Co-Editors, ESM Newsletter Committee

APPENDIX I

Entomological Society of Manitoba
Report of the Social Committee

On April 22nd, this year's ESM New Members Social luncheon was held at the Round Table Steakhouse on Pembina. There was a large turnout of 43 ESM members and friends in attendance. Five New Members attended, and nine were unable to attend.

During the luncheon, Pat MacKay and Bob Lamb gave a talk entitled “Antarctica: only three insects in three weeks, but what a trip!” based on their most recent travel adventure. Pat and Bob shared several fascinating images of the Antarctic including: red “bleeding” bacteria, ice, penguins, birds, marine mammals, and more. Thank you to the presenters and all those that attended. If anyone has any ideas for future ESM social events, please let me know.

For next year's ESM New Members luncheon, a new format will be attempted which will allow for a shorter time for the lunch portion to allow people to eat and enjoy a presentation with less of a time investment. Possibly at the UofM?

Discounts were given to students attending this year's New Members Social. Students had free lunches, but had to pay for their own drinks.

Lisa Capar
Chair, Social Committee

APPENDIX J

Entomological Society of Manitoba
Youth Encouragement and Public Education Committee

For another year the Youth Encouragement Program has delivered off-campus presentations and visits to U of M's Department of Entomology to increase the general public's understanding of insects. With the help from students in the Department, this year we achieved an outreach of more than 3,000 people throughout different events. Collaboration with the Manitoba Conservation Districts Association for the annual Water Day Festival events drew great attention from the public and the media including CBC, CJOB and Global News Winnipeg. Funding for the program was received through the Youth Education Grants offered by the Entomological Society of Canada, for a total of $400.00.

As determined in a meeting held by DEGSA, a transfer of the Youth Encouragement portfolio is now taking place. Arash Kheirodin, a PhD student under the supervision of Dr. Alejandro Costamagna, will be taking over as Chair of YE this fall (2015).

Aldos Rio
Chair, Youth Encouragement and Public Education Committee

APPENDIX K

Entomological Society of Manitoba
Report of the Archivist

No activity to report.

Barb Sharanowski
Archivist

APPENDIX L

Entomological Society of Manitoba
Report of the Common Names Committee

It would be helpful for final digital version of all reports be consolidated into one pdf document so they can be filed digitally and as a hard copy.

Barb Sharanowski
Chair, Common Names Committee

APPENDIX M

Entomological Society of Manitoba
Report of the ESM Student Awards and ESM Scholarship Committee

Student Achievement Award: Awarded to a student who is in a Bachelor's degree program or recently completed a program. This award recognizes students who have shown exceptional interest in entomology as evidenced by their insect collections, insect photography, published articles of entomological interest, insect experiments and/or outstanding contributions during summer employment.

This year's winner of the Entomological Society of Manitoba Student Achievement award is Ms. Kaitlyn Watts. Kaitlyn took the Veterinary and Wildlife Entomology course in the Dept. of Entomology at the University of Manitoba last winter and subsequently worked as a summer technician in the Department. Kaitlyn is in her final year of a degree in Microbiology at the University of Manitoba. Kaitlyn showed exceptional interest in Veterinary Entomology and subsequently took Introductory Entomology. Katilyn has an excellent academic record and is a worthy recipient of the Student Achievement Award.

Orkin Student Award: This award is designed to foster and encourage student interest in general Entomology including natural methods of insect pest control and the proper use of insecticides. Candidates must have a demonstrated interest in entomology, superior scholastic ability, high research potential, originality and industriousness in their university courses and/or summer work.

This year's winner of the Orkin award is Ms. Erin McNally. Erin has worked as a student research technician in 2014 and 2015 in the Department of Entomology at the University of Manitoba. Erin's experience includes projects on ectoparasites on birds including presenting a poster at the Annual Meeting of the ESM in 2014 of her work. Erin is enrolled as an Entomology Minor and has taken several entomology courses. Erin has a

strong interest in entomology and has demonstrated originality and industriousness throughout her time in the Department of Entomology.

The ESM Graduate Scholarship: This scholarship is awarded to a student in a M.Sc. or Ph.D. program in entomology at the University of Manitoba or the University of Winnipeg. Students must be enrolled in their graduate program for at least 12 months prior to Oct 1 of the award year. This award recognizes superior scholastic ability, high research potential as evidenced by industriousness, good judgment, originality, a conscientious attitude and organizational ability, and excellent communication skills.

The winner is Aldo Rios Martinez. Aldo is enrolled as a MSc. candidate in the Dept. of Entomology at the University of Manitoba and is being supervised by Dr. Alejandro Costamagna. Aldo received his B.Sc. in Biology from the Universidad Simon Bolivar in Mexico in 2012. Aldo's M.Sc. research focuses on the role of environmental factors inducing wing development in the soybean aphid and to determine the effect of predator-free space colonization by alates on the overall fitness (numerical contribution) of soybean aphid colonies including the relationship of surrounding landscape diversity on abundance of parasitoids.

Committee: Desiree Vanderwel
Lara Toews
Taz Stuart
Richard Westwood, Chair, October 23, 2015.

APPENDIX N

Entomological Society of Manitoba
Fundraising Committee

The Fundraising Committee raised a total of $1,400.00 to cover some of the costs of the AGM. An additional $200.00 was donated by Orkin for the Orkin Student Award. The Fundraising Committee acknowledges the continued support of our sponsors in making the AGM successful in providing quality speakers for this very educational event. The Fundraising Committee would appreciate leads from ESM members for parties who are using the valuable services that entomologists provide, so the Fundraising Committee could solicit them for financial support.

Joel Gosselin, Chair,
Fundraising Committee

APPENDIX O

Entomological Society of Manitoba
Report of the Scientific Programme Committee

The 71st Annual Meeting of the Entomological Society of Manitoba was held in Winnipeg MB at the Freshwater Institute, Fisheries and Oceans Canada on 23 October, 2015 and at the Entomology Department, University of Manitoba on 24 October, 2015. The theme of the meeting was "Molecular Approaches to Fundamental and Applied Entomology".

The invited speakers were:
Keynote Speaker:
Insect cell lines: useful models to study the mode of action of insecticides**.**
Daniel Doucet, Great Lakes Canadian Forest Service, Natural Resources Canada.

Saturday Symposium: Molecular Approaches to Fundamental and Applied Entomology.

Divergent transcriptional regulation and speciation in Drosophila.
Alberto Civetta, **PhD**,
Department of Biology, University of Winnipeg.

The use of proteomics in marker assisted selection for resistance to honey bee diseases and parasites.
Rob Currie, Department of Entomology, University of Manitoba

Prevention of Israeli acute paralysis virus (IAPV) infection in honey bees using dsRNA.
Suresh Desai, **PhD**, Department of Biological Sciences, University of Manitoba

Mitogenomic hypothesis testing in Junonia butterflies.
Jeffrey Marcus, Department of Biological Sciences, University of Manitoba

A molecular approach to control populations of dengue vector mosquitoes.
Steve Whyard, Department of Biological Sciences, University of Manitoba

There was a full programme with: 1 keynote talk, 5 symposium papers, 8 submitted oral papers, 1 submitted poster (student competition entry), 10 student oral papers (9 in the student competition). The meeting organizers thank our generous sponsors for their support; Abell Pest Control, Inc, Bayer Cropscience Canada Co., Canadian Centre for Mosquito Management, Canadian Grain Commission, Canola Council of Canada, City of Winnipeg Insect Control Branch, Dow Agro Sciences Canada Inc., Gilles Lambert Pest Control, Metro Pest Control, North South Consultants, Orkin PCO Services, and Poulins Pest Control for the donation of door prizes.

There were 60 paid attendees, of whom xx were regular registrations (one was a single day registration), and xx were student registrations. A total of $1600 was received in donations and $1095 in registration fees were generated from the meeting.

As in other years, the ESM Annual General Meeting was held after the symposium on the Saturday and the mixer was held at Pat McKay and Bob Lamb's house on the Friday evening.

Submitted with respect and honour:

Chair: Steve Whyard
Past Chair: Rob Anderson
Members: Paul Fields, Richard Westwood, Suresh Desai, Aditi Singh
Fund Raising: Joel Gosselin
Social/Refreshments: Suresh Desai, Aditi Singh, Lisa Caspar
Venue: Cheryl Podemski
Registration: Ian Wise

APPENDIX P

Entomological Society of Manitoba
Report of the ESM Membership Committee

There are currently 101 members in the ESM, compared to 96 last year. I would like to thank Ian Wise (Treasurer) for his careful record keeping of the membership.

Désirée Vanderwel, Chair.

APPENDIX Q

Entomological Society of Manitoba
Web Site Report

The Entomological Society of Manitoba operates a website that is currently hosted through the public access portion of Paul Field's personal University of Manitoba web page. The website contains information about the Society and its committees, dates of meetings, programs for meetings, and provides links to other sources of entomological resources on the web.

The site is currently kept up to date with regular updates of newsletters, proceedings, reprints of papers from the proceedings and announcements for the annual general meeting. Copies of all issues of the Proceedings of the Entomological Society of

Manitoba and the former journal the "Manitoba Entomologist", and the historical publication of the ESC, "Entomologists of Manitoba" can now be found on the site. A major redesign of the look and organization of the site was done by Jonathan Veilleux in 2011. There was some discussion at last year's meeting with respect to converting the website to a more "mobile friendly" platform but no action was taken in the past year.

Any suggestions for additions or changes to the website should be forwarded to Rob Currie, Dept. of Entomology, University of Manitoba (rob_currie@UManitoba.ca).

Rob Currie
ESM Webmaster

APPENDIX R

Entomological Society of Manitoba
Election Report

Elections closed September 15, 2015 for the Entomological Society of Manitoba offices of President-Elect, Member-at-Large and Regional Director. The successful candidate for President-Elect is **John Gavloski,** for Member-at-Large is **Randy Gadawski,** and for Regional Director is **Rob Currie.** We thank all candidates for their willingness to participate in the election. Formal announcement and commencement of terms will be at and after the ESM Annual Business Meeting, respectively.

Colin Demianyk, Chair, Scrutineer Committee
Noel White, Witness

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