

# Seed Bugs and their allies (Hemiptera: Heteroptera: Lygaeoidea) of the Canadian Prairie Provinces

David J. Larson<sup>1\*</sup>, G.G.E. Scudder<sup>2</sup>

1 Box 56, Maple Creek, SK, S0N 1N0 (dmlarson@sasktel.net)

2 Dept. of Zoology, University of British Columbia, Vancouver, B.C. V6T 2A9 (scudder@zoology.ubc.ca)

\* Corresponding Author

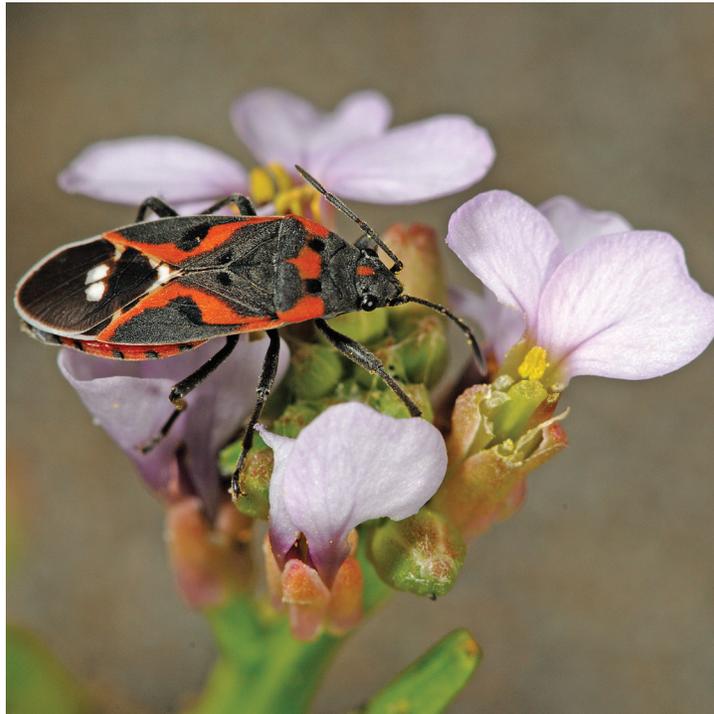


## Abstract

The Hemiptera superfamily Lygaeoidea is represented in the Canadian Prairie Provinces of Alberta, Saskatchewan and Manitoba by 76 species distributed among 10 families, namely: Artheneidae (1 species), Berytidae (2), Blissidae (3), Cymidae (4), Geocoridae (7 described plus 1 undescribed species), Lygaeidae (18) (Ischnorhynchinae (2), Lygaeinae (7), Orsillinae (9)), Oxycarenidae (3), Pachygronthidae (1), Piesmatidae (4) and Rhyparochromidae (31). Keys to families and species are presented and for each species we provide notes on distribution, recognition and ecology as well as a photograph of the dorsal habitus. The general ecology of lygaeoid bugs with special reference to those of the Canadian Prairies is discussed.

Within the region, known lygaeoid fauna is most diverse in the Cypress Hills and adjacent dry prairie regions of southeastern Alberta and southwestern Saskatchewan. There the dominant transcontinental faunal element is enriched by western, eastern and southern species reaching their distribution limits. Few introduced species are present, and these are largely synanthropic or ecological specialists and appear to have had little effect on the native fauna. Humans, through disrupting natural ecosystems, generally enhance lygaeoid bug faunas for most species favour disturbed or early successional stage environments. However, modern prairie agriculture has probably greatly impacted the fauna by fragmenting and reducing habitat through the wide extent of cultivation, use of chemicals and intensive grazing. Most species of Lygaeoidea appear to be resilient to these impacts due to their rather general ecological requirements and there is no evidence that any species has been lost from the fauna although some are in surprisingly low densities or have small, very widely distributed populations.

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*Lygaeus kalmii*, Brookings OR. Photo courtesy of S.A. Marshall.

**Contents**

Introduction .....	5
What are bugs? .....	5
Important Publications on Lygaeoidea .....	6
Bug anatomy – structure of bugs and features important in their identification .....	7
Seed Bug Ecology .....	9
Feeding .....	9
The Food of Lygaeoid Bugs .....	12
Life History Patterns .....	13
Reproduction .....	15
Wings and Flight .....	16
Chemical Defences .....	17
Natural Enemies .....	19
Sound Production and hearing .....	19
Rearing .....	20
Collecting .....	21
What is the good of a seed bug? .....	23
Distribution and Ecology of Prairie Lygaeoidea .....	24
Materials & Methods .....	32
Table 4: Checklist of Lygaeoidea of the Canadian Prairie Provinces and Ecozones .....	37
The Lygaeoidea of the Canadian Prairie Provinces .....	40
Key to families of Lygaeoidea .....	41
A. Family Berytidae – Stilt bugs .....	43
Key to genera and species of Berytidae of the Prairie Provinces .....	44
<i>Berytinus minor</i> (Herrich-Schaeffer) .....	45
<i>Neoneides muticus</i> (Say) .....	46
<i>Jalysus wickhami</i> Van Duzee .....	47
<i>Jalysus spinosus</i> (Say) .....	48
B. Family Geocoridae – Big-eyed bugs .....	49
Key to species of Geocoridae of the Prairie Provinces .....	51
<i>Geocoris limbatus</i> Stål .....	53
<i>Geocoris atricolor</i> Montandon .....	54
<i>Geocoris barberi</i> Readio & Sweet .....	55
<i>Geocoris howardi</i> Montandon .....	56
<i>Geocoris</i> species .....	57
<i>Geocoris discopterus</i> Stål .....	58
<i>Geocoris bullatus</i> (Say) .....	59
<i>Geocoris pallens</i> Stål .....	60
C. Family Rhyparochromidae – Seed Bugs .....	61
Key to genera and species of Rhyparochromidae of the Prairie Provinces .....	63
<i>Plinthisus americanus</i> Van Duzee .....	69
<i>Plinthisus indentatus</i> Barber .....	70
<i>Antillocoris minutus</i> (Bergroth) .....	71
<i>Neosuris castanea</i> Barber .....	72

<i>Mydocha serripes</i> Olivier .....	73
<i>Sisamnes claviger</i> (Uhler).....	74
<i>Kolenetrus plenus</i> (Distant) .....	75
<i>Pseudocnemodus canadensis</i> (Provancher).....	76
<i>Perigenes constrictus</i> (Say) .....	77
<i>Zeridoneus costalis</i> (Van Duzee).....	78
<i>Zeridoneus petersoni</i> Reichert .....	79
<i>Slaterobius insignis</i> (Uhler) .....	80
<i>Ligyrocoris diffusus</i> (Uhler).....	82
<i>Ligyrocoris sylvestris</i> (Linnaeus).....	83
<i>Stygnocoris rusticus</i> (Fallén) .....	84
<i>Stygnocoris sabulosus</i> (Schilling).....	85
<i>Drymus unus</i> (Say) .....	86
<i>Scolopostethus thomsoni</i> Reuter .....	87
<i>Scolopostethus diffidens</i> Horváth.....	88
<i>Eremocoris setosus</i> Blatchley .....	89
<i>Eremocoris ferus</i> (Say) .....	90
<i>Eremocoris obscurus</i> Van Duzee .....	91
<i>Eremocoris borealis</i> (Dallas).....	92
<i>Megalonotus sabulicola</i> (Thomson).....	93
<i>Atrazonotus umbrosus</i> (Distant) .....	94
<i>Malezonotus angustatus</i> (Van Duzee) .....	95
<i>Malezonotus arcuatus</i> (Ashlock) .....	96
<i>Uhleriola floralis</i> (Uhler).....	97
<i>Emblethis vicarius</i> Horváth .....	98
<i>Sphragisticus nebulosus</i> (Fallén).....	99
<i>Rhyparochromus vulgaris</i> (Schilling).....	100
<i>Trapezonotus arenarius</i> (Linnaeus).....	101
<i>Peritrechus convivus</i> (Stål).....	102
<i>Peritrechus fraternus</i> Uhler .....	103
D. Family Artheneidae – Cattail bugs .....	104
Key to species of Artheneidae of North America.....	104
<i>Holcocranum saturejae</i> (Kolenati) .....	105
<i>Chilacis typhae</i> (Perris) .....	106
E. Family Piesmatidae – Ash-gray Leaf Bugs .....	107
Key to species of Piesmatidae of the Prairie Provinces .....	108
<i>Parapiesma cinereum</i> (Say).....	109
<i>Piesma explanatum</i> McAtee .....	110
<i>Piesma patruela</i> McAtee .....	111
<i>Piesma costatum</i> (Uhler) .....	112
F. Family Cymidae – Sedge Bugs .....	113
Key to species of Cymidae of the Prairie Provinces.....	114
<i>Cymus coriacipennis</i> (Stål).....	115
<i>Cymus angustatus</i> Stål .....	116
<i>Cymus discors</i> Horváth.....	117
<i>Cymus luridus</i> Stål.....	118

G. Family Pachygronthidae .....	119
Key to genera and species of Pachygronthidae of Canada .....	119
<i>Oedancala dorsalis</i> (Say) .....	120
<i>Phlegyas abbreviatus</i> (Uhler) .....	121
<i>Phlegyas annulicrus</i> Stål .....	122
H. Family Blissidae (Chinch bugs) .....	123
Key to genera and species of Blissidae of the Prairie Provinces .....	124
<i>Ischnodemus hesperius</i> Parshley .....	125
<i>Blissus leucopterus</i> (Say).....	126
<i>Blissus canadensis</i> Leonard.....	127
I. Family Oxycarenidae .....	128
Key to genera and species of Oxycarenidae of the Prairie Provinces.....	129
<i>Mayana ramosus</i> (Barber) .....	130
<i>Crophius disconotus</i> (Say).....	131
<i>Crophius bohemani</i> (Stål).....	132
J. Family Lygaeidae, Subfamily Lygaeinae – Milkweed Bugs .....	133
Key to genera and species of Lygaeidae, Lygaeinae, of the Prairie Provinces .....	135
<i>Oncopeltus fasciatus</i> (Dallas).....	136
<i>Neacoryphus bicrucis</i> (Say).....	137
<i>Lygaeospilus tripunctatus</i> (Dallas) .....	138
<i>Melacoryphus admirabilis</i> (Uhler) .....	139
<i>Melacoryphus lateralis</i> (Dallas) .....	140
<i>Lygaeus kalmii</i> Stål.....	141
<i>Melanopleurus pyrropterus</i> (Stål) .....	143
<i>Melanopleurus perplexus</i> Scudder .....	144
K. Family Lygaeidae, subfamily Orsillinae – False Chinch Bugs .....	145
Key to genera and species of Lygaeidae, Orsillinae, of the Prairie Provinces.....	147
<i>Neortholomus scolopax</i> (Say).....	149
<i>Xyonysius californicus</i> (Stål).....	150
<i>Nysius fuscovittatus</i> Barber.....	151
<i>Nysius groenlandicus</i> (Zetterstedt) .....	152
<i>Nysius angustatus</i> Barber .....	153
<i>Nysius grandis</i> Baker.....	154
<i>Nysius paludicola</i> Barber.....	155
<i>Nysius tenellus</i> Barber .....	156
<i>Nysius niger</i> Baker.....	157
<i>Nysius raphanus</i> Howard.....	159
L. Family Lygaeidae, subfamily Ischnorhynchinae – Catkin Bugs.....	160
Key to species of Lygaeidae, Ischnorhynchinae, of the Prairie Provinces.....	160
<i>Kleidocerys ovalis</i> Barber.....	161
<i>Kleidocerys resedae</i> (Panzer) .....	162
Afterwords and Acknowledgements.....	163
References .....	163
Appendix 1. Common and Scientific names of Plants. ....	172

## Introduction

You can scratch on the ground almost anywhere, be it in the garden, a flower bed, under trees or bushes, on dry prairie grassland, in dry sand dunes or on beaches, and chances are you will find small, gray or brown to blackish, fast running bugs (Fig. 1). These are likely to be members of the True Bug (order Hemiptera, suborder Heteroptera) superfamily Lygaeoidea. A general common name for the group is “seed bugs”, for many of them feed on the seeds of a variety of plants. However, this name is too narrow, for as a group they have a great variety of diets ranging from the typical seed eaters to sap feeders to predators. Although typically denizens of the soil surface, some burrow shallowly into litter or among the roots of plants whereas others occur on plant stems and leaves and some complete their entire life on a host plant. Many occur in the driest environments whereas others are inhabitants of wet meadows, forests and marshes. The purpose of this paper is to introduce the ecology of these insects and provide an identification aid to the Canadian Prairie species of seed bugs and their allies (Hemiptera: Heteroptera: Lygaeoidea).

The North American members of the Lygaeoidea are defined and enumerated in several comprehensive works, namely Blatchley (1926), Slater (1964), Slater and Baranowski (1978), and Ashlock and Slater (1988). Henry (1997a) established the current family classification, which was followed for the most part by Maw *et al.* (2000) in a catalogue of Canadian Hemiptera. Many papers by Scudder treat species of the Canadian prairies. In general, the taxonomy of the North American Lygaeoidea is well known and few new species have been described in the last 100 years. Even the immature stages of most genera have been recognized (Sweet & Slater 1961). However, these works either give lists of names without providing a way of identifying the bugs to which the names apply or provide identification keys that are not comprehensive (at least for the Prairie Provinces) and therefore leave the user in doubt as to whether a correct identification has been made. This study is intended to provide a comprehensive list of all species of Lygaeoidea known to occur in the Canadian Prairie Provinces along with descriptions and illustrations of adults that allow their identification. No doubt more species will be added to this fauna in the future as additional native species are discovered and as invasive species enter the area. This work should make recognition of both types easier. We have seen reliably identified specimens of most of the included species, but there are a few species for which identifications need to be confirmed by comparison with types or reliably identified specimens. Situations where identification or application of a name is in doubt are discussed and the problem described.

## What are bugs?

The word bug has a variety of meanings. To many it is something that lurks in a computer and manifests itself at the most inopportune times. Or it is something planted by CSIS in motel rooms or light fixtures. Often it is a general term applied to any small animal of dubious heritage. Sometimes we are laid low by one residing in our gut or we may use the word as a verb to indicate annoying behavior. However, to an entomologist the word has a precise meaning. The “True Bugs” are insects of the suborder Heteroptera of the order Hemiptera. This follows the classification and names of most authors although Maw *et al.* (2000), the most recent catalog of Canadian Hemiptera, used the name Prosorrhyncha for the group treated here as suborder Heteroptera.

This is an outline of where true bugs and seed bugs fit into the classification of animals.

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Subclass:	Pterygota, Exopterygota
Order:	Hemiptera
Suborder:	Heteroptera (True Bugs)
Infraorder:	Pentatomomorpha
Superfamily:	Lygaeoidea (seed bugs and allies)

The orders of insects are based on characteristics such as the type of development from egg to adult, the possession of wings and the type of mouthparts. Wings of True Bugs form as rigid external pads on the back of the developing insect and at the final moult expand to form the functional, basally articulated wing. Insects with this type of development are Pterygota (winged insects), Exopterygota (wings developing externally on the body through a type of development called incomplete metamorphosis). Members of the order Hemiptera are further characterized by their mouthparts which consist of a tube-like structure through which liquid food is taken in. The members of the Heteroptera have the mouthparts arising as a feeding tube or labium from the front of the head and when at rest the labium lies tucked back under the body. When feeding, it can be rotated forwards, so the insect can stand on its food and feed or even extend the labium forward from the front of the head allowing the insect to reach out to a food source. The suborder Heteroptera is divided into a number of superfamilies which in turn contain families then genera and species. The characteristics of these superfamilies and families become quite technical so we will not follow this classification further at this point. At the beginning of the section dealing with the Prairie Province’s seed bugs, the characteristics of the members of the superfamily Lygaeoidea are given and then in each following family section the family characters are described.

**Important Publications on Lygaeoidea**

There is a rich literature on the Lygaeoidea of North America. Publications relevant to the taxa of the Canadian Prairie Provinces are cited in the reference section. The following short selection is presented as an essential library on the topic for not only are these works generally extensive in their coverage, many of them are illustrated with excellent drawings of bugs. There is something about the Hemiptera that brings out the best in graphic artistry. Although some of these works are old, these are mainly available online through the Biodiversity Heritage Library.

- Ashlock, P.D. and A. Slater. 1988. Family 20. Lygaeidae, pp 167–245. *In* Henry, H.J. and R.C. Froeschner. 1988. Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States. New York, E.J. Brill. 958 pp.
- Blatchley, W.S. 1926. Heteroptera or True Bugs of Eastern North America, With Special Reference to the Faunas of Indiana and Florida. Nature Publishing Company, Indianapolis, Indiana. 1116 pp.
- Burdfield-Steel, E.R. and D.M. Shuker. 2014. The evolutionary ecology of the Lygaeidae. *Ecology and Evolution* 4: 2278–2301.
- Dellapé, P.M. and T.J. Henry. Lygaeoidea Species File, Version 5.0/5.0 (January 15, 2018). <<http://Lygaeoidea.SpeciesFile.org>>. (A database that contains taxonomic and other information about all the seed bugs of the world, both living and fossil).
- Froeschner, R.C. 1944. Contributions to a synopsis of the Hemiptera of Missouri, pt. III. Lygaeidae, Pyrrhocoridae, Piesmididae, Tingidae, Enicocephalidae, Phymatidae, Ploiariidae, Reduviidae, Nabidae. *American Midland Naturalist* 31: 638–683.
- Henry, T. J. 2017. Biodiversity of Heteroptera. Pp. 279–335. *In* Footitt, R. G. and P. H. Adler. *Insect Biodiversity: Science and Society*. Volume I. Second Edition. Wiley & Sons, Ltd.
- Henry, T.J., P.M. Dellapé, and A.S. de Paula. 2015. The Big-eyed Bugs, Chinch Bugs, and Seed Bugs (Lygaeoidea). *In* Panizzi, A. and J. Grazia (eds.). *True Bugs (Heteroptera) of the Neotropics*. *Entomology in Focus*, Vol. 2. Springer, Dordrecht. (Contains keys to all Neotropical and most North American genera).
- Henry, H.J. and R.C. Froeschner. 1988. Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States. New York, E.J. Brill. 958 pp.
- Hoffman, R.L. 1996. Seed Bugs of Virginia (Heteroptera: Lygaeidae). *Insects of Virginia*, No. 14. Virginia Museum of Natural History. Martinsville. 111 pp.
- Larochelle, A. 1984. Les Punaises Terrestres (Heteropteres: Geocorises) du Québec. *Fabriques, Supplément* 3. 513 pp.
- Maw, H.E.L., R.G. Footitt, K.G.A. Hamilton and G.G.E. Scudder. 2000. Checklist of the Hemiptera of Canada and Alaska. NRC Research Press, Ottawa. 220 pp.
- Schuh, R.T. and J.A. Slater. 1995. True Bugs of the World (Hemiptera: Heteroptera). Classification and Natural History. Cornell University Press, Ithaca. 336 pp.
- Slater, J.A. 1964. A Catalogue of the Lygaeidae of the World. Volume 1 and 2. University of Connecticut, Storrs, CT. 1688 pp. (Updated by Slater & O'Donnell 1995).
- Slater, J.A. and R.M. Baranowski. 1978. How to Know the True Bugs (Hemiptera – Heteroptera). The Picture Key Nature Series, Wm. C. Brown Co. Publishers. Dubuque, Iowa. 256 pp.
- Slater, J.A. and R.M. Baranowski. 1990. The Lygaeidae of Florida (Hemiptera: Heteroptera). Vol. 14 The Arthropods of Florida and neighbouring land areas. Florida Department of Agriculture and Consumer Services. Contribution No. 725. 211 pp.
- Sweet, M.H. 1964. The biology and ecology of the Rhyparochrominae of New England (Heteroptera: Lygaeidae). Part I. *Entomologica Americana* (new series) 43: 1–124. Part II. *Entomologica Americana* (new series) 44: 1–201.
- Sweet, M.H. and J.A. Slater. 1961. A generic key to the nymphs of North American Lygaeidae (Hemiptera – Heteroptera). *Annals of the Entomological Society of America* 54: 333–340.
- Torre-Bueno, J. R. de la. 1946. A synopsis of the Hemiptera-Heteroptera of America north of Mexico. Part III. Family XI – Lygaeidae. *Entomologica Americana* (New Series) 26: 1–141.

### Bug anatomy – structure of bugs and features important in their identification

True Bugs are archetypal insects in their structure. A general knowledge of insect structure and terminology, such as found in any introductory textbook on entomology, will provide sufficient background for most of the morphological terms used in the keys and descriptions. We have tried to avoid using features that are difficult to observe in either live or intact dry preserved specimens so that dissections, microscope slide preparations or other specialized techniques are not required. However, because of their small size, a microscope, especially a dissecting microscope, with magnification of up to 100X is needed. At these magnifications an LED bulb of about 7W provides ample, cool light for examining fine detail of both live and preserved specimens.

However, bugs do possess some special features for which there is a unique terminology. These features and their names are described below and terms in bold type are illustrated in Figures 1-6. These structures are described in the order of the major body regions on which they occur, namely **head**, **thorax** and **abdomen**.

**Head.** The most prominent structures of the head are a pair of **antennae** that arise from the front between the eyes. The antennae are 4-segmented: segment 1, the basal segment, is usually somewhat shorter and stouter than the outer segments 2 to 4. Between the antennae the head is more or less trilobed with the middle lobe, the **clypeus** (= tylus of earlier authors), flanked on each side by a lateral **mandibular plate** (Torre-Bueno 1989) (= paraclypeal lobe or jugum). These lobes form the base of the **mouthparts** which consist of an elongate, 4-segmented **labium** within which lie the **labrum** and **mandibular** and **maxillary stylets**. The labium, which arises from the anterior ventral surface of the head, is sometimes referred to as the beak or rostrum, and is adapted for feeding on fluids. The labium in repose folds backwards along the mid-ventral line of the body, but it can be flexed forward in front of the body for feeding. The length of the labium varies between species and in repose may range from reaching the level of the procoxae to extending to the level of the basal abdominal segments. On the head, the base of the labium lies in an impression, the **gula**, which is delimited on each side by an elevated ridge, the **buccula (bucculae)**; the lengths of the gula and bucculae vary and provide useful characters for taxon recognition. The mid-ventral body surface, especially the mesosternum, is often channelled for the reception of the labium. Behind the antennae on each side of the head are usually prominent, convex **compound eyes**. Between the eye and antennal socket of species of Piesmatidae (Figure 6) there is an anteriorly projecting **antennal tubercle** which is usually bifid but may be simple. The side of the head behind the eye is the **postocular area** which may be

abruptly constricted behind the eyes to form a neck, or may be gradually narrowed or even somewhat inflated. Between and behind the level of the compound eyes are a pair of small simple eyes, the **ocelli** (ocellus).

**Thorax.** This is the body region behind the head that bears the legs and wings. This is composed of 3 body segments called, from front to back, the **prothorax**, the **mesothorax** and the **metathorax**.

Structures associated with each of these segments are given the prefixes pro-, meso- or meta- to distinguish to which segment they belong. For example, the profemur belongs to the first set of legs that attach to the prothorax.

The **pronotum** is a large shield-like plate that covers the dorsal surface of the body between the head and the base of the **wings** and the medial triangular **scutellum**. Two general regions can usually be recognized on the pronotum, the **anterior lobe** and the **posterior lobe**. The anterior lobe tends to be more convex and often of a different color or sculpture than the flatter posterior lobe. The division between the two may be sharp and indicated by a distinct impression or line, or change in convexity, color or sculpture, but in some forms the transition is gradual. The anterior lobe may have a pair of smooth or faintly punctate areas (**callus**, pl. **calli**) or may bear impressed more or less transverse **pronotal grooves** (The term ‘cicatrices’ has been used for these grooves by various authors (e.g. Barber 1947a, Fig. 1), but the term has a more specific use for structures in the Homoptera (Torre-Bueno 1989) so the more general descriptive term ‘groove’ is used here). These have also been called ‘lines’ by other authors, but these impressions are more than a line, they are generally of some width and smooth bottomed without punctures or setae and often distinctly colored (usually darker than surrounding pronotal surface, but may be paler in some taxa). The lateral margin of the pronotum may be smoothly rounded, somewhat angulate or ridged (carinate if sharply ridged) or even extended laterally as a flat plate (explanate) or **paranotal lobe**, and this may differ between the front and hind lobes. In some species in which the postocular area is very short, the hind margin of the eye impinges on the anterior-lateral angle of the pronotum which may be distinctly concave (as seen in lateral aspect) to receive it.

The **wings** fold to lie over the abdomen with the front wings uppermost and hiding the underlying hind wings. A front wing is usually termed **hemelytron** (pl. hemelytra). The hemelytron consists of three major regions: an apical **membrane**, usually hyaline (clear), but sometimes pigmented, with 4 or 5 longitudinal veins; and a basal portion which is thickened (**coriaceous**) and often punctate, setose and/or pigmented and in turn consists of the **clavus**, a strap-like piece adjacent to the **scutellum**, and a more lateral **corium**, the outer margin

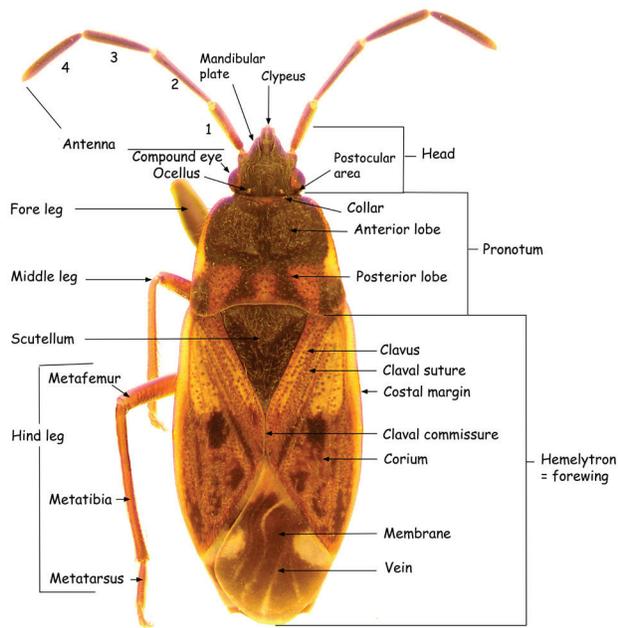


Fig. 1. Bug anatomy. Structural features described in text. *Eremocoris ferus*, dorsal aspect.

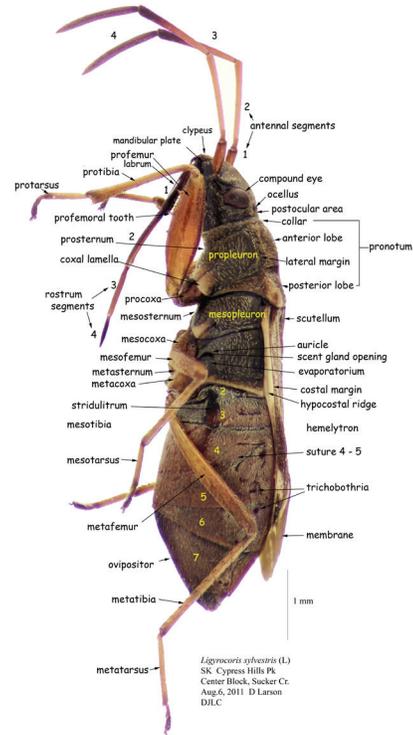


Fig. 2. Bug anatomy. *Ligyrocoris sylvestris*, female, lateral aspect.

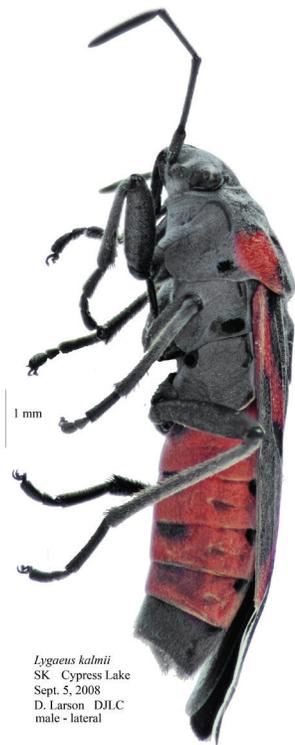


Fig. 3. Bug anatomy. *Lygaeus kalmii*, male, lateral aspect.

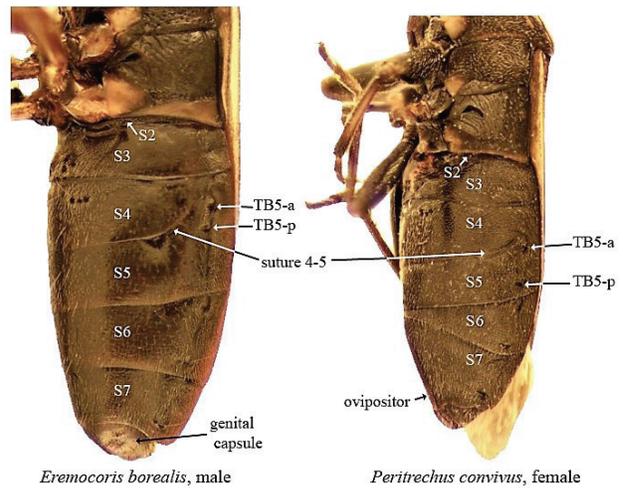


Fig. 4. Bug anatomy. Abdomen of Rhyparochromidae, lateral aspect. S – abdominal sternum; TB5 –trichobothria of segment 5, a –anterior, p –posterior.

of which is called the **costa** or costal margin. In some taxa the costal margin is produced ventrally as a ridge (**hypocostal ridge**, Schuh & Slater 1995, = infracostal or hypohemelytral lamina, Drake & Davis 1958) which clasps the side of the abdomen. Wings vary in size between species and even within species between individuals. When the wings are as long as the abdomen they are referred to as **full** or **macropterous** (specimen called a **macropter**); when shorter they are said to be **reduced** or **brachypterous** (**brachypter**). An extensive discussion of wing reduction is given under the ecology section.

The sides of the thorax are made up of several large plates referred to as the **pleural sclerites**. Ventrally, between and anterior to the leg bases are the thoracic sterna (**pro-**, **meso-** and **metasternum**). The sterna may be longitudinally impressed or grooved in some taxa to receive the labium when it is in repose. The lateral portions of the pleura that are produced over the base of the legs (the **coxae**) are the **coxal lamellae**. The **legs** are generally unmodified and suited for fast running. However, many species have the **profemur** thickened and armed beneath with **spines** or **teeth**. These legs look like the raptorial leg of a predator, but apparently the spines serve to hold seeds on which the insects feed. In adult insects, **scent glands** occur on the ventral portion of the metathorax with a prominent **scent gland opening** on the metapleuron between and lateral to the bases of the middle and hind pairs of legs. This structure consists of an **orifice** through which defensive chemicals are extruded, a surrounding raised or calloused area (**auricle** or **peritreme**) which in turn in many species is surrounded by an area of distinctly textured cuticle (**evaporatory area** or **evaporatorium**).

**Abdomen.** This makes up the hind end of the body. The correct terminology for abdominal structures has been discussed by Snodgrass (1960). The abdomen is made up of a series of segments each basically with a transverse dorsal plate (**tergum**) and a corresponding ventral plate (**sternum**). In dorsal view the abdomen is hidden, at least at its base, by the folded wings, but wing reduction frequently occurs so that a various number of abdominal **tergites** are visible. The tergum may be subdivided into a large median **tergite** and lateral pieces often called **paratergites**, but there is debate about the correct terminology of lateral parts of the tergum (Sweet 1996). The sharp lateral margin of the abdomen is called the **connexivum** and is the line of contact between the dorsal **laterotergites** and ventral **sterna**. In ventral view, **sterna** appear as a series of transverse plates behind the hind legs. The abdomen consists of 11 segments; however, they are not all visible in external view. For example, immediately behind and lateral to the hind legs is a very narrow strap-like sternum. The sternum of the first abdominal segment

is missing so this is the sternum of the second abdominal segment and therefore called **sternum 2**. In any reference to the sterna, the sternal number begins here at 2 so that in most Rhyparochromidae, for example, the **suture** (line between adjacent sterna) that curves forward laterally and not attaining the lateral margins of the abdomen lies between sterna 4 and 5 (some authors count only what is visible and they would say the curved suture lies between sterna 3 and 4). The tergum with which a sternum is associated is given the same number as the sternum. Towards the apex of the abdomen, its segmental nature is complicated by fusion of plates and presence of the genitalia. The **external genitalia** are the best feature to identify the sex of a bug. In a male it consists of an oval plate (**male genital capsule**) that can be clearly seen in posterior view. The male genitalia offer very useful characters for taxon recognition and classification, but as observation of these characters requires dissection and clearing of the structure, these characters are not treated in this work other than mention of the **parameres** (= claspers). In the female the last sterna are longitudinally split to contain an **ovipositor**, which is flipped out like a jackknife blade to guide and position eggs when they are laid. **Spiracles** (openings of the respiratory system) occur laterally on the abdomen with one pair per segment. They may be either on the dorsal side or ventral side of the segment, the position often being characteristic of a family or tribe. Because this feature is often difficult to see it is mentioned in the family and some tribal descriptions, but has been used only as an ancillary character in the keys. Also, on the abdomen, and sometimes head, are **trichobothria** (slender, elongate sensory **setae** arising from enlarged spots or pits), the position and number of which are useful in the recognition of some species. The term **seta** (setae) is used for any hair-like structure on the cuticle.

## Seed Bug Ecology

### Feeding

The initial impression one has of many seed bugs is that they are predators of other arthropods. Many species have the front legs modified as grasping organs: the profemora are enlarged and bear cuticular spines or denticles along the anterior and often the posterior ventral margins and the opposing face of the profemur is often roughened or denticulate to form a grasping raptorial leg such as that of many predaceous insects. However, within the fauna this form of grasping leg is always associated with seed predation. The leg is used to hold, manipulate and transport seeds on which the insect feeds. Some lygaeoids are predators of other arthropods, notably the big-eyed bugs (Geocoridae), but they lack front leg modifications as do the stilt bugs (Berytidae)

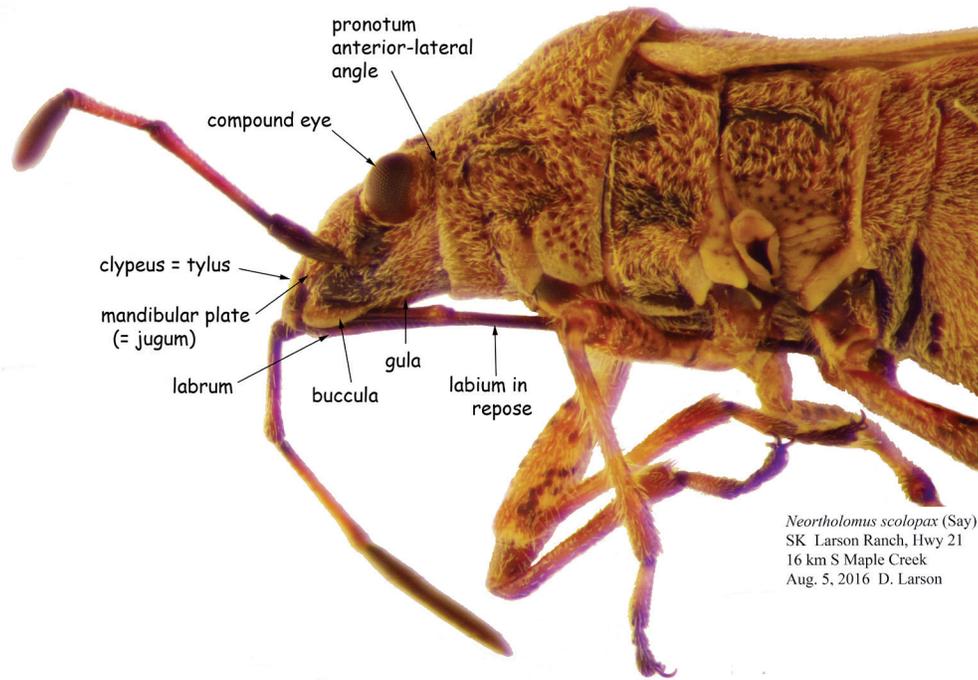


Fig. 5. Bug anatomy. Head and thorax of *Neortholomus scolopax*, lateral aspect.

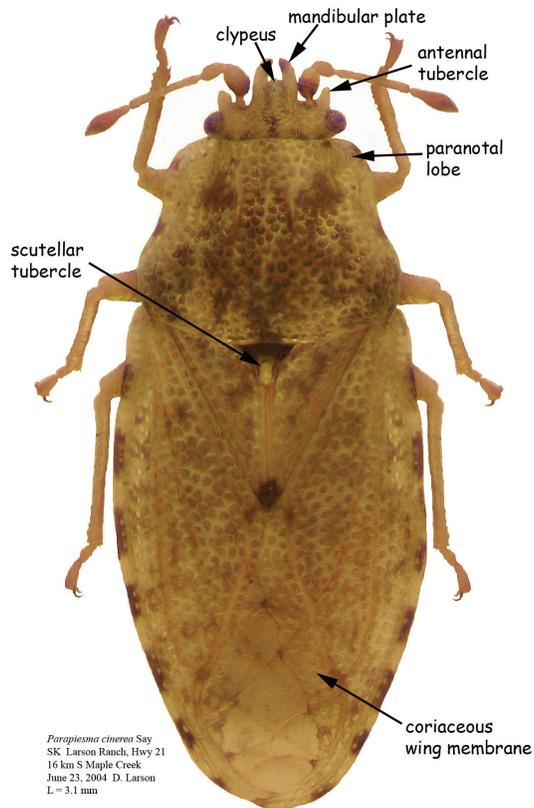


Fig. 6. Bug anatomy. *Parapiesma cinerea*, dorsal aspect.

which are opportunistic predators. Not all seed feeding bugs have raptorial legs, so this characteristic is not a prerequisite for seed feeding, but may be associated with foraging strategies that involve seed finding, movement and guarding. Species that feed above the ground while on vegetation lack or have less strongly modified front legs.

The essence of a bug is its sucking mouthparts. These are comprised of the principal parts of a typical insect mouth, but are elongated, simplified or otherwise modified to the point that they are not immediately recognizable. However, some very astute and careful insect morphologists have worked out the homologies of the parts so that the hemipteran mouth can be understood as a reworking of the basic insect biting design to produce a sucking tube (Snodgrass 1935). But what a sucking tube! It probably first evolved in a terrestrial insect feeding on plant sap, a flowing liquid that may have rushed up into the insect's mouth under pressure. But from this condition, heteropteran modifications include: two way flow of materials so that saliva can be injected into the food and liquid food drawn up; pumping mechanisms to move these liquids; the tips modified to be probes and chisels to get at food through various barriers; and the whole assembly elongated with points of flexibility so that the tube can be stored away under the body when at rest, but rotated forwards towards food sources to feed.

The morphology of hemipteran mouthparts is well described in most entomology texts, but one of the best descriptions is by Snodgrass (1935, Chapter XII). Very briefly, what you see when looking at the head of a lygaeoid bug is a rather thick tube, the labium, arising from the front of the head and folded backwards to pass midventrally down the body to at least the level of the forecoxae, but often reaching the level of the hind coxae or even abdomen. The labium is composed of four segments and can flex at the joints between segments. Along the front of the labium (its ventral surface when tucked under the body) is a groove within which lie 4 bristles or stylets. These are the mandibles (an outer pair) between which lie two maxillae. The bundle of stylets is held together because adjoining surfaces have longitudinal dovetailing grooves and ridges that hold the stylets together, but allow them to slide in and out past one another. Between the two inner maxillary stylets are a pair of canals formed from opposing grooves on their inner surfaces. The anterior-most canal is the food canal which is continuous to the mouth opening at the base of the head; the posterior canal is the salivary canal and the salivary glands open into it through a pointed structure, the hypopharynx, at the base of the head. At the base of the hypopharynx is the salivary syringe which injects saliva into and down the salivary canal. Liquid food

is taken up at the tip of the labium into the food canal and drawn up into the head by means of a suction pump located in the front of the head. When feeding, the stylets are inserted into the food source by means of muscles located at their base in the head, those of the mandibles inserting on the mandibular plates. The labium does not enter the food and as the stylets drill down into the food the labium folds between its segments to accommodate the shortening distance between the head and the food surface. The stylets penetrate in a step-wise process: a mandibular stylet is extended as far as possible (only a short distance, limited by the size of muscle at its base) and anchors due to either barbs at its tip or a clasp mechanism in the labium. The other mandibular stylet is then advanced, held, and the maxillary stylets are moved forward between them. The process is repeated with the stylet bundle advancing into the food and the labium folding. The final basic insect mouthpart is the labrum, the upper lip. It is attached to the clypeus at the front of the head and forms a narrow triangular flap over the base of the stylets and the mouth opening. Hemiptera lack palps, sensory appendages associated with the mouth of most insects, and instead the taste receptors are located at the tip of the labium.

Lygaeoid bugs, as well as other terrestrial Heteroptera, have two major functional feeding strategies which have been termed by Cobben (1978) as stylet-sheath feeding and lacerate-flush feeding, but they are not mutually exclusive. Stylet-sheath feeding is typically used when feeding on plant fluids. The bug produces salivary secretions that form a cone that attaches the tip of the labium to the feeding substrate and may even form a salivary sheath that lines the feeding puncture through which the stylets are inserted. Functionally the cone and sheath may help seal the tube and improve the efficiency of the drinking straw, but also enzymes and other chemicals in the saliva may help liquefy food, detoxify plant chemicals and aid in ingestion or modifying food quality.

Bugs can feed on cell contents or on solid food and to do this they employ lacerate-flush feeding. In this feeding mode the barbed apical portions of the mandibular stylets are used to macerate tissue within the food source (generally dry, mature seeds, but may also be adapted to feeding on animal or plant bodies) which is then mixed with saliva, usually containing digestive enzymes, to liquefy the food material so it can then be sucked up the food canal. A salivary cone and sheath may also be produced in this feeding and the cone remaining on the surface of a seed after feeding is an indication of the seed having been attacked (Sweet 1964a). Dry seed is unsuitable for an insect equipped with a sucking tube, but lacerate-flush feeding makes this food source accessible.

The water concentration in food affects Hemiptera in two ways. Species that feed entirely on plant sap have an abundant source of food that may even be pushed up into the mouth by fluid pressure within the plant. The down side of this is that although food is abundant and easily ingested, it tends to have low concentrations of nutrients although it may be sugar-rich. The insects need ways to throughput large quantities of water and sugars to allow them to concentrate less abundant nutrients. A by-product of this sort of feeding is excretion of sugar-rich wastes (generally called honeydews) which are eagerly sought out by a variety of sugar-craving insects and other animals.

However, lygaeoid bugs have taken a different feeding tactic. They feed on cell contents or on solid plant storage materials, substances that are richer in food value, but more difficult to extract, especially with a sucking tube. Generally, the insect must inject fluid, saliva, at the feeding site either as a carrier for food particles or often containing enzymes that liquefy the food externally so that it can be sucked up. This means that instead of having too much water in the diet, these insects must supply water in order to feed. Seed bugs are generally considered to be easily reared in culture by supplying them with suitable seed and access to water. Various authors (e.g. Sweet 1964a, b) comment on the dependency of bugs on water sources and that they are not capable of surviving without this water. This is curious as many seed bugs are inhabitants of desert and arid environments, but water needs for feeding puts constraints on them.

The midgut of lygaeoids, like that of other plant feeding Heteroptera, has numerous caecae which are inhabited by bacteria. The bacteria are of varied form and characteristic of each host species (Wigglesworth 1965). Kuechler *et al.* (2012) examined a variety of lygaeoid bugs and found that all the bugs studied possess paired bacteriomes in the abdomen but between different taxa of bugs these are differently shaped and harbor specific endosymbionts. Endosymbionts were also detected in female gonads and at the anterior poles of developing eggs, indicating vertical transmission of the endosymbionts via ovarial passage. The diverse endosymbionts and the differently shaped bacteriomes may reflect independent evolutionary origins of the endosymbiotic systems among lygaeoid bugs. The role of these bacteria is unknown. They may aid in digestion in some way or they may contribute to nutrition or metabolism. For example, they could synthesize some protein useful to the host such as some accessory factors that enable the host to live on a restricted or specialized diet which is incomplete in some respect.

### The Food of Lygaeoid Bugs

The feeding mechanisms of these insects are well understood, as described above. Also, the general classes of foods they use are known, as indicated in some of the group names such as seed bug, cattail-bug, etc. However, for most species the details of food selection are poorly known. Some species are obviously monophagous and have a close association with their host plant so that their food habits can be easily inferred from field observations. However, for most species food habits are less obvious. Sedge bugs are associated with marsh plants, especially sedges, bulrushes and rushes. Adults may feed on the seeds of a variety of these plants, but the nymphal stages may be much more restricted, developing on only one host species and similar species may have different host plants (Slater 1952). In some cases, host selection may be based on taxonomic relationships, but in others it may be based on the physical structure of the plant, for example catkin bugs feed on a variety of catkin-bearing plants. Selection may simply be based on what is available in the habitat in which the bug lives. Certain families of plants are especially favored, notably members of the Chenopodiaceae and the Asteraceae. Grasses which are so abundant and diverse on the prairies appear to be relatively little attacked for the lygaeid community is much richer in sites where a diversity of broad-leafed plants are interspersed with grasses. Legumes, which are a very prominent component of the prairie flora, are relatively infrequently mentioned as plant associates of lygaeoids.

The big-eyed bugs (Geocoridae) take the widest range of foods recorded for any lygaeoids. They are best classified as predators for successful development and reproduction requires animal food in their diet. Acceptable prey is any animal, generally arthropod, within a suitable size range, including mites, Hemiptera, Lepidoptera larvae and Coleoptera. They also feed on seeds, plant saps, nectar, and obtain water from plants (Yokoyama 1980 and included references).

Sweet (1964a, b) has done the most extensive feeding studies of North American Rhyparochromidae in his work on the ecology of the species of the northeastern US. He found that in the lab most species accepted and grew on a variety of seeds, but did have favorites. Many of the species he studied also occur on the prairies, but often their eastern favorite host plants do not occur here. This indicates that there are a variety of acceptable host plants, which may vary from region to region, or that if host specificity occurs then our concepts of species may be wrong and that there are more ecologically specialized species than we currently appreciate. More detailed studies on seed bug ecology have been conducted in Europe where host specific sibling species have been discovered. Chinch bugs (Blissidae) are important pests

of grasses in the eastern United States. The bugs have preferences between different species of grasses as well as between different cultivars of the same grass species so that selection of grass cultivars not favored by chinch bugs (with chinch bug resistance) is a valuable technique for preventing plant damage.

Seed-feeding bugs need to be in environments where seeds both exist and occur in suitable abundance. Not all plants produce large amount of seed on a regular basis. Annual weeds grow rapidly and put all of their production into seed and do this on an annual basis. Thus, they are ideal food plants for seed bugs. Such plants are generally weedy, colonizing plants that grow up quickly on disturbed, bare sites where the open soil is sun-warmed and dry. Seeds falling onto such soil are winnowed by the wind and sifted into windrows or accumulations in lee sites. Being dry, seeds in such sites are less likely to germinate or rot and so have a prolonged period of availability to seed bugs. It is not surprising that sites with early successional stages of vegetation are among the best seed bug habitats. As vegetation develops, perennial species come to dominate. These plants put more resources into vegetative growth so produce smaller seed crops and as well may not set seed on an annual basis, decreasing the quantity and predictability of food for seed-feeding animals. Climax communities usually have relatively depauperate seed bug faunas. Dominant prairie grasses persist and reproduce mainly vegetatively. Their seed production is light and very erratic – it may be many years between seed crops making them a too unpredictable food source for seed eaters. Prairie seed bugs feed mainly on forbs, usually those growing on disturbed sites.

Seeds are not evenly scattered over the soil surface. Many fall to lie beneath the mother plant but many have adaptations to be dispersed by wind or water. Where these dispersed seeds accumulate can be rich sources of food for seed eaters. Edges and obstructions in and around open areas accumulate wind-blown plant material including seeds and become focal points for seed bugs. Water similarly collects and concentrates plant material as wrack along beaches where seed bugs are often diverse and abundant.

### Life History Patterns

The north wind shall blow  
 And we will have snow  
 And the seed bug will be in diapause.  
 It will be on the ground  
 Midst plant litter all around  
 And not move until the frost thaws.

Seed bugs, being exopterygote insects, have a life history that consists of three distinct parts: the egg, the immature or nymphal stages, and the adult. The nymphal stages represent the growth period for the insect. They consist of a series of nymphal forms separated by cuticular moults and are referred to as Instar 1 nymph, Instar 2 nymph, ... Instar 5 nymph. Some authors use the term larva for immature stages of bugs as it shows the homology in the immature stages across the class Insecta. However, the use of the term nymph is so ingrained in the Hemiptera literature that we use it. Seed bugs have 5 nymphal instars, the fifth of which moults into the adult stage which does not moult again. The nymphal stages are somewhat like the adults in that they are recognizable bugs with sucking mouthparts, long antennae, compound eyes and are long-legged and active. However, they differ from adults in that their bodies tend to be more ovate in shape, the wings are only pads on the back and are non-functional, there are scent glands on the dorsal surface of the abdomen, the color is often quite different and internally the gonads and genitalia are not developed. The nymphs and adults of bugs generally occur in the same habitat and feed on the same things. Often nymphs and adults occur together; new adults may occur with slower developing brethren which are still large nymphs, or adults of one generation may overlap with their offspring. Situations like these provide the opportunity to associate nymphal stages with adults, which is very useful if the nymphs are different in some ways such as color or shape.

Given this simple life history pattern, bugs have been able to do some amazing things with it in adaptation to diverse ecological systems. Almost everywhere there is seasonality in climate, but especially so in the cold northern latitudes. This sets the timing each year for biological events such as flowering of plants, seed germination, maturation of fruit as well as for temperature and usually moisture budgets. There are optimal times of the year for activities such as a time to feed and grow, a time to disperse, a time to reproduce and a time to shut down for the cold. Depending on the habitat or the food source used, different species have different optimal times for their life history activities. They have a cunning way of controlling when an activity occurs, called diapause.

Diapause occurs when an insect stops feeding, growing, developing or some other activity in preparation for an adverse event, which in our latitudes generally means winter. For example, an adult bug will stop feeding in the fall and hide in a protected spot to pass the winter. However, there is more to diapause than this. Bugs are cold blooded or poikilothermic, which means their body temperature is controlled by the temperature of the environment, a cooling environment slows them down so that the low temperature of winter stops their activity.

However, if temperature alone was controlling the bug's development we would expect that the insect would slow down as the temperature drops and resume activity when it rises. In diapause this does not happen. The stop in activity occurs before the cold of winter begins and even if there is a chinook or warm spell the insect remains shut down and only resumes activity after temperatures start to rise in the spring. The shut down is clearly related to some factor other than temperature even though the shut down is an adaptation to surviving the low temperatures of winter. Usually the factor that triggers diapause is day-length or photoperiod, the numbers of hours of light in a day. So, in our example the bug could be induced to go into diapause when day-length starts shortening such as happens in late summer or fall, or it may not involve sensing change, but may be triggered if day-length is less than say 14 hours of light per day. In either case, these conditions occur before winter arrives and can be used as a surrogate of temperature and one that is a more reliable indicator of the coming cold season. How can this be done? Its due to hormones. Hormones, chemicals within the body that control almost all its activity, can be affected by external factors such as day-length. The insect's eyes, and especially the simple ocelli on the head, can perceive light intensity and duration. This information feeds into the brain which can control the production of hormones that can either enhance or stop an action. Thus, a decreasing day length can result in the insect stopping hormones involved in feeding and activity and result in the insect going into a suspended state suitable for passing the winter. It is more complex than this, but this gives the gist of the process, so we can define diapause as a cessation of activity prior to the onset of unfavorable conditions and is triggered by cues (e.g. photoperiod) other than those for which diapause is an adaptation (cold temperatures). Diapause can be coded for in the genes and thus an insect will go into a state of diapause at some point in development (obligate diapause) or the insect may develop continuously unless a particular condition is met in which case diapause ensues (facultative diapause). Diapause need not apply to overall body activity; adult insects often have reproductive diapause in which development of gonads and reproductive activity stops even though the insect

may remain active. With this background we have the necessary information to understand bug life histories.

In cold climates there is usually one life history stage of a species that is best adapted for surviving the winter. It is usually either the adult or egg stage, but can be a nymphal stage. All the individuals in a population of a species remain in developmental synchrony by going into diapause under the same set of conditions. For example, a certain photoperiod could induce all adults of a species to go into an overwintering diapause which, when broken in the spring, results in synchronous activity such as dispersal and reproduction, and at a time when plants start growing so bugs would also be in synchrony with plant development. This is an ideal strategy for species that feed on new growth of perennial plants. On the other hand, some insects feed on annual plants which germinate in the spring and take a while to grow enough to become suitable for an insect to find and feed on. In such cases, a delay in spring activity is required. Table 1 gives some overwintering strategies and their possible consequences to life histories.

The above life histories consider plant phenology as an important factor. Some groups of seed bugs, such as the chinch bugs (Blissidae) feed on sap of green plants and big-eyed bugs (Geocoridae) are predators. Interestingly the big-eyed bugs, which are predators and least dependent on plants, appear to have the weakest diapause. However, most seed bugs feed on seeds so we would expect their life history to follow the pattern of seed availability and quality. In fact, this seems to be the case with some species breeding early, presumably to catch overwintering seeds before they germinate in the spring, whereas others breed about the time seeds of host plants mature. However, so little is known about the seed food base of these bugs that relating life history with seed availability is largely speculation. In the species discussions we describe the life history pattern: for some it is based on careful research which is cited, for others it is our speculation based on when we have found the various life history stages in the field. The study by Sweet (1964a, b) is a model for faunistic life history studies and similar local studies would be most rewarding and informative.

**Table 1. Life history patterns of lygaeoid bugs.**

Simplified from Sweet (1964a) who gives a more nuanced classification. (the term univoltine means 1 generation per year; bivoltine - 2 generations; multivoltine - 3 or more generations).

Diapausing stage	Description	Life history effects	Number of generations
1. Adult, early maturation in spring (species in many families)	Overwintered adults become active early in spring with rapid gonad development and egg laying.	Eggs can be laid early to take advantage of spring conditions; increases length of season for bug.	Early spring resources available for 1 generation (univoltine), more time in summer for several generations (bi- or multivoltine).
2. Adult, delayed maturation in spring (Rhyparochromidae, Drymini, Sweet 1964a)	Overwintering adults are slow to become sexually mature, reproduction in mid to late summer	Delay in spring reproduction as gonads mature; adults have time to disperse to find a host plant, eggs and nymphs occur later in season. Eggs of some species develop very slowly so nymphs occur in late summer	Reduces time for multiple generations, but allows for annual plants to be found and for seeds to mature.
3. Egg, no or little development of embryo. (Many Rhyparochromidae, Sweet 1964a)	Egg laid, but no embryological development occurs until the following spring. Diapause caused by the cues the mother is exposed to.	Eggs in suitable habitat, but a delay in hatching allows nymphs to feed on late developing foods.	Produces nymphs earlier in season than spring egg-laying so improves opportunity for several generations.
4. Egg, with partial embryonic development. ( <i>Drymus</i> , <i>Stygnocoris</i> , Sweet 1964a)	Embryological development proceeds in fall to point of being prepared to hatch.	Nymphs produced relatively quickly in spring.	Better chance for multiple generations. Over-wintered seeds are at maximum availability.
5. No apparent diapause, nymphs and adults quiescent over winter. (A few Rhyparochromidae, Sweet 1964a, perhaps in some Geocoridae).	Continuous development of nymphs and adult reproduction when conditions are suitable.	Adults and nymphs overwintering. Nymphs feed and grow in fall, stop over winter and resumes in spring. Requires habitat consistency between fall and spring.	Reproduction can proceed continuously as nymphs are not caught out by winter.

## Reproduction

Aspects of the reproductive behavior of lygaeid bugs have been reviewed by Burdfield-Steel & Shuker (2014). Reproductive behavior of a variety of seed bugs has been described, mainly based on observations of specimens in culture. Some of the most extensive observations are those of Sweet (1964a, b) who observed mating and egg-laying behavior of many of the New England species of Rhyparochromidae. He found that when stridulatory structures were present, the male had a courtship dance consisting of appendage and body vibrations or movements. In species lacking such structures, the male may approach the female with his antennae vibrating rapidly then deliberately climb onto her if she does not reject him, or an even more direct approach was shown by some species in which males immediately mounted the female when they recognized her. Copulation begins with the male on the female's back, but the male then moves off the female to put the pair in an end-to-end position or side-by-side in the case of Cymidae and Berytidae. Duration of copulation varies considerably

and has been observed to last for at least several hours in *Stygnocoris*. Mating aggregations of adult bugs have been described as occurring in some species. Such aggregations are likely to be enabled by chemical cues such as bug-produced pheromones or by environmental cues such as host plant scents.

The female has an elongate, pointed ovipositor, but it is relatively soft and not adapted to insert eggs into plant tissue. Rather, it is used to place the eggs into protected spots such as in the soil or crevices, under cover, in stem axils or even into cavities within plant stems or pieces of debris. Eggs differ in shape, surface sculpture and whether laid with a cement coating or not, these features differing between species depending upon the type of substrate into which the egg is laid. Burdfield-Steel & Shuker (2014) state that in the Lygaeidae *sensu lato* eggs tend to be laid in batches of 10 to 100 at a time. However, Sweet (1964a, b) found that in the Rhyparochromidae eggs tend to be laid singly or in small groups with a small number of eggs being laid daily over an extended oviposition period. He found that the total number of eggs

laid tended to be related to species size with small species laying as few as an average of 70 and larger species an average of up to 270 eggs under laboratory conditions. Leonard (1966) reported a *Blissus leucopterus* female laying an average of 15 eggs/day to a total of 1,091 eggs.

### Wings and Flight

Despite the obvious advantages of flight, many adult pterygote insects, including seed bugs, have wings that are reduced in size and incapable of supporting flight. A seed bug captured in flight can be seen to have wings that in the position of rest, folded back over the abdomen, are approximately as long as or longer than the abdomen. Many bugs have wings that are distinctly shorter than the abdomen and are never observed to fly thus the length of the wing can be used as an indication of the bug's ability to fly. Individuals with long, functional wings are said to be **macropterous** (macro = long, pterous = winged) or called **macropters** whereas short winged individuals are **brachypterous** (brachy = short, pterous = winged) or **brachypters**. The terms full winged and short winged are also often used respectively to express potential flight capability. Within many species, there are both macropterous as well as brachypterous individuals and such species are said to be dimorphic in wing development.

Why would an insect give up the ability to fly when flight has so many obvious advantages? Many biologists have considered this and Darwin (1859) had something insightful to say on the matter. He related the ability to fly to the insect's available resources. Wings take material and energy to make and flight requires energy expenditure. If by not flying an insect has more resources to put into reproduction and thus achieve higher reproductive success, then the loss of flight will be selected for. However, if flight is essential for the insect's life style then flight loss will not occur for it would lead to the insect's extinction. For example, an insect like a bee that needs to visit many flowers that are spaced out over the landscape and which change in position from day to day can not survive without flying. On the other hand, a prairie insect that eats grass is always surrounded by available food and if its other requirements for life are met, it can persist and reproduce without the costs and dangers of flying.

Through examining the life styles of a variety of insects including those which never lose their flight ability and those that have lost the ability to fly, several general trends have been observed. These involve relationships between habitat permanency and habitat isolation. If an insect lives in a very ephemeral habitat, it must move frequently to remain in a suitable environment for survival and reproduction. For example, an insect species that lives on an annual plant must colonize a new host every year

so there is a premium on dispersal abilities such as flight. A species that lives in an environment that changes little over long periods of time and can find life's requirements within short distances, can dispense with flight and its costs. As a general pattern, the frequency of flight loss increases with increasing habitat stability. Habitat isolation also promotes increased levels of flightlessness. Imagine a small island with a population of insects, some of which can fly, others that are flightless. Flying individuals are more likely to be lost to the population as they disperse (e.g. they could be blown away or fly to places from which they can not return) than are those that are grounded. This would give a differential loss of the two types in the population so that survivalship and reproductive success of flying forms would be less than for nonflying forms and thus selection would act in favour of loss of flight. An island habitat need not be literally surrounded by water. A mountain top that supports an alpine species, a forest patch in otherwise grassland, a pond in a desert all represent insular habitats and those insects that disperse from them are lost to the population and are unlikely to be replaced by dispersers from similar habitats elsewhere.

So, a long-lasting habitat promotes flight loss. However, no habitat is truly permanent. Climates change, biotas wax and wane and those species that can not adapt to the change perish. Many insects that show flight loss hedge their bets by being wing dimorphic: some individuals retain the ability to fly even though flightlessness is currently advantageous. Thus, we see that in most species of bugs with wing reduction there are usually some individuals that can fly. The simplest way this can be achieved, and it is known to be the case for various species of bugs and beetles, is for flight loss to be controlled by an allele, usually dominant, of a single gene. Nonflying individuals then are homozygous or heterozygous for the nonflying gene and flying individuals have to be homozygous for the recessive gene. Nonflying individuals, whether homozygous or heterozygous, are equally selected for and this means that the allele for flight can remain in a population even if is selected against in the homozygous condition. The flight gene will decrease in frequency in the population, but can persist at low frequencies for very long time periods and even if flight is manifested only every once in a while the species can still disperse as habitats change. Under this model, new populations established by flying founders will contain only individuals homozygous for flight. Over time, mutations for flightlessness could be selected for so that the relative frequency of the two flight morphs should be related to the age of the population

This discussion has been on the external appearance of the adult wings. However, for wings to function they must be powered and controlled by muscles located in

the thorax at the wing bases. These muscles take up a great deal of space in the body and require a lot of the animal's resources to make and maintain. These muscles do not have a function when the wings are reduced. As we know only too well with our own bodies, muscles that are not used atrophy. The same applies to the flight muscles. Flight muscle reduction or loss goes hand in hand with wing reduction and this is where the reproductive advantages of flightlessness accrue. Without flight muscles there is more room in the body for gonads and the material that would go into muscles can be diverted into reproduction such as increased egg production. There is a general tendency for flightless individuals to begin reproduction earlier in their adult life than flying individuals and for their lifetime reproductive output to be greater. Flight muscle loss need not be limited only to individuals with reduced wings. Even fully winged individuals can have their flight muscles break down and then use this material for reproduction (Solbreck 1979). A common life history pattern is for new adults to have well-developed flight muscles and immature gonads. These individuals can fly, and after a dispersal period, during which time suitable habitat for reproduction is found, flight muscles are autolyzed, and the material is put into maturing the reproductive organs, thus obtaining the advantages of both flight and flightlessness.

Southwood (1960) observed that for many lygaeoids flight tended to occur mostly in spring (posthibernational) and fall (prehibernational). Posthibernational flight occurs when overwintering adults become active in the spring and disperse to breeding habitat. This is when the largest number of specimens occur in lake wash, these presumably being day flying insects that land or fall into water then are cast up onto the shoreline by wind and waves. The abundance of insects in the drift generally peaks in the heat of the day and falls off rapidly if temperature falls or the sky becomes cloudy, indicating flight is temperature and/or light related. Spring light trapping is generally not very productive, probably because at prairie latitudes the nights are short and cool thus most bug activity occurs during warmer parts of the day. Prehibernational flight occurs when bugs move to overwintering sites or perhaps to spring breeding sites. The dispersal of *Chilacis typhae* (cattail bug, Artheneidae) to new cattail heads in the fall serves both functions. August and September, with their longer, warm nights, are peak periods for light trap catches. As prairie dries out over the summer, there is often considerable movement of lygaeids. Most economic damage occurs when insects leave drying grasslands and move into crops that are still green. Some of the least common lygaeids have been collected in late summer by sweeping those plants that remain green either because they are drought hardy or are growing in moist sites. Most such specimens are

macropterous suggesting they have found these habitats by flight, but brachypterous specimens also show this pattern indicating short-distance walking movements occur.

### Chemical Defences

All lygaeid bugs, like most bugs, have glands that secrete strong smelling, foul tasting chemicals. Aldrich (1988) noted that the scent gland chemistry of only a few of the 2700 world species of seed bugs had been examined to that date. Nevertheless, enough was known for him to declare "the metathoracic gland chemistry of seed bugs is extraordinary". He discussed the chemistry of the secretions, a topic beyond the scope of this paper other than to say some of these substances are nasty for us and presumably for other animals and therefore protect the bugs from being eaten by predators. One could say these insects excel in chemical warfare except their chemical secretions are for peaceful uses: protection and communication. You probably know what the defensive secretions of some bugs taste like even if you do not know the source. Have you ever eaten a raspberry that was unexpectedly bitter and tarry in favour? If so you ate a berry on which a bug, probably a plant bug (Miridae) or stink bug (Pentatomidae), had been sitting and when you picked the berry the bug discharged some of its scent. No, you did not eat the whole bug, just a lick of its defensive secretions, but enough to know you do not want more. You can get the same effect by picking up a bug and giving it a slight pinch (usually this is not necessary) then smelling it or your fingers. There will be a smell that lingers and does not wash off easily. Sweet (1964b) calls this a characteristic "buggy" smell: it is hard to describe, but once encountered you know it. These experiences are enough to convince one of how repellent this material must be to predators.

Interestingly the glands differ between nymphs and adults, those of nymphs open on the dorsum of the abdomen (abdominal glands) whereas the adult glands are located on the underside of the thorax and open between the bases of the middle and hind legs (metathoracic glands, Figures 2, 3). The structure of the metathoracic scent gland of adult Hemiptera has been thoroughly studied (Staddon 1979). Basically, the cuticle is invaginated to form a reservoir into which secretory cells discharge material. There may also be an additional gland that delivers enzymes that modify the primary secretions and zap them up to make the final defensive secretion. This reservoir opens to the outside through a muscle-operated valve which allows the bug to control the release of the liquid. The external parts of the system consist of the orifice and auricle. Around the scent gland opening in many species is an area of distinctively textured cuticle, the evaporatorium. It is believed this

specialized area holds onto the scent fluids and prevents their spreading over the body for these fluids are toxic both to the attacker as well as to the bug that produces them (Carayon 1971).

Most seed bugs are small, dull colored insects that live on the ground. The name of the largest family, Rhyparochromidae, means earth- or filth- (*rhyparos* – G, dirty) colored (*chroma* – G, color) referring to the dull, cryptic color of many of the species. Ground-feeding birds that scratch through litter and plant debris are potential predators as are shrews and possibly mice, and the dull color of the bugs would make them less easily found. However, predators that are ubiquitous with seed bugs are ants which are probably the targets of the defensive secretions (Aldrich 1988), for cryptic colors mean little to them. One can visualize a seed bug, being attacked by an ant, dabbing its feet into the defensive secretion on the evaporatorium then pushing them into the ant's face. Or maybe volatile materials produce a protective vapour cloud around the bug acting as an irritant or in other ways interfering with the ant's attack behavior. Aldrich (1988) noted that various Hemiptera emit chemicals that are ant alarm or trail pheromones and thus would interfere with ant behavior. In fact, he went so far as to suggest that "the entire battery of heteropteran scent-gland weapons may have evolved to mimic ant pheromones". Following Eisner's (2003) observational-experimental approach, it would be fascinating to look at this by putting a seed bug and ants into an arena and watching the action. The reaction of ants to just the secretions of the metathoracic gland of some representative bugs would make an interesting study.

Although the metathoracic glands produce bad tasting substances, they are somewhat ineffective against birds which frequently prey on Heteroptera (Staddon 1979). Despite this, there are species of the family Lygaeidae which are large, brightly colored and live openly on plants. Sillen-Tullberg (1985) has shown that it is possible for a conspicuous bug to survive better than a cryptic one. Such conspicuous bugs show aposematic or warning coloration that is associated with them having some sort of defence, in this case chemicals. Examples of bugs with this strategy are the milkweed bugs which feed on milkweed and are among the largest, most colorful members of the superfamily Lygaeoidea.

Milkweeds produce cardenolides which are toxic, bitter-tasting steroids that attack the sodium-potassium-ATPase enzyme system of most animals. Some insects eat milkweed, but they have biochemical adaptations that protect them from the harmful effects of cardenolides. Instead they store this material in their bodies and it can be passed along to any predator that eats them. This is the way the famous Monarch Butterfly obtains its protection from predators for Monarchs have been shown to taste

bad and are toxic to birds and mammals. If this chemical protection is going to work though, potential predators must be able to recognize poisonous prey before they attack. The Monarch advertises itself through its bright orange and black color essentially warning a predator it is not good to eat. An experience or two with bad-tasting colorful butterflies is enough to teach the predator to leave them alone. Although Monarchs are among the best-known examples of insects obtaining toxic materials from their food plant and using them for protection, they are not alone. The milkweed bugs also feed on milkweed and sequester cardenolides in their body and advertise they are bad to eat through colorful contrasting patterns of orange or red and black. Slater and O'Donnell (1995, pp. 357-399) give an extensive bibliography on the large milkweed bug, *Oncopeltus fasciatus*, many entries of which discuss cardenolide uptake and unpalatability in this species. Mechanisms through which *O. fasciatus* achieves tolerance to and sequesters toxic chemicals of milkweed plants are discussed by Meredith et al. 1984, Moore & Scudder 1985, 1986, and Scudder et al. 1986. Cardenolides in *Lygaeus k. kalmii* are discussed by Duffy & Scudder (1972) and Scudder & Duffey (1972).

Sweet (1964a: 66-67) described a pattern of cleaning behavior shown by rhyparochromine as well as other taxa of bugs. It involves rubbing appendages against each other as well as other body parts in a sequence from the anterior part of the body towards the posterior. Of interest is the rubbing of the protibial brushes against the maxillary plate (lorum) and the first labial segment. Large cephalic glands (described in detail by Under 1956) open in this area and their products could be picked up by the tibial brushes and transferred to more posterior body parts in subsequent cleaning stages. Although the function of the substance is not known, Sweet suggested it could have a species-specific odor which has a role in sexual and aggregational activities. The glands could have a defensive function as the cephalic glands of some water bugs secrete a mixture of steroids as a defensive secretion (Lokensgard et al. 1993). Because the lygaeid secretion seems to be involved in grooming and general body maintenance it may have an antiseptic role helping the insect control bacteria or fungi that might attach to the cuticle or it could be involved in maintaining cuticle properties such as waterproofing. The function of this secretion and cleaning process needs further investigation.

Aggregation behavior introduces another area where chemicals are important in the life of bugs. Both alarm and aggregation pheromones are known to affect the behavior of some species. Sex attractant pheromones certainly exist, as Sweet (1964a, b) frequently noted males sensing and reacting to females from a distance. Chemical sensitivity and smell must be involved in

habitat and food selection. In short, like most insects, these bugs live in a world of chemicals that passes largely unnoticed by our visually dominated senses.

### Natural Enemies

Possession of anti-predator defenses is a good indication that predation is an important mortality factor on lygaeids. All lygaeoid bugs possess scent glands whose primary function is apparently to deter predators. Additional adaptations of many bugs that protect against visually hunting vertebrate predators include cryptic or aposematic coloration and mimicry (usually of ants). Most ground-dwelling seed bugs live with ants, in the prairie region often with larger and aggressive species of *Formica*. Aldrich (1988) pointed out that the role of the defensive glands is mainly against ants. In addition to vertebrates and ants, there are probably many other predators of lygaeids. Although lygaeids are alert, active insects there are equally active predators sharing their environment including spiders, ground beetles (Carabidae) and other predaceous bugs such as damsel bugs (Nabidae). Such predators are generalists and their predation on seed bugs is probably opportunistic for we know of no predator specializing on seed bugs. The closest to a specialized seed bug predator might be *Geocoris* species preying on small *Blissus*. Despite being regarded as generalist predators, Readio & Sweet (1982) found that in culture, *Geocoris* did better preying on small *Blissus* than on fruit flies. *Geocoris* and *Blissus* are often common in the same habitats so there is an opportunity for focused predation.

Few groups of insects are immune from the attack of insect parasitoids, and lygaeid bugs are no exception. The most frequently recorded parasitoids are flies of the genus *Catharosia* (Diptera: Tachinidae: Phasiinae) which are known from a number of species of the tribes Drymini and Myodochini (Rhyarochromidae) (Sweet 1964a,b, Ashlock & O'Brien 1964, Thorpe & Harrington 1979). Females of these flies are distinctive in having a field of stout spines on abdominal segment 4 and a needle-like ovipositor, presumably adaptations for inserting an egg (or larva?) into the body of a nymph or adult seed bug. The fly larvae feeds within the bug's abdomen for 3 to 4 weeks then when fully grown exits from the end of the adult bug's abdomen to pupate. This parasitism kills or at least sterilizes the host. Thorpe & Harrington (1979) observed up to 60% parasitism of field collected adult bugs and suggested the fly may play an important role in controlling seed bug populations. Sweet (1964a) suggested that several host specific species of *Catharosia* might exist, but recent catalogues of Diptera suggest that there are only a few species with wide host ranges (O'Hara 2013).

Eggs are also susceptible to parasitoid attack.

Several genera and species of the wasp family Scelionidae (subfamily Telenominae) (Hymenoptera: Proctotrupoidea) have been recorded from eggs of diverse groups of seed bugs, including members of the genera *Blissus*, *Geocoris*, *Lygaeus* and *Nysius* (Krombein *et al.* 1979). Wright & Danielson (1992) found that *Eumicrosoma beneficum* Gahan parasitized almost half the field-collected eggs of the chinch bug, *Blissus leucopterus*, in Nebraska. This level of parasitism was similar to that of an earlier study in Kansas suggesting egg parasitism may play a significant role in the control of this pest.

### Sound Production and hearing

Sound production in bugs generally involves an action called stridulation which can be defined as making a shrill, grating or chipping sound by rubbing certain body parts. A stridulatory structure consists of a movable and a stationary part: the movable part referred to as the **plectrum** and the stationary part, the **stridulitrum** (Schuh & Slater 1995). The plectrum can consist of a sharp ridge, a peg or spine or a series of pegs which are dragged across the surface of the stridulitrum which may be just a roughened surface, but is usually exquisitely sculptured parallel lines, pits or pegs. Stridulatory organs possessed by some prairie lygaeoid bugs are described below along with analogous structures of other prairie insects to give an appreciation of the diversity of these organs.

A. Forewing – metafemur. (*Xyonyssius californicus* (Stål): Orsillinae). The costal margin of the corium is finely, transversely striate and in dorsal view looks like the edge of a hacksaw blade (stridulitrum). The inner ventral surface of the metafemur has a subapical raised pigmented area which bears about half a dozen longitudinal rows of very fine pegs (plectrum). As the leg swings alongside the body the pegs can be drawn across the corial margin. The sound produced by this organ has not been described. Most of the prairie broad-headed bugs (family Alydidae) have a similar organ. In these insects the costal margin of the hemelytron is straight and is finely cross-striated forming a stridulitrum as in *Xyonyssius* with the plectrum formed from a somewhat diffuse group of small spines on the upper basal area of the metafemur. Although there are no observations on the functioning of this organ, Schaefer and Pupedis (1981) suggest it has an aggregation and/or premating isolating function. Slant-faced grasshoppers of the subfamily Gomphocerinae have an analogous organ consisting of a row of pegs on the inner face of the metafemur and a ridge on a vein of the forewing. These insects are famous for their songs, but they are larger and have distinctly audible calls which the wing is modified to amplify (Vickery & Kevan 1985).

B. Abdominal sterna – metafemur. (*Ligyrocoris* spp., *Slaterobius insignis* (Uhler): Rhyparochromidae). Abdominal sternum 3 (and often adjacent portions of sterna 2 and 4) has a shiny, glabrous area between the metacoxa and side of the abdomen. At high magnification (X 50) this area can be seen to bear fine, transverse, parallel striae. The plectrum is a row or group of small spines near the base of the posterior-ventral face of the metafemur. A variety of bugs have similar, but probably analogous organs.

C. Prosternum – profemur. (*Pseudocnemodus canadensis* (Provancher): Rhyparochromidae). The prosternum is concave and flattened anterior to the procoxae (more so in male than female) and its somewhat produced and angulate lateral margins bear regular, oblique rows of fine spines (stridulitrum). The basal portion of the anterior-ventral margin of the profemur has a distinct spine row plus some more irregular smaller spines (plectrum) that can be drawn across the stridulitrum. Sweet (1964b) has observed courting males moving their forelegs in a manner that suggests they were stridulating, but he did not hear any sound. The fineness of the structure suggests any sound made would be rather quiet and high frequency. We know of no other insects with an analogous organ.

D. Hind wing – metanotum. This organ is unusual in that it is easier to hear the stridulation than to see the structure. Members of *Kleidocerys* spp. (Ischnorhynchinae) will stridulate audibly when disturbed. The sound is made by rubbing a striate vein at the base of the hind wing against a roughened area on the metathoracic dorsum (Haskell 1957). Possibly the wings act to amplify the sound that this rather fine structure makes. An organ involving abdominal segment 1 and the hind wing has been described for *Plinthisus* (Rhyparochromidae) (Schuh & Slater 1995) and *Piesma* (Piesmatidae) (Leston 1957, Drake & Davis 1958).

E. Tymbals formed by fused abdominal tergal plates which vibrate over a hollow chamber within the abdomen have been described for a variety of Heteroptera, including the Lygaeidae (Goula 2008). Muscular contractions activate the tymbal and produce low frequency body vibrations.

Sound producing organs are easily detected on many Heteroptera, but sound receiving organs or “ears” are not so evident. If a bug is to produce a sound, that sound is meant for some audience. Sounds could be used to deter an enemy, but in most cases, they are probably for intraspecific communication. Therefore, we would expect hearing organs to be present. Goula (2008) makes the interesting observation that among land bugs, no sensory organs for airborne sounds have been found although he did not consider slender setae such as those of certain trichobothria which can be flexed by air movement. Bugs

are sensitive to substrate-borne vibration which can be detected by scolopodial organs (modified neurons which sense stretching between body parts), located especially in the base of the antenna, at leg joints, at the base of setae or spines that are set in sockets in the cuticle that allow them to rock, as well as other body parts. Such organs are not visible in external view and are sensitive primarily to vibration in the substrate. Such vibration could be produced during courtship and mating, but also by individuals in general, both adults and immatures, as part of the aggregation behavior shown by many lygaeoid bugs.

### Rearing

The only chance we have of gaining insight into details of the lives of cryptic insects, such as many species of seed bugs, is by rearing them in the laboratory. While it is true that lab conditions do not closely mimic field conditions, we can often achieve an environment in which the basic needs of life are met and under which patterns of development, feeding and aspects of reproductive behavior can be observed. Through simplification of the rearing environment the relationships between particular factors and the insects can be more clearly seen and manipulation of the conditions can allow an experimental approach to their ecology which the complexity and difficulty of making observations in the field largely preclude.

For the most part, rearing seed bugs is simple in the extreme (Sweet 1960). They need a source of food, and for most species readily available, raw, shelled sunflower seeds are accepted. Not all species will develop successfully on sunflower seeds, but the diet will keep most alive for extended periods. A source of water is also necessary. Both the food and water need to be kept clean and free of mold. Beyond that the rearing container can be as minimal as a Petri dish, but a non-slippery base should be provided, such as a piece of blotting or filter paper. Something more natural such as soil or litter would produce more natural behavior, but at the cost of being more difficult to keep clean and can be a source of pathogens or pests (especially mites which can take over culture containers). Room temperature suits most species, and although many species are found in dry, sun-exposed sites, most do not tolerate high temperatures and drought. The existence or induction of diapause may set the conditions under which continuous rearing is possible, but these must be determined on a species, or even population to population, basis.

The web site, *Bugs in Our Backyard* (<https://www.bugsinourbackyard.org/>), gives a very good description of how to rear the large milkweed bug, *Oncopeltus fasciatus* (Dallas) ([doi:10.3752/cjai.2018.34](https://www.bugsinourbackyard.org/wp-content/uploads/2014/12/BIOB-Keeping-Milkweed-</a></p>
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Bugs.pdf). Because it is so easily reared, especially lab strains that have been selected to feed on sunflower seeds, this insect has been used extensively in experimental work. The bugs can be obtained commercially and are ideal for classroom use, science fair projects, or just general observations on insect behavior and development. Unfortunately, this species is not available in the field locally, but the lesser milkweed bug, *Lygaeus kalmii*, is, and it does about as well in captivity.

Some species have differing or more specialized feeding requirements and need a different rearing set up. For example, members of the family Blissidae feed on the sap of grasses and therefore need access to fresh grass. Leonard (1966) reared *Blissus* spp. in two different ways. He kept some in small containers, such as Petri dishes or small vials, and fed them on grass stem plugs, the ends of which were sealed in paraffin to prevent rapid desiccation. The plugs needed to be changed every second day and either a blotting material or cotton-stoppered ventilation holes had to be provided to control condensation. He found rearing chinch bugs on live plants to be more efficient. He grew grass in small clay pots and covered them with round, plastic cages in which screened holes were cut for ventilation. Forcing the end of the cage down into the soil prevented the bug's escape. Some species of *Blissus* show specificity towards feeding on certain grasses or even cultivars so it may take some testing to determine the optimum food source. Burgess, and Weegar (1986) described a rearing system for false chinch bugs (*Nysius*) that used hulled sunflower seeds and either radish slices or *Brassica* spp. seedlings as food.

Big-eyed bugs (*Geocoris* species) have complex nutritional requirements. All apparently need animal prey for successful reproduction and growth, but they can survive for extended periods on sunflower seeds and a source of water. Naturally they feed on both animals and plant material with the role of the plants being primarily as a source of water. Readio & Sweet (1982) conducted breeding studies on a variety of species, rearing them in Petri dishes on sunflower seeds and vestigial-winged *Drosophila*. They could maintain adults that would mate and lay viable eggs, but could not rear nymphs past the second instar and they suggested that some other form of prey may be required. Many authors have referred to *Geocoris* feeding on chinch bugs so maybe a colony of chinch bugs could be used to keep big-eyed bugs going. Predaceous bugs are often cannibalistic so the density of colonies or the availability of refuges would need to be considered in a rearing setup.

Other bugs with more specialized habitats would probably require suitable choices of food. For example, catkin bugs could be fed birch seed, cattail bugs fed cattail seeds and sedge bugs the seeds of sedges and rushes. And in all cases with a water source.

## Collecting

Most of the techniques commonly used to collect, prepare and preserve specimens of lygaeoid bugs are well described in Martin (1977).

Success in finding and collecting lygaeoid bugs depends upon a knowledge of the habitat and habits of the species. There is a relationship between the biology of the various lygaeoid families and the most effective methods to collect these insects. Members of the Artheneidae, Cymidae, and Lygaeidae (Ischnorhynchinae and Lygaeinae) live mostly on plants and are up off the ground. They can be collected by sweeping these plants, especially their flower and seed heads. The association between a bug and particular plant species or its structures can be very close. For example, the cattail bug, *Chilacis typhae* (Artheneidae), is totally dependent in both its adult and immature stages on seed-heads of the common cattail. Many of the Lygaeidae that sequester cardenolides rely on the seed heads of milkweeds as its source. Focused sweeping or visual searching of plants and potential feeding sites are the most effective ways of identifying host associations. Some species feed on a small range of host plants as nymphs, but as adults may feed on a range of other plants which may change with the different seasons.

Catkin bugs (Lygaeidae: Ischnorhynchinae), which feed on the flowers and seeds of woody plants, are best collected by sweeping trees and shrubs. However, for most other species, sweeping herbaceous vegetation, especially plants in bloom or with maturing seeds, is the best collecting technique. While a good way to get specimens, the ecological inferences that can be drawn from these specimens is much more tentative. For example, unless one is sweeping a monoculture there is uncertainty as to which plant species a given bug was on, but even if this is known, there is the question of whether this is a fundamental host relationship or a casual or opportunistic association. This is best resolved by extensive collecting and looking for repeating patterns of occurrence of bugs within vegetation communities.

When sweeping, it is helpful to have a deep plastic basin into which the net contents can be dumped then sorted through. If the basin is deep and with smooth sides, the bugs cannot run away. Most bugs taken by sweeping can fly and they may take wing very quickly – an all too common experience is to see something good just as it flies off. The sides of a deep basin often intercept such escapees and give the collector a second chance. Some specimens will remain motionless for some time after being captured so it is necessary to search carefully through the sweeping debris, but even with a careful search, most are missed until they move. Again, a basin is very helpful for a pale, smooth surface makes the search easier. However, white is advised against as the

best collecting is on hot, sunny days and the reflection of sunlight from the basin bottom can be almost blinding so a pale yellow or blue is the best color choice.

Some species spend virtually all the time on the ground. These ground dwelling bugs are best collected by searching on the ground on hands and knees, looking under vegetation rosettes or scratching through litter and plant debris. A hand garden rake is especially valuable where spiny plants occur. In cool weather bugs will generally be in protected, sun-warmed sites; on hot days under the shade of leaves. Bugs found in this way will often flee rapidly and be difficult to catch. An aspirator works well for catching smaller species but some of the larger species are very fast especially on a hot day. For these the best technique is to grab a handful of soil and debris from the general area in which the bug was last seen and throwing it into a basin where, if the grab was lucky, the bug is more confined, so it can be captured. These insects can also be obtained in pitfall traps.

Where vegetation is denser or there is an accumulation of leaves or litter, bugs are most easily collected by using a trowel or hand rake to scratch up soil and litter which is then sieved into a basin. This reduced volume of litter can then be searched for insects. Some species move almost immediately on being sieved whereas others may remain catatonic for some time and are virtually invisible until they move. Some of the smaller, less common species can be found this way. Collapsible, cloth-sided sieves, available from entomology equipment suppliers, are light-weight, easily fit into a knapsack and are almost always useful in the field. Marshall (2006) described a collecting technique for dense grass areas which involves using a juice can with the top and bottom cut out. One end of the can is pushed into the soil then it is partly filled with water which flushes out chinch bugs that can be picked off the water surface. The scarcity of water in

many dry grassland collection sites limits the use of this possibly very productive technique.

Post-teneral adults of many species of Lygaeoidea, like those of many other insects, disperse (Johnson 1969). Such dispersing bugs may be collected at night in light-traps, but the abundance of such dispersing adults may be quite periodic and associated with the voltinism. Hence univoltine species tend to disperse as adults only once a year, although overwintered adults may often show a second period of dispersal in the spring. Only the large milkweed bug, *Oncopeltus fasciatus*, is a well-known migrant in North America, and migrates mostly as a non-reproductive adult (Johnson 1969). Many lygaeoids occur along the edge of water or at least on beaches (Fig. 7). This is the normal habitat of some species but for many it is due to dispersing individuals falling into the water then being drifted to shore where sometimes huge numbers of specimens accumulate. These specimens from the drift or wash can generally be recognized because they must be macropterous to get there, and when they do land on a shoreline they climb up onto objects just out of the splash zone where they dry and warm before resuming flight. In contrast, species that live on beaches do not sit around in exposed positions and they usually occur on the upper beach amongst early successional vegetation.

In general, imagination and effort in collecting are rewarded. But there are some signposts to the best collections: goldenrod in bloom or seed is usually a better choice for sweeping than almost any other plants; leaf-litter along edges of copses and forests is often a fine place for sifting; and open, sun-warmed light soils are generally better bets than heavy soils although cracked, dry soil surfaces may harbour large numbers of some species. A few collecting successes will provide direction for further searches.



Fig. 7. A good place and time to collect? Wind squalls are blowing insects caught in the lake's surface onto the windward shore where they are concentrated in the wash. Higher up the beach the vegetation is patchy and in various stages of succession, habitat favored by many Lygaeoids.

### What is the good of a seed bug?

I (DJL) keep pigeons. They have a room in the end of the poultry shed. I provide shelter, food and water and the birds are free to come and go and be pigeons. Most visitors look at them, shake their heads and ask “why do you keep them? What are they good for?” However, over time we noticed that Indigenous visitors who see and comment on them never ask why? Their comments are along the lines of aren’t they lovely, what graceful and acrobatic flight, isn’t the cooing soothing, look at them courting, what revolting housekeepers the parents are, etc. They understand why I keep them - because they are pigeons, because they do pigeon things which no other animal does, and which delight and entertain me, - and more deeply these people subconsciously accept an inherent worth in living things and nature.

That is where my interest in seed bugs comes from. It is existential arising from the fact that they are. With all our cleverness and innovation could we ever conceive of a seed bug? And yet here is an improbable life form, a self-effacing little gray bug that has found a niche for itself scavenging and sucking seeds. But there is not just one seed bug, there are many seed bug species (dozens locally, over 4000 globally (Schuh & Slater 1995)) that have found variation on this theme of being. This diversity is amazing especially as it is interwoven with variation in the bug’s morphology, life history patterns, habitats and ultimately history. There is so much for the eye and the mind to take in. This is not to say seed bugs are special. No, they are another manifestation of the wonder of life in general, and something that when seen enriches our daily existence. They contribute to and are a product of a wonderful, diverse world that too often passes us by unseen and undervalued.

Now to address our consumer society’s values. Can you make money from them? I am not aware of anyone yet finding a way of benefiting financially from seed bugs (an exception: you can purchase bug cultures and rearing equipment. See Rearing). However, some very ingenious researchers have taken advantage of the fact that certain of these insects can be easily reared in the laboratory and have used them as models to understand many fundamental aspects of animal biology including their biochemistry and molecular genetics. The genome of the greater milkweed bug is being sequenced and certain of its genes have been cloned (Burdfield-Steel & Shuker 2014; <https://www.ncbi.nlm.nih.gov/bioproject/229125>), and the mitochondrial genome of species of Ischnorhynchinae and Rhyparochromidae have been sequenced (Li *et al.* 2016a, b). Commercialization of the molecular parts may not be far away. A few people have made very good careers by studying seed bugs either for their own sake or as models for more general patterns and processes in nature, to these we have much to thank for their insights.

Will they hurt me? Very rarely one is bitten by a seed bug. Many types of bugs alight on a person and in the process of testing the environment they will prod and pierce the skin with their mouthparts which can produce sharp, local pain. This is probably the basis of the rare seed bug bites. Can they transmit disease? Living on the ground they could passively transport bacteria and fungi that accidentally adhere to them, but as they do not seek out humans they are of low probability to transfer pathogens. In the fall, overwintering adult bugs search for protected sites in which to pass the winter, and these can be our buildings and habitations. It is protection from the elements and not us or our food that they seek. Maybe a nuisance, but little more. Can they act as an intermediate host for parasites? Again, their mode of feeding, sucking liquids, and feeding on plant material, especially seed contents, makes parasite uptake very unlikely. Parasite transmission usually involves the intermediate host being eaten which would seem unlikely for chemically protected bugs. In summary, our seed bugs at least have no medical or veterinary importance.

Seed bugs’ greatest conflict with humans is related to their plant feeding (Schaefer & Panizzi 2000). Bugs feeding directly on seeds have been reported as damaging newly seeded crops and sometimes making minor raids into loosely stored seeds. However, the most damaging species are those that feed on plant sap, the chinch bugs (*Blissus* spp.) and false chinch bugs (*Nysius* spp.). Under the right conditions chinch bugs can attain huge population densities and their feeding can kill or seriously damage lawns, golf courses, pastures and grain crops. The conditions for chinch bug outbreaks are well drained, light soils and hot dry weather so their outbreaks tend to be localized and sporadic depending upon weather and soil conditions. *Nysius* species also cause sporadic damage. They live mainly in natural grasslands and pastures, but can move into crops where they can reach high densities and cause significant damage to a variety of plants. Again, this generally happens during hot dry periods when grasslands are drying up and the bugs move onto greener feed. They have also been implicated in transmission of plant pathogens (e.g., Burgess *et al.* 1983).

The role of seed bugs in various ecosystems is largely unknown. By feeding on seeds they must influence the reproductive success of some plant species (e.g. Luts and Ricardo 2008), especially as they do show varying degrees of preference in species of seeds selected. Is this enough to change the dynamics and composition of plant communities? Some of the species of plants whose seeds seem to be especially attacked are various composites, weedy colonizing plants, and some catkin-bearing trees such as birch. These plants produce copious seeds so that seed predation may be a rather small factor in their

overall reproductive success. I like to think the bugs feed on weed seeds and try to welcome them into my garden. Admittedly though, the garden is still overwhelmed by a variety of weeds that are limited only by available space and apparently not by the seed bank. On the other hand, Lundbye *et al.* (2012) have made the fascinating observation of *Nysius* feeding on seeds and not hurting the viability of seeds, but improving their germination. Perhaps some seeds need a seed bug. We also assume that by piercing the seed coat the seed is at increased risk of infection - but what might be the role of the saliva in acting as a physical barrier to invasive organisms or even in containing antibiotic materials? One thing is certain, any assessment we make of the role of seed bugs in ecosystems will be simplistic.

### Distribution and Ecology of Prairie Lygaeoidea

A classic book in the field of insect ecology is Andrewartha & Birch (1954), "The Distribution and Abundance of Animals". This title reflects the major questions of ecology: why do animals occur where they do? and what determines their abundance?

These are questions we can ask about seed bugs. Where do the various species, and groups of species, occur and are there patterns in these distributions that we can relate to environmental and historical factors? Scudder (1979) reviewed distribution patterns of Canadian insects and related these to climatic, geographic, biotic and historical factors. These patterns have been applied to the Hemiptera within Canadian grasslands (Scudder 2014a) and prairie ecozones (Scudder 2014b) and we have adopted them for the entire Lygaeoidea fauna of the Prairie Provinces. Table 3 lists these patterns, describes the general geographical range shown by species of each pattern and assigns species to each pattern.

Scudder (2014b) reported 582 species of Heteroptera as occurring in the Prairie Ecozone of Canada. These constitute about 40% of the Canadian Heteroptera species and 80% of the species recorded from the three Prairie Provinces. If only the Lygaeoidea is analyzed in this way, the 64 prairie species Scudder listed represent 50% of the Canadian total (127 species) and 85% of the Prairie Provinces total (75 species)<sup>1</sup>. Compared to the total heteropteran fauna, the Lygaeoidea are proportionately slightly better represented in the Prairie Provinces than they are in Canada as a whole, with most of this fauna occurring in the Prairie Ecozones.

In reference to the distribution patterns of Prairie Province Lygaeoidea (Table 2), the largest group of species are those of Pattern 2. Nearctic, excluding Beringia (17 1 Henry & Froeschner (1988) listed over 337 species of Lygaeoidea (included are Berytidae and Piesmatidae) from America north of Mexico of which 75 species are here recorded from the Prairie Provinces.

species) followed by 10. Nearctic-Neotropical (10 spp.), 11. Holarctic (7 spp.), and 1. Nearctic, including Beringia (7 spp.). These species are all widely distributed within North America, with members of the groups differing mainly in the extent of their north-south ranges. These transcontinental species constitute 55% of the fauna (41 species).

The remainder of the fauna consists of:

- A. western species that extend east (21%) [4. Western Nearctic, including Beringia (2 spp.), 5. Western Nearctic, excluding Beringia (7 spp.), 8. Western Cordilleran, excluding Beringia (6 spp.), 7. Western Cordilleran, including Beringia (1 sp.)];
- B. eastern species that extend west (15%) [3. Nearctic, excluding the Western Cordillera and Beringia (4 spp.), and 6. Eastern Nearctic (7 spp.)];
- C. a few Great Plains species (5%) [9. Great Plains-Prairies (4 spp.)];
- D. and a few introduced species (5%) [13. Introduced (4 spp.)].
- E. no endemic species are known from the prairie area, although the range of the undescribed species of *Geocoris*, here included with the western species, is unknown.

Some more specific examples of distributions are instructive. The Prairie Provinces are far enough north that the large milkweed bug, *Oncopeltus fasciatus* (Dallas), the iconic North American seed bug, does not occur in the region. The group to which it belongs, Lygaeidae: Lygaeinae, is represented in North America by 42 species (Henry & Froeschner 1988), of which 7 have been collected from our area and even within this small group half the species are known from only a few specimens. This example shows two general trends within the Lygaeoidea: they are most diverse in warmer climates and their diversity drops off very quickly at higher latitudes; and as a group they are not forest insects, they are typically insects of herbaceous plants and generally those in open stands, in early successional habitats or frequently disturbed sites. In other words, the cool, closed boreal and montane forests do not suit most them. This is not to say all seed bugs do better in warm climates. The most notable exception is the cosmopolitan genus *Nysius* (Orsillinae) of which seven of the 12 North American species occur in the Prairie Provinces. Several of these also occur beyond the prairies into cold arctic and alpine regions where the bugs frequent open, sun-warmed sites.

The general continental faunal pattern for the Lygaeoidea is decreased species richness from south to north as diversity drops off with higher latitudes (Table 4). Dry grasslands along the international border give way progressively towards the north to more mesic grasslands, parkland and then various types of boreal

**Table 2. Geographical distribution patterns of lygaeoid bugs of Canadian Prairie Provinces.**

Geographical distribution patterns recognized in the Heteroptera of the Prairies Ecozone and species of Lygaeoidea assigned to each (from Scudder 2014b, Table 1 & Table 2). We add the following additional species to include all species known from the Prairie Provinces along with the number of their distribution pattern: *Cymus discors* Horváth (6), *Geocoris barberi* Readio & Sweet (9), *Geocoris* new species (8), *Nysius fuscovittatus* Barber (7), *N. grandis* Baker (8), *N. groenlandicus* (Zetterstedt) (11), *Phlegyas abbreviatus* Stål (6), *Eremocoris setosus* Blatchley (3), *Scolopostethus diffidens* Horváth (2), *Malezonotus angustatus* (Van Duzee) (8), *M. arcuatus* Ashlock (8).

Geographical Pattern	Description	Species
1. Nearctic, including Beringia.	Species with a wide Nearctic distribution and which also occur in the unglaciated areas of northwestern North America, as well as the Western Cordillera.	Family GEOCORIDAE
		<i>Geocoris bullatus</i> (Say)
		<i>G. discopterus</i> Stål
		<i>G. howardi</i> Montandon
		Family OXYCARENIDAE
		<i>Crophius disconotus</i> (Say)
		Family RHYPAROCHROMIDAE
		<i>Eremocoris borealis</i> (Dallas)
		<i>Ligyrocoris diffusus</i> (Uhler)
		<i>Slaterobius insignis</i> (Uhler)
2. Nearctic, excluding Beringia.	Species with a wide Nearctic distribution, including the Western Cordillera, but which are absent from the unglaciated areas of northwestern North America.	Family BERYTIDAE
		<i>Jalysus wickhami</i> Van Duzee
		<i>Neoneides muticus</i> (Say)
		Family CYMIDAE
		<i>Cymus luridus</i> Stål
		Family GEOCORIDAE
		<i>Geocoris limbatus</i> Stål
		Family LYGAEIDAE
		ISCHNORHYNCHINAE
		<i>Kleidocerys ovalis</i> Barber
		LYGAEINAE
		<i>Melacoryphus lateralis</i> (Dallas)
		<i>Neacoryphus bicrucis</i> (Say)
		ORSILLINAE
		<i>Nysius angustatus</i> Uhler
		<i>N. niger</i> Baker
		Family RHYPAROCHROMIDAE
		<i>Eremocoris ferus</i> (Say)
		<i>Perigenes constrictus</i> (Say)
<i>Peritrechus fraternus</i> Uhler		
<i>Plinthisus americanus</i> Van Duzee		
<i>Scolopostethus diffidens</i> Horváth		
<i>Sisannes claviger</i> (Uhler)		
<i>Uhleriola floralis</i> (Uhler)		
<i>Zeridoneus costalis</i> (Van Duzee)		
3. Nearctic, excluding the Western Cordillera and Beringia.	Species with a wide Nearctic distribution, but which are absent from both the Western Cordillera and unglaciated areas of northwestern North America.	Family LYGAEIDAE
		<i>Lygaeospilus tripunctatus</i> (Dallas)
		<i>Melacoryphus admirabilis</i> (Uhler)
		Family RHYPAROCHROMIDAE
		<i>Drymus unus</i> (Say)
<i>Eremocoris setosus</i> Blatchley		

Geographical Pattern	Description	Species
4. Western Nearctic, including Beringia.	Species that are usually confined to western North America, west of about the 100th meridian, and which also occur in the unglaciated areas of northwestern North America.	Family OXYCARENIDAE <i>Crophius bohemani</i> (Stål) <i>Mayana ramosus</i> Barber
5. Western Nearctic, excluding Beringia.	Species that are usually confined to western North America, west of about the 100th meridian, and which are absent from the unglaciated areas of northwestern North America.	Family CYMIDAE <i>Cymus coriacipennis</i> (Stål) Family GEOCORIDAE <i>Geocoris atricolor</i> Montandon Family LYGAEIDAE <i>Lygaeus kalmii kalmii</i> Stål <i>Melanopleurus perplexus</i> Scudder Family PIESMATIDAE <i>Piesma costatum</i> (Uhler) <i>P. explanatum</i> McAtee <i>P. patrule</i> McAtee
6. Eastern Nearctic.	Species that are usually confined to the eastern part of North America, east of about the 100th meridian.	Family BLISSIDAE <i>Blissus leucopterus hirtus</i> Montandon <i>Ischnodemus hesperius</i> Parshley Family CYMIDAE <i>Cymus angustatus</i> Stål <i>Cymus discors</i> Horváth Family LYGAEIDAE <i>Lygaeus kalmii angustomarginatus</i> Par Family PACHYGRONTHIDAE <i>Phlegyas abbreviatus</i> Stål Family RHYPAROCHROMIDAE <i>Antilocoris minutus</i> (Bergroth)
7. Western Cordilleran, including Beringia.	Species that in North America are usually confined to the mountainous Cordilleran area in the west, sometimes including the Cypress Uplands, and which are also present in the unglaciated areas of northwestern North America.	Family LYGAEIDAE ORSILLINAE <i>Nysius fuscovittatus</i> Barber
8. Western Cordilleran, excluding Beringia.	Species that in North America are usually confined to the mountainous Cordilleran area in the west, sometimes including the Cypress Uplands, and which are absent in the unglaciated areas of northwestern North America.	Family GEOCORIDAE <i>Geocoris</i> new species Family LYGAEIDAE ORSILLINAE <i>Nysius grandis</i> Baker Family RHYPAROCHROMIDAE <i>Eremocoris obscurus</i> Van Duzee <i>Malezonotus angustatus</i> (Van Duzee) <i>M. arcuatus</i> Ashlock <i>Neosuris castanea</i> (Barber)
9. Great Plains-Prairies.	Species confined to the Great Plains and/or Prairies Ecozone in Canada.	Family BLISSIDAE <i>Blissus canadensis</i> Leonard Family GEOCORIDAE <i>Geocoris barberi</i> Readio & Sweet Family RHYPAROCHROMIDAE <i>Plinthisus indentatus</i> Barber <i>Zeridoneus petersoni</i> Reichert

Geographical Pattern	Description	Species
10. Nearctic-Neotropical.	Species widely distributed in North America and with a range that extends well into the Neotropical region.	Family GEOCORIDAE <i>Geocoris pallens</i> Stål Family LYGAEIDAE LYGAEINAE <i>Melanopleurus pyrrhopterus</i> (Stål) ORSILLINAE <i>Neortholomus scolopax</i> (Say) <i>Nysius raphanus</i> Howard <i>N. tenellus</i> Barber <i>Xyonysius californicus</i> (Stål) Family PIESMATIDAE <i>Parapiesma cinereum</i> (Say) Family RHYPAROCHROMIDAE <i>Atrazonotus umbrosus</i> (Distant) <i>Emblethis vicarius</i> Horváth <i>Kolenetrus plenus</i> (Distant)
11. Holarctic.	Species widely distributed in both the Palearctic and Nearctic.	Family LYGAEIDAE ISCHNORHYNCHINAE <i>Kleidocerys resedae</i> (Panzer) ORSILLINAE <i>N. groenlandicus</i> (Zetterstedt) Family RHYPAROCHROMIDAE <i>Ligyrocoris sylvestris</i> (Linnaeus) <i>Peritrechus convivus</i> (Stål) <i>Scolopostethus thomsoni</i> Reuter <i>Sphragisticus nebulosus</i> (Fallén) <i>Trapezonotus arenarius</i> (Linnaeus)
12. Cosmopolitan.	Species widely distributed in the world, occurring in several zoogeographical realms.	
13. Introduced.	Species not native to North America, having been accidentally or intentionally introduced.	Family ARTHENEIDAE <i>Chilacis typhae</i> (Perris) Family RHYPAROCHROMIDAE <i>Megalonotus sabulicola</i> (Thomson) <i>Stygnocoris rusticus</i> (Fallén) <i>S. sabulosus</i> (Schilling)

forest (ESWG 1995, Shorthouse 2014) so that the pattern in the bug community follows patterns in climate, specifically seasonality, temperature and humidity, and in turn vegetation. When the number of ecozones that each species occupies is tallied (Fig. 8), about half the species occur in one or two ecozones (49%), whereas the remaining species (51%) occupy three or more ecozones. The latter group comprises most of the transcontinental species, their wide geographical ranges being related to wide ecological range.

Faunal enrichment occurs in the southwestern and southeastern portions of the area where western and eastern elements respectively are superimposed on the distribution of the transcontinental fauna, in areas identified by Remington (1968) and Scudder (1979) as ‘biotic suture zones’ — that is bands of geographic

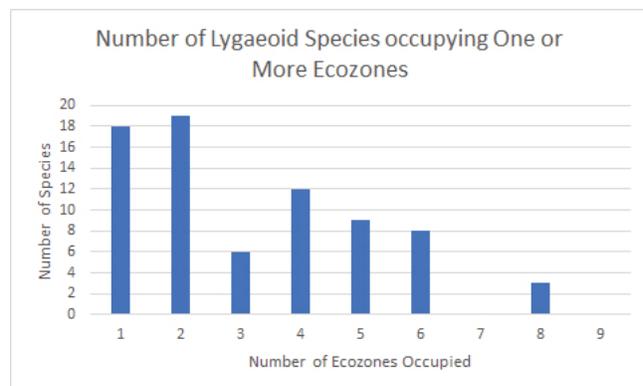


Fig. 8. Frequency distribution of the number of Ecozones occupied by prairie species of Lygaeoidea (data from Table 4).

overlap between major biotic assemblages. An area of notable diversity is the Cypress Hills (CH) and adjacent dry prairie (PD) of southeastern Alberta and southwestern Saskatchewan. This is an area of elevated topography surrounded by the driest grasslands. The higher areas of the hills (highest point -1465 M, almost 500 m above surrounding grasslands) are sufficiently high and moist to support an island of mesic vegetation, including coniferous forest, with much intermingling and interdigitation of habitat types along gradients of elevation, aspect and soil types. This is a suture area between transcontinental species with the addition of southwestern, eastern and southern Great Plains elements to produce a small region where many species of the fauna occur in close proximity (CH + PD = 60 species, 80 % of Prairie Province total; Table 4). However, these patterns must be tempered by the fact that species richness also closely follows the pattern of collecting intensity. The Cypress Hills are probably the most extensively collected part of the Prairie Provinces in terms of seed bugs, followed by areas around the larger cities which house universities, museums and research stations. The apparently depauperate north as well as the Rocky Mountains have been little explored and are largely *Terra incognita* as far as seed bugs are concerned. Collecting bias is also shown in the provincial totals where Saskatchewan has the most diverse fauna (61 species), followed by Alberta (54 species) then Manitoba (45 species). In virtually all larger groups of insects, Alberta has the most diverse fauna because it contains the rich Montane Cordilleran (MC) ecozone in addition to all the ecozones of Saskatchewan. Manitoba has the lowest provincial species count. However, the only Prairie Province records of several eastern species are from the mesic grasslands and forests of southern and southeastern Manitoba and it seems certain that more extensive collecting in this area will uncover a much richer fauna of eastern and southeastern species.

The ecologically specialized species of more restricted distribution produce faunal regionality. The alpine *Nysius* species and the shoreline-inhabiting *Malezonotus arcuatus* and *Eremocoris obscurus* are unique to the Montane Cordilleran (MC) zone whereas *Neosuris castanea* and *Malezonotus angustatus* are known only from dry prairie (PD). The MC species are no doubt eastern populations of species that are widely distributed in montane regions of British Columbia and Montana. However, the explanation for the occurrence of some of the PD species is not so obvious as the Canadian populations are not connected directly by belts of suitable habitat to other known populations, which in the case of the two examples given here, are in the arid areas of western North America west of the Rocky Mountains. Have these and other species with distributions in the arid west entered the prairies along arid valleys of Montana

and Wyoming or was there long-range flight dispersal from west to east with the prevailing winds across the Rocky Mountains? The present brachypterous condition of Prairie populations suggests their ancestors took the crawling route moving north along courses of dry terrane in the eastern rain-shadow of the Rocky Mountain Ranges. On the other hand, trans-montane flight could explain why some western, dry country macropterous species occur in very small numbers on DP, e.g. *Geocoris pallens* and *Nysius tenellus*. These are dominant species in the dry grasslands of BC but known from only a few scattered records from southern AB and SK. In warm summer days, the snowbeds at the summits of mountain passes between BC and AB are littered with a fallout of insects, many of which are not local species but rather are species of lower valleys and drier, warmer areas. Some bird species, notably Gray-crowned Rosy Finches and American Pipits are frequently seen feeding on these insects. Probably there is a flow, from west to east through the mountain passes, of dispersing insects that fall out onto the Great Plains.

A similar air-borne flow of insects may occur across the plains from south to north. Several species of macropterous seed bug, especially of the family Lygaeidae *s. str.*, are known in the study area from only a few widely spaced, adult specimens. For example, *Melacoryphus admirabilis*, *M. lateralis* and *Melanopleurus pyrropterus* are abundant on the southern US plains but rare north of the border. Possibly the Canadian specimens are occasional dispersers from the south and permanent populations do not occur locally. Many members of this family are known to fly readily, be abundant at electric light at night and even show pronounced migratory habits.

An interesting question is why are there so few species with distribution pattern 9 (Great Plains-Prairies)? Why are there so few grassland specialists? This has to do with the relationship of seed bugs to grasses. The principal group of grass-feeding lygaeoids is the family Blissidae and these are sap feeders, not seed feeders. Other monocot feeding lygaeoids, such as Artheneidae, Cymidae, and Pachygronthidae, feed on seeds of marsh and wetland plants of the families Cyperaceae, Typhaceae, and a few wetland grasses. There are observations of various Rhyparochromidae feeding on grass seeds, e.g. *Slaterobius insignis*, but not specializing on them. Is there some reason that grass seed is not a good food source for seed bugs? In spite of the abundance of grass, grass seeds may actually be a sparse, erratic food source. Studies on grass seed in prairie soil seed banks show that grass seeds are not abundant, and probably for several reasons. There may be intense competition for available seeds, mainly from ants, but also rodents and birds. Also, prairie grasses are renowned for variation in seed production from year

to year. Years of heavy seed production may be separated by many barren years and this pattern may occur across the entire biome so that patchiness and refugial areas may not save a seed specialist during hard times, such as drought, which is a recurring theme in prairie history.

Most seed bugs feed on the seeds of weedy plants, those with short life cycles and regular prolific seed production. These are species of disturbed sites and subclimax communities. Under natural conditions lake shores, stream banks, erosional slopes, mammal excavations and other types of repeating disturbance maintain the early successional plant community with which most seed bugs are associated. These are habitats where seed production is prolific and regular and adequate to keep predator competition for seeds low. The problem with many disturbed sites is they can change rapidly in time so that any bug inhabiting them needs to have good dispersal abilities, that is be capable of flight. Being macropterous or dimorphic for flight ability gives a species the ability to move and track unstable habitats. On the other hand, there are unstable habitats that are predictable such as lake shores and stream banks. Exactly where the water line occurs varies, but this variation is predictable, a condition of predictable instability that maintains early successional vegetation within a limited area. As stream courses are long-lasting features within a landscape they provide an opportunity for complete flightlessness to be a viable long-term strategy. Mountain slopes and steep hillsides with unstable or erodible soils and sand dunes also provide the conditions of instability that can maintain seed bug habitat over long periods of time. In recent times, man has entered the picture as the most destabilizing force in most ecosystems. Whether this is a good thing or not for seed bugs is discussed below.

There are species that occur in more stable plant communities. Most such species appear to be generalist feeders, but with a predilection for the seeds of various plants of the family Asteraceae. Sweet (1964a,b) found that many species of Rhyparochromidae fed on the seeds of goldenrod, and sweeping flowering or post-flowering goldenrod is one of the most productive collecting techniques. Sage, aster, yarrow, everlasting and other Asteraceae are also favored by diverse bugs. Common features of these plants are: they are perennials, flower in mid to late summer, produce copious seeds usually with a tuft of hairs or pappus that aids in wind dispersal, and seeds tend to hang onto the plant late into the year and even over winter. A few seed bug species occur in litter in closed forest. These may feed on seeds of conifers. Some *Eremocoris* are regularly found in squirrel middens where there is probably a constant supply of seeds missed by squirrels when they shuck the cones.

One of the most widespread and consistently present

group of Lygaeoidea is the big-eyed bugs, *Geocoris*. Being mainly predators, these are free of association with particular plant species. Rather they prey generally on small insects, some form or another of which is present in almost all types of habitat. Geocorids generally avoid shaded areas such as forests and dense brush, but occur almost everywhere else where there are open patches of sun-warmed ground. The various species are generally associated with particular soil types.

The other big concern in ecology is abundance. Many authors have commented on the apparent rarity of certain seed bugs. However, Sweet (1964a) in the most comprehensive survey of a regional seed bug fauna, considered only a few of the New England Rhyparochromidae species to be rare and that an apparent rareness reflected a specificity to certain habitats. But maybe this is just transferring the concept of rareness from the insect to its habitat: the insect may be common, but only in a habitat that is uncommon or very limited. Most species have very clumped distributions perhaps due to high habitat specificity, aggregation behavior or maybe a function of the recent history of the population.

*Malezonotus angustatus* is known in the Prairie Provinces from one small section of upper beach of a reservoir in the driest grassland area where specimens have been found in the same site over several summers. Other species of *Malezonotus*, including the local *M. arcuatus*, apparently have similar disjunct ranges and narrow habitat distributions, existing in small, widely separated populations. When these species have been found, several specimens occurred together seemingly showing aggregation behavior. *Blissus* species usually occur in groups at the base of grass stems, probably a family group arising from a female producing many eggs over an extended period so that nymphs of a variety of ages and sizes coexist and continue to feed within their natal grass clump. The xerophilous, long-legged, fast moving *Staterobius insignis* and *Uhleriola floralis* usually occur in loose aggregations. These may be family groups or may be defensive associations for these ant mimics. When a group is disturbed, individuals explode out in all directions, certainly making it difficult for a collector to focus on and catch any single individual. Certain species of Lygaeidae are known from the Prairie Provinces from single or a few specimens. These are insects that have full wings and are known to be vagile and come to lights at night in the United States where they are common. Prairie specimens could be vagrants, so the species is represented by the occasional passing specimen and not established populations in the area. Even the common small milkweed bug, *Lygaeus kalmii*, is usually found as single specimens without any definite habitat association and appearing as individual wanderers.

Hamilton & Whitcomb (2010) recognized two

principal ecological strategies for grassland leafhoppers: generalists, which colonize a wide variety of grasses and forbs and occur on many of the plant species in a given association; and specialists, which occur on a single or a few related plant species. Assemblages of grassland leafhoppers in a given vegetational formation often consist of a few species of generalists and many species of specialists. Lygaeoid bugs tend towards being generalists and for this reason are less diverse than some of the other plant-feeding hemipteran groups such as leafhoppers and myrid bugs. The degree of habitat specificity would certainly affect the dispersal and apparent abundance of the various species. As the prairie lygaeoid fauna is generally low in specialist species, this is probably a saving grace for the long-term survival of the fauna that is under stress.

Sweet (1964a) concluded that the “influence of man has greatly extended the abundance and variety of the Rhyarochrominae of New England.” Seed bugs benefited from European settlement, with its subsequent forest clearing, which produced what Lindroth (1971) termed a cultural steppe environment - an open environment dominated by disturbed soils, ruderal sites and subclimax herbaceous plant communities. This created conditions suitable for native species adapted to grasslands and non-forested habitats to spread eastward as well as producing conditions similar to those of human-altered Europe and providing a welcoming environment for immigrants from abroad. Both processes enriched the diversity of the northeast American fauna. Human impact on the Great Plains has been different - a steppe environment already existed with an adapted native fauna. Forest species

could not move in from the east. Invasive species were less likely to be introduced into the American plains than onto the east coast simply due to the types and patterns of trade, but even if European species did reach the Great Plains they would encounter an already mature fauna that would be unlikely to welcome new taxa (Turnbull 1979). Thus, it is not surprising Scudder & Footitt (2006) observed that the Prairie Provinces have some of the lowest levels of alien bug species. Those alien species that have entered the fauna are either clearly synanthropic or have found a niche not exploited by the native fauna (e.g. cattail bug). Although the Prairie lygaeid fauna has been slightly enriched by alien species, this may be a blessing as aliens in most places make up a disproportionately large part of pest species.

Although Prairie bugs were already somewhat preadapted to the environmental changes man wrought, they have still been affected by his activities. Bird (1961) considered the effects of agriculture on the prairie biota and concluded that the numbers of animals that decreased is much larger than the numbers that increased. He considered the loss of refuges as natural habitat diminished because of ever increasing field and machinery size, drainage and increasing herbicide use. He presaged the direction of agriculture, unfortunately correctly. We are now into an era of chemical agriculture where huge swaths of the land lie lifeless during parts of the year, without a bit of green or even the smallest bug (Fig. 9). And when greened up it is with a monoculture that has been created to be the only plant able to withstand the arsenal of toxins to which modern agricultural is addicted.



Fig. 9. No place for a bug. Modern agriculture takes all, the grain, the straw and even the chaff. Biocides suppress all life other than the genetically modified crop.

Turnbull (1979) assumed that faunal losses had already occurred in parts of Canada where environmental stresses were greatest, among which he included the cereal farming regions of the prairies, and overgrazed cattle ranges of Alberta and British Columbia. Livestock grazing is often accepted as a benign use of grasslands. It is assumed that grasslands developed with grazing animals as a key component and thus the vegetation is adapted to grazing. This assumption is so ingrained that wherever there is a patch of grassland, whether it be a park, nature reserve or an otherwise unused grassy area, addition of livestock is almost inevitable under the mantra that grasslands need grazers. There is no doubt some truth to this, but modern grazing practices differ from primordial grazing about as much as modern farming differs from scratching the earth with a fire hardened stick and casting a few seeds onto the land. The Canadian Prairie cattle herd now (2017) numbers 8.355 million animals and is growing (Statistics Canada, in *Western Producer*, March 16, 2017, p. 7) and the United States herd is about ten times as large and growing (USDA, Jan. 2017). The pre-European Colonization bison population of the Great Plains is essentially unknown, guesstimated at between 40 (MacEwan 1995) to 60 million animals (Shaw 1995, [https://wikipedia.org/wiki/American\\_bison](https://wikipedia.org/wiki/American_bison), Apr. 2017) and certainly less than that of the modern cattle herd. In addition, this bison population potentially occupied all of the land whereas modern cattle are on land not used for urban development, roads, crops, etc. With a larger grazer population on a smaller land base, current grazing pressure is certainly much greater than that of the bison. If grazing of the prairies is natural, this current grazing pressure is not, nor is it qualitatively equivalent. Bison are largely grass feeders and have a suite of behavioural, anatomical and biochemical adaptations to efficiently utilize grass (Pauls 1995). Cattle are more indiscriminate and eat more broad-leafed plants and tend not to spread their grazing effort as evenly on their range. Grazing is now geared to removing as much plant material as possible from the range and converting it into saleable protein. And cattle are a wonderful vehicle for this. Unlike agricultural machinery which can be deterred by rocks, trees, water or gullies, a cow can access almost every plant that grows within its prairie pasture. It does not matter if a plant is unpalatable, enough cows tasting it or treading on it or its seedlings, or defecating on it, or rubbing on it, the plant will be reduced so that both the palatable and unpalatable vegetation eventually succumb or are reduced. Native prairie existed in a balance between grazing intensity and the flora's ability to grow and reproduce. Modern grazing breaks this balance. Livestock numbers are now adjusted to take almost all the primary production during the grazing season, with extra food requirements of the animals met through feeding of hay

or grain which is grown intensively elsewhere thereby altering other unseen fields. Even if a veneer of pasture vegetation is left, grazing can eliminate seed production by taking flower shoots, flowers and developing seeds as well as the leaves and stems necessary for the production required for reproduction. This is where seed bugs are affected — there may be a coverage of plants on the range, but no seed production and in many pastures almost no seed bugs.

The declining refuges of natural habitat which Bird (1961) lamented are now so reduced that few sites support anything close to the original biota. In a CBC radio interview, the Saskatchewan minister of Agriculture stated there were no habitat problems with current farming as farmers were no longer plowing up large tracts of land, rather they were just “squaring the corners and straightening the edges” of fields. But the corners and the edges are the only remaining refuges for the biota over much of the prairie and these are now largely jeopardized. Road allowances give a narrow linear strip of land between the fences of fields and the surface of a road. These can support a diverse variety of plants, usually weedy, but the floral composition varies depending upon soil and moisture conditions and history of disturbance. However, to control weeds these allowances are treated with herbicides, which reduces plant diversity, and are mowed for hay, which removes biomass and from the perspective of seed bugs removes flowers and seeds. Fences around fields can protect vegetation growing under the wires, but by grazing cropped fields out of the growing season, cattle eat out even these plants. Road allowances used to be good places to look for bugs, but many have now been eliminated with cropping taken right to the road edge, and those road allowances that remain are often littered, dust-covered strips of sterile brome.

An Alberta study (ABMI, 2015) has quantified the current state of human impact on ecological integrity and biological diversity in prairie and parkland ecozones of that province. Basically, this study supported Bird (1961) and the observations made above. About 63 percent of Alberta's prairie region has been permanently affected by human activity and this value grew by about 2% over the 15-year study period. Biodiversity intactness (a measure of how much more or less common a species is relative to its respective reference conditions) averaged 53 % (a paved parking lot would measure 0%, pristine prairie 100%) with the biggest changes associated with lower than expected abundances of native grassland species. Non-native species were detected at all survey sites and all regions showed high habitat fragmentation due to the human footprint. Overall, 1.4% of the prairie region was managed as protected areas. The prairie regions of Saskatchewan and Manitoba are probably comparable.

The consequences of loss of biodiversity intactness are demonstrated by a long-term experimental manipulation of grassland plant species diversity by Haddad *et al.* (2011). They found that higher plant diversity provides more temporally consistent food and habitat resources to arthropod foodwebs. Consequently, actively managing for high plant diversity may have stronger than expected benefits for increasing animal diversity. In conclusion, the Canadian prairie is showing a high level of permanent human impact which is continuing to grow, native species are in decline, non-native species form a major part of the biota and there is little management for protection of the natural biota. This bodes poorly for the fate of diverse biotas such as seed bugs.

The chemical assault intensifies. The use of neonicatenoid seed treatment is now regarded as essential in several crops and used without regard as to whether it is needed or not. A perverse form of the “precautionary principle” justifies this use by exhorting chemical use as a precaution just in case there might be a pest problem. This is certainly a deviation from the road of integrated pest management that applied entomology so strongly advocates. Increased fertilizer use must be good though? Addition of fertilizers produces lovely large, fast-growing crops with heavy yields, but it ultimately reduces diversity by favouring a few vigorous species (Goulson 2014). A good way to destroy a flower-filled meadow is to fertilize it. And of course, extensive broad-spectrum herbicide used both before planting and at seasons end to “desiccate” the crop destroys the biota. Modern agriculture is geared to relentlessly push the limits of production with a concomitant squeeze on the natural system. In a bizarre twist, agriculture is now seeking remuneration for ecological services, i.e. finding a commercial value to that part of nature that the industry has not to date destroyed or been able to harvest and sell.

Turnbull (1979) concluded “We will probably never know how much the prairie insect fauna has been altered by settlement. Probably few species are totally extinct, but many species have been reduced to small populations inhabiting small, scattered refuges. On the whole we can guess that the prairies are the only major region of Canada that has been impoverished of insect species by human settlement.” Almost 40 years later, the situation has only worsened as the intensity of the human assault on the land escalates. Past and current trends in our society’s treatment of the land lead to the conclusion that the stress on nature on the prairies will only get worse. How does one counter this uncontrolled, runaway process? It is a tiny step, but we can only hope that in finding a positive answer to “What’s the good of a seed bug?” we will also learn that the answer applies to nature as a whole and that this answer will help guide our relationship to the land.

## Materials & Methods

Most of the specimens on which this study is based are from a collection of lygaeoid bugs made by DJL in southwestern Saskatchewan. This collecting was focused on the Larson Ranch, south of Maple Creek, and surrounding areas. The ranch straddles the Cypress Upland and the Mixed Grass Ecoregions of the Prairies Ecozone and the 1000 m contour runs through the yard. This is a minute portion of the region that the study purports to cover, but the area has been found to contain most species reported from the prairies as well as several new prairie and even Canadian records justifying this disproportionate collecting effort. However, we have tried to obtain a more complete and balanced view of the fauna by amassing literature records of lygaeoid bugs for the area and by examining the specimens held in the principal public collections. We have examined specimens or obtained distribution records of specimens from the following collections:

(abbreviations for collections follow Evenhuis 2017)

- AACS – Agriculture and Agri-Food Canada, Saskatoon, Saskatchewan, Canada.
- BDUC – Department of Biological Sciences, University of Calgary, Calgary, Alberta, Canada.
- CAS – California Academy of Sciences, San Francisco, California, USA.
- CNC – Canadian National Collection, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada.
- DBUW – Department of Biology, University of Waterloo, Waterloo, Ontario, Canada.
- DJLC – D.J. Larson Collection, Maple Creek, Saskatchewan, Canada.
- GGES – G.G.E. Scudder Collection, Vancouver, British Columbia, Canada.
- JBWM – J.B. Wallis and R.E. Roughley Collection, University of Manitoba, Winnipeg, Manitoba, Canada.
- LEMU – Lyman Entomological Museum, Macdonald College, McGill University, Ste-Anne-de-Bellevue, Quebec, Canada.
- MMMN – Manitoba Museum of Man and Nature, Winnipeg, Manitoba, Canada.
- NFRC – Northern Forest Research Centre, Canadian Forest Service, Natural Resources Canada, Edmonton, Alberta, Canada.
- OSAC – Oregon State University, Corvallis, Oregon, USA.
- PFCA – Pacific Forestry Centre, Canadian Forest Service, Natural Resources Canada, Victoria, British Columbia, Canada.
- PMAE – Royal Alberta Museum, Edmonton, Alberta, Canada.
- RBCM – Royal British Columbia Museum, Victoria, British Columbia, Canada.
- ROME – Royal Ontario Museum, Toronto, Ontario, Canada.
- SMNH – Royal Saskatchewan Museum, Regina, Saskatchewan, Canada.
- UASM – E.H. Strickland Entomological Museum, University of Alberta, Edmonton, Alberta, Canada.
- UBC2 – Spencer Entomological Collection, Beaty Biodiversity Museum, University of British Columbia, Vancouver,

British Columbia, Canada. (formerly Spencer Entomological Museum, Department of Zoology)

USNM – National Museum of Natural History (formerly United States National Museum), Washington, D.C., USA.

WFBM – W.F. Barr Entomological Museum, University of Idaho, Moscow, Idaho, USA.

Collection records of most species are few and the area surveyed is vast. If these records were to be plotted, the map so produced would show where collectors had been, but may not give much insight into the distribution of the species. As an alternative we have chosen to use the Terrestrial Ecological Classification developed by the Ecological Stratification Working Group (ESWG 1995) as the basis for reporting the distribution of species. ESWG (1995) recognized 7 major divisions or Ecozones within the Prairie Provinces and in turn these were subdivided into several sub-units or Ecoregions. We have modified this system slightly, uniting some of the northern Ecozones for which we have little information and in which the fauna is expected to be depauperate and rather homogeneous, and elevating the rank of a few southern prairie ecoregions where the fauna is diverse and well collected. Our system of ecological classification is as described in Table 3 and a map showing the area included in each of the zones is given in Map 1. ESWG (1995) described the major geographical and biotic features of each of these ecozones and Shorthouse (2010) provided more detail on the Prairie Ecozone and its constituent Ecoregions. Figures 10 to 16 show some landscapes from several of the ecozones.

An information table is provided for each species following the family key to species. These pages follow the same sequence as the species are keyed out. Each species page has a dorsal habitus photograph of a representative specimen, and sometimes additional

photographs showing other anatomical features. The page provides the name and author of the species, the Prairie Provinces from which it has been recorded, the ecozones in which it occurs (if a species is known from only one or a few collections, we also give the collection locality), and notes on distribution, taxonomy and variation, wing development, ecology and collecting observations. Distribution information consists of the Geographical Distribution Pattern and a general overview of the range through listing the Canadian Provinces and US States from which the species has been recorded or by giving the extreme localities with the implication it also occurs in intermediate areas. Standard postal abbreviations are used for provinces and states (as in e.g. Maw *et al.* 2000). Lower case letters are used for cardinal directions (n= north, s - south, e - east, w - west). For example, BC to NL would mean the species has been collected from all provinces. The information on range is from Maw *et al.* (2000) for Canadian records and Ashlock & Slater (1988) for US and other localities. Sources for more recently published records are cited.

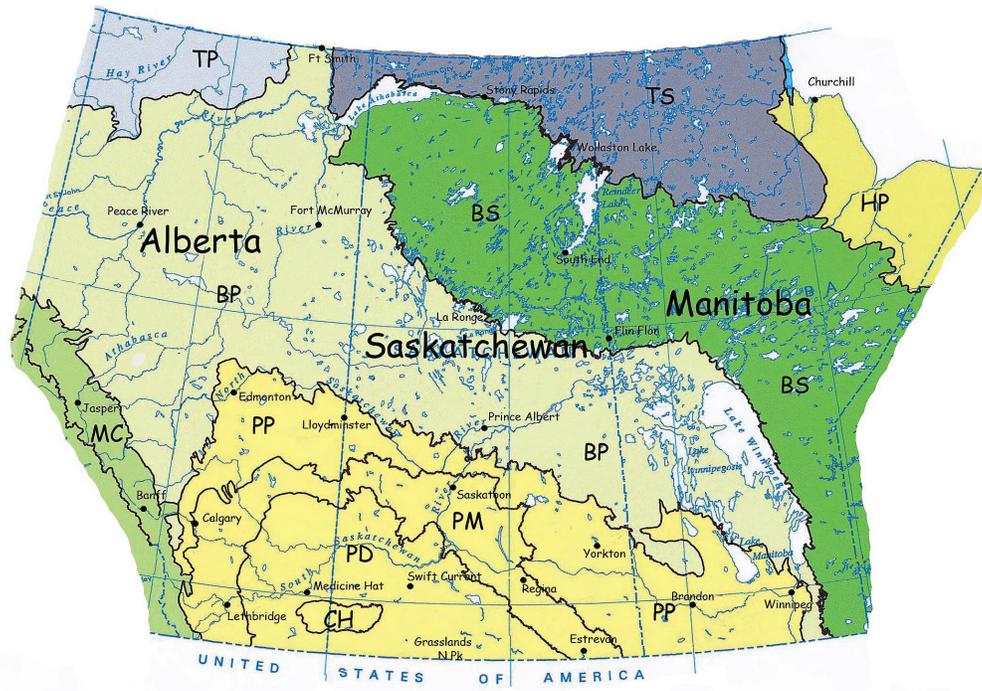
This work is intended to be user-friendly by avoiding as much technicality as possible. Therefore, there are no extended sets of measurements comparing relative lengths of body parts within or between species. Variation in mensurative characters is indicated by giving the extreme values observed. Measurements given by other authors are incorporated and cited if differing from our measurements. The following standard measurements and ratios are presented for each species:

- L – a single measurement of mid-dorsal length from the tip of the clypeus to the posterior-most part of the body, either the apex of the abdomen or the tip of the folded wing, whichever is longer.
- W – maximum width of body in dorsal aspect

**Table 3. Ecological classification of the Canadian Prairie Provinces.**

The area contained within each of the Ecozones is indicated on Map 1, and their characteristics are described in ESWG (1995).

Ecozone	ESWG name	Location
MC - Montane Cordillera	Montane Cordillera	southwestern and western AB (Figs. 1, 2)
CH - Cypress Upland	Cypress Upland Ecoregion of Prairie Ecozone	southeastern AB, southwestern SK (Fig. 3, 4)
PD - Prairie, dry	Mixed Grassland Ecoregion of Prairie Ecozone	southeastern AB, southern SK (Figs. 5, 6)
PM - Prairie, moist	Moist Mixed and Fescue Ecoregions of Prairie Ecozone	southern AB, southern SK, southwestern MB
PP - Prairie, Parkland	Aspen Parkland of Prairie Ecozone as well as Fescue Grasslands of southwestern AB, Lake Manitoba Plains and Manitoba Uplands of southwestern MB.	south-central AB, south-central SK, southern MB
BP - Boreal Plains	Boreal Plains	Central-northern AB, central SK, central MB (Fig. 7)
BS - Boreal Shield	Boreal Shield	northern SK, northern and eastern MB
TP - Taiga Plains	Taiga Plains	northwestern AB
TS, HP - Taiga Shield, Hudson Plains	Taiga Shield, Hudson Plains	northern SK, northern MB



Map 1. Ecozones and Ecoregions of the Prairie Provinces (modified from ESWG 1995). Abbreviations as in Table 1.



Fig. 10. Montane Cordillera Ecozone (MC). AB: Waterton National Park, Lineham Pass. Biological Survey of Canada Bioblitz, July 2005. The little, grey bug found here was *Nysius grandis*, which occurred along moist gullies at the edges of the scree slope.



Fig. 11. Montane Cordillera to Prairie, moist Ecozones (C to PM). AB: Waterton National Park, Carthew Summit. The abrupt eastern edge of the Rocky Mountains compresses several ecozones into an area no more than a few tens of kilometre wide: alpine of the foreground gives way to coniferous forest, aspen parkland and finally grasslands in the distance. Alderson Lake, not visible but at the base of the cliff beyond the last visible lake, is a locality for the western species, *Eremocoris obscurus*.



Fig. 12. Cypress Upland / Prairie dry ecozones (CH/PD). SK: Belanger Creek. Streams that arise in the Cypress Hills flow out onto the dry grasslands. The valley sides have short- and mixed-grasses where as the valley has moist meadows, brush and trees and riparian zones.



Fig. 13. Cypress Upland / Prairie dry ecozones (CH/PD). SK: The Frenchman River in its broad glacially sculpted valley drains the south-central portion of the Cypress Hills and produces a mixture of upland, riverine and arid grassland habitats.



Fig. 14. Prairie, dry (PD). SK, Grasslands National Park. Short, sparse but diverse xeric vegetation dominates this region.



Fig. 15. Prairie, dry (PD). SK, Piapot Sand Hills. Sandy soil, blowouts, sand hills and active dunes produce a dynamic flora in various states of succession.



Fig. 16. Boreal Plains (BP). SK, Little Bear Lake. Water breaks up the coniferous forest and beaches at the edges of lakes and rivers provide sites for herbaceous plants and deciduous shrubs and trees.

measured at right angles to L.

- L/W – a ratio of length divided by width. It gives a measure of whether the body is slender or broader.
- Wing L – length of wing from middle hind margin of the prothorax to the most distal portion of the wing when the wing is in the folded position.
- Abdomen L – length of body from middle of hind margin of pronotum to the tip of the abdomen. In some male specimens the genital capsule is extended and increases this length. In such cases the apex of the abdomen with the normally positioned capsule is estimated.
- Wing L/abdomen L – this is a ratio that gives the relative length of the wing to the length of the abdomen. A value of close to or greater than 1 is considered fully developed wings.

A sample of 20 specimens was used for measurements of each species. If more specimens were available, the largest and smallest specimens were also included to cover the range of variation within the species. If fewer specimens were available, all were measured and if measurements were made on only one or two specimens, this is indicated.

The position of the abdominal spiracles, whether opening on the dorsal or lateral surface of the segment, is a very useful character in the higher classification of the Lygaeidae. The spiracles are small and difficult to see, especially on the dorsal surface of the abdomen where they are hidden by the wings. We have not used spiracle position in the keys, but give this information, obtained mainly from Schuh & Slater (1995), in the family and tribal (for Rhyparochromidae) descriptions. For each species of Rhyparochromidae a ventral spiracle ( $Sp_v$ ) formula is given as follows:  $Sp_v - 2,5,6,7$ . Each number refers to the number of a segment on which the spiracle is ventral so in this example spiracles open ventrally on abdominal segments 2 and 5 to 7.

A color photograph of each species is provided. This shows the general body shape and proportions as well as

color patterns, which are often complex and difficult to otherwise describe. The photographs are of dried, pinned specimens and were taken with a digital camera attached to a Wild M7 dissecting microscope. Several photos at different focal distances were taken of each specimen and these were combined using the program Zerene Stacker® to produce a composite photograph of increased depth of focus. Photographs were manipulated with Photoshop® to repair any damaged spots, rearrange appendages, and correct color. There is a tendency for the photos to have enhanced yellow or reddish tones for two reasons. They were made with compact fluorescent lights in a light box and some have been lightened to enhance color pattern which in dark specimens is sometimes lost.

Knowledge of the host plants on which a species feeds is fundamental to understanding the biology of a species and its role in the ecosystem. However, we have very inadequate knowledge of host selection and suitability for many lygaeoid species. Immature stages and adults may have different requirements but for many species we have only adult records, usually obtained by picking or sweeping an adult bug from a plant. The assumption is that the bug was on the plant to feed. This is obviously often not the case, for as bugs move and disperse they must encounter many plants which they do not feed on or may only sample then reject the plant or use it as an opportunistic water source. Thus, when we read a plant name on a collecting label we report this as a plant association rather than a host plant unless there is good evidence of a recurring pattern of association or rearing data to demonstrate that the plant does in fact represent a host. Many of these plant associations are obviously chance occurrences and we have used our judgment as to whether to include such data in the ecology section. Also, we use the common names of plants in the text, following the names given by Budd and Best (1969) and Scoggan (1978 - 1979). The scientific names are given in Appendix 1, again following the same authors.

**Table 4: Checklist of Lygaeoidea of the Canadian Prairie Provinces and Ecozones**

Prairie Provinces and Ecozones with records, and source of records; reference to Maw *et al.* (2000) indicates the authors have detailed records of the specimens examined. Abbreviations: AB–Alberta, SK–Saskatchewan, MB–Manitoba, MC–Montane Cordillera, CH–Cypress Uplands, PD–Prairie (dry), PM–Prairie (moist), PP–Prairie Parkland, BP–Boreal Plains, BS–Boreal Shield, TP–Taiga Plains, TS–Taiga Shield.

	Province			Ecozone								Ecozones occupied
<b>Family Artheneidae</b>												
<i>Chilacis</i> Fieber												
<i>typhae</i> (Perris)*	AB <sup>t</sup>	SK <sup>t</sup>		CH	PD	PM						3
<b>Family Berytidae</b>												
<i>Neoneides</i> Stusak												
<i>muticus</i> (Say)	AB <sup>w1,j</sup>	SK <sup>j</sup>	MB <sup>p,j</sup>	MC	CH	PD	PM	PP	BP	BS	TP	8
<i>Jalysus</i> Stål												
<i>wickhami</i> Van Duzee		SK <sup>‡4</sup>	MB <sup>p,j</sup>			PD		PP				2
<b>Family Blissidae</b>												
<i>Blissus</i> Burmeister												
<i>canadensis</i> Leonard	AB <sup>w2,j</sup>	SK <sup>x1,j</sup>	MB <sup>k,j</sup>	CH	PD	PM	PP					4
<i>leucopterus hirtus</i> Montandon		SK <sup>‡4</sup>		CH	PD							2
<i>Ischnodemus</i> Fieber												
<i>hesperius</i> Parshley		SK <sup>x,j</sup>					PP					1
<b>Family Cymidae</b>												
<i>Cymus</i> Hahn												
<i>angustatus</i> Stål	AB <sup>?w</sup>		MB <sup>x,j</sup>				PM					1
<i>coriacipennis</i> (Stål)		SK <sup>t</sup>		CH	PD							2
<i>discors</i> Horváth			MB <sup>j</sup>							BS		1
<i>luridus</i> Stål	AB <sup>w,j</sup>	SK <sup>j</sup>	MB <sup>x,j</sup>	CH	PD	PM	PP	BP				5
<b>Family Geocoridae</b>												
<i>Geocoris</i> Fallén												
<i>atricolor</i> Montandon	AB <sup>x,w,j</sup>	SK <sup>t</sup>		CH	PD	PM		BP				4
<i>barberi</i> Readio & Sweet	AB <sup>‡4</sup>	SK <sup>‡4</sup>		CH	PD							2
<i>bullatus</i> (Say)	AB <sup>x,w,j</sup>	SK <sup>x,j</sup>	MB <sup>x,j</sup>	CH	PD	PM	PP	BP	BS			6
<i>discopterus</i> Stål	AB <sup>j</sup>	SK <sup>x,j</sup>			PD							1
<i>howardi</i> Montandon	AB <sup>j</sup>	SK <sup>t</sup>	MB <sup>j,t</sup>	CH		PM	PP	BP				4
<i>limbatus</i> Stål	AB <sup>j</sup>	SK <sup>j</sup>	MB <sup>j</sup>	CH	PD	PM	PP	BP	BS			6
<i>pallens</i> Stål	AB <sup>w3,u</sup>	SK <sup>t</sup>		CH	PD	PM						3
new species	AB <sup>‡4</sup>			MC								1
<b>Family Lygaeidae</b>												
<b>Subfamily Ischnorhynchinae</b>												
<i>Kleidocerys</i> Stephens												
<i>ovalis</i> Barber	AB <sup>r</sup>	SK <sup>r</sup>	MB <sup>r</sup>	CH	PD	PM	PP	BP	BS			6
<i>resedae resedae</i> (Panzer)	AB <sup>w4,j</sup>	SK <sup>j</sup>	MB <sup>x2,j</sup>		PD	PM	PP	BP	BS			5
<b>Subfamily Lygaeidae</b>												
<i>Lygaeospilus</i> Barber												
<i>tripunctatus</i> (Dallas)		SK <sup>j</sup>	MB <sup>j</sup>				PP					1
<i>Lygaeus</i> Fabricius												
<i>kalmii angustomarginatus</i> Parshley			MB <sup>1,x,j</sup>				PP		BS			2
<i>kalmii kalmii</i> Stål	AB <sup>x,w,j</sup>	SK <sup>1,x,j</sup>	MB <sup>1,x,j</sup>	MC	CH	PD	PM	PP	BP			6
<i>Melacoryphus</i> Slater												
<i>admirabilis</i> (Uhler)		SK <sup>t</sup>		CH	PD							2
<i>lateralis</i> (Dallas)		SK <sup>0,j</sup>			PD		PP					2
<i>Melanopleurus</i> Stål												
<i>perplexus</i> Scudder	AB <sup>n,j</sup>	SK <sup>n,j</sup>	MB <sup>n,j</sup>	CH			PP	BP				3
<i>pyropterus</i> (Stål)	AB <sup>0,j</sup>				PD							1

	Province			Ecozone						Ecozones occupied		
<i>Neacoryphus</i> Scudder												
<i>bicrucis</i> (Say)			MB <sup>†1</sup>			PP				1		
<b>Subfamily Orsillinae</b>												
<i>Neortholomus</i> Hamilton												
<i>scolopax</i> (Say)	AB <sup>j</sup>	SK <sup>x3,j</sup>	MB <sup>f,x3,j</sup>	CH	PD	PM	PP	BP		5		
<i>Nysius</i> Dallas												
<i>angustatus</i> Uhler	AB <sup>b,j</sup>	SK <sup>b,j</sup>	MB <sup>b,j</sup>	CH	PD	PM	PP			4		
<i>fuscovittatus</i> Barber	AB <sup>d,w5,y,j</sup>			MC						1		
<i>grandis</i> Baker	AB <sup>e,w,j</sup>		MB <sup>e,j</sup>	MC					TS	2		
<i>groenlandicus</i> (Zetterstedt)			MB <sup>e,j</sup>						BS			
<i>niger</i> Baker	AB <sup>x4,w6,j</sup>	SK <sup>j</sup>	MB <sup>x4,j</sup>	MC	CH	PD	PM	PP	BP	BS	TS	8
<i>raphanus</i> Howard	AB <sup>w7,j</sup>	SK <sup>h1,x4,j</sup>			CH	PD					2	
<i>tenellus</i> Barber	AB <sup>v</sup>	SK <sup>t</sup>			CH	PD					2	
<i>thymi</i> (Wolff) <sup>x,§</sup>											0	
<i>Xyonysius</i> Ashlock & Lattin												
<i>californicus</i> (Stål)	AB <sup>w8,j</sup>	SK <sup>j</sup>	MB <sup>j</sup>	CH	PD	PM	PP				4	
<b>Family Oxycarenidae</b>												
<i>Crophius</i> Stål												
<i>bohemani</i> (Stål)		SK <sup>t</sup>		CH	PD						2	
<i>disconotus</i> (Say)	AB <sup>j</sup>	SK <sup>x,j</sup>	MB <sup>j</sup>	CH	PD	PM	PP	BP			5	
<i>Mayana</i> Distant												
<i>ramosus</i> (Barber)	AB <sup>j</sup>	SK <sup>o1,j1</sup>		MC	CH	PD	PM	PP			5	
<b>Family Pachygronthidae</b>												
<i>Phlegyas</i>												
<i>abbreviatus</i> (Uhler)			MB <sup>j</sup>						BS		1	
<b>Family Piesmatidae</b>												
<i>Parapiesma</i> Pericart												
<i>cinereum</i> (Say)	AB <sup>w,j</sup>	SK <sup>j</sup>	MB <sup>j</sup>	CH	PD	PM	PP	BP	BS		6	
<i>Piesma</i> Lepeletier and Serville												
<i>costatum</i> (Uhler)	AB <sup>j</sup>	SK <sup>‡4</sup>		CH	PD						2	
<i>explanatum</i> McAtee	AB <sup>j</sup>	SK <sup>j</sup>	MB <sup>j</sup>	CH	PD	PM	PP				4	
<i>patruelle</i> McAtee	AB <sup>j</sup>	SK <sup>‡4</sup>		CH	PD						2	
<b>Family Rhyparochromidae</b>												
<b>Subfamily Plinthisinae</b>												
<i>Plinthisus</i> Stephens												
<i>americanus</i> Van Duzee	AB <sup>j</sup>	SK <sup>x5,j</sup>	MB <sup>j</sup>	CH	PD						2	
<i>indentatus</i> Barber		SK <sup>x,j</sup>			PD						1	
<b>Subfamily Rhyparochrominae</b>												
<b>Tribe Antillocorini</b>												
<i>Antillocoris</i> Kirkaldy												
<i>minutus</i> (Bergroth)			MB <sup>f</sup>					BP			1	
<b>Tribe Drymini</b>												
<i>Drymus</i> Fieber												
<i>unus</i> (Say)		SK <sup>j</sup>	MB <sup>j</sup>		PD		PP				2	
<i>Eremocoris</i> Fieber												
<i>borealis</i> (Dallas)	AB <sup>x6,w9,j</sup>	SK <sup>j</sup>	MB <sup>e1,x6,j</sup>	MC	CH		PM	PP	BP		5	
<i>ferus</i> (Say)	AB <sup>‡2,6</sup>	SK <sup>t</sup>	MB <sup>‡3</sup>		CH	PD	PM	PP			4	
<i>obscurus</i> Van Duzee	AB <sup>‡5</sup>			MC							1	
<i>setosus</i> Blatchley	AB <sup>v</sup>	SK <sup>‡4</sup>			CH				BP		2	
<i>Scolopostethus</i> Fieber												
<i>diffidens</i> Horváth			MB <sup>‡3</sup>						BS		1	
<i>thomsoni</i> Reuter	AB <sup>j</sup>	SK <sup>j</sup>	MB <sup>e1,j</sup>	CH	PD	PM	PP				4	

	Province			Ecozone								Ecozones occupied
<b>Tribe Gonianotini</b>												
<i>Atrazonotus</i> Slater & Ashlock												
<i>umbrosus</i> (Distant)		SK <sup>j</sup>	MB <sup>j</sup>				PP		BS		2	
<i>Emblethis</i> Fieber												
<i>vicarius</i> Horváth	AB <sup>x,w,j</sup>	SK <sup>x,j</sup>	MB <sup>g,x,j</sup>	CH	PD	PM	PP	BP			5	
<i>Malezonotus</i> Barber												
<i>angustatus</i> (Van Duzee)		SK <sup>‡4</sup>			PD						1	
<i>arcuatus</i> Ashlock	AB <sup>‡5</sup>			MC							1	
<i>Trapezonotus</i> Fieber												
<i>arenarius</i> (Linnaeus)	AB <sup>j</sup>	SK <sup>x,j</sup>	MB <sup>h2,x,j</sup>	CH	PD	PM	PP				4	
<b>Tribe Megalonotini</b>												
<i>Megalonotus</i> Fieber												
<i>sabulicola</i> (Thomson)*	AB <sup>‡2,4,5</sup>	SK <sup>t</sup>		MC	CH	PD	PM	PP			5	
<i>Sphragisticus</i> Stål												
<i>nebulosus</i> (Fallén)	AB <sup>x,w,j</sup>	SK <sup>x,j</sup>	MB <sup>h,x,j</sup>	CH	PD	PM	PP	BP	BS		6	
<b>Tribe Myodochini</b>												
<i>Kolenetrus</i> Barber												
<i>plenus</i> (Distant)	AB <sup>j</sup>	SK <sup>j</sup>		CH	PD	PM	PP	BP			5	
<i>Ligyrocoris</i> Stål												
<i>diffusus</i> (Uhler)	AB <sup>e,w,j</sup>	SK <sup>x,j</sup>	MB <sup>j</sup>	CH	PD	PM	PP	BP	BS		6	
<i>sylvestris</i> (Linnaeus)	AB <sup>x,w,j</sup>	SK <sup>x,j</sup>	MB <sup>j</sup>	MC	CH	PD	PM	PP	BP	BS	TP	8
<i>Perigenes</i> Distant												
<i>constrictus</i> (Say)		SK <sup>r</sup>			PD						1	
<i>Sisamnes</i> Distant												
<i>claviger</i> (Uhler)		SK <sup>t</sup>		CH	PD						2	
<i>Slaterobius</i> Harrington												
<i>insignis</i> (Uhler)	AB <sup>x7,w10,j</sup>	SK <sup>x7,j</sup>	MB <sup>x7,j</sup>	CH	PD	PM	PP	BP	BS		6	
<i>Zeridoneus</i> Barber												
<i>costalis</i> (Van Duzee)	AB <sup>x,w,j</sup>	SK <sup>x,j</sup>	MB <sup>x,j</sup>	CH	PD	PM	PP				4	
<i>petersoni</i> Reichart	AB <sup>s</sup>	SK <sup>s</sup>	MB <sup>s</sup>	MC	PD	PM	PP				4	
<b>Tribe Rhyparochromini</b>												
<i>Peritrechus</i> Fieber												
<i>convivus</i> Stål	AB <sup>x8,w11,q,j</sup>	SK <sup>a,i,x8,q,j</sup>	MB <sup>x8,q,j</sup>	CH	PD	PM	PP				4	
<i>fraternus</i> Uhler	AB <sup>w,j</sup>	SK <sup>j</sup>	MB <sup>j</sup>	CH	PD	PM					3	
<i>Uhleriola</i> Horváth												
<i>floralis</i> (Uhler)	AB <sup>w,j</sup>	SK <sup>j</sup>	MB <sup>j</sup>		PD	PM	PP				3	
<b>Tribe Stygnocorini</b>												
<i>Stygnocoris</i> Douglas & Scott												
<i>rusticus</i> (Fallén)*	AB <sup>j</sup>	SK <sup>t</sup>		CH	PD						2	
<i>sabulosus</i> (Schilling)*	AB <sup>j</sup>	SK <sup>‡4</sup>	MB <sup>m</sup>	CH	PD		PP				3	
<b>Tribe Udeocorini</b>												
<i>Neosuris</i> Barber												
<i>castanea</i> (Barber)		SK <sup>t</sup>		CH	PD						2	
<b>Total Species</b>	54	61	45	13	49	56	37	41	23	16	2	2

\*-introduced species; §-record deleted, not a currently recognized North American species; ‡-new record (specimens: <sup>1</sup>-AACS; <sup>2</sup>-BDUC; <sup>3</sup>-CNC; <sup>4</sup>-DJLC; <sup>5</sup>-NFRC; <sup>6</sup>-USAM).

<sup>a</sup>-Barber 1918 (as *P. saskatchewanensis*); <sup>b</sup>-Barber 1947a; <sup>c</sup>-Barber 1947b; <sup>d</sup>-Barber 1949 (as *N. paludicola*); <sup>e</sup>-Criddle 1921; <sup>f</sup>-Criddle 1921 (as *E. ferus*); <sup>g</sup>-Criddle 1932; <sup>h</sup>-Gibson 1912; <sup>i</sup>-Gibson 1912 (as *S. atlanticus*); <sup>j</sup>-Gibson 1913; <sup>k</sup>-Gibson 1913 (as *N. minutus*); <sup>l</sup>-Gibson 1913 (as *T. agrestis*); <sup>m</sup>-Gibson 1919 (as *P. saskatchewanensis*); <sup>n</sup>-Maw et al. 2000; <sup>o</sup>-Maw et al. 2000 (as *Crophius*); <sup>p</sup>-Mitchener & Criddle 1932 (as *B. occidius*); <sup>q</sup>-Parshley 1923; <sup>r</sup>-Scudder & Footitt 2006; <sup>s</sup>-Scudder 1981; <sup>t</sup>-Scudder 1985; <sup>u</sup>-Scudder 1985 (as *Crophius*); <sup>v</sup>-Scudder 1991; <sup>w</sup>-Scudder 1999; <sup>x</sup>-Scudder 2008a; <sup>y</sup>-Scudder 2009; <sup>z</sup>-Scudder 2010; <sup>aa</sup>-Scudder 2012; <sup>ab</sup>-Scudder 2013; <sup>ac</sup>-Strickland 1953; <sup>ad</sup>-Strickland 1953 (as *Neides*); <sup>ae</sup>-Strickland 1953 (as *B. occidius*); <sup>af</sup>-Strickland 1953 (as *G. discopterus*); <sup>ag</sup>-Strickland 1953 (as *Ischnorhynchus*); <sup>ah</sup>-Strickland 1953 (as *N. paludicola*); <sup>ai</sup>-Strickland 1953 (as *N. ericae*); <sup>aj</sup>-Strickland 1953 (as *N. minutus*); <sup>ak</sup>-Strickland 1953 (as *Nysius*); <sup>al</sup>-Strickland 1953 (as *E. ferus*); <sup>am</sup>-Strickland 1953 (as *Sphaerobius*); <sup>an</sup>-Strickland 1953 (as *P. saskatchewanensis*); <sup>ao</sup>-Walley 1934; <sup>ap</sup>-Walley 1934 (as *B. occidius*); <sup>aq</sup>-Walley 1934 (as *Ischnorhynchus*); <sup>ar</sup>-Walley 1934 (as *Ortholomus*); <sup>as</sup>-Walley 1934 (as *N. ericae minutus*); <sup>at</sup>-Walley 1934 (as *P. compactus*); <sup>au</sup>-Walley 1934 (as *E. ferus*); <sup>av</sup>-Walley 1934 (as *Sphaerobius*); <sup>aw</sup>-Walley 1934 (as *P. saskatchewanensis*).

Note: Several introduced species have been found recently in southern British Columbia, and because their ranges are expanding they may eventually extend to the Prairie Provinces. The species *Berytinus minor* (Herrich-Schaeffer) (Berytidae) (Scudder 2012) and *Rhyparochromus vulgaris* (Schilling) (Scudder 2016) are included in the following keys. *Heterogaster urticae* (F.) (Heterogastridae) (Wheeler and Hoebeke 2013) has not been included. It is a specialist on nettle and so far, known in Canada only from Vancouver and southern Vancouver Island where it co-occurs with the native *Heterogaster behrensii* (Uhler).

## The Lygaeoidea of the Canadian Prairie Provinces

### Recognition of Lygaeoid bugs

Generally, these bugs are of small to medium size, of elongate-oval shape, with relatively firm bodies, and gray to brownish or black color with various amounts of darker or paler patterning. The body surface may be smooth and shiny or dull, usually distinctly punctate and variously setose. However, many differ considerably from this general picture and a number of other bugs are similar. Therefore, a more technical and comprehensive diagnosis of the adult bug is:

- Terrestrial Hemiptera, suborder Heteroptera, that is with sucking mouthparts arising from front of head.
- antenna longer than head, with 4 segments, in lateral aspect its base usually below an imaginary horizontal line through the middle of the eye;
- compound eyes present, ocelli usually present (absent in *Neosuris castanea* (Barber));
- labium composed of 4 segments, its apex extending posteriorly at least as far as level of procoxae;
- forewing variously developed, macropterous (large and presumably functional, with a well developed apical membrane and covering most or all of abdomen in repose) or brachypterous (reduced in size, obviously shorter than abdomen and with apical membrane reduced in size), cuneus absent, wing membrane when developed with only 4 to 5 veins;
- tarsi usually 3-segmented (2-segmented in Piesmatidae);
- metathorax with scent gland ostiole well developed;
- abdomen with lateral trichobothria;
- female ovipositor geniculate;
- male claspers (= parameres) symmetrical.

**Key to families of Lygaeoidea**

1. Body and appendages very elongate and slender, body length/width greater than 5.5; antennal segment 1 elongate and slightly clavate apically, subequal to or longer than combined lengths of segments 2 and 3, and from two-thirds to greater than combined lengths of head and pronotum. .... **A. Berytidae**
- 1<sup>?</sup>. Body and appendages not unusually elongate and slender, body length/width less than 5.0; antennal segment 1 shorter than combined length of segments 2 and 3, and shorter than head length. .... 2
- 2(1). Head very broad with eyes large and protuberant and extending posteriorly to envelope anterior angles of pronotum. .... **B. Geocoridae**
- 2<sup>?</sup>. Head narrower with eyes smaller, if convex and protuberant not extending posterior of anterior lateral angle of pronotum. .... 3
- 3(2). Abdomen with suture between sterna 4 and 5 (= visible sterna 3 and 4) laterally curving forwards and ending before lateral margin of abdomen. .... **C. Rhyparochromidae in part, Rhyparochrominae**
- 3<sup>?</sup>. Abdomen with suture between sterna 4 and 5 not curved forward laterally, reaching lateral margins of abdomen. .... 4
- 4(3). Pronotum lateral margin with a sharp carina or lateral flange along entire length. .... 5
- 4<sup>?</sup>. Pronotum lateral margin rounded or at most with a vague longitudinal tumidity along part of its length, without a sharply defined lateral margin. .... 6
- 5(4). Body dorsally with both coarse and very fine punctures, punctures bearing conspicuous long, erect setae; antenna elongate, segment 1 extending well beyond apex of clypeus, segment 4 elongate and at most only slightly wider at middle than segment 3; profemur with two or three teeth on anterior ventral margin. .... **C. Rhyparochromidae in part, Plinthisinae**
- 5<sup>?</sup>. Body dorsally with irregular coarse punctures, setae minute and inconspicuous; antenna short, segment 1 not reaching apex of clypeus, segment 4 distinctly dilated and at middle about twice width of segment 3; profemur not toothed ventrally. .... **D. Artheneidae**
- 6(4). Head in dorsal aspect with mandibular plates extending forward beyond apex of clypeus as a pair of often distally upwards or inwardly curved horns; antennal tubercle present between eye and base of antenna, tubercle simple or bifid; tarsi 2-segmented; dorsal surface of body with coarse alveolate sculpture; length less than 3.5 mm. .... **E. Piesmatidae**
- 6<sup>?</sup>. Head with mandibular plates shorter than clypeus; antennal tubercle absent between eye and base of antenna; tarsi 3-segmented; dorsal surface often punctate but not areolate; length various. .... 7
- 7(6). Hemelytron with a sharp sublateral ventral carina (hypocostal ridge) extending from base to apex of corium and clasping the connexival margin of the abdomen, clavus and corium distinctly punctate; head with each ocellus nearly encircled by a distinct furrow; body slender and fusiform. .... **F. Cymidae**
- 7<sup>?</sup>. Hemelytron lacking a sublateral ventral carina or if present not extending posteriorly past level of base of abdomen; punctuation of clavus and corium various; head with ocelli not encircled by a groove, but they may lie within or at the edge of a groove. .... 8
- 8(7). Pronotal calli each with an impressed, usually shiny, transverse groove; scutellum usually with a cross- or T-shaped carina; spiracles of abdominal segments 2 - 7 all located dorsally ..... **Lygaeidae**, 11
- 8<sup>?</sup>. Pronotal calli without impressed transverse grooves; scutellum without a carina; at least spiracles on abdominal segment 7 located ventrally. .... 9

- 9(8). Head very short and broad, hind margin of eye contacting anterior margin of pronotum which is slightly emarginate for its reception, face in lateral aspect almost vertical, antennal base located beneath eye and separated from labium by a blunt tubercle; body very coarsely punctate, shiny with patches of short appressed white setae; profemur incrassate, with a row of coarse spines along distal half of anterior-ventral margin; abdomen with suture between sterna 3 and 4 obsolete laterally; spiracles ventral on segments 3 to 7. .... **G. Pachygronthidae**
- 9'. Head more elongate and horizontal, eye usually distinctly separated from truncate anterior margin of pronotum, antennal base more or less anterad of anterior margin of eye and not separated from labium by a tubercle; dorsal surface and vestiture various; profemur unarmed or with one or two small, sharp spines on anterior-ventral margin; abdomen with suture between sterna 3 and 4 distinct to lateral margin; abdomen with spiracle position various. .... 10
- 10(9). Body elongate and subparallel in form; wings full or reduced, if full wings narrower and shorter than abdomen so that sides and tip of abdomen visible in dorsal aspect; protibia without spines on ventral surface; abdomen with spiracles of visible segments 2 to 6 located dorsally, segment 7 ventrally. .... **H. Blissidae**
- 10'. Body ovate or wedge-shaped with head narrow and body more or less evenly widening to point of maximum width well behind middle then evenly and broadly rounded posteriorly; wings full, broader and longer than abdomen so hiding abdomen in dorsal aspect; profemur with one or two small, sharp spines on anterior-ventral margin; abdomen with spiracles of segments 1 and 2 dorsal, segments 3 to 7 ventral. .... **I. Oxycarenidae**
- 11(8). Pronotum in lateral aspect with anterior lateral angle impressed and concave for reception of eye; general color mainly black, often with red or orange markings; legs fuscous to black; coarse punctation reduced, dorsally restricted to anterior submarginal and medial transverse areas of pronotum, and ventrally on prosternum and propleuron; setae various, small and appressed to short and recurved, or some specimens with erect longer bristles on head and pronotum. .... **J. Lygaeidae, Lygaeinae**
- 11'. Pronotum in lateral aspect with anterior margin straight, not concave posterior to eye; general color mainly yellow to gray or brown; legs largely pale, with or without fuscous spots; dorsal surface of at least pronotum and scutellum coarsely punctate, ventrally thoracic pleura coarsely punctate; body dorsally with vestiture various, from small appressed setae to densely setose with elongate erect setae. .... 12
- 12(11). Clavus lacking rows of coarse punctures; corium in dorsal aspect either with lateral margin straight for its entire length and wings in repose lying entirely between lateral margins of abdomen, or corial margin straight basally to at least level of middle of scutellum then curved outwards to produce a narrow flange beyond lateral margin of abdomen, body more elongate; body with fine appressed setae and often with conspicuous erect setae; color grayish to grayish-brown. .... **K. Lygaeidae, Orsillinae**
- 12'. Clavus with rows of coarse punctures; corium with lateral margin evenly convexly curved from its base to apex and extending beyond lateral margin of abdomen, body more ovate; dorsal surface glossy, setae short and inconspicuous; color reddish-brown. .... **L. Lygaeidae, Ischnorhynchinae**

### A. Family Berytidae – Stilt bugs

The stilt bugs are of medium size, L = 5 to 10 mm, but of very slender shape, length/ width = 5.6 to 9.1.

Antenna and legs long and thin; antennal segment 1 very elongate, terminal antennal segment short and swollen. Color generally yellowish to reddish-brown, somewhat darker ventrally. Strongly punctate dorsally, setae absent or short and mainly inconspicuous. Head elongate and subcylindrical with eyes far forward, ocelli located well behind eyes posterior to a transverse groove; frons between antennae lowly and bluntly conical or strongly produced above clypeus into a laterally flattened plate or a downwardly curved process; antennae located above level of mid-horizontal point of eye; antenna elongate, segment 1 swollen apically, segment 2 much shorter than 1, segment 3 elongate and segment 4 short and ovate; labium 4-segmented, extending to level of forecoxae or farther, meso- and metasterna then channelled for its reception. Pronotum cylindrical, its anterior margin truncate, laterally with a low, bluntly rounded lateral ridge which may project anteriorly beyond pronotal margin; scutellum short. Wing long or short, either lying flat on abdomen or with costal margin



slightly produced ventrally and clasping connexivum; veins strong, but division between clavus, corium and membrane not distinct. Forefemur without ventral spines. Metacoxae widely separated and lateral in placement. Abdominal venter with suture between sterna 4 and 5 transverse and extending to lateral margin; all spiracles dorsal.

Within the fauna some assassin bugs (family Reduviidae, subfamily Emesinae (thread-legged bugs)) are of similar size and have elongate bodies with long slender appendages. However, they differ from stilt bugs in that antennal segment 4 is long and slender, the labium is short and apparently 3-segmented with its tip resting in the finely transversely striated median groove of the prosternum, and the front legs are raptorial with the fore coxae elongated and the tibia toothed ventrally to grasp prey.

These insects are generally plant feeders, but are recorded to also prey on small insects and insect eggs (Henry 2000). They show a strong preference for feeding on sticky plants where they can scavenge on entrapped insects (Wheeler & Schaefer 1982) (Fig. A-1). Most species occur on herbaceous vegetation, but the introduced *Berytinus minor* occurs on the ground. Adults overwinter.

Henry (1997b) presented the phylogeny and a key to the genera of the world and (Henry 1997c) monographed the fauna of the Western Hemisphere. Twelve species are known from North America, five of which occur in Canada. Scudder (1991) treated the Canadian species providing a key to species, descriptions, distribution records and notes on ecology. Two species are known from the prairies, but the following key includes two additional species that may occur in the fauna. Some species that occur outside our faunal area have the body ornamented with long acute spines. One of the spiniest of these is *Hoplinus echinata* (Uhler) known from BC and western states south to CA and NM.

Fig. A-1. Berytid buffet. Aphids and other small insects trapped on sticky hairs of night-flowering catchfly.

**Key to genera and species of Berytidae of the Prairie Provinces**

1. Antenna with segment 2 very short, about half as long as width of expanded apex of segment 1; labium short, at most reaching anterior margin of mesosternum between procoxae; pronotum with medial and lateral carinae distinct and extended as projections beyond anterior margin of pronotum; body more robust, hind legs shorter, metafemora not reaching apex of abdomen. .... *Berytinus minor* (Figs. A-2, A-3)
- 1'. Antenna with segment 2 more elongate, two or more times as long as width of expanded apical portion of segment 1; labium longer, at least reaching level of mesocoxae; pronotum with medial and lateral carinae low and often obsolete on anterior lobe, not projecting beyond anterior margin of pronotum; slenderer, legs more elongate, apex of metafemur subequal to or only slightly shorter than apex of abdomen. .... 2
- 2(1). Head produced forward between antenna as a prominent down-curved cylindrical process; scutellum triangular, without a dorsal spine; scent gland ostiole distinctly raised apically, but not produced laterally and dorsally into a spine-like process; abdomen with venter coarsely punctate; wings extending beyond apex of abdomen. .... *Neoneides muticus* (Figs. A-4, A-5)
- 2'. Head short between antennal bases, lowly conical and not produced anteriorly over clypeus; scutellum short, apically truncate and with an acute dorsal spine; scent gland ostiole produced laterally and dorsally into a prominent spine-like process; abdomen venter impunctate; wings shorter than abdomen, attaining tergum 8. .... *Jalysus*, 3
- 3(2). Head with side strongly and deeply punctate both above and below eye; male genital capsule ventrally with a faint median ridge and lacking a preapical transverse furrow; parameres thick with two distinct processes on inside edge near middle. .... *Jalysus wickhami* (Figs. A-6, A-7)
- 3'. Side of head with only a few scattered punctures, most confined to lower part beneath upper portion of eye; male genital capsule ventrally with a preapical transverse impression, lacking a low median ridge; paramere relatively slender with one small process on outer edge. .... *Jalysus spinosus*

## *Berytinus minor* (Herrich-Schaeffer)

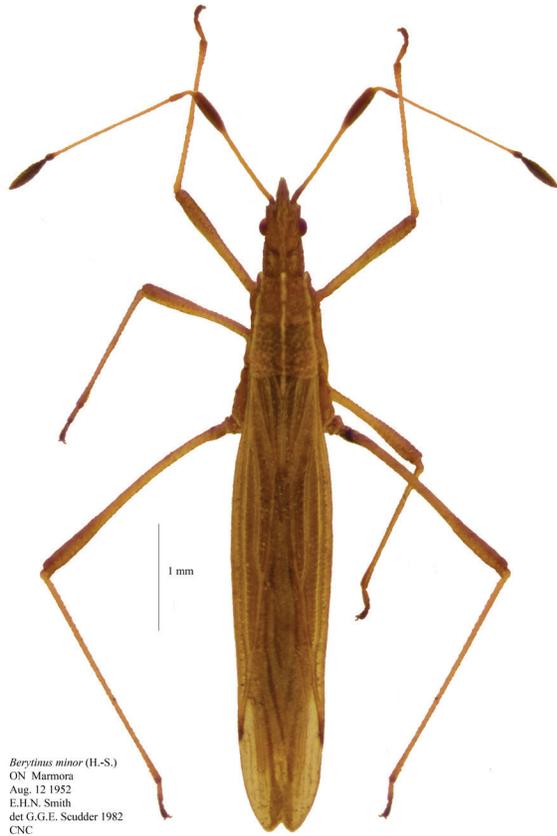


Fig. A-2. *Berytinus minor*

**Distribution:** 13. Introduced. A European species first recorded in North America (ON) in 1935. Now known in Canada from NL to ON, the ne US and recently from BC (Scudder 2012). Such introduced species often have expanding ranges so in time its occurrence on the prairies is possible.

**Taxonomy:** A description is given by Scudder (1991). In addition to the key characters, other features of the species are: the head between the antennal bases has an anteriorly projecting, laterally flattened process, the scutellum is triangular and without a dorsal spine, the abdomen is coarsely punctate and the ostiole of the metasternum is not prominent.

**Measurements (n = 12):** L = 5.1 to 7.4 mm ( $\sigma$  = 5.1 to 6.5 mm;  $\text{♀}$  = 6.7 to 7.4 mm); L/W = 5.6 to 6.5.

**Wing development:** Occurs in macropterous and brachypterous forms. The macropters have the pronotum widened and raised posteriorly compared to brachypters in which the pronotum is flatter and narrower. Macropters wing ratio = 1.07 to 1.14 (2).

**Ecology:** This species lives on the ground surface, often associated with clover. The species is univoltine, overwintering as an adult in sheltered sites on the ground.

**Collecting:** We have collected specimens from under plant rosettes in disturbed sites with over-drained soils in Atlantic Canada.



Fig. A-3. *Berytinus minor*, forebody, lateral

# *Neoneides muticus* (Say)

AB SK MB MC CH PD PM PP BP BS TP

**Distribution:** 2. Nearctic, excluding Beringia. The species occurs in all conterminous US states and in Canada from BC to NS.

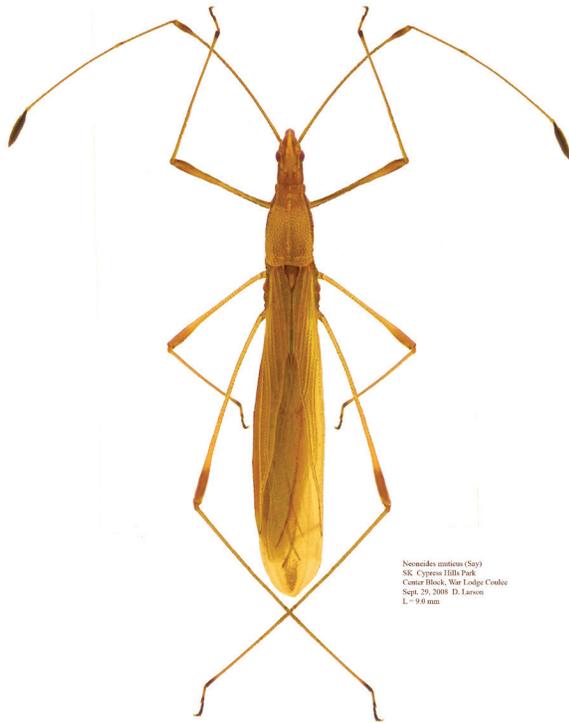
**Taxonomy:** A description is given by Scudder (1991) under the name *Neides muticus*.

**Measurements (n = 22):** L = 7.2 to 10.0 mm (♂ = 7.2 to 9.0 mm; ♀ = 8.0 to 10.0 mm); L/W = 7.59 to 9.08 (♂ = 8.00 to 9.08; ♀ = 7.59 to 8.07).

**Wing development:** Macropterous, wing longer than abdomen; wing ratio = 1.06 to 1.15.

**Ecology:** Although there are a few PD records, the species is not an inhabitant of dry grasslands. It is common in open areas and forest edge of the Cypress Hills and extends along drainages into the surrounding grasslands. The insects live on low plants such as herbs and shrubs. They are largely plant feeding (Henry (1997c gave an extensive review of host plants), but also feed on small arthropods and insect eggs. Scudder (1991) reviewed the host plant records and stated he had often found specimens on common mullein (which is not common on much of the prairies). Other reported hosts that are common in the area are hawkweed and raspberry. In the northeastern US there are two generations per year with adults overwintering (Wheeler 1978).

**Collecting:** Usually collected by sweeping herbaceous vegetation and leafy shrubs.



*Neoneides muticus* (Say)  
SK, Cypress Hills Park  
Cancer Block, War Lodge Codes  
Sept. 29, 2008; D. Larson  
L = 9.0 mm

Fig. A-4. *Neoneides muticus*.



Fig. A-5. *Neoneides muticus*, forebody, lateral.

# *Jalysus wickhami* Van Duzee

SK MB PD PP

**Distribution:** 2. Nearctic, excluding Beringia. Reported from almost every US state (Froeschner & Henry 1988) and from BC, MB, ON and QC in Canada (Scudder 1991). New SK record (SK. Cypress Lake, Recreation Area, Sept. 8, 2017, D. Larson. 1♂. DJLC ).

**Taxonomy:** This species and *J. spinosus* had often been confused until Wheeler & Henry (1981) gave detailed information on how to separate both adults and nymphs. Scudder (1991) provided characters for their separation, which are repeated here in the key.

**Measurements (n = 14):** L = 6.6 to 8.2 mm (♂ = 6.6 to 7.9 mm; ♀ = 7.2 to 8.2 mm); L/W (n = 4) = 6.25 to 7.79.

**Wing development:** An active flyer although wings slightly shorter than abdomen; wing ratio = 0.85 to 91.

**Ecology:** The ecology has been reviewed by Scudder (1991). Adults overwinter and there is probably more than one generation a year (3 or 4 reported in MO). It has a broad range of host plants (Henry 1997c) but seems to prefer “glandular-hairy plants” of the families Malvaceae, Onagraceae, Oxalidaceae, Scrophulariaceae and Solanaceae. It is also a well-known predator of small insects such as aphids and insect eggs and has been considered for biological control. It is commonly found in disturbed habitats. The Cypress Lake, SK, locality is an ungrazed, infrequently inundated upper beach and is a jungle of weedy herbs and patches of marsh vegetation such as cattails, bulrushes and sedges.

**Collecting:** These insects are very active and fly readily. Such activity is a characteristic of this species and not other members of the family (Scudder 1991). Specimens are usually collected by sweeping but if not captured immediately, they fly from the net or beating tray.

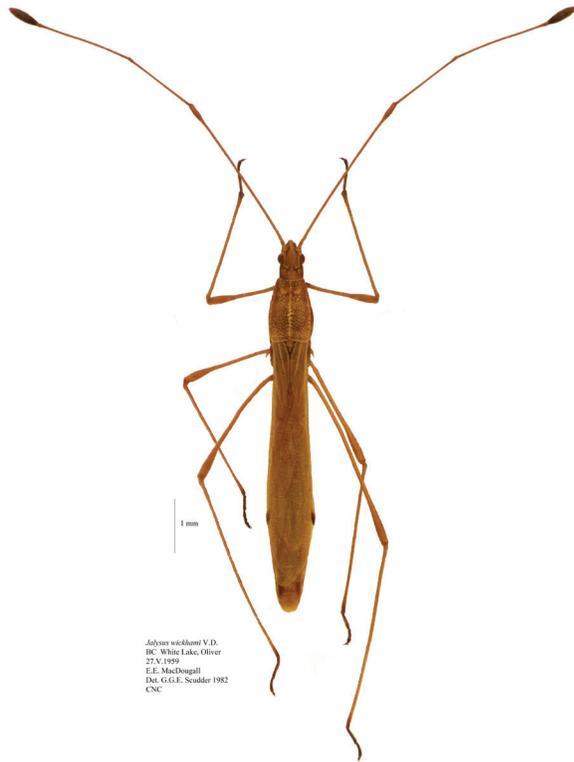


Fig. A-6. *Jalysus wickhami*.



Fig. A-7. *Jalysus wickhami*, forebody, lateral.

## *Jalysus spinosus* (Say)

**Distribution:** Common in eastern North America, occurring n to ON and nw to ND, SD and MN. It may occur in MB, so the key characters given by Scudder (1991) for separating *J. wickhami* and *J. spinosus* are included here.

**Taxonomy:** Very similar to *J. wickhami* and the two species have been frequently confused in the past.

**Measurements (n = 10):** L = 6.0 to 8.1 mm (♂ = 6.0 to 7.0 mm; ♀ = 6.5 to 8.1 mm).

**Wing development:** Wings shorter than abdomen but an active flyer.

**Ecology:** Wheeler (1994) and Henry (1997c) reviewed host plants. The species has been recorded from a variety of herbaceous plants, most of which are incidental, but the chief hosts are species of millet, Enchanter's nightshade and spiderwort, plants that have very limited distribution or do not occur in the Prairie region.

## B. Family Geocoridae – Big-eyed bugs

At a glance it is obvious why these are commonly called big-eyed bugs. The eyes are huge, bulging from the sides of the head and curving backwards to embrace the front angles of the pronotum. The width of the head across the eyes is subequal to the width across the abdomen and the insect has a short, broad habitus.

Small (L = 2.8 to 4.3 mm), broad (L/W = 1.26 to 2.42), somewhat depressed bugs. Dorsal color pale yellow or gray to black, punctures usually darkened, legs usually pale with fuscous spots, spots may be enlarged and contiguous or much of leg may be fuscous; dorsal surface of pronotum, scutellum, clavus and at least apical half of corium rather shiny and coarsely punctate, ventrally thoracic pleura coarsely punctate; body dorsally with setae short and inconspicuous. Bucculae short; labium long, reaching beyond mesocoxae, thorax ventrally not grooved for reception of labium. Pronotum anterior lobe with a pair of transverse impunctate calli, lacking transverse grooves. Pronotum in lateral aspect with anterior margin straight, not concave posterior to eye; lateral margin finely carinate. Wing development various, macropterous or brachypterous; macropters with costal margin broadly convex and following outline of abdomen and membranous apex reaching or extending shortly beyond apex of abdomen; brachypters with costal margin more convex, membrane shorter and exposing from 1 to several apical terga; in both forms wing membrane reaching apex of scutellum and separating distal ends of clavi so that medial commissure not formed; apex of corium more or less straight or slightly concave near apical-lateral angle of macropters. Profemur without ventral spines. Abdominal venter with suture between sterna 4 and 5 transverse and extending to lateral margin of abdomen; spiracles of abdominal segments 2 to 4 dorsal, those of 5 to 7 ventral.

Geocorids are quite diverse with ten species recorded from Canada, seven (plus an undescribed species) of which (all in the genus *Geocoris*) occur in the Prairie Provinces. Some of the species are distinctive, but others differ only subtly and are best recognized when series are available, and something is known about their habits. Color offers some of the best characters for species recognition, but color does vary so that it is best used in combination with other characters such as size and wing development. The validity of some of these weakly characterized species has been tested through laboratory breeding studies which have supported the reproductive isolation of the morphospecies (Readio & Sweet 1982, Robinson 1985). Antennal color is useful for species recognition in many bugs, but within geocorid species it varies sexually and is more useful to separate the sexes than the species. Female antennae tend to be variously fuscate and somewhat uniform in color or becoming paler

apically whereas the antennae of males have the dorsal surface of at least segments 2 and 3 white or cream in color and contrasting with the darker ventral surface. The dorsally white antennal segments are very conspicuous when the antennae are in motion. Such color contrast could make the antenna useful in intraspecific signalling (such as brightly colored palps in spiders) and suggests there might be interesting courtship behavior. Readio & Sweet (1982) treated the eastern North American species, but not all Prairie Province species are included. Apparently, there are several species complexes in western North America that are not well understood and some of these are represented in the prairie provinces. The Geocoridae of Mexico have recently been reviewed (Brailovsky 2016).

Wing dimorphism occurs within this genus. Most species are either always macropterous or brachypterous so that wing development is a useful character for species recognition. However, a few species are dimorphic with both long- and short-winged individuals occurring. Searching lake wash is often a productive way to collect these insects, but because only flying insects get caught in the water and washed up on the beach, it selectively produces macropterous forms, almost the only time they are seen in some mainly brachypterous species.

Eye size in insects is related to visual acuity and predators that visually search for prey during daylight typically have large eyes. Geocorids have been described as “energetic” day-hunting predators. There have been several studies on the role of these insects in controlling crop pests. Tamaki & Weeks (1972) gave a detailed account of the ecology of 2 species, both represented in our area. In general, these are omnivorous predators that feed on small soft-bodied prey like mites, insect eggs, aphids, Lepidoptera larvae, etc., but will also feed on plant seeds and plant juices. A female *G. atricolor* was observed on a dandelion (SK, Maple Creek, Aug. 28, 2016) feeding alternately on thrips then probing florets, presumably for nectar. Readio and Sweet (1982) reviewed the feeding behaviours of geocorids and concluded they are predaceous, but often feed on green plants and seeds. Although the insects can maintain themselves on plant food alone, prey is required for proper development and fecundity. Carstens *et al.* (2008) found *G. uliginosus* to be an important predator of *Blissus occiduus* (especially smaller nymphs), a pest of buffalo grass on short-grass prairie of the central Great Plains. Schuman *et al.* (2013) reviewed the feeding biology of *Geocoris* spp. and concluded “despite plant feeding, the net effect of *Geocoris* spp.-plant interactions is usually beneficial to plants and *Geocoris* spp. can be effective biological control agents in many agricultural systems”. Philip (2015) included geocorids as beneficial predators of field crop and forage pests in western Canada.

Adults of some species overwinter, but eggs and/or nymphs also overwinter. In a discussion of the life history of *G. bullatus*, Readio and Sweet (1982) stated “the cold resistance and survival of the adults ... would give the impression that the adults diapause in the field, whereas actually the chief functional overwintering stage is the egg”. However, they observed that egg diapause is relatively weak and that eggs need to be in normal field conditions to remain in diapause, with warmer temperatures development proceeded. This pattern explains why adults and nymphs of various sizes can be collected in the spring for many species. On the other hand, in the relatively mild climate of SW Utah, Schuman *et al.* observed *Geocoris* spp. (*G. pallens* and *G. punctipes*) to overwinter as adults and start laying eggs in May with these eggs giving rise to a second generation, the adults of which then overwinter. On the Prairies, most adult specimens have been collected from mid-summer into fall. There are probably more than one generation per year, but life history patterns are not known for northern prairie populations.

These insects generally live on the ground surface where there are patches of open ground interspersed with tufts of vegetation or litter. They are often common in patchily grassed areas and in disturbed sites where there are clumps of weedy vegetation. Here they can be found running on the open soil or lurking under the shadows of cover. Specimens of most species have been taken by sweeping vegetation as they also climb and hunt on plant surfaces. Schuman *et al.* (2013) described how the habitat and prey use of *Geocoris* spp. changes over time in relation to plant conditions and prey availability.

It is interesting that several other types of big-eyed insects share this predatory mode of life and together form a guild of small, active, day-hunting predators (Fig. B-1). Conspicuous local examples include the ground beetle genus *Notiophilus* (Coleoptera: Carabidae) and the rove beetle genus *Stenus* (Coleoptera: Staphylinidae). As a group they collectively stab (*Geocoris* using its labium), grab (*Notiophilus* with mandibles) or daub (*Stenus* with a chameleon-like sticky tongue) small prey.



Fig. B-1. Big-eyed predator gallery. Left to right: *Geocoris* (Hemiptera: Geocoridae), in dry upland sites; *Notiophilus* (Coleoptera: Carabidae), generally in woodlands and forest edges; *Stenus* (Coleoptera: Staphylinidae) mainly on wet soils near water.

**Key to species of Geocoridae of the Prairie Provinces**

1. Head orange, dorsally and ventrally, sometimes diffusely darker reddish-brown to piceous medially; pronotum behind calli with a black median area more or less equal in width to base of scutellum, this black area anteriorly widened to include calli and anterior margin; scutellum black; legs yellow; coarse punctures of pale areas of pronotum and hemelytra not infuscate; usually brachypterous. .... *Geocoris limbatus* (Fig. B-2)
- 1'. Head dorsally black or if pale, then with at least some distinctly limited dark medial spots; pronotum and scutellum mainly black or if pale, punctures within pale areas usually distinctly infuscate; leg and antennal color various. .... 2
- 2(1). General color shiny black; head, pronotum (except usually with a small anterior-medial yellow spot) and scutellum black, forewings slightly paler, piceous medially and with base and costal margin fuscous to yellowish on some specimens; legs with at least metafemora (usually also pro- and mesofemora) black except at apex, tibia infuscate basally becoming paler apically, tarsi pale; macropterous. ....  
..... *Geocoris atricolor* (Fig. B-3)
- 2'. Color paler, if largely black then at least posterior-lateral angle of pronotum and humeral and lateral portions of hemelytron yellow; leg color various, yellow to brown or fuscous, seldom black. .... 3
- 3(2). Pronotal calli entirely black; head with posterior half black, lacking a posterior medial pale spot and most specimens without pale spots near ocelli. .... 4
- 3'. Pronotal calli each with a various sized yellow spot, spot may be small and located near medial end or may be variously larger and covering much or all of callus; head with pale spots on posterior half, consisting at least of a posterior medial spot and pale areas near each ocellus. .... 6
- 4(3). Pronotum between anterior margin and calli pale with infuscate punctures; black calli usually separated by a longitudinal pale area; posterior lobe of pronotum yellow with infuscate spots; scutellum usually with apical-lateral pale areas but may be entirely black on some specimens; wings pale with infuscate spots; brachypterous, wing shorter, usually not extending beyond middle of tergite 5, membrane of adjacent wings narrowly overlapping. .... *Geocoris barberi* (Fig. B-4)
- 4'. Pronotum between anterior margin and calli black except for a pale anterior medial spot; black color of calli continuous medially; scutellum black; wings with at least apical half of corium and base of membrane infuscate, brown to piceous; brachypterous or macropterous. .... 5
- 5(4). Brachypterous; legs pale yellow to light orange, without infuscation; pronotum mainly black except posterior lateral angles and sometimes lateral margin of posterior lobe pale. .... *Geocoris howardi* (Fig. B-5)
- 5'. Macropterous to submacropterous; legs variously infuscate, females with femora dark fuscous to black, male with pro- and mesofemora variously pale but with brown to fuscous spots or ventral stripes, metafemora dark. .  
..... *Geocoris species* (Fig. B-6)
- 6(3). See Scatter Plot 1 (Fig. B-8) for separation of the 3 species of this complex based on size and wing length. Brachypterous, some apical abdominal tergites and associated connexivia visible; smaller and usually broader, L = 2.8 to 3.8 mm, L/W = 1.95 to 2.42; legs with femora pale yellow with fuscous spots on distal parts of anterior and posterior faces. .... *Geocoris discopterus* (Fig. B-7)
- 6'. See Fig. B-8. Submacropterous to macropterous, wing membrane reaching at least apex of connexivum 6 and covering at least base of last tergite, usually reaching or exceeding apex of abdomen; length and shape various; leg color various, yellow with brown to fuscous spots to entirely fuscous. .... 7

- 7(6). Larger, L = 3.3 to 4.3 mm; macropterous or submacropterous, WL/AL = 0.93 to 1.10; pronotum basally and corium yellow with punctures infusate, hind margin of pronotum and corium usually with distinct brown spots; abdominal sterna black, lateral margins of some specimens with posterior lateral angles yellow or entire lateral margin very narrowly yellow; leg color various, yellow with fuscous spots or more often fuscous areas expanded and most of femur dark brown to fuscous. .... *Geocoris bullatus* (Figs. B-9)
- 7'. Smaller, L = 3.2 to 3.8 mm; macropterous with wing extending beyond apex of abdomen, WL/AL = 1.05 to 1.17; corium with punctures not or only faintly infusate, apical border non-pigmented or with very faint brownish spots; abdominal sterna with lateral margin pale from trichobothria to edge; legs yellow with brown to fuscous spots. .... *Geocoris pallens* (Fig. B-10)

# *Geocoris limbatus* Stål



*Geocoris* yellow  
SK: 6 km N, 9 km E  
Maple Creek, Sept. 12  
2008. D. Larson  
L = 3.3 mm

Fig. B-2. *Geocoris limbatus*.

AB SK MB CH PD PM PP BP BS

**Distribution:** 2. Nearctic, excluding Beringia. In Canada recorded from BC to QC. US records are from ND and KS to New England and ME.

**Taxonomy:** The color makes this one of the most distinctive species of *Geocoris*. However, there is variation especially in the color of the head which may be infuscate and dark reddish or even piceous medially and basally, the pronotal calli may be reddish to even yellow, and the scutellum may have pale apical-lateral areas.

**Measurements (n = 20):** L = 2.9 to 3.7 mm ( $\sigma$  = 2.9 to 3.3 mm;  $\phi$  = 3.2 to 3.7 mm); L/W = 1.33 to 1.89 ( $\sigma$  = 1.33 to 1.44;  $\phi$  = 1.59 to 1.89).

**Wing development:** Usually brachypterous, but macropterous specimens have been collected in lake wash (SK: Harris Reservoir, July 12, 2013) as well as occasionally amongst series of brachypters. WL/AL = 0.67 to 1.10 (brachypters = 0.67 to 0.87; macropters 0.97 to 1.10).

**Ecology:** Most prairie specimens have been collected in sparsely vegetated, dry grasslands, especially in sand hills and areas of sandy soil as well as on hard, packed sandy-clay pans, south-facing clay coulee sides and on pale clay alluvium at the base of hills. They feed on small insects and leafhoppers have been especially mentioned as prey (Readio & Sweet 1982). Overwintering is probably as eggs as nymphs have been collected in June and adults collected July through September.

**Collecting:** A good place to find specimens is along the edge of cattle trails or roads crossing packed sandy clay soils. The bugs hide in clumps of grass that have bent over onto the ground. In cool weather they are often in sunny, warm microhabitats along the trails. Many specimens have also been collected by sweeping xeric vegetation on south facing hill sides.

# *Geocoris atricolor* Montandon



*Geocoris atricolor*  
SK Larson Ranch, Hwy 21  
16 km S Maple Creek  
Sept. 24, 2008 D. Larson  
L = 3.2 mm

Fig. B-2. *Geocoris atricolor*.

AB SK CH PD PM BP

**Distribution:** 5. Western Nearctic, excluding Beringia. This is a western species that occurs in BC, AB and SK and in w US e to SD (Scudder 2012) and s to TX and CA.

**Taxonomy:** In Readio and Sweet (1982), specimens key to dark specimens of the eastern species, *G. uliginosus*, except in *G. atricolor* the legs of both males and females are dark whereas in *G. uliginosus* the male has pale legs. Other differences include: *G. atricolor* is shinier and more linear whereas in *G. uliginosus* the costal margin of the wing is somewhat more convex and the anterior corners of the pronotum are more angulate. Both species are macropterous.

The northern and western limits of the recorded range of *G. uliginosus* include ON, QC, WI and ND. Dark *Geocoris* from MB should be examined carefully.

**Measurements (n = 20):** L = 3.0 to 3.8 mm (♂ = 3.0 to 3.6 mm; ♀ = 3.3 to 3.8 mm); L/W = 1.26 to 1.63 (♂ = 1.26 to 1.55; ♀ = 1.48 to 1.63).

**Wing development:** submacropterous to macropterous. WL/AL = 0.94 to 1.16.

**Ecology:** Widespread with specimens being collected in dry mixed grasslands, fescue/cinquefoil grasslands, hay fields, upper beaches of lakes and reservoirs and even in red samphire mats near saline ponds. Half-grown nymphs were collected in the later half of April in a year with an early spring (2016), thus overwintering probably occurs as eggs.

**Collecting:** The shiny black body gives these insects a very beetle-like appearance. They occur in a variety of habitats, but tend to be in areas of denser cover than other species of *Geocoris*.

## *Geocoris barberi* Readio & Sweet

AB SK

CH PD

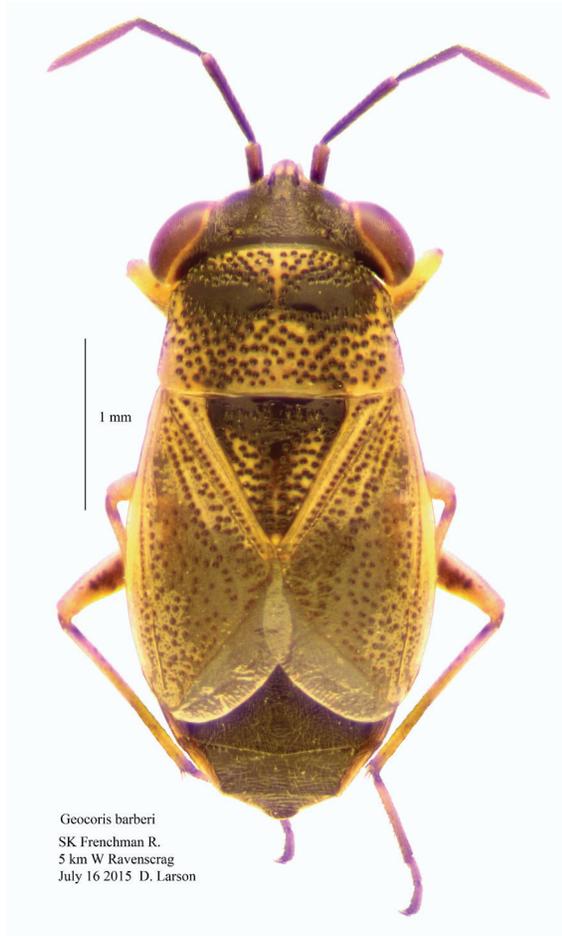


Fig. B-4. *Geocoris barberi*.

**Distribution:** 9. Great Plains-Prairies. New record for Canada. The previously recorded range is KS and SD.

**Taxonomy:** The species can be confused with *G. bullatus*, but is brachypterous, the hind margin of the head is darker, lacking the medial pale spot, and has smaller or absent post-ocellar spots, the calli are black and on most specimens separated by a yellow area, and the legs are paler. The color of the scutellum varies, most specimens have pale lateral areas, but in some the infuscation of the punctures is continuous and the scutellum is entirely black. Readio and Sweet (1982), in their description of the species, state a black scutellum is diagnostic of the species, but in their key the species is treated as having a black or a black and pale scutellum.

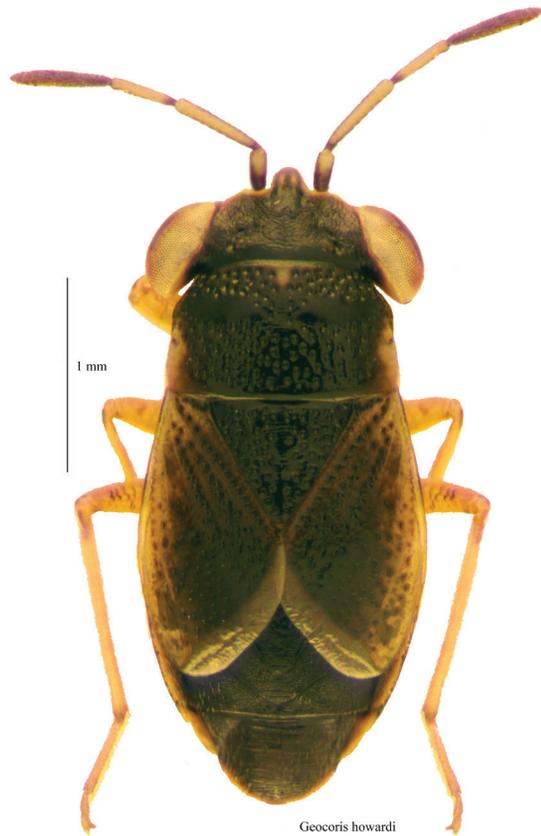
**Measurements (n = 20):** L = 3.1 to 3.8 mm ( $\sigma$  = 3.1 to 3.5 mm;  $\phi$  = 3.4 to 3.8 mm); L/W = 2.00 to 2.37 ( $\sigma$  = 2.19 to 2.37;  $\phi$  = 2.00 to 2.27).

**Wing development:** Brachypterous. WL/AL = 0.65 to 0.78.

**Ecology:** The species was previously known only from the high plains area of Kansas and South Dakota. SK specimens have been collected from dry, mixed grasslands; the CU records are from dry, south-facing slopes at lower elevations and are extensions of dry mixed prairie into the uplands.

**Collecting:** Most specimens were taken by sweeping Silvery sagebrush. Sagebrush is often infested with colonies of aphids which could be prey for the bugs, although these aphids are generally vigorously guarded by *Formica* sp. ants.

## *Geocoris howardi* Montandon



*Geocoris howardi*  
SK Cypress Hills Park  
W Block, 4 Mile Road  
49 36N 109 49A  
Aug 8 2010, D. Larson

Fig. B-5. *Geocoris howardi*.

AB SK CH PM PP BP

**Distribution:** 1. Nearctic, including Beringia. Recorded from AK, YT, NT and BC to ME, NY, SD and ID (Scudder 2012).

**Taxonomy:** The dark body color with the pale legs is distinctive. In addition, the insects are relatively robust and coarsely punctate.

**Measurements (n = 20):** L = 3.1 to 3.9 mm (♂ = 3.1 to 3.5 mm; ♀ = 3.5 to 3.9 mm); L/W = 1.92 to 2.21 (♂ = 2.09 to 2.21; ♀ = 1.92 to 2.04).

**Wing development:** All prairie specimens examined are brachypterous; WL/AL = 0.68 to 0.79. Readio and Sweet (1982) state most specimens are brachypterous but macropterous specimens occur and the holotype is a macropterous female from Marquette, Michigan.

**Ecology:** Prairie specimens have been collected from central and northern regions, along the AB foothills and from the Cypress Hills. In the Cypress Hills specimens have been collected from fescue grasslands but not in the surrounding dry grasslands, as well as on pine duff, on open areas among heaths at the edge of lodgepole pine forest and in brome hay fields. Scudder (1997) collected specimens on south-facing sage slopes in YT.

**Collecting:** This dark colored species can only be confused in the field with *G. atricolor*. However, specimens are more robust and brachypterous, have pale legs and tend to occur in more mesic habitats and at higher elevations.

## *Geocoris* species



Fig. B-6. *Geocoris* species.

AB

MC

**Distribution:** 8. Western Cordilleran, excluding Beringia. Known from 7 specimens collected Highwood Pass, Kananaskis Hwy., AB (Sept. 3, 2017, D. Larson. DJLC).

**Taxonomy:** This small series of specimens differs as much from the other *Geocoris* species treated here as they differ amongst themselves and therefore is equally deserving of specific status. We have not been able to associate these specimens with a named species but are not willing to describe them as a new species based on the single population sample.

Characteristics of this taxon are body relatively large, robust; color dark, head almost entirely black, pronotum with anterior lobe including calli black, posterior lobe variously darkened at least medial-laterally, some specimens with entire median area fuscous, scutellum black, wings with apical half of corium and at least base of membrane darker brown to fuscous; legs of female with femora dark fuscous to black, male femora yellow with fuscous spots or stripes especially on ventral surface; dorsal punctation strong; wings slightly shorter than to subequal to length of abdomen.

**Measurements (n = 1♂, 6♀):** L = 3.7 to 4.1 mm (♂ = 3.7 mm; ♀ = 3.7 to 4.1 mm); L/W = 2.04 to 2.27 (♂ = 2.27; ♀ = 2.04 to 2.20).

**Wing development:** submacropterous to macropterous. WL/AL = 0.90 to 1.08 (♂ = 1.08; ♀ = 0.90 to 1.01).

**Ecology:** The specimens were collected along the shoulder of the Kananaskis Highway at the summit of Highwood Pass. This area is slightly below the treeline in an area of patches of conifers and heath-covered avalanche slopes. The bugs were on over-drained ground consisting of small gravel overlain by a thin layer of clay and silt. Vegetation was sparse and mowed and consisted of low, generally separated patches of avens, yarrow, willow and other low plants. The bugs were collected when they were observed running in the sunlight between plant clumps. *Nysius grandis* was also common in this site.

# Geocoris discopterus Stål



Fig. B-7. *Geocoris discopterus*.

AB SK PD

**Distribution:** 1. Nearctic, including Beringia. Western records from AK (Scudder & Sikes 2014), YT, BC, AB and SK; in the US s to PA. (Scudder 1997).

**Taxonomy:** This species is recognized here based on small size, pale color and brachypterous condition (Fig. B-8). Readio and Sweet (1982) used the small size as a key character giving mean length for males = 2.99 mm and female = 3.24 mm. However, they also described the corium as bicolored with the discal area being brown and darker than the costal margin. Prairie specimens have the hemelytra yellow with distinctly infusate punctures over most of their surface. The other small species in the fauna is *G. pallens* which is macropterous, and less coarsely punctate with the punctures not or only faintly infusate. Readio and Sweet (1982) recognized *G. discopterus* as occurring in the ne US and state that records from western US and Canada probably refer to brachypterous species of the *bullatus-pallens* complex. However, Robinson (1985) and Scudder (1997) found Yukon specimens to be very similar to eastern specimens and treated them as being conspecific. In Fig. B-8, 3 specimens are intermediate between *G. discopterus* and *G. bullatus* and could not be assigned unambiguously to either species.

**Measurements (n = 26):** L = 2.8 to 3.8 mm (♂ = 2.8 to 3.4 mm; ♀ = 2.9 to 3.8 mm); L/W = 1.95 to 2.42 (♂ = 2.11 to 2.42; ♀ = 1.95 to 2.21).

**Wing development:** Brachypterous. WL/AL = 0.77 to 0.94 (♂ = 0.77 to 0.93; ♀ = 0.83 to 0.94).

**Ecology:** Specimens have been collected from dry south-facing hillsides where the soil was friable to sandy, as well as in sparse, short grasses growing on solenzic soils. A long series was swept from Prairie sage (Cypress Lake, West dam, Aug. 26, 2017, DJLC). The plants, growing in a moist depression of a gravel pit, were in bloom and emitting copious amounts of pollen. The summer was extraordinarily dry, and these were amongst the few plants still green and were covered in green nymphal mirid bugs which may have been the prey attracting the geocorids (which also included a smaller number of *G. bullatus*). *Geocoris barberi* was present on sagebrush growing on grazed short grass prairie in the vicinity but none were found on the Pasture sage nor were specimens of *G. discopterus* found on the sagebrush.

Readio and Sweet (1982) state the species is generally collected in sandy open areas. Robinson (1985) considered the usual YT habitat to be arid south-facing slopes and Scudder (1997) collected specimens on south-facing *Artemisia* slopes.

Robinson (1985) found that in YT the species generally overwinters as unmated adults and as nymphs are slow developing there is a single generation per year.

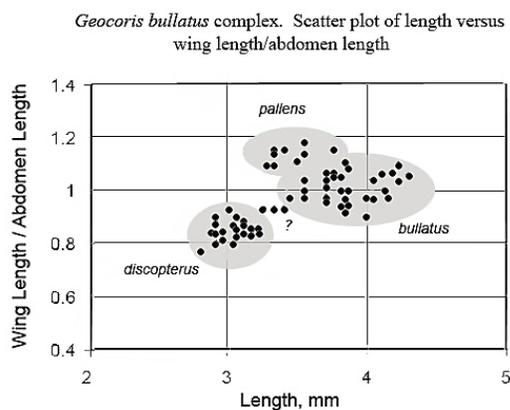


Fig. B-8. Scatter plot, *Geocoris bullatus* complex.

## *Geocoris bullatus* (Say)



*Geocoris bullatus* macropterous  
SK, Harris Reservoir, Hwy 21  
10 km S Maple Creek, drift  
May 26, 2008, D. Larson  
L = 4.0 mm

Fig. B-9. *Geocoris bullatus* macropterous.

AB SK MB CH PD PM PP BP BS

**Distribution:** 1. Nearctic, including Beringia. Transcontinental in Canada, north to AK, YK and NT, south to CA and VA.

**Taxonomy:** This is a common large species that can usually be readily recognized, but the color characters are similar to the states of *G. pallens* and *G. discopterus*. These 3 species are best separated on the basis of length (L) and length of wing (WL/AL) as in Fig. B-8. Specimens of *G. bullatus* generally have darker legs with the femora, especially metafemora, fuscous.

**Measurements (n = 31):** L = 3.3 to 4.3 mm (♂ = 3.3 to 3.9 mm; ♀ = 3.7 to 4.3 mm); L/W = 2.08 to 2.40 (♂ = 2.1`8 to 2.40; ♀ = 2.08 to 2.32). Robinson (1985) gives mean L of YT specimens as: 3.67 mm (♂), 4.17 mm (♀).

**Wing development:** This species shows some variation in wing length with wings being slightly shorter than to slightly longer than the abdomen (WL/AL = 0.93 to 1.10). About two thirds of specimens, including all those collected in lake wash, have wings that equal or exceed the tip of the abdomen and presumably can fly. The other third of specimens have wings slightly shorter, the wing membrane reaching the end of connexivum 6, but exposing the tip of the last tergite. The flight capacity of such individuals is not known, but as they have not been found in lake wash they may not fly. Robinson (1985) similarly found that in YT populations about 61% were macropterous and 39% submacropterous.

**Ecology:** This is the most common species in lake wash. Specimens are typically collected on sandy to clayey soil in mesic grasslands and weedy disturbed areas. Readio & Sweet (1982) stated it is “the characteristic species of open disturbed sandy areas across the northern United States, and is abundant along roadsides, waste lots, especially where the soil is sandy or gravelly”, but also stream-sides, gravelly alpine areas, agricultural clearings and other open disturbed sites in early stages of succession. Robinson (1985) found the usual YT habitat to be “disturbed wasteland” and considered this to be an r-selected species which colonizes disturbed sites and has a fast developmental rate. We have collected only adults in early spring, but Readio & Sweet (1982) gave evidence to suggest that the chief overwintering stage is the diapausing egg. Robinson (1985) found that in YT the species overwinters in the egg stage then develops rapidly enough to have two summer generations.

**Collecting:** This is the most common species of gardens and flower beds where specimens are often found lurking under the shade of leafy plants. Protection of these active little predators is a good reason for not using garden insecticides.

# *Geocoris pallens* Stål

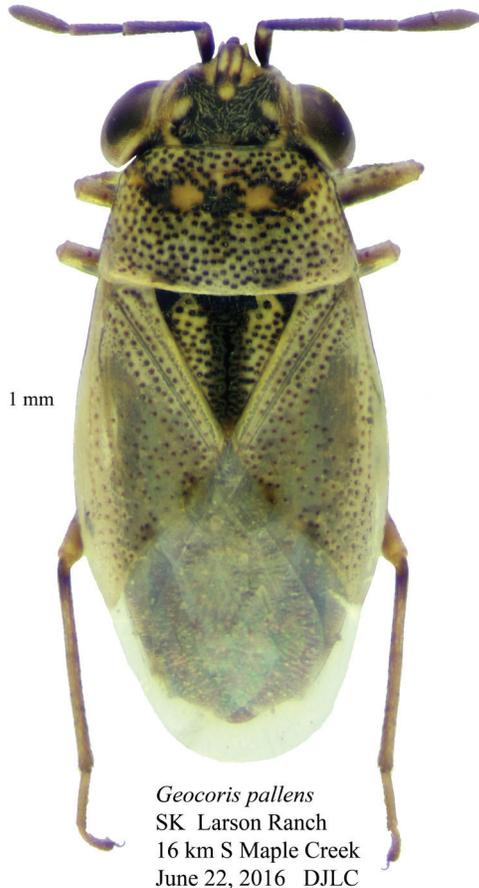


Fig. B-10. *Geocoris pallens*.

AB SK

CH PD PM

**Distribution:** 10. Nearctic-Neotropical. Recorded in Canada from BC, AB (Scudder 2012) and SK (Scudder 2010) and in US from middle states of IL, IN, MO, AR and west to WA, OR, CA and s to Mexico and Central America.

**Taxonomy:** Members of this species look like small, pale yellowish specimens of *G. bullatus*. Readio and Sweet (1982) noted that in *G. pallens* the forewings and hindwings are of the same length and “considerably” exceed the length of the abdomen whereas in *G. bullatus* the wings are slightly longer to shorter than length of the abdomen and the hind wings are slightly shorter than the forewings. However, this difference in fore and hind wing lengths is a difficult character to see on preserved specimens and any contraction of the abdomen makes relative length hard to determine. The illustration is of a specimen from sw SK which is darker in color than BC specimens. However, Readio and Sweet (1982) noted that specimens vary in color geographically as well as seasonally with spring and fall generation specimens darker than those of summer generations. In addition, they regarded the “*pallens* complex” in western North America as a Pandora’s box of difficult and confusing taxa.

**Measurements (n = 10, BC & SK):** L = 3.3 to 3.8 mm (♂ = 3.2 to 3.4 mm; ♀ = 3.3 to 3.8 mm); L/W = 2.13 to 2.47 (♂ = 2.43 to 2.47; ♀ = 2.13 to 2.25). Readio & Sweet (1982) give mean L = 3.32 mm (♂), 3.66mm (♀).

**Wing development:** Macropterous. WL/AL = 1.05 to 1.17.

**Ecology:** Readio and Sweet (1982) state that in the western United States this is the typical *Geocoris* of open, disturbed habitats and of early successional stages of plant communities where there is much open ground. This fits the habitat of SK specimens which were mainly collected in a weedy vegetable garden. This is a predator, but apparently does best on a diet including green plants and seeds (Tamaki & Weeks 1972). At least some populations overwinter as adults (Schuman *et al.* 2013).

**Collecting:** The species seems to be mainly synanthropic with most collections being from disturbed sites such as gardens, unpaved driveways, and barnyards.

### C. Family Rhyparochromidae – Seed Bugs

This is the most diverse family of lygaeoid bugs. These are the archetypal seed bugs, but despite this it is difficult to define the family. A unique feature of most species is on the abdomen, where the suture between sterna 4 and 5 curves anteriorly near the lateral margin of the abdomen and disappears before reaching the margin (Fig. 4). Members of the infrequently collected subfamily Plinthisinae lack this feature, but both subfamilies also have head trichobothria which define them (Henry 1997a).

Size various, minute to moderate, L = 1.8 to 10.0 mm. Dorsal color various, from uniformly pale brown to almost black, often with conspicuous paler markings on posterior lobe of pronotum and wing; sculpture and vestiture various. Head with antennae large and prominent; eyes convex, prominent, separated from anterior margin of pronotum by a postocular area or if contiguous, anterior lateral pronotal margin straight and not concave for reception of hind margin of eye; ocelli sometimes vestigial. Pronotum with lateral margin smoothly rounded to distinctly carinate or even explanate; anterior lobe without transverse grooves or distinctly delimited calli. Wing development various, macropterous or brachypterous with many species dimorphic; apical margin of corium straight or emarginate near commissural angle. Labium length various, extending from level of mesosternum to well onto abdomen; mesosternum longitudinally grooved for its reception or not; bucculae length various. Fore femur variously enlarged and ventrally toothed or with setiferous tubercles. Abdominal venter with suture between abdominal sterna 4 and 5 curved anteriorly and ending before lateral margin on most specimens; position of abdominal spiracles various.

These bugs are generally ground-dwelling, usually living in areas of early successional herbaceous growth where the soil is well drained and at least somewhat sun-exposed. However, there are many exceptions to this with some species living in wetlands, others in litter of closed canopy forest, some are found climbing on plants whereas others are never seen on vegetation. All are seed feeders and for the most part seem quite catholic in seed choice, opportunistically feeding on what is available. There seems a paucity of records for feeding on seeds of grasses as compared with broad-leaved, weedy species. There is a very strong correlation between the permanency of a species habitat and wing development: long-winged species are in the most unstable, temporary habitat types (Sweet 1964a, b). In summer and fall, certain species can be found regularly on the flowers of various plants, especially Asteraceae (Fig. C-1).

These bugs are relatively easy to keep in captivity having rather simple needs and taking easily obtained and maintained food (especially shelled sunflower seeds with water made available). In the field nymphs can generally be associated with adults or at least brought into the lab and reared so that the problem of associating immature and adult stages that plagues studies on insects with larval stages is largely avoided. The nymphs of most genera can also be keyed in Sweet and Slater (1961). Thus, quite a bit is known about the ecology and development of these insects. Our observations are based mainly on field observations made during collections of adults. However, we have drawn freely from the literature to give an overview of the life cycle and habitat in the species accounts. For this we have mainly consulted the excellent study on the ecology of New England Rhyparochromidae by Sweet (1964a, b), unless specifically stated otherwise.



Fig. C-1. Various seed bugs can be swept from A. gumweed, and B. goldenrod in late summer and fall.

Life history patterns are described in Table 2. There are two basic life history patterns, depending on how the winter is passed. Insects overwinter in a diapausing state, either as an egg in arrested embryonic development, or as an adult that is reproductively inactive. With the advent of warm weather, embryonic development resumes and the egg hatches into a nymph that grows through 5 instars to adulthood. Overwintering adults have the gonads immature until spring when they mature, and mating and egg laying begin. Adults that develop during the summer may immediately become sexually mature and lay developing eggs that give rise to a second generation thus the species is bivoltine. Alternatively, adults may not become sexually mature that summer and overwinter or they may become sexually mature and lay eggs, but the eggs undergo developmental arrest and overwinter, in either case giving rise to a univoltine life cycle. The speed with which development of an overwintering stage resumes can determine when in the summer the nymphal stages occur so that there can be spring or summer developing species. By altering the stage in which diapause occurs and the rate of development after diapause a great variety of life history patterns can be produced, giving rise to life histories suited to a wide variety of environments. It is possible that different geographical populations of a species might have different life cycles, at least northern populations

may be more likely than southern to be univoltine to fit their growth into a shorter season. We have not reared any local species and have depended upon published life history information obtained from other regions. For this reason, life histories of prairie species might not be as we state.

This family is large and diverse. It has been subdivided into several subunits. Two subfamilies, Plinthisinae and Rhyparochrominae, occur in Canada. The Rhyparochrominae in turn have been divided into a number of tribes, many of which are represented in the prairie fauna. We have tried to use tribal characters in the key so that related species generally key out in the same general section, but we do not give a formal tribal classification in the key. Barber (1918) presented a key to the United States tribes and genera but the discursive style and lack of illustrations make it somewhat difficult for an uninitiated person to use. A diagnosis of the tribe Drymini and a key to the included North American genera were given by (Ashlock 1979). Harrington (1980) revised the world genera and Schuh and Slater (1995) recap the history of the classification of the family and provide a key to the world tribes and give the spiracle configuration. Slater & Baranowski (1990) have a simpler key to some of the North American tribes and they illustrate some of the abdominal spiracle configurations used in tribal classification.

**Key to genera and species of Rhyparochromidae of the Prairie Provinces**

1. Abdomen with all sutures transverse and reaching lateral margins of abdomen; body relatively broad; dorsal surface shiny, it and appendages with long, erect pale setae; metathoracic scent gland with auricle elongate and linear, extending posterior-laterally and ending lateral to metacoxa, evaporatorium large and coarsely reticulate; color yellowish-brown to dark chestnut, not black. L = 2.8 to 3.5 mm. ....  
..... subfamily Plinthisinae, *Plinthisus*, 2
- 1'. Abdomen with suture between sterna 4 and 5 laterally curving forwards and ending without reaching lateral margin of abdomen; other characters various. ....subfamily Rhyparochrominae, 3
- 2(1). Pronotum wider than long, its anterior lobe not elevated, anterior angles rounded; scutellum finely punctate. ....  
.....*Plinthisus americanus* (Fig. C-2)
- 2'. Pronotum subquadrate, its anterior lobe swollen, anterior angles forming a distinct angle; scutellum almost impunctate. ....*Plinthisus indentatus* (Fig. C-3)
- 3(1). Very small, L = 1.7 to 2.5 mm; dorsal color yellowish to dark reddish-brown, not black..... 4
- 3'. Larger, 2.5 mm or more; color various, but head and anterior lobe of pronotum black on most specimens..... 5
- 4(3). Body surface matte with coarse, but irregular punctation; antennal segment 1 extending about half its length beyond clypeus; head with ocelli; pronotum trapezoidal, widened more or less evenly from front angles to hind angles, lateral margin with a blunt carina; hemelytra with lateral margins subparallel basally, with distinct clavus, corium and membrane; profemur slender, without ventral teeth; abdomen ventrally with a deep sublateral furrow containing trichobothria.....*Antillocoris minutus* (Fig. C-4)
- 4'. Body shiny between coarse more or less even punctation; antennal segment 1 subequal in length to clypeus; head lacking ocelli; pronotum subrectangular, broader than long, lateral margins more or less parallel except emarginate before hind angles, lateral margin smoothly rounded; hemelytra with lateral margin smoothly arcuate, not divided into distinct clavus, corium and membrane, apex of corium less sclerotized and broadly paler; profemur robust, with small, sharp ventral teeth; abdomen without a deep sublateral furrow, trichobothria distinct. ....*Neosuris castanea* (Fig. C-5)
- 5(3). Pronotum with lateral margin of anterior lobe evenly rounded or with at most a slight longitudinal tumidity adjacent to pleural suture; abdominal segments 2, 3 and 4 with spiracles dorsal.....(Tribe Myodochini), 6
- 5'. Pronotum with lateral margin of anterior lobe longitudinally carinate or explanate, not smoothly and evenly rounded; some specimens with carina low, but still evident as a raised usually shiny bead demarcated from dorsal pronotal disc by a groove; abdomen with position of spiracles various. .... 15
- 6(5). Head with postocular area greatly elongate and narrowed, head length 1.5 to 2 X length of pronotum.....  
.....*Mydocha serripes* (Fig. C-6)
- 6'. Head short, postocular space short and head length less than pronotal length. .... 7
- 7(6). Antenna with segments 3 and 4 much enlarged and considerably broader than segment 2; dorsal surface rugosely punctate and dull from reticulate sculpture, bearing short, broad, scale-like white setae; head ventrally with a broad longitudinal impression in which segment 1 and base of 2 of labium lie; shape oblong-oval, brachypters especially wedge-shaped, widest at about middle of abdomen and evenly narrowing to front of head except for abrupt emargination demarcating anterior and posterior lobes of pronotum; macropters more elongate with lateral margins of basal half of wings more parallel-sided. L = 2.2 to 3.0 mm.....  
.....*Sisamnes claviger* (Fig. C-7)
- 7'. Antenna slenderer, segments 3 and 4 not conspicuously broadened; body dorsally without scale-like setae; head ventrally without a longitudinal impression for reception of base of labium; shape and size various..... 8

- 8(7). Pronotum in dorsal aspect with distinct although bluntly rounded anterolateral angles, without a collar delimiting anterior foramen; head constricted abruptly behind eye so postocular area short and eye close to pronotal angle; procoxa lacking a distinct setiferous tubercle on anterolateral surface; head, pronotum and scutellum black; pronotum more or less bell-shaped, with lateral margin distinctly emarginate before outwardly flaring hind lobe, its hind margin broadly concave; macropterous or brachypterous; dorsal surface shiny, setae short and appressed, their length subequal to or shorter than distance between punctures. Smaller species, L = 2.5 to 3.1 mm. .... *Kolenetrus plenus* (Fig. C-8)
- 8'. Pronotum in dorsal aspect with anterolateral angles broadly rounded and more or less obsolete, with an anterior collar, collar delimited by an impressed line or at least a row of more or less contiguous punctures; head with a distinct postocular area which separates eye from anterior margin of pronotum; procoxa with a setiferous tubercle or spine on anterolateral surface (often also with a second smaller more distal tubercle). Larger, L = 3.6 to 9.0 mm. .... 9
- 9(8). Abdominal sterna 3 and 4 without a medial-lateral stridulatory area, surface of sterna more or less uniform in sculpture and vestiture; pronotum with constriction between lobes shallower. Larger species, L = 5.4 to 9.0 mm. .... 10
- 9'. Abdominal sternum 3 and often adjacent portions of 2 and 4, with a medial-lateral stridulatory area (Figs. 9, C-15) which at low magnification appears as a smoother, shining, more or less glabrous curved area, at higher magnification (50X or more) seen to consist of fine, dense, parallel lines (plectrum of organ consists of a longitudinal row of small denticles along posterior ventral margin of base of metafemur); pronotum with constriction between anterior and posterior lobes deeper and sharper. Smaller, L = 3.6 to 6.5 mm. .... 13
- 10(9). Prosternum flattened medially and lateral to this with a blunt longitudinal ridge the edge of which bears parallel rows of fine pits (stridulatory file) across which a row of small spines on anterior ventral face of profemur (plectrum) can be drawn; slender, especially forebody; color reddish-brown, shiny, femora unbanded; profemur very large, male protibia with a large midventral spine; usually brachypterous, but macropterous specimens known. .... *Pseudocnemodus canadensis* (Fig. C-9)
- 10'. Prosternum not flattened medially, without stridulatory file; dorsal surface darker brown to fuscous with a variegated pattern, surface matte and not shining, femora banded; profemora slenderer and without stridulatory organ, male protibia lacking a medial spine; macropterous. .... 11
- 11(10). Pronotal collar punctate and not so ring-like; hind tarsus with segment 1 three times as long as combined length of segments 2 and 3; body less setose, dorsally with a few erect setae on posterior portion of head, laterally on anterior pronotal lobe and lateral margins of scutellum; antenna with setae fine, dense and appressed; legs with setae short and appressed with tibial spines more prominent than setae; profemur usually with two or three prominent spines and several smaller denticles on anterior ventral surface. Smaller, L = 5.2 to 7.6 mm; narrower, L/W = 3.2 to 3.7, ratio of head width across eyes to maximum width of anterior pronotal lobe = 0.85 to 1.00. .... *Zeridoneus*, 12
- 11'. Pronotal collar impunctate and ring-like; hind tarsus with segment 1 little more than twice as long as combined length of segments 2 and 3; body with conspicuous elongate, erect setae over most of dorsal surface; antenna, especially segments 2 and 3, with erect setae longer than segment width; legs with long erect setae, those of tibia longer than tibial spines; profemur usually with one prominent subapical spine and several small denticles on anterior ventral surface. Larger, L = 7.0 to 9.0 mm; body broader, L/W = 2.84 to 2.93, ratio of head width across eyes to maximum width of anterior pronotal lobe = 0.70 to 0.75. .... *Perigenes constrictus* (Fig. C-10)

- 12(11). Hemelytron variegated with browns, without strongly contrasting medial transverse dark band and subapical pale spot; metafemur yellowish brown, with fuscous spots and gradually darkening to fuscous distally. Larger, L = 5.5 to 7.5 mm, pronotum W/L = 1.12 to 1.22..... *Zeridoneus costalis* (Fig. C-11)
- 12'. Clavus pale yellowish, usually with infuscation of medial series of punctures fusing to give a medial longitudinal stripe; corium ivory to pale yellowish basally, apical half dark brown with a distinct subapical, more or less triangular, pale spot; metafemur yellow with apical third abruptly infuscate. Smaller, L = 5.2 to 6.4 mm, pronotum W/L = 1.21 to 1.35. .... *Zeridoneus petersoni* (Fig. C-12)
- 13(9). Head large and inflated, in lateral view both dorsal and ventral surfaces distinctly convex; pronotum with transverse constriction deep, anterior lobe large, globular and rather shiny, color variable from rufous to black with collar paler; corium with basal half and a subapical transverse spot whitish. .... *Slaterobius insignis* (Figs. C-13, C-14, C-15)
- 13'. Head flatter, ventral surface in lateral aspect almost flat or only lowly convex; pronotum with medial constriction shallower, anterior lobe not so globular, its surface dull in texture, and its color very dark brown or piceous to black, collar concolorous with anterior lobe or slightly paler medially; corium color various, some specimens with a whitish base and subapical patch, but these less bright and not contrasting. .... 14
- 14(13). Dorsal surface with conspicuous erect setae; macropterous with forewing reaching or almost reaching apex of abdomen; forewing color pattern less distinct, medial transverse dark band of corium often of uneven pigmentation and irregular shape, laterally not reaching costal margin; thoracic pleura with setae white and elongate, lacking yellowish tint of ventral setae of head. Size more varied, L = 4.0 to 6.2 mm. .... *Ligyrocoris diffusus* (Fig. C-16)
- 14'. Dorsal surface of body with fewer erect setae; all specimens examined slightly brachypterous with forewing not attaining apex of abdomen; corium color pattern more distinct, medial transverse band more evenly and darkly pigmented and more definite in shape, laterally broadly contacting costal margin; thoracic pleura with setae faintly yellowish and similar in color to those of ventral surface of head. Larger and of more uniform size, L = 5.5 to 6.5 mm..... *Ligyrocoris sylvestris* (Fig. C-17)
- 15(5). Dorsal surface of body with coarse, closely spaced punctures, punctures bearing suberect pale brown setae of similar length, interspaces between punctures of pronotum shiny, lightly reticulate, less so on scutellum and wings; ventral surface of head and thorax coarsely punctate and bearing dense appressed setae; profemur lacking distinct ventral spines, but with a row of 3 to 6 elongate, erect setae on low tubercles on both anterior and posterior margins of ventral surface; body ovate, widest at about middle of abdomen..... (Tribe Stygnocorini) *Stygnocoris*, 16
- 15'. Dorsal surface mainly dull, punctures small, but if coarse punctures present these are distributed unevenly; profemur with one or more distinct cuticular projections along anterior-ventral margin, these may be simple cuticular teeth or each may bear a stout articulated seta; body form various, most more parallel. .... 17
- 16(15). Head, pronotum and scutellum black or almost so, forewings dark reddish brown to piceous with lateral margins narrowly pale, legs fuscous; pronotum and dorsum rather dull; pronotum with hind angles clearly produced posteriorly, hind margin of pronotum shallowly and broadly concave; brachypterous individuals predominate. Larger, L = 3.1 to 4.1 mm. .... *Stygnocoris rusticus* (Fig. C-18)
- 16'. Head and anterior lobe of pronotum black, posterior lobe of pronotum and scutellum paler, dark rufous to piceous, wings dark rufous and faintly patterned, legs pale; pronotum and dorsum shining; pronotum with hind margin almost truncate; macropterous. Smaller, L = 2.6 to 3.3 mm. .... *Stygnocoris sabulosus* (Fig. C-19)

- 17(15). Abdomen sternum 4 with the two lateral trichobothria situated within the anterolateral extension of the segment and clearly closer to each other than the posterior-most trichobothrium is to the hind margin of the segment (Fig. 11, *Eremocoris*); pronotum with transverse constriction between anterior and posterior lobes evident, especially laterally where lateral margin is widened as a shelf across the emargination. .... (Tribe Drymini), 18
- 17'. Abdomen sternum 4 with the two lateral trichobothria well separated and the posterior one closer to the hind margin of the segment than to the anterior trichobothrium (Fig. 11, *Peritrechus*); pronotum not or less distinctly impressed between anterior and posterior lobes, lateral carina of more or less even width and either narrow or broad and shelf-like throughout its length. .... 24
- 18(17). Head, pronotum and scutellum reddish brown to chestnut or almost piceous, hemelytron pale brown basally, distal portion and membrane infuscate; dorsal surface glabrous, punctation distinct, especially coarse on basal lobe of pronotum and apical portion of scutellum; body subshiny to shiny, especially interspaces of pronotum; pronotum lateral margins slightly concave medially in dorsal aspect. .... *Drymus unus* (Fig. C-20)
- 18'. Without above combination of characters. .... 19
- 19(18). Smaller species, L less than 4.0 mm; dorsal surface of body with only short, inconspicuous setae; antenna stouter, segment 1 extending beyond clypeus by less than one half its length; bucculae shorter, extending posteriorly to about level of mid point of eye then enclosing a broadly rounded gular area.... *Scolopostethus*, 20
- 19'. Larger species, L = 4.5 mm or more; dorsal surface of body with numerous elongate pale setae; antenna elongate, segment 1 extending beyond apex of clypeus by at least half its length; bucculae elongate, extending to or almost to back of head and enclosing a narrowly pointed gular space. .... *Eremocoris*, 21
- 20(19). Fore femora anterior-ventral margin with minute spines both proximally and distally to the larger subapical spine, posterior-ventral margin with small spines on apical half (best developed in males); clavus with three rows of punctures; membrane of hemelytra pale with fuscous veins and at most a weak spot laterally. .... *Scolopostethus thomsoni* (Fig. C-21)
- 20'. Fore femora anterior-ventral margin with minute spines only distally to the larger spine, posterior-ventral margin without small spines; clavus with four rows of punctures, with middle two rows coalescing near base; membrane of hemelytra dark brown with conspicuous round white spot laterally. .... *Scolopostethus diffidens* (Fig. C-22)
- 21(19). Hind tibia with long, erect setae at right angles to both inner and outer surfaces; dorsal surface of body conspicuously bristly with erect, elongate setae. .... 22
- 21'. Hind tibia lacking such elongate setae; dorsal surface of body not conspicuously bristly, either with short, somewhat sparse erect setae or setae sparse and appressed and inconspicuous. .... 23
- 22(21). Fore femur with two larger spines; hemelytra with clavus and corium uniform dark brown; antenna and legs dark brown. .... *Eremocoris setosus* (Fig. C-23)
- 22'. Fore femur with one large spine; hemelytra not uniform dark brown, clavus and basal portion of corium distinctly paler; antenna and legs not uniform dark brown. .... *Eremocoris ferus* (Fig. C-24)
- 23(21). Corium appearing glabrous with setae very short and appressed and inconspicuous; wing membrane with basal pale spot shorter and more rounded; apical two-thirds of corium with darker mottling less conspicuous and overall color more uniform; slightly smaller on average, L = 4.6 to 5.5 mm. .... *Eremocoris obscurus* (Fig. C-25)
- 23'. Corium with short, semi-erect setae, most prominently on basal half; wing membrane with pale spot tending to be longer and relatively narrower so appearing more transverse; apical two-thirds of corium with dark brown mottling more conspicuous and color less uniform; larger on average, L = 4.7 to 6.6 mm. .... *Eremocoris borealis* (Fig. C-26)

- 24(17). Frons with a deep excavation or fold mesad to posterior inner angle of eye, ocellus situated on hind margin of excavation; body with abundant long, erect setae and dense appressed setae; head, pronotum and scutellum black, hemelytra mottled brown-testaceous; L = 4.0 to 5.0 mm L/W = 2.58 to 2.87. ....  
 ..... (Tribe Megalonotini, in part) *Megalonotus sabulicola* (Thomson) (Fig. C-27)
- 24'. Frons not impressed mesad to inner hind angle of eye, ocellus not situated in a depression; body glabrous dorsally or if setose, without combination of dense appressed setae and conspicuous erect bristles. .... 25
- 25(24). Head, pronotum and scutellum uniformly black or at most some specimens with posterior and lateral margins of pronotum diffusely paler, but without distinct spots..... (tribe Gonianotini, in part), 26
- 25'. Head, pronotum and scutellum not uniformly black, with distinct pale areas present at least on posterior lobe of pronotum..... 28
- 26(25). Smaller, L = 4.4 to 5.4 mm, narrower, L/W = 2.8 to 3.7; dorsal surface with setae absent to short and inconspicuous; head and pronotum black, hemelytra strikingly bicolored; ocelli small and inconspicuous. ....  
 ..... *Malezonotus*, 27
- 26'. Larger, L = 5.9 to 6.4 mm, broader, L/W = 2.3 to 2.4; dorsal surface conspicuously setose; entire dorsal surface black or with base and lateral portions of hemelytra vaguely rufescent; ocelli normal.....  
 ..... *Atrazonotus umbrosus* (Fig. C-28)
- 27(26). Pronotum longer than scutellum, length pronotum/length of scutellum = 1.25 to 1.33; body apparently glabrous dorsally, setae very small and sparse; body mainly black, pronotum with anterior lobe shiny black, posterior lobe matte black; scutellum shiny black anteriorly, matte black posteriorly; wings strikingly bicolored with claval suture, sublateral margin basally and base of membrane white; body narrow, subparallel; ocelli very small and inconspicuous. .... *Malezonotus angustatus* (Fig. C-29)
- 27'. Pronotum subequal in length to scutellum, length pronotum/length of scutellum = 0.97 to 1.08; dorsal surface with setae short and appressed but evident; pronotum and scutellum with a more or less uniform black sheen; wings with basal half of corium pale; apex of corium convexly curved; body broader and more arcuate laterally; ocelli small but evident. .... *Malezonotus arcuatus* (Fig. C-30)
- 28(25). Head dark reddish to light piceous, never black; remainder of body ivory and light reddish-brown with lateral margins, veins and punctures dark brown to piceous; pronotum with lateral margins broad and reflexed. ....  
 ..... (tribe Rhyparochromini, in part), *Uhleriola floralis* (Fig. C-31)
- 28'. Head black, black with pale spots, or if pale with conspicuous infuscate punctures; body color not as above; pronotum lateral margins various, narrow to broadly explanate, but not reflexed upwards. .... 29
- 29(28). Pronotum with lateral margin very wide and shelf-like, at middle of anterior lobe about as wide as middle width of antennal segment 3, margin pale with dark spots. .... 30
- 29'. Pronotum with lateral margin much narrower, at middle of anterior lobe one half or less width of medial width of antennal segment 3, unicolorous or not distinctly spotted..... 31
- 30(29). Pronotum lateral margin spotted, but without row of conspicuous stiff, erect bristles; head pale with infuscate punctures, infuscation may be variously expanded to make regions of the head black, remainder of body straw-yellow to pale brown with numerous dark spots, spots may be irregularly confluent, but not producing a well defined black median area on anterior lobe of pronotum; body broad, dorsally flattened. ....  
 ..... (Tribe Gonianotini, in part), *Emblethis vicarius* (Fig. C-32)
- 30'. Pronotum with lateral explanate margin with a row of black setiferous punctures each bearing a conspicuous erect black seta; head, anterior lobe of pronotum except anterior and lateral margins and scutellum basally and medially, black, remaining body pale brownish yellow with dark spots and irregularly expanded darker areas medially and apically on corium..... (Tribe Megalonotini, in part), *Sphragisticus nebulosus* (Fig. C-33)

- 31(29). Large, L = 6.5 to 8.3 mm. Head, anterior half of pronotum, scutellum and wing membrane (except for a small white mark at apex usually present), black; posterior lobe of pronotum white to pale yellow, narrowly fuscous across base, with dark punctures; hemelytra pale to yellowish-brown, with dark punctures and a large quadrate dark spot on inner apical angle of corium. ....  
 ..... (Tribe Rhyparochromini, in part), *Rhyparochromus vulgaris* (Fig. C-34)
- 31'. Smaller, L = 3.6 to 5.6 mm; color darker. .... 32
- 32(31). Color paler with more extensive pale pattern, scutellum with apical third largely pale, wing membrane only faintly infuscate or with fuscous mottling between veins; pronotum with lateral margin narrow, less than basal width of antennal segment 3; macropterous; body narrower, L/W = 2.38 to 2.79.....  
 .....(Tribe Rhyparochromini, in part), 33
- 32'. Color darker, pale spots smaller and less abundant, scutellum black, wing membrane darkly infuscate with contrasting pale veins; pronotum with lateral margin broader, subequal in width to basal width of antennal segment 3; wing dimorphic, but brachypterous specimens predominate; body broader, L/W = 2.13 to 2.33.....  
 .....(Tribe Gonianotini, in part), *Trapezonotus arenarius* (Fig. C-35)
- 33(32). Pronotum with lateral margin slightly convex, in dorsal aspect the lateral margin clearly visible throughout its length and often paler medially; femora of middle and hind legs entirely black; wing membrane with fuscous mottling on most specimens; antenna a little more robust. L= 4.1 to 5.6; body broader L/W = 2.38 to 2.60. ....  
 .....*Peritrechus convivus* (Fig. C-36)
- 33'. Pronotum appearing narrower and more triangular with lateral margin straight or usually very slightly concave, in dorsal aspect its lateral carina usually visible only medially and hidden anteriorly and posteriorly; femora of middle and hind legs with basal quarter to half pale and contrasting with black apex; wing membrane more evenly and lightly infuscate; antenna with outer segments slightly slenderer. L - 3.8 to 5.3 mm; body slightly narrower L/W = 2.44 to 2.79.....*Peritrechus fraternus* (Fig. C-37)

# *Plinthisus americanus* Van Duzee

AB SK MB CH PD PP

**Distribution:** 2. Nearctic, excluding Beringia. BC (Scudder 2008a) and AB to NB; New England states.

**Taxonomy:** Tribe Plinthisini. Sp v - 2,3,4,5,6,7.

Barber (1918) reviewed the taxonomy of the North American species of the genus. However, there are problems reconciling this work with the few prairie specimens we have seen. Barber used the claval suture as a primary character to separate species. The suture was stated to be present in both *P. compactus* (= *P. americanus*) and *P. indentatus*, the two species occurring on the prairies. However, amongst 4 prairie specimens examined it is present in a macropter, but absent from 3 brachypters suggesting it is related to wing development. Barber separated *P. americanus* from *P. indentatus* on the basis of the pronotal shape: in *P. americanus* said to be wider than long, anterior lobe not elevated, anterior angles behind eyes rounded; in *P. indentatus* subquadrate, anterior lobe swollen, anterior angles forming a distinct angle. Again, these are the differences we observe between the macropterous male and 3 brachypterous females. *Plinthisus indentatus* was described based on 2 brachypterous males and the diagnostic characters may not represent species differences.

Sweet (1964b) concluded that *P. compactus* sensu Barber was composite and that *P. compactus* occurred in NM whereas northern and eastern populations are a separate species with the name *P. americanus* being available. He separated the two species on the setae of the hemelytra: that of the female of *P. americanus* is densely pilose whereas in *P. compactus* it is glabrous.

A European species, *Plinthisus brevipennis* (Latreille), is established in BC and ON (Scudder 2007). It can be recognized

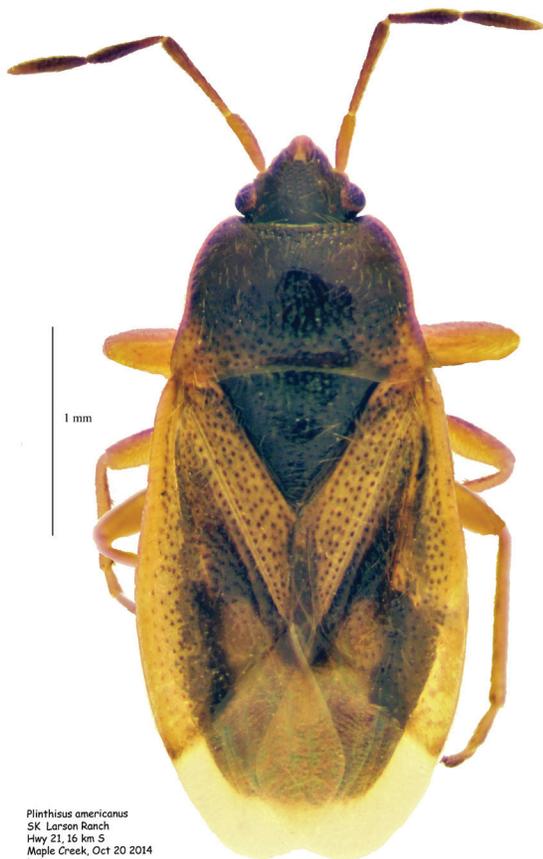


Fig. C-2. *Plinthisus americanus*.

by size,  $L = 2.45$  to  $3.2$  mm, and the fore femur width is equal to, or greater than, the width of the vertex.

**Measurements (n = 4):**  $L = 2.9$  to  $3.5$  mm;  $L/W = 2.16$  to  $2.40$ .

**Wing development:** Dimorphic,  $WL/AL$ : macropter (1 ♂) = 1.09; brachypters (3 ♀) = 0.77 to 0.83.

**Ecology:** Sweet (1964b: 59 - 61) described the biology. This is a forest species that occurs in leaf litter. In the ne US it is usually in forests of spruce, hemlock, fir, and birch, especially where the soil is cool and moist, but not wet, and the litter loose. In SK it has been taken in loose leaf litter of aspen/spruce forest as well as amongst leaves under river birch, aspen, willow and caragana. The long erect setae over much of the body and the very long trichobothrial setae of the abdomen suggest a species that lives in confined areas, but where there are open spaces such as in uncompacted leaf litter. Sweet observed feeding on the seeds of forest trees, but it is not known if the small seeds of aspen and willow are eaten.

The species is univoltine with eggs overwintering (Sweet 1964a). Eggs hatch rather late in the spring and adults are found in late summer to fall.

**Collecting:** The species is uncommon in collections indicating a general low density of occurrence, but also specimens are difficult to find amongst the dead leaves, even by sifting litter. They are small, colored like dry leaves and are slow to move so they are easily overlooked.

# *Plinthisus indentatus* Barber

SK

PD

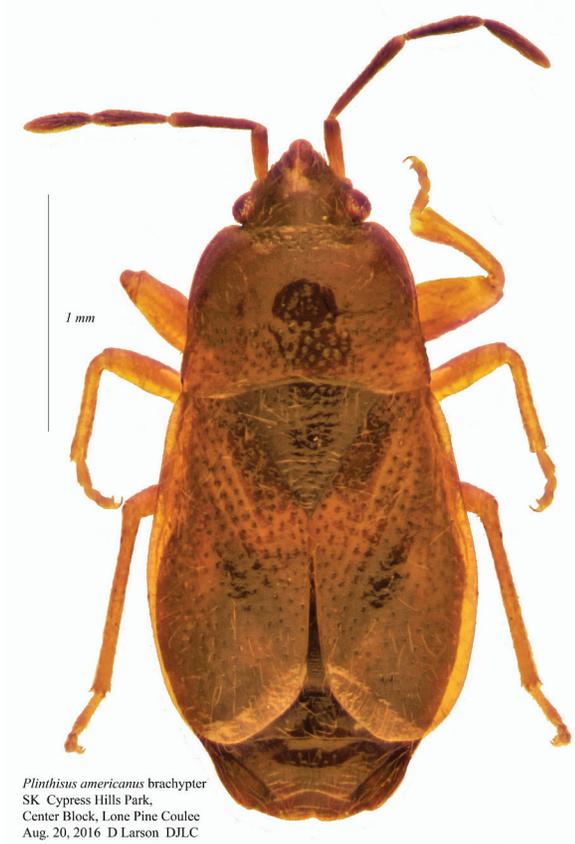


Fig. C-3. *Plinthisus indentatus*.

**Distribution:** 9. Great Plains-Prairies. Described from “Assiniboine, Montana” (= SK, holotype) and “Bear Paw, Mt. Montana”.

**Taxonomy:** See discussion under *P. americanus*. It is possible the 3 brachypterous females belong to this species and the macropterous male belongs to *P. americanus*. We suspect the differences are related to wing development and that *P. indentatus* is a junior synonym of *P. americanus*. However, it will take more specimens and ideally some rearing and breeding studies to sort out species differences from wing morph differences.

**Measurements (n = 2 type specimens):** L = 3.0 and 3.5 mm.

**Wing development:** The type specimens are brachypterous.

**Ecology:** Not known, presumably similar to *P. americanus*.

**Collecting:** As above, found amongst deciduous leaf litter.

## *Antillocoris minutus* (Bergroth)

MB

BP



*Antillocoris minutus* (Bergroth)  
 QUE Gatineau Pk.  
 5.X.1969 L. Masner  
 CNC 461169

Fig. C-3. *Antillocoris minutus*.

**Distribution:** 6. Eastern Nearctic. E Canada, MB (Scudder 2008a) to NL and NS; northeastern US, ME to NC, west to NE and TX.

**Taxonomy:** Tribe Antillocorini. Sp v – 2,3,4,5,6,7.

This is the only member of the tribe Antillocorini present on the prairies and as such has several unique features, namely: the bucculae are elongate and meet well behind the labium, forming a distinct gular area; the posterior of the head dorsally is without iridescent areas; abdomen dorsally with inner laterotergites (Ashlock 1964) and ventrally with the trichobothria linearly arranged on all sterna, on sternum 5 arranged such that the middle and posterior trichobothria are posterior on the segment and almost touching (Sweet 1967, Schuh and Slater 1995).

Two of the four North American species occur in eastern Canada: *A. minutus*, having the most northerly distribution, has shorter more even length setae and has longer wings; *A. pilosulus* (Stål), occurring from southern ON, QC and New England south to FL and TX, has longer setae especially on scutellum and corium and is usually brachypterous.

**Measurements (n = 2):** L = 1.9, 2.1 mm; L/W = 2.39, 2.48.

**Wing Development:** Reported to be macropterous, but some specimens show reduction in the membrane. WL/AL = 0.88 to 1.06.

**Ecology:** Sweet (1964b) described the biology in New England stating the species usually occurs in forest litter, most frequently beneath birch, but also under hemlock and maple and in sphagnum bogs. Barber (1923) and Blatchley (1926) mentioned the species as occurring in damp situations and

near stream and pond margins. Specimens have been collected by sweeping vegetation in forests.

The species is univoltine with overwintering by diapausing adults.

The single specimen known from the Prairie Provinces is a female collected in a pitfall trap at St. Charles Rifle Range, Winnipeg, MB (6-13. X.1999 (UM)). This is a small tall-grass prairie remnant within the city limits of Winnipeg (Shorthouse 2010).

**Collecting:** This little species is very easy to overlook in its habitat of forest litter. Seemingly suitable habitat occurs in a broad swath across the southern boreal ecozone of the Prairie Provinces and it would be interesting to carefully sift birch litter and extract the insects in a Berlese funnel to see if specimens could be found from a wider area.

# *Neosuris castanea* Barber

SK

CH PD



*Antillocooris minutus* (Berg.)  
SK Lareson Ranch, 16 km  
S Maple Creek July 30, 2003  
D. Larson  
L = 2.2 mm

Fig. C-5. *Neosuris castanea*.

needle grass, club moss and moss phlox. Scudder (1993) reported collecting specimens in pitfall traps in the arid antelope-bush, triple-awned grass and sage plant communities of the Osoyoos area of BC. Adults have been collected in early spring after the ground thawed (April 12 to May 2), but a specimen was also taken July 30. Adults apparently overwinter and there is probably only one spring generation before this habitat dries out in mid-summer.

**Collecting:** These insects are quite difficult to collect. They occupy a Lilliputian world of scattered dry, stiff plants and loose sandy clay soil. Other insect associates are the tiniest specimens of chinch bugs (*Blissus canadensis*), *Geocoris atricolor*, minute ground beetles (*Microlestes curtippennis*), lady beetles (*Diomus debilis*), and fungus beetles (*Arthrolips decolor*) and tiny ants (*Temnothorax*). The insects must be flushed from the base of clumps of grasses by lightly scraping the soil surface then caught as they scurry to other cover. Their small size, speed and rather delicate bodies (at least to grasping fingers or forceps) make getting good specimens difficult. A hillside that yielded a few specimens in early spring when the soil was weathered and loose, later in the year had no specimens after heavy rain had compacted the soil and the clay dried and hardened into a solid crust. Sweet (1977b) speculated that a porous soil was probably important to these insects.

**Distribution:** 8. Western Cordilleran, excluding Beringia. Widely distributed in arid and semiarid portions of western North America from BC and SK (Scudder 1993, 2010) to AZ, CA, TX and Mexico (Sweet 1977b).

**Taxonomy:** Tribe Udeocorini. Sp v - 5,6,7.

This is the only member of the tribe Udeocorini on the prairies. Unlike members of the tribe Myodochini which lack inner laterotergites, the latter are present in the Udeocorini (Sweet 1967, Schuh and Slater 1995).

The species is known to vary considerably in color from largely yellow to brown to dark brown or almost black, but much of this is intrapopulation variation and the different colored individuals interbreed (Sweet 1977b). Size may vary geographically for the smallest prairie specimens are smaller than those reported elsewhere (2.0 to 2.5 mm). A second species, *N. fulgida* (Barber) occurs in AZ and CA.

**Measurements (n = 10):** L = 1.8 to 2.4 mm ( $\sigma$  = 1.8 to 2.2 mm;  $\text{♀}$  = 2.1 to 2.4 mm); L/W = 2.38 to 2.76 ( $\sigma$  = 2.40 to 2.76;  $\text{♀}$  = 2.38 to 2.50).

**Wing development:** All Canadian specimens seen are brachypterous and the fore wing is elytron-like, that is it is not subdivided into distinct claval, corial and apical membranous sections. WL/AL = 0.57 to 0.71. Sweet (1977b) reported the occurrence of rare macropterous individuals in southwestern US.

**Ecology:** Collected from dry south-facing hillsides and sparsely vegetated dry grasslands where the principal vegetation consists of short grasses such as blue grama, prairie muhly, needle grass, club moss and moss phlox.

## *Mydocha serripes* Olivier



Fig. C-6. *Mydocha serripes*.

**Distribution:** 6. Eastern Nearctic. No records from Prairie Provinces. Eastern Canada, ON and QC; eastern US, ME to FL, west to NE, CO, TX and NM.

**Taxonomy:** Tribe Mydochini Sp v - 5,6,7.

The very elongate head is unique to this species over most of eastern US, except a similar species, *M. annulicornis* Blatchley, replaces it in FL. Other species of the genus occur in Central and South America. This is a species of eastern US, mainly east of the Great Plains, in the south extending west to CO and NM. Blatchley (1926) noted the species becomes less common towards the northern limits of its range. The only Canadian records are from southern ON and QC although records from MN and MI suggest a possibility of occurrence in southeastern MB. The species flies readily and is somewhat migratory, so long-distance dispersal is a possibility.

**Measurements:** L = 8.0 to 9.5 mm (Blatchley 1926).

**Wing Development:** Macropterous

**Ecology:** Several earlier authors suggested the long “neck” was an adaptation allowing the insect to search for prey in crevices. However, Sweet (1964b) found the species to feed on seeds of a variety of plants, but not generally grasses. Adults, in reproductive diapause, overwinter in leaf-litter in forest edges. In spring they move into breeding sites which are open areas relatively recently covered by forbs and with light litter.

**Collecting:** Reported as being common at light, especially during late summer and fall when individuals are moving to hibernation sites. Lives on the ground surface so is not usually taken by sweeping.

## *Sisamnes claviger* (Uhler)



*Sisamnes claviger* (Uhler)  
SK Larson Ranch, Hwy 21  
16 km S Maple Creek  
May 10, 2008 D. Larson  
L = 2.7 mm

Fig. C-7. *Sisamnes claviger*.

dense, weedy vegetation of upper beaches of lakes. Scudder (1993) has found it to be abundant in the antelope-brush/sagebrush communities in the south Okanagan of BC.

Adults overwinter, but Sweet found diapause to be facultative so there can be two generations per year. Sweet reared adults in the lab on sunflower seeds, but they also readily took little bluestem grass seeds as well as those of St. John's wort and cinquefoil.

**Collecting:** These are cryptically colored and slow moving so they can be quite a challenge to find. Most specimens have been found by sifting the litter and soil surface layers in patches of grass. A few specimens have been found clinging to the underside of boards lying on grass.

SK

CH PD

**Distribution:** 2. Nearctic, excluding Beringia. Canadian records are from BC and SK. It occurs in eastern US from NY to NC and in the west from WA, OR, CA, NM and TX.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

The swollen terminal segments of the antennae are unmistakable making the species easily recognizable in the field. Two additional species of *Sisamnes* occur in the southernmost US, Central America and Brazil. Sweet (1964b) observed that the peculiar scale-like setae melt when heated and are therefore wax extrusions. The setae on segment 4 of the antenna are unusual in that they consist of rather dense, somewhat decumbent setae and sparser erect setae, the decumbent setae are dark on the basal half, but pale on the apical half giving the antenna a two-tone appearance.

**Measurements (n = 22):** L = 2.2 to 3.0 mm ( $\sigma$  = 2.2 to 2.7 mm;  $\text{♀}$  = 2.5 to 3.0 mm); L/W = 2.14 to 2.58 ( $\sigma$  = 2.14 to 2.58;  $\text{♀}$  = 2.27 to 2.56).

**Wing development:** Dimorphic. WL/AL: macropters = 0.95 to 1.04; brachypters = 0.62 to 0.71. The abundance of the two morphs seems about equal in females, but brachyptery dominates in males.

**Ecology:** Sweet (1964b: 41-46) found the species to be uncommon in the northeastern US, occurring where the soil was sandy and dry and vegetation sparse and moisture limited. In the prairies it is more widely distributed and at least in the dry grasslands area occurs in more mesic sites such as hay fields, road allowances and ruderal sites with such plants as smooth brome, timothy and sweet clover. It has also been found in

## *Kolenetrus plenus* (Distant)

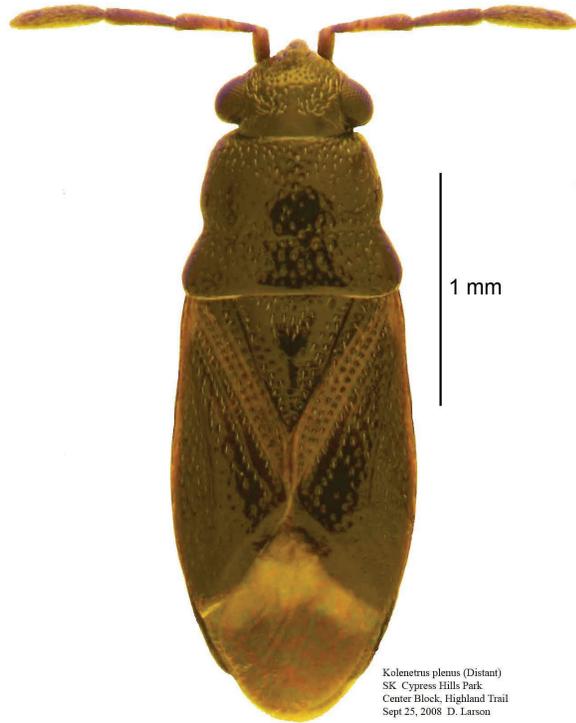


Fig. C-8. *Kolenetrus plenus*.

and (Scudder 1997) in pitfall traps on south-facing sage slopes in YT. Sweet did not collect adults after Sept. 1 whereas adult Prairie specimens have been collected from Aug. 14 to Oct. 2, most in September. Sweet was not able to make a definite statement on the life history for a univoltine life cycle with either adult or egg overwintering were possible although he favored the interpretation of an obligate egg diapause. Our lack of spring and early summer collection of adults favours egg overwintering.

**Collecting:** Most specimens were collected by sweeping vegetation. Such sweeping usually produces only the occasional specimen, but short series have been collected from flowering sagebrush, broomweed and goldenrod.

AB SK CH PD PM PP BP

**Distribution:** 10. Nearctic-Neotropical. BC and YT to QC; in eastern US, New England to NC, in the west south to UT, AZ and Guatemala.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

The genus contains a single species, but Sweet (1964a) noted that specimens from different areas varied in color and punctuation and raised the possibility that a complex of geographically separated species may be involved.

**Measurements (n = 20):** L = 2.5 to 3.1 mm (♂ = 2.5 to 2.7 mm; ♀ = 2.8 to 3.1 mm); L/W = 2.50 to 2.88.

**Wing development:** WL/AL = 0.82 to 1.00 with two major groups: brachypterous - 0.82 to 0.93; macropterous - 0.96 to 1.00. Sweet (1964b) observed variation in wing length which he found was sexual with females macropterous and males submacropterous and both types capable of flight. This is not the case in prairie populations as both sexes have long and short-winged individuals.

**Ecology:** Sweet (1964b: 54 - 58) stated "The essential requirements of this species would appear to be xeric habitat which is cool and partly shaded, as an old field ecotone". We have collected specimens from varied habitats including mixed grasslands with sagebrush, a blueberry patch adjacent to lodgepole pine forest, meadow adjacent to aspen stands and from moist draws in grasslands. Scudder (1993) collected specimens among tufts of rushes at the edge of ponds in southern BC grasslands

## *Pseudocnemodus canadensis* (Provancher)



Fig. C-9. *Pseudocnemodus canadensis*.

late hatching eggs produce adults laying diapausing eggs and are thus univoltine.

**Collecting:** There are no records from the Prairie Provinces, but the southern boreal zone would seem to offer suitable habitat.

**Distribution:** This species is known in Canada from BC, ON and QC and in the US from New England to NC and west to KS, NE and SD. There are no records from the Prairie Provinces.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

The stridulatory organ comprised of the prosternal file and the profemur plectrum has been described by Ashlock and Lattin (1963) and its potential use in courtship by Sweet (1964b).

**Measurements (n = 2):** L ♂ = 6.5 mm; ♀ = 5.6 mm; L/W ♂ = 3.52; ♀ = 3.38.

**Wing development:** Most specimens are brachypterous, but a few macropters occur in most populations and macropters in lake drift have been reported. WL/AL of 2 brachypterous specimens = 0.70, 0.74.

**Ecology:** Sweet (1964b) described the New England habitat as dry, over-drained slopes which have sparse, but usually complete ground cover. Specimens occur especially on dry edge habitats between forest and old fields, areas that tend to be dominated by low, bunch-forming grasses such as fescue, bluestem and three-awn as well as in open patches of low blueberry. The insects feed readily on seeds of a variety of plants, but especially fescue and blueberry.

The insect is alert and rapid-moving and has an ant-like appearance and behaviour.

Overwintering is as a diapausing egg. However, egg hatch is very staggered over time and early developing adults may lay non-diapausing eggs so that a second generation is produced,

## *Perigenes constrictus* (Say)



Fig. C-10. *Perigenes constrictus*.

The species overwinters as an egg with two generations a year in New England.

**Collecting:** We have not collected the species, but apparently one must search the ground rather than depending upon sweeping.

SK

PD

**Distribution:** 2. Nearctic, excluding Beringia. Recorded from SK (Big Beaver, Scudder 2008a) and eastern Canada, ON, QC and NS. Recorded from most US states east of Rocky Mountains, including states bordering the Prairie Provinces (ND, MI).

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

Specimens are similar to those of *Zeridoneus costalis*, but larger, more robust, and much more densely setose. The spines on the ventral surface of the profemur are variable, but generally there is a single large spine subapically and several smaller ones.

**Measurements (n = 2):** L ♂ = 7.0 mm; ♀ = 7.7 mm; L/W = 2.84 to 2.93.

**Wing development:** Macropterous, WL/AL = 0.95 to 0.98.

**Ecology:** There is only one prairie record of the species. Sweet (1964b: 8 - 11) described the habitat as follows: "*P. constrictus* is typically collected in exposed, level ruderal habitats in vacant lots, roadsides, and newly fallow fields. In general, it is found ... in a community of rank forbs and grasses such as bluestem grass, lambs quarters, Canada fleabane, and common ragweed. The herb layer is usually two to three feet in depth. The ground biotype is shaded from direct sunlight by the field layer, and little litter is present on the ground. The soil is usually loam or sandy loam, moderately dry, and the soil temperatures moderate. Only once was the species swept from low ruderal forbs." Wheeler (2013) described its association with poverty-weed in Nebraska salt marshes.

## *Zeridoneus costalis* (Van Duzee)



*Zeridoneus costalis* (Van Duzee)  
SK 6 km N 9 km E  
Maple Creek Sept. 12, 2008  
D. Larson  
L = 7.2 mm

Fig. C-11. *Zeridoneus costalis*.

AB SK MB CH PD PM PP

**Distribution:** 2. Nearctic, excluding Beringia. Canadian distribution extends from BC to QC and in the US in Dakotas, midwest states and New England to NC.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

The species is easily recognized by its large size and slender shape. It is similar to species of *Ligyrocoris*, but its color tends to be darker with less contrasting pattern, and it is macropterous and lacks the abdominal stridulatory area. *Perigenes constrictus* is similar, but larger (L = 7.5 to 9.0 mm), more robust, darker, and strongly setose.

**Measurements (n = 22):** L = 5.5 to 7.5 mm ( $\sigma$  = 6.0 to 6.4 mm;  $\text{♀}$  = 5.5 to 7.5 mm); L/W = 3.22 to 3.60 ( $\sigma$  = 3.37 to 3.42;  $\text{♀}$  = 3.22 to 3.60); pronotum W/L = 1.12 to 1.22.

**Wing development:** WL/AL = 0.92 to 1.02. Specimens collected in lake drift tend to have longer wings (WL/AL = .99 to 1.02) than specimens collected elsewhere (0.92 to 1.02).

**Ecology:** This is a species of grasslands, but at least in short-grass and mixed prairies it generally occurs in moister sites such as along draws, coulee bottoms, aspen bluff edges, etc. where there is a mixture of herbs and grasses. It has also been found in disturbed sites such as along road allowances where vegetation is more luxuriant, but patchier than adjacent grassland.

Sweet (1964b: 2 - 8) reported feeding on seeds of a variety of plants, but especially sedges, cinquefoil and Rudbeckia and that it is readily reared on sunflower seeds. Although it is often collected in areas with goldenrod, Sweet observed it does not feed on goldenrod seed.

Sweet described the life history as bivoltine with egg diapause.

**Collecting:** Most specimens have been collected by sweeping shrubs and herbaceous vegetation.

## *Zeridoneus petersoni* Reichert

AB SK MB MC PD PM PP



Fig. C-12. *Zeridoneus petersoni*.

**Distribution:** 9. Great Plains-Prairies. AB, SK and MB (Scudder 2009, 2014b). UT.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

Specimens have been collected from goldenrod flowers, in association with specimens of *Slaterobius insignis*, *Ligyrocoris diffusus* and *L. sylvestris*. The members of this assemblage of species are similar in size, body form and color so that recognition of specimens *Z. petersoni* in the field is often problematical, although they tend to be more brightly colored than the others. Under the microscope, the lack of a stridulatory organ on the basal abdominal segments allows easy recognition of specimens of *Z. petersoni*.

**Measurements (n = 3):** L = 5.9 to 6.3 mm (Reichert 1966: L = 5.2 to 6.4 mm); L/W = 3.40 to 3.56; pronotum W/L = 1.21 to 1.35.

**Wing development:** WL/AL = 0.87 to 0.96. Wings slightly shorter than abdomen, extending to about base of genital segment.

**Ecology:** The type specimens were collected by sweeping in dense weed growth along Bear Lake in northern UT (Reichert 1966). The species apparently occurs in moister grasslands than *Z. costalis* for most records are from PM and PP, the MC record is Canmore, AB, an area where grasslands and forest

interdigitate. A collection from DP was from along the bottom of a moist coulee where buckbrush, Canada thistle, Canadian goldenrod, nettle and asters were abundant. CH would appear to offer suitable habitat, but there are no records to date.

Adult specimens have been collected in August and September, so the life history is probably univoltine with egg diapause.

**Collecting:** The two collections we have made of this species have been by sweeping flowers of Canadian goldenrod.

# *Slaterobius insignis* (Uhler)

AB SK MB CH PD PM PP BP BS

**Distribution:** 1. Nearctic, including Beringia. AK and across Canada from YT, NT and BC to NL. Northern US to CA, CO, NE and NY.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

Highly varied in size and color, but this variation is mostly individual as the range of variation occurs within populations of even small geographic areas.

**Measurements (n = 20):** L = 3.6 to 6.4 mm (♂ = 4.0 to 5.2 mm; ♀ = 3.6 to 6.4 mm); L/W = 3.07 to 3.75 (♂ = 3.33 to 3.60; ♀ = 3.07 to 3.75).

**Wing development:** WL/AL = 0.73 to 1.08; wing dimorphic: macropters = 0.92 to 1.08; brachypters = 0.73 to 0.79. Six specimens from lake drift have wing ratios 0.92 to 1.08 indicating the macropters can fly. Brachypters predominate in most collections (Table C-1).

**Ecology:** This insect is a very convincing ant mimic with its long, slender legs, large head and narrow prothorax. Even its variation in size and color corresponds to that of *Formica obscuripes*, a conspicuous and common ant of the dry grasslands. Workers of these ants vary in length from 3.25 to 7.5 mm and in color from all black to having the head and thorax variously reddish to brownish (Wheeler & Wheeler 1963). Several authors have discussed an active association with ants, but Sweet (1964b) put things in perspective by saying any insect living in the environment these bugs do will inevitably be in proximity to ants.

The insects occur in sun-exposed, well drained areas where the vegetation is patchy with open, bare ground. This can be in forest glades, along roadside, upper beaches, old fields or on short, mixed prairie. In YT specimens were found on south-facing sage slopes and on sand dunes (Scudder 1997).

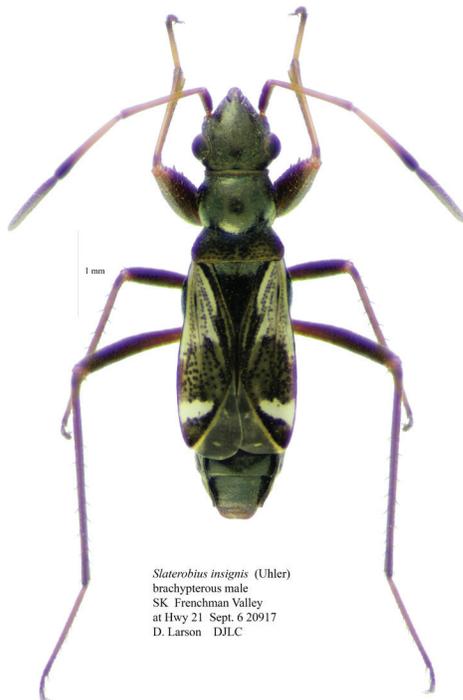
Sweet (1964b: 12 - 14., as *Sphaerobius insignis*) described the life history as bivoltine with facultative egg diapause. Most adult specimens have been collected from July to September, but we have collected adults from lake drift as early as May 26 and June 12, suggesting some adults overwinter. Small nymphs have been found on a sun-warmed south facing coulee slope in mid-April. The insects feed on grass seeds (little bluestem, millet) and in the lab on sunflower seeds. Paiero et al. (2010) noted an association with *Andropogon* in southern ON. Mixed groups of nymphs and adults have been found several times in clumps of crested wheat grass in disturbed sites and old pastures.

**Collecting:** The bright color pattern of the wings both contributes to the ant-like appearance as well as serving to break up the outline of the body. When running across the ground they have a very ethereal appearance and can be difficult to pin down and capture. The best way to catch them is to snatch a handful of soil from the general area where a specimen has



*Slaterobius insignis* Uhler  
SK 6 km N, 9 km E  
Maple Creek, sandy road  
allowance, Sept. 12, 2008  
D. Larson  
L = 5.2 mm

Fig. C-13. *Slaterobius insignis*, macropter.



*Slaterobius insignis* (Uhler)  
brachypterous male  
SK Frenchman Valley  
at Hwy 21 Sept. 6 20917  
D. Larson DJLC

Fig. C-14. *Slaterobius insignis*, brachypter.

*Slaterobius insignis* (Uhler) (continued)Fig. C-15. *Slaterobius insignis*, female, lateral aspect.

been seen running and throwing it into a deep pan where, if the grab successfully caught the bug, it is confined and can eventually be captured. These bugs are often gregarious so that when discovered, the group explodes off in all directions further confusing pursuit. Although found mainly on the ground, specimens have been collected in late summer and fall by sweeping broomweed and gumweed. A long series of specimens collected in pitfall traps in Grasslands National Park had males outnumbering females 4 to 1 (Table C-1). We have seen no evidence of an unequal sex ratio in the species and these results are probably due to a sex bias in the collecting method – perhaps males are more active.

Table C-1. Sex and wing morph frequencies in pitfall trapped *Slaterobius insignis*, West Block Grasslands Park, SK, July 1996 (A.T. Finnamore, PMAE).

	macropterous	brachypterous	total
male	37	135	172 (80%)
female	9	33	42 (20 %)
	46 (21 %)	168 (79 %)	214 (100 %)

## *Ligyrocoris diffusus* (Uhler)



Fig. C-16. *Ligyrocoris diffusus*.

AB SK MB CH PD PM PP BP BS

**Distribution:** 1. Nearctic, including Beringia. Transcontinental in Canada, from YT, NT and BC to NL. Throughout much of the US except the southeast.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

Sweet (1964a) noted the species shows some variation in size and color over its wide range and there may be justification for future separation into subspecies. In New England, males are smaller (L = 4.0 to 6.2 mm) than females (L = 6.0 to 8.3 mm) and both are larger than prairie specimens (measurements given below).

*L. diffusus* is generally bristlier than *L. sylvestris*, but this character is variable and there are many specimens that are ambiguous. Macroscopically *L. diffusus* specimens tend to be duller with less distinct wing pattern and series of specimens can be separated fairly easily on color. Although tending to have different habitats both species are sometimes found together.

Sweet (1963, 1986) provided keys to the eastern North American species of *Ligyrocoris*. In addition to the long setae of the dorsum of the body he stated the labium of *L. diffusus* is longer, extending to the metacoxae or abdomen, and femora with many setae, these longer than width of tibia. *Ligyrocoris sylvestris* has a shorter labium, extending only to the mesocoxae, and femora with few setae and these shorter than width of tibia.

**Measurements (n = 20):** L = 4.1 to 6.1 mm ( $\sigma$  = 4.1 to 4.6 mm;

$\text{♀}$  = 4.4 to 6.1 mm); L/W = 2.82 to 3.21 ( $\sigma$  = 3.06 to 3.21;  $\text{♀}$  = 2.82 to 3.20).

**Wing development:** WL/AL = 0.95 to 1.02. Macropterous, lower values for some females but females also show the full range of values. A specimen was collected in lake drift June 12 (SK, Harris Reservoir, WL/AL = 1.00).

**Ecology:** Sweet (1964a: 103-113) described the habitat in New England as “open disturbed habitats, roadsides, as well as old fields with many forbs present, especially composites”, and that it prefers the seeds of certain composites such as oxeye daisy, goldenrod, tansy and especially Rudbeckia and will congregate on ripe seed heads. He noted that sweep net collections led to a different conclusion regarding population density from what is obtained from ground searches. The best ground habitats are relatively open, unshaded sites on level exposed areas and in general the population density decreases as the herbaceous level becomes denser and shades the ground. The greatest densities occur in sites which are in early pioneer stages of vegetation succession. Regarding feeding habits, Sweet concluded it is oligophagous on seeds, especially of the Asteraceae, even though in the lab it was found to take a wide variety of seeds.

Prairie specimens have been collected by sweeping in mixed grasslands, both on dry prairie as well as moister sites such as draws, stream bottoms, slough edges, etc., especially where composites such as aster and goldenrod are abundant amongst the grasses. Specimens have frequently been found along road allowances, old disused gravel pits and other ruderal sites, and upper reservoir beaches.

Sweet found New England populations to overwinter in the egg stage and have two generations per year.

**Collecting:** This is one of the most commonly collected species when sweeping herbaceous vegetation.

## *Ligyrocoris sylvestris* (Linnaeus)

AB SK MB MC CH PD PM PP BP BS TP

**Distribution:** 11. Holarctic. Boreal in North America from AK and BC to NL. Across the northern US south to SC, SD and along the western Mountains to CO and UT.

**Taxonomy:** Tribe Myodochini. Sp v - 5,6,7.

Separation of specimens of *L. diffusus* and *L. sylvestris* is discussed under *L. diffusus*. We have not noted the relatively small males in this species, such as occurs in *L. diffusus*, but the specimens examined have been predominantly females.

**Measurements (n = 20):** L = 5.5 to 6.4 mm (♂ = 5.5 to 5.7 mm; ♀ = 5.5 to 6.4 mm); L/W = 3.15 to 3.52 (♂ = 3.21 to 3.52; ♀ = 3.15 to 3.45).

**Wing development:** WL/AL = 0.81 to 0.95. Wings slightly shorter than abdomen, with 80% of specimens 0.90 or less.

**Ecology:** Sweet (1964a: 117 - 120) described the habitat of New England populations as cool, mesic and semishaded areas along north exposed ecotones between meadows or bogs and woodlands with the insects occurring in the meadows and not in closed canopy forest. Some associated plants include fescue, sedges, aster, and goldenrod. Scudder (1997) collected YT specimens from alder, birch, root mats of Jacob's-ladder, on south-facing sage slopes and in pitfall traps along a shoreline. We have also found this species tends to occur in cooler and more mesic sites than *L. diffusus*. For example, it is the species of the fescue meadows of the Cypress Hills, and while occurring at the edge of aspen bluffs or pine forest, it is on herbaceous vegetation in the open and not under trees. However, a few collections have been taken from dry



*Ligyrocoris sylvestris* (L.)  
SK Sand Hills 7 km W Piapot  
July 26, 2003  
D. Larson  
L = 6.0 mm

Fig. C-17. *Ligyrocoris sylvestris*.

grassland areas such as the Great Sand Hills and along streams south of the Cypress Hills, but specimens were then in the more mesic areas with taller herbaceous vegetation. Within fescue grasslands specimens are mainly associated with aster and goldenrod.

Sweet (1964a) found the life cycle in New England to be univoltine with eggs overwintering, similar to the life cycle reported in a Finish study. However, some other studies, based on more anecdotal observation, suggest adult overwintering may occur. We have seen adults collected from July 20 to mid-September, supporting Sweet's interpretation.

**Collecting:** Frequently collected by sweeping as well as by ground searches in suitable grasslands.

## *Stygnocoris rusticus* (Fallén)



*Stygnocoris rusticus* (Fall.)  
SK Cypress Hills Park  
Center Block, War Lodge Coulee  
Sept. 29, 2008 D. Larson  
L = 4.0 mm

Fig. C-18. *Stygnocoris rusticus*.

AB SK CH PD

**Distribution:** 13. Introduced. A European species introduced into North America. Some first dates for Canadian records are: QC (1907), BC (1919), AB (1993), SK (2010) (Scudder & Footitt 2006). The current North American distribution is BC to NL in Canada (no MB record to date) and New England, Great Lake and Pacific Northwest states in US.

**Taxonomy:** Tribe Stygnocorini. Sp v – 2,3,4,5,6,7.

**Measurements (n = 20):** L = 3.1 to 4.1 mm ( $\sigma^7$  = 3.1 to 3.5 mm;  $\sigma^7$  = 3.7 to 4.1 mm); L/W = 2.16 to 2.41 ( $\sigma^7$  = 2.26 to 2.41;  $\sigma^7$  = 2.16 to 2.27). Males smaller and narrower than females.

**Wing development:** WL/AL = 0.71 to 1.00 ( $\sigma^7$  = 0.71 to 0.79;  $\sigma^7$  = 0.73 to 1.00). Dimorphic with brachypterous forms predominating (all males examined brachypterous, 75% of females brachypterous; macropters = 0.97 to 1.00; brachypters = 0.71 to 0.81).

**Ecology:** Sweet (1964b: 83-88) described the usual habitat as mesic open fields where tall forbs such as goldenrod, geranium, tall buttercup, catchfly and shrubby cinquefoil are abundant. We have also found it mainly in open sites that have been disturbed and are in early to middle states of succession where a variety of tall, broad-leaf plants occur. Specimens have also been collected from old hay fields and moist pastures where grazing is light and there is a diversity of forbs. The association with disturbed sites makes the species somewhat synanthropic (Scudder & Footitt 2006).

Reported to feed on a variety of small seeds, which interestingly include chickweed and yarrow, which are very common plants, but seldom mentioned as food of seed bugs. Wheeler (1983b) observed bugs in late summer climbing plants, including yarrow, to feed on ripening seeds.

Sweet (1964b) described the life cycle as univoltine with diapausing eggs passing the winter and adults maturing and reproducing late in the summer or fall.

**Collecting:** Most specimens have been collected by sweeping herbaceous plants, most productively in sites where Canadian goldenrod is abundant. Sweet mentioned the long period during which these insects remain in copulation and that even when disturbed they do not separate. We have preserved specimens that have remained in copulation through both collecting and preservation.

## *Stygnocoris sabulosus* (Schilling)

AB SK MB CH PD PP

**Distribution:** 13. Introduced. European introduction, some first Canadian records: NS (1913), BC (1924), AB (1998), SK (new record), MB (1998) (Scudder & Footitt 2006). Now known to occur from BC to NL and in northeastern US.

**Taxonomy:** Tribe Stygnocorini. Sp v - 2,3,4,5,6,7.

Earlier authors, including Sweet (1964b), refer to this species as *S. pedestris*. The species does not show the pronounced sexual dimorphism in size that its congener, *S. rusticus*, shows.

**Measurements (n = 20):** L = 2.4 to 3.3 mm ( $\sigma$  = 2.4 to 3.3 mm;  $\text{♀}$  = 2.9 to 3.3 mm); L/W = 2.12 to 2.40 ( $\sigma$  = 2.31 to 2.40;  $\text{♀}$  = 2.12 to 2.29).

**Wing development:** WL/AL = 0.90 to 1.11. Macropterous or with only slightly reduced wings, wing length similar between sexes.

**Ecology:** Sweet (1964b: 88-94) described the New England habitat as woodland margins, disturbed roadside areas, and open fields where grasses dominate over tall forbs. He found it in some natural habitats whereas *S. rusticus* was restricted to sites with a history of disturbance.

We have collected too few specimens to allow a generalization on the habitat type, but most specimens have been in collections that also include *S. rusticus*. A small series was collected in litter under a caragana hedge where cleavers had been dense earlier in the season, but had dried back by the time of collection. Collections in the Cypress Hills have generally been near the edge of aspen woods such as along field and road edges.

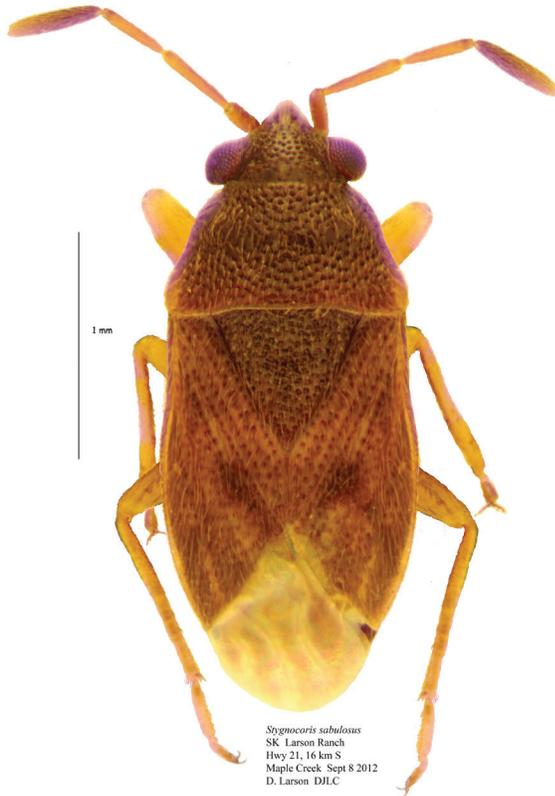


Fig. C-19. *Stygnocoris sabulosus*.

Food records are for seeds of pearly everlasting, aster, goldenrod, spirea and tansy.

The life cycle is univoltine, overwintering as a diapausing egg.

**Collecting:** Specimens have been collected by sweeping, with most specimens occurring on goldenrod. A few specimens were collected by sifting leaves under a caragana hedge in late September.

## *Drymus unus* (Say)



Fig. C-20. *Drymus unus*.

**SK MB PD PP**

**Distribution:** 3. Nearctic, excluding the Western Cordillera and Beringia. Recorded in Canada from SK to NS and NL (Scudder 2008a) and from northeastern US.

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

There are two North American species of *Drymus*. *Drymus crassus* is a larger (L = 5.5 to 7 mm), darker and usually flightless (forewing narrowed, and hind wing reduced in size) species that occurs in moister woodland habitats. Its range is more eastern and southern, from ON and QC in Canada and south in US to NC, and west to SD and TX.

**Measurements (n = 11):** L = 4.1 to 5.1 mm ( $\sigma^7$  = 4.1 to 4.5 mm;  $\text{f}$  = 4.4 to 5.1 mm); L/W = 2.38 (n = 1 $\sigma^7$ ).

**Wing development:** WL/AL = 1.00 (1 $\sigma^7$ , SK). Sweet (1964b) found the species to be macropterous.

**Ecology:** Sweet (1964b: 95-101) stated this is a common and characteristic species of the forest litter of light mesic woodlands, but may also be found in litter along forest edges and even under isolated trees. It is most abundant where there is fine friable, mull litter such as beneath birch and maple. It requires moist, cool soils.

Apparently, they do not feed on the seeds of many of the trees under which they occur, but prefer the seeds of composites, such as asters and goldenrod, as well as those of spirea and birch.

This exactly describes the habitat of the single specimen collected in southwestern SK. It was in a creek valley in litter

at the edge of an open stand of river birch where there were nettles, goldenrod and aster.

The life cycle is univoltine, overwintering as a diapausing egg.

**Collecting:** Apparently adults readily feign death and freeze their movements. This makes them difficult to find in a basin of sifted litter where their brown color also matches that of dead leaves and may partly explain the paucity of records.

# *Scolopostethus thomsoni* Reuter



Fig. C-21. *Scolopostethus thomsoni*.

spines of the posterior row may be small on female specimens.

The other two Canadian species, *S. pacificus* Barber and *S. tropicus* (Distant), are restricted to BC. Sweet (1964b) noted that within *S. thomsoni* there was variation in color, habitats used and food plants so there is a good possibility that this wide-ranging species actually consists of several as yet not recognized species. He also observed that some populations of *S. thomsoni* possess a sweet aromatic scent gland odor different from the usual “buggy” smell of most seed bugs, whereas it is lacking in individuals from other populations.

**Measurements (n = 24):** L = 2.7 to 3.9 mm ( $\sigma^7$  = 2.7 to 3.5 mm;  $\text{f}$  = 3.1 to 3.9 mm); L/W = 2.60 to 3.00 ( $\sigma^7$  = 2.76 to 3.00;  $\text{f}$  = 2.60 to 2.93).

**Wing development:** WL/AL = 0.64 to 1.07. Wings dimorphic: macropters = 1.00 to 1.07; brachypters = 0.64 to 0.78. Wing length does not seem to be related to sex, and brachypters are more frequent than macropters.

**Ecology:** Habitats are moist to wet sites with abundant vegetation, open or with at most patchy tree cover. Specimens have been collected from sedge clumps in marshes, in grasses in light open forest and in mesic sites with rank forbs. It also occurs along prairie water courses in shrub or tree litter where the soil is shaded and moist and litter/ herb cover is dense.

Reported to feed on seeds of a variety of plants including nettles, sedges, rushes, evening primrose, dock, mint, Rudbeckia, fir and birch (Sweet 1964b, Scudder 1997).

Sweet (1964a) found this species to have a cold quiescence rather than a diapausing stage. On the prairies, at least adults overwinter for we have seen specimens as early as April 27 and many in May as well as late as October 14. Populations have been reported with one or two generations per year, the number in the prairies is unknown.

**Collecting:** Specimens have usually been collected by sifting leaf litter, including: moist spruce litter near a stream, willow and grass litter along banks of a stream flowing through dry grasslands, and a densely weedy upper beach of a prairie reservoir.

AB SK MB CH PD PM PP

**Distribution:** 11. Holarctic. A boreal species occurring in North America from AK, YT and BC to NL, New England, northern tier of US states and along the mountains in the west south to NM and AZ.

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

Five species of *Scolopostethus* were recorded from Canada by Maw et al. 2000. *S. thomsoni* is the most widespread, occurring from coast to coast. *S. atlanticus* was recorded from BC, MB, ON, QC and NF. However, Sweet (1964b) discounted the record of *S. atlanticus* from BC. GGES has examined specimens of *Scolopostethus* from across Canada and has not seen specimens of *S. atlanticus*. The records of the species from MB (Winnipeg, 13.V.1909, Wallis (Gibson 1912)) and ON (Ottawa, 13.VII.1913, Germain (Gibson 1915)) are old and probably incorrect. Therefore *S. atlanticus* should be deleted from the Canadian faunal list. *S. atlanticus* seems to be restricted to the northeastern US, from MA, CT, LI, NY and NJ.

If *S. atlanticus* does appear in Canada it can be recognized on the basis of the following characters (from Sweet 1964b).

*S. atlanticus* – scent gland evaporatorium covers about 3/5 of the metapleuron; male with large spine of fore femur “oddly” bent; male parameres only slightly curved;

*S. thomsoni* – scent gland evaporatorium covers less than 1/2 of the metapleuron; male with large spine of fore femur straight; male parameres strongly curved.

Scudder (2012) stated *S. thomsoni* is easily recognized by the double row of spines ventrally on the fore femora although the

# *Scolopostethus diffidens* Horváth

MB

BS



Fig. C-22. *Scolopostethus diffidens*.

**Distribution:** 2. Nearctic, excluding Beringia. Reported in Canada from BC, ON, QC and NS (Maw et al. 2000). GGES examined 2 specimens from MB (Rennie; Seddon's Corner). US records are from the west (WA, ID, CA) and northeast (ME, MA, CN, NY, NJ).

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

The conspicuous white spot of the hemelytral membrane usually allows specimens to be identified macroscopically.

**Measurements (n = 3):** L = 2.9 to 4.3 mm (♂ = 2.9 mm; ♀ = 3.5 to 4.3 mm); L/W = 2.70 to 2.79 (♂ = 2.79; ♀ = 2.70 to 2.76).

**Wing development:** Dimorphic with brachypterous condition predominant. WL/AL = 0.77 to 0.96.

**Ecology:** Sweet (1964b) stated *S. diffidens* is a species of northern birch-conifer forests and is restricted to the litter beneath birch, hemlock and spruce. Specimens are most abundant in thick, loose, dry-mesic litter. They have been reared on the seeds of the trees under which they occur, e.g. birch, hemlock and spruce.

The species is univoltine with an obligate adult diapause.

**Collecting:** The species should be searched for in birch and coniferous litter of the southern boreal zone.

# *Eremocoris setosus* Blatchley



Fig. C-23. *Eremocoris setosus*.

southern boreal zone. Our experience suggests an association with conifers, but in the east, it seems the species also occurs in deciduous forest. Cool, shaded forest litter habitat is occupied by few other lygaeids and so is not much searched by seed bug collectors.

AB SK CH BP

**Distribution:** 3. Nearctic, excluding the Western Cordillera and Beringia. The species has been reported from AB (Scudder 2012) and QC (Moore 1950) and now SK ((2 ♂, 1 ♀: SK. Cypress Hills Park, Center Block, fire guard, Sept. 10, Sept. 29, 2013, D. Larson). In the eastern US it has been recorded from MA and NY to FL and west to OH and IN.

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

Similar to *E. ferus* but color darker, head pronotum and scutellum black; wing dark brown, with a nebulous piceous area medially and membrane with a small white transverse spot adjacent to corium; pronotum narrower, lateral margin concave before hind angle; profemur with two evidently enlarged teeth in anterior ventral row.

**Measurements (n = 3):** L = 5.2 to 5.6 mm (♂ = 5.2 to 5.6 mm; ♀ = 5.6 mm); L/W♂ = 2.81 to 2.92; ♀ = no measurement.

**Wing development:** The wings are slightly reduced, WL/AL = 0.88 to 0.96.

**Ecology:** Barber (1928) reported the species to be abundant in VA where he collected it by sifting dead leaves in or near woods. Cypress Hills, SK, specimens were collected in mature lodgepole pine forest where they were sifted from lodgepole pine litter. The life history is unknown, but presumably is similar to other species of the genus and tribe, that is univoltine with adult overwintering.

**Collecting:** This is a species that should be looked for across the

## *Eremocoris ferus* (Say)

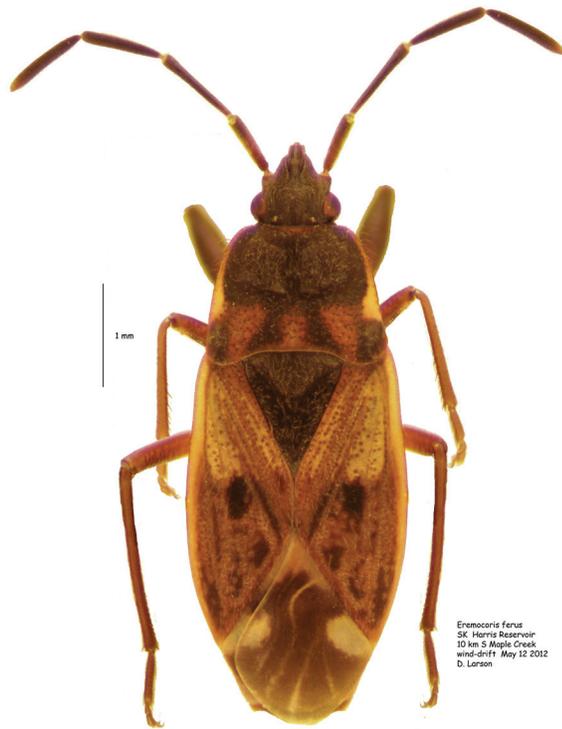


Fig. C-24. *Eremocoris ferus*.

*Eremocoris borealis* was a northern species and *E. ferus* southern with only a narrow zone of sympatry in southern New England. In this area *E. borealis* was in cooler hemlock forest ravines and *E. ferus* in warmer deciduous edge habitats and the two were never found together in the same habitat type. This also holds in southern SK where *E. borealis* occurs in the coniferous forest of the Cypress Hills and *E. ferus* is known only from lower elevation sites where it occurs in the litter of deciduous trees and bushes along water courses.

The life history is rather unusual for there is no diapause, just cold temperature quiescence (similar to *Scolopostethus thomsoni*) so adults and nymphs occur throughout the year (Sweet 1964a).

**Collecting:** A few specimens have been collected by sifting leaf litter.

AB SK MB CH PD PM PP

**Distribution:** 2. Nearctic, excluding Beringia. Recorded from BC, ON, QC and NS and previously from SK (Scudder 2010). Widely distributed in the eastern US from New England to SC and TX and west to KS, also in northwest, ID, WA (Scudder 2012).

Some earlier AB records from MC, e.g. Jasper (Criddle 1922) and Nordegg and Waterton (Strickland 1953), are probably incorrect

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

*E. ferus* and *E. borealis* had been considered synonyms until Sweet (1977) showed two morphologically and reproductively distinct species were involved and provided a key to their recognition. In addition to the characters given in the key, specimens of *E. ferus* differ from *E. borealis* in lighter coloration with a more distinct pattern; pronotum with basal lobe patterned; wing membrane with a larger oval spot adjacent to corium; pronotum with lateral margin broadly and evenly convex; and protibia with one evidently enlarged tooth.

**Measurements (n = 5):** L = 5.2 to 5.8 mm (♂ = 5.2 to 5.8 mm; ♀ = 5.5 to 5.6 mm); L/W = 2.67 to 2.96 (♂ = 2.89 to 2.90; ♀ = 2.67 to 2.96).

**Wing development:** WL/AL = 0.98 to 1.04. Apparently macropterous. One specimen was collected in lake drift (SK, Harris Reservoir, May 12).

**Ecology:** Sweet (1977) found that in eastern North America *Eremocoris borealis* was a northern species and *E. ferus* southern with only a narrow zone of sympatry in southern New England. In this area *E. borealis* was in cooler hemlock forest ravines and *E. ferus* in warmer deciduous edge habitats and the two were never found together in the same habitat type. This also holds in southern SK where *E. borealis* occurs in the coniferous forest of the Cypress Hills and *E. ferus* is known only from lower elevation sites where it occurs in the litter of deciduous trees and bushes along water courses.

The life history is rather unusual for there is no diapause, just cold temperature quiescence (similar to *Scolopostethus thomsoni*) so adults and nymphs occur throughout the year (Sweet 1964a).

**Collecting:** A few specimens have been collected by sifting leaf litter.

## *Eremocoris obscurus* Van Duzee

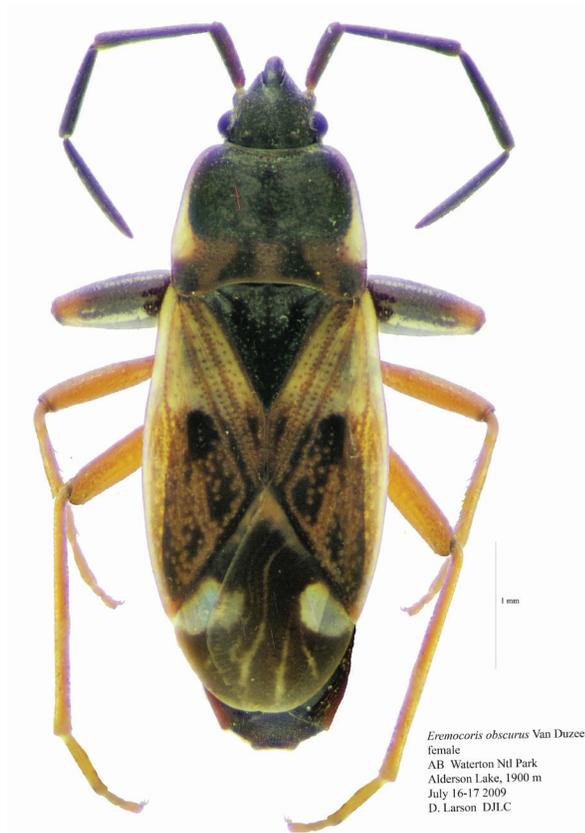


Fig. C-25. *Eremocoris obscurus*.

AB MC

**Distribution:** 8. Western Cordilleran, excluding Beringia. Recorded from BC, CA and ID. New record for AB (Waterton Lakes National Park, Crandall Lake, 49.089°N 113.918°W, 1500 m, shoreline, 30.VI.2003, D. Langor (1♂, NFRC); Waterton Lakes National Park, Alderson Lake, 1900 m, July 16-17, 2009, D. Larson (1♂, 4♀, DJLC)).

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

This species is very similar to *E. borealis* and the lack of erect setae on the hemelytra on specimens of *E. obscurus* is the principal way of recognizing the species. Other differences are pale spot on wing membrane smaller, more broadly oval and less obviously transverse; apical two-thirds of corium more or less uniform dark brown and male with anterior lobe of pronotum markedly convex although some males of *E. borealis* are similar. On average specimens of *E. obscurus* are smaller and slightly more ovate in outline as the pronotum is more evenly convex with the maximum width clearly behind the middle. The pronotum of many specimens of *E. borealis* is widest anterior to the middle and the margins are then subparallel to the hind angles. However, this character is both individually and sexually variable and some specimens are similar to *E. obscurus*. In the male the pregenital segment usually lacks medial elongate setae (in *E. borealis* there are usually several widely spaced medial setae making a medial transverse row) and the subapical spine on the inner margin of the protibia is narrower and more acute.

**Measurements (n = 5):** L = 4.6 to 5.5 mm (♂ = 4.6 to 5.0 mm; ♀ = 5.3 to 5.5 mm); L/W = 2.67 to 2.81.

**Wing development:** Wing submacropterous to macropterous, WL/AL = 0.92 to 0.98.

**Ecology:** The Waterton Lakes Park specimens were collected from the shorelines of small subalpine lakes. Alderson Lake has a very narrow shoreline with alders and willows growing to the rocky water's edge with conifers behind the shoreline. The bugs were found in leaf litter near the water's edge.

**Collecting:** The two collections of *E. obscurus* are from the margins of small subalpine lakes and at least the Alderson lake specimens did not appear to be drift. None of our records for *E. borealis* indicate any association with littoral habitats so these similar species may be ecologically segregated.

## *Eremocoris borealis* (Dallas)



*Eremocoris borealis* (Dallas)  
SK Cypress Hills Provincial Park  
Center Block, pine clear-cut  
June 4, 2006 D. Larson  
L = 5.6 mm

Fig. C-26. *Eremocoris borealis*.

species to feed on the seeds of birch, hemlock and spruce in New England. Wheeler (2007) reported the species occurring in the cones of pitch pine.

Adults have been collected from April 14 until the end of September. Adults seem to be the overwintering stage with probably only one generation per year.

**Collecting:** Red squirrel middens have been good places to collect these bugs. Probably squirrels miss seeds as they shuck a cone, and these are available to the bugs so squirrels do the foraging, the bugs wait for food to be brought to them.

AB SK MB MC CH PM PP BP

**Distribution:** 1. Nearctic, including Beringia. A northern, boreal species with a range that extends from AK, YK, NT and BC to NL, and into the eastern US south to WS, MI and NC and along the western mountains to MT and OR.

**Taxonomy:** Tribe Drymini. Sp v - 2,3,4,5,6,7.

Sweet (1977) gave a key to the eastern species of *Eremocoris* and discussed the diagnostic features of the species and aspects of its ecology. Specimens are very similar to those of *E. obscurus* but can be recognized by the presence of the semi-erect setae of the corium as well as other features discussed under *E. obscurus*.

**Measurements (n = 20):** L = 4.7 to 6.6 mm (♂ = 4.7 to 6.6 mm; ♀ = 5.6 to 6.3 mm); L/W = 2.75 to 3.00 (♂ = 2.75 to 3.00; ♀ = 2.80 to 2.93).

**Wing development:** Wing length various, from wings as long as or slightly longer than abdomen to wings slightly, but distinctly reduced. There is not a clear dimorphism, WL/AL varies almost continuously from 0.88 to 1.04.

**Ecology:** This is a cool adapted forest species usually found in or along the edges of conifer forest. In the Cypress Hills it is usually in lodgepole pine forest where specimens have been sifted from pine needle litter. Specimens have also been found in spruce and spruce/aspen forest. Sweet (1964b) reported the

# *Megalonotus sabulicola* (Thomson)



*Megalonotus sabulicola* (Thomson)  
SK Larson Ranch,  
Hwy 21, 16 km S Maple Creek,  
May 6, 2013 D. Larson

Fig. C-27. *Megalonotus sabulicola*.

AB SK MC CH PD PM PP

**Distribution:** 13. Introduced. A European introduction, first Canadian records: BC (1926), ON (1965) (Scudder & Footitt 2006), SK (2010). It has since been found in several AB localities (Onefour, Edmonton). Widespread in western US from WA to CA, ID, UT, ND, limited occurrence along east coast, New England to MD.

**Taxonomy:** Tribe Megalonotini. Sp v - 2,5,6,7.

This is a distinctive bug. The head is scarred above the eye, the body is very hairy and unkempt with dense, short and somewhat recumbent setae and abundant longer, erect setae; the thorax is barrel-shaped, being elongate and broad anteriorly and the femur of the front leg is robust and armed beneath with a large dagger-like spine.

There are two European species that had been long confused and there was uncertainty as to which was introduced into North America. Scudder (1961) established that North America has only *M. sabulicola*, but the similar *M. chiragrus* Fabricius should be considered a possibility if a population of larger, darker, brachypterous specimens is found. Sweet (1964b) and Wheeler (1989) described some of the history in the recognition of the two species.

**Measurements (n = 20):** L = 4.0 to 4.9 mm (♂ = 4.0 to 4.2 mm; ♀ = 4.5 to 4.9 mm); L/W = 2.58 to 2.87 (♂ = 2.65 to 2.87; ♀ = 2.58 to 2.81). (Wheeler 1989 gave length as 3.8 to 5.4 mm in eastern US).

**Wing development:** WL/AL = 0.86 to 1.03. Wing length somewhat varied, from slightly reduced to full, with a suggestion of two modes: 0.97 to 1.03, and 0.86 to 0.95.

Longer winged individuals have been collected in lake drift June 18 and 25 (SK, Harris Reservoir).

**Ecology:** Sweet (1964b: 133-139) described the habitat as disturbed, early successional and ruderal sites. He noted an association with sandy soils and knapweed, seeds of which are favored. Wheeler (1989) also confirmed this association with knapweed. Scudder & Footitt (2006) suggested the entry of *M. sabulicola* into natural communities in grasslands of the South Okanagan could well have been facilitated by the previous invasion of alien diffuse and spotted knapweed into these communities. Most prairie specimens we have examined come from a farm yard where they occur along a gravel drive under mats of knotweed or under dandelions. Specimens are also commonly found on upper beaches of reservoirs where wave action during infrequent flooding sorts the substrates to produce sandy beach areas and the flooding maintains a disequilibrium plant community with many weedy species, almost always including silverweed. Sweet noted the favorite food was seeds of knapweed, but other seeds must be taken where knapweed doesn't grow, such as the prairie sites described above. Wheeler (1989) discussed the potential of *M. sabulicola* as a biological control agent for knapweed and concluded the species probably has little effect on a plant with such large seed production.

Both Finland and New England populations overwinter as adults and have two generations per summer. Prairie populations also appear to overwinter as adults for specimens have been collected as early as April 2 and are common through May and June and again in September. Sweet observed that there was barely enough time for a second generation in his New England study site so in the short prairie summer there is probably time for only one generation.

**Collecting:** It is noteworthy that we have seen no specimens from sand hills where the combination of sandy soils and knapweed occur. Perhaps they have been overlooked. Also, Sweet did not find the species in natural habitats, only in places that had undergone disturbance and it may be mainly synanthropic. Specimens have been taken commonly in pitfall trapping in the Antelope-brush community of the South Okanagan, BC.

## *Atrazonotus umbrosus* (Distant)



Fig. C-28. *Atrazonotus umbrosus*.

SK MB PP BS

**Distribution:** 10. Nearctic-Neotropical. Widespread in the US, but only just entering Canada in SK (Lac la Ronge (RSM); Waskesiu (RBCM)), MB, NT (Slave R. (CNC), Maw et al. 2000), and ON.

**Taxonomy:** Tribe Gonianotini. Sp v - 2,3,5,6,7.

Sweet (1964b) discussed problems in the generic placement and naming of this species.

**Measurements (n = 2♀):** L = 5.9 & 6.4 mm; L/W = 2.32 & 2.35.

**Wing development:** WL/AL = 0.98, 0.99. Macropterous.

**Ecology:** Sweet (1964b: 156-161, as *Delochilocoris umbrosus*) described habitats where he collected the species as generally exposed, open areas, habitats of recent origin and temporary nature, i.e. newer subclimax communities. The ground is dry and the litter layer sparse. This is a common habitat type, yet he did not find the species often and then only in low densities. Overwintering occurs in the adult stage. The number of generations per summer not known.

**Collecting:** Although this species has a very wide range and occurs in a commonly occurring habitat type, it seems to be uncommon everywhere. We do not know collection details for western Canadian specimens, but the upper zone of sandy beaches might be well worth examining.

# *Malezonotus angustatus* (Van Duzee)

SK

PD



Fig. C-29. *Malezonotus angustatus*.

Pronotum length/scutellum length = 1.25 to 1.33.

**Wing development:** Ashlock (1958) reported both macropterous and brachypterous individuals with the brachypterous form predominating. All SK specimens seen are brachypterous with  $WL/AL = 0.62$  to  $0.66$ .

**Ecology:** Little has been recorded on the habitat of this species but Ashlock (1958) observed adults to feed on seeds and to be able to lay viable eggs on a seed diet although he was not able to rear the nymphs. SK Specimens were collected from only a short section of the upper beach of Altawan Reservoir. The soil was coarse sand with some intermixed gravel and held by plants and runners of silverweed, clumps of foxtail and a variety of weeds such as sweet clover and cocklebur, and adjacent to heavily grazed blue grass.

Adults were collected on June 9 (mature female) and July 28 (3 teneral, 2 nymphs). This scanty evidence suggests adult overwintering.

**Collecting:** These are very fast running insects and difficult to capture if there are any clumps of vegetation. Sweet (1964b: 161-163) also remarked on the fast movement of *M. fuscus* Barber, a species of the eastern US seaboard, and its occurrence in small, isolated colonies.

**Distribution:** 8. Western Cordilleran, excluding Beringia. New Saskatchewan record (Altawan Dam, nr jct. Hwy 13 & Lodge Creek, 2 km E AB border). Otherwise known from west of the Rocky Mountains, BC to CA, ID and UT (Downes 1927; Parshley 1919).

**Taxonomy:** Tribe Gonianotini. Sp v - 2,3,5,6,7.

Ashlock (1958, 1963), who revised the genus, placed *M. angustatus*, and the two California species, *M. barberi* Ashlock and *M. obrieni* Ashlock, in the *M. angustatus* group based on the pronotum being longer than the scutellum and similarity in shape of the clasper of the male paramere. Within the group specimens of *M. angustatus* are recognized by their long, narrow body, the usually reddish or ferruginous color of the clavus and corium and the black lateral margins of the prothorax, although he also noted that *M. angustatus* is the most diverse species within the genus. SK specimens have the clasper (paramere) of the male genitalia of the form illustrated by Ashlock (1958, Fig. 9) and their color pattern is similar although the intensity of pigment is greater in the SK specimens than described for western specimens (e.g. rufous areas of hemelytra tend to be replaced by black). The geographically isolated SK population and the color differences suggest that while belonging to the *M. angustatus* complex, these specimens could be recognized as a distinct population, perhaps as a subspecies. We have seen only 4 adult SK specimens (1 ♂, 3 ♀), too few to allow one to form an opinion on their taxonomic status.

**Measurements (n = 4):** L = 4.4 to 4.7 mm (♂ = 4.6 mm; ♀ = 4.4 to 4.7 mm); L/W = 3.15 to 3.65 (♂ = 3.65; ♀ = 3.15 to 3.20). Ashlock (1958) gives L: ♂ = 4.5 to 5.0 mm; ♀ = 4.6 to 5.3 mm. Pronotum width/pronotum length = 1.33 to 1.40;

## *Malezonotus arcuatus* (Ashlock)

AB

MC

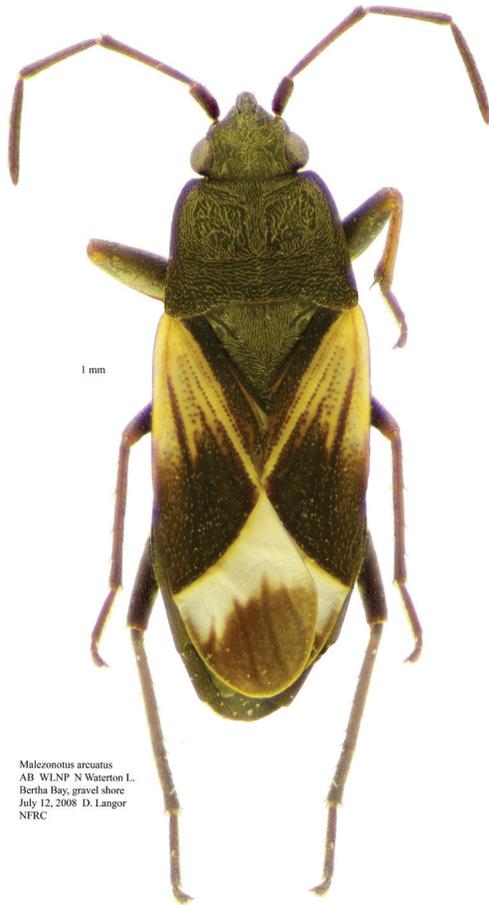


Fig. C-30. *Malezonotus arcuatus*.

some other habitat but as all known specimens were found under similar shoreline conditions, it has to be assumed this represents the normal habitat. The holotype was collected above 6000 feet on Mt. Ranier, WA.

The occurrence of adult specimens in early July in a cool mountain environment suggests they had overwintered as adults.

**Distribution:** 8. Western Cordilleran, excluding Beringia. New AB record: Waterton Lakes National Park (North Waterton Lake, Bertha Bay, Driftwood Lake, Upper Waterton Lake, Alderson L (1861 m), D. Langor. NFRC). Known from west of the Rocky Mountains, BC and WA.

**Taxonomy:** Tribe Gonianotini. Sp v - 2,3,5,6,7.

Ashlock (1958) described the species in his revision of *Malezonotus*.

The characters he gave for the recognition of the species are: pronotum subequal in length to scutellum; corium broadly pale anteriorly, its costal margin black on distal half; corium with apex (junction with apical wing membrane) convexly curved. Ashlock described the species from 3 macropterous female specimens and did not describe the male clasper. We have seen 5 specimens, all macropterous females.

In addition to the subequal pronotum and scutellum, specimens differ from *M. angustatus* in that they are larger and broader.

**Measurements (n = 5♀):** L = 5.1 to 5.4 mm (Ashlock 1958: 5.0 to 5.3 mm); L/W = 2.81 to 3.04; Pronotum width/pronotum length = 1.50 to 1.61; Pronotum length/scutellum length = 0.97 to 1.08.

**Wing development:** All known specimens are macropterous. WL/AL = 0.97 to 1.08.

**Ecology:** Like *M. angustatus*, the species seems to be associated with the shorelines of standing water. All specimens examined were collected by David Langor from Waterton Lakes National Park (July 3 -12, 2008) and have label data indicating “gravel shore Upper Waterton Lake”, “rocky beach and on driftwood”, and “lake shore” so the species seems to be an inhabitant of rocky beaches of cold, oligotrophic lakes. It is possible that these specimens were from lake wash and that they flew from

## *Uhleriola floralis* (Uhler)



*Uhleriola floralis*  
SK Cypress Lake, dam, E end  
Sept. 5, 2008 D. Larson  
L = 5.7 mm

Fig. C-31. *Uhleriola floralis*.

AB SK MB PD PM PP

**Distribution:** 2. Nearctic, excluding Beringia. This is mainly a species of the Great Plains, occurring from the Canadian Prairie Provinces east to the midwestern US (IL, Slater 1948), south to KS and CO and in the west in ID, UT, AZ and CA.

**Taxonomy:** Tribe Rhyparochromini. Sp v - 2,5,6,7.

The genus contains only a single species. Scudder (1984) presented a key to separate it from the other two North American genera of Rhyparochromini.

**Measurements (n = 13):** L = 5.3 to 6.1 mm ( $\sigma$  = 5.3 to 5.7 mm;  $\text{♀}$  = 5.3 to 6.1 mm); L/W = 2.64 to 3.14 ( $\sigma$  = 3.00 to 3.14;  $\text{♀}$  = 2.64 to 2.98).

**Wing development:** WL/AL = 0.80 to 0.97. Two females with ratios of 0.87 and 0.97 were collected from drift so specimens with wings shorter than the abdomen can still fly.

**Ecology:** This very distinctive species seems quite local and has been found in only a few localities. These have been disturbed sites which were very dry with sandy soil and widely separated bunch grasses and sparse herbs. On two occasions, bugs were found in clumps of crested wheatgrass in overgrazed pastures. Adults are probably the overwintering stage as the earliest seasonal records are for female specimens found in drift (SK, Harris Reservoir, May 9 and 12).

**Collecting:** The species is quite gregarious. When discovered, there are usually a number of specimens together in a single tussock of grass, with none in surrounding tufts. When disturbed on a hot day the bugs are extremely fast, scattering

into the neighbouring vegetation so quickly it is difficult to capture even a single specimen.

# *Emblethis vicarius* Horváth

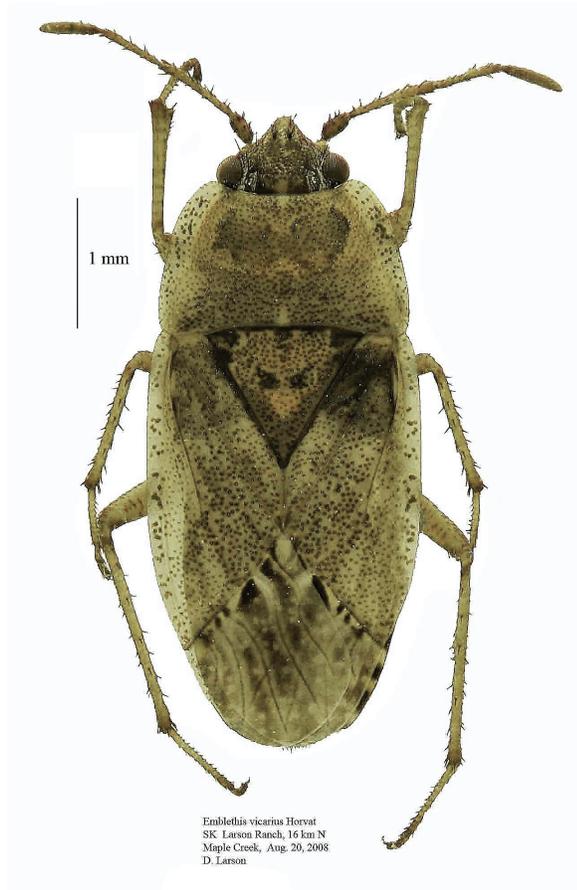


Fig. C-32. *Emblethis vicarius*.

This heat-tolerant species, with its diverse seed-feeding habit, is widely distributed from South America north to AK, YT and NT (Scudder 1993).

Adults overwinter and in New England there are two generations per summer. The number of generations on the prairies is not known. Adults have been collected in lake drift as early as April 17 and as late as Oct. 1.

**Collecting:** The color, pale body with dark spots, and broad shape allow this species to blend in well without a shadow on a background of light-colored soil. Thus, it is well adapted to live in exposed areas and specimens are difficult to find until they move.

AB SK MB CH PD PM PP BP

**Distribution:** 10. Nearctic-Neotropical. AK, YT, BC to QC. Throughout the US and into Mexico and South America.

**Taxonomy:** Tribe Gonianotini. Sp v - 2,3,5,6,7.

This is the only American species of a genus that is diverse in the Palearctic Region. Sweet (1964b) noted that the species varied in North America and that specimens from various areas resembled some of the Palearctic species, so he suggested that a species complex may be involved.

This is a very distinctive species with a broad flat shape due to the greatly expanded lateral margins of the body, and the color is unique, mottled gray to brown with dark punctures.

**Measurements (n = 20):** L = 4.6 to 6.0 mm (♂ = 4.6 to 5.9 mm; ♀ = 5.6 to 6.0 mm); L/W = 2.15 to 2.37 (♂ = 2.15 to 2.34; ♀ = 2.25 to 2.37).

**Wing development:** Macropterous, WL/AL = 1.00 to 1.06. The species has good dispersal ability which correlates with the temporary nature of its habitat (Scudder 1993).

**Ecology:** Sweet (1964b: 144-148) suggested the name “sandbug” for this species as it is strongly associated with open, sandy habitats. It occurs along beaches, dry sandy fields, overgrazed pastures, dry hillsides and disturbed areas, where the soil is light and well drained, and sun exposed. Scudder (1993) reported the species occurring in all sage associations and in fescue communities in YT and in all the dry grasslands of BC. A wide variety of seeds of grasses and forbs are eaten in the laboratory including those of bluestem grass, brome, lamb’s quarters, evening primrose, dock, goldenrod, and common chickweed but not millet (Sweet 1964b). Scudder (1993) observed feeding on lamb’s quarters seeds in the wild.

# *Sphragisticus nebulosus* (Fallén)



*Sphragisticus nebulosus* (Fallén)  
SK Larson Ranch, Hwy 21  
16 km S Maple Creek  
Aug. 12, 2003 D. Larson

Fig. C-33. *Sphragisticus nebulosus*.

AB SK MB CH PD PM PP BP BS

**Distribution:** 11. Holarctic. AK, YT, BC to NS. Northeastern US and south on Great Plains and western Mountains to TX, NM, AZ and CA.

**Taxonomy:** Tribe Megalonotini. Sp v - 2,5,6,7.

The conspicuous erect setae along the lateral pronotal margins are distinctive. Another species, *Spinigerotus simulatus* (Scudder 1984), from NM and Mexico has similar setae.

**Measurements (n = 20):** L = 4.4 to 5.5 mm (♂ = 4.4 to 5.1 mm; ♀ = 4.4 to 5.5 mm); L/W = 2.43 to 2.71 (♂ = 2.46 to 2.71; ♀ = 2.43 to 2.54).

**Wing development:** WL/AL = 0.92 (2 ♀♀ specimens); 1.00 to 1.06 (18 specimens). Sweet (1964b) reported New England specimens to be all macropterous which corresponds to the temporary nature of the habitat they occupy. Several collections were made from lake drift in April.

**Ecology:** Sweet (1964b: 139-144) found the species to be restricted mainly to disturbed habitats such as a sandy flood plain, ruderal areas and along cultivated fields. Populations in cultivated fields tend not to persist long in a given location as succession proceeds. Highest populations occur where low prostrate pioneer forbs predominate. As plants grow up and shade the ground the species disappears from the community. The insects occur on light loam to sand, not on clayey or wet soils, often in sites with no litter layer so the bugs are living on a bare mineral surface in a dry, hot microenvironment.

Food is a wide variety of weed seeds such as primrose, dock, lambs-quarters, speedwell, tumbleweed, pigweed, purslane, and ragweed, thus earning the name “clouded weed bug”.

There are also records of feeding on planted seeds (e.g., corn, peas).

Diapausing adults overwinter. Two generations per year occur in New England and the huge population build-up described below would only seem possible in a species with more than one summer generation.

**Collecting:** The Calgary Herald (page A8, August 4, 2003) reported D.L. Johnson observed *Sphragisticus nebulosus* (Fallén) in the “millions” attracted to light at 2200 hours in a shopping center at Medicine Hat, AB. The exceptionally high number of these bugs forced the closure of a McDonald’s restaurant and the employment of a Bobcat to clean the parking lot (D.L. Johnson, pers. comm., Scudder 2014b). As far as is known, this population explosion has not reoccurred since, and the factors responsible for the vast numbers have not been determined.

## *Rhyparochromus vulgaris* (Schilling)



*Rhyparochromus vulgaris* (Schilling)  
from Scudder 2016

**Distribution:** Palearctic. Widespread in Europe, North Africa and Asia. Recently established in northwestern US, OR and WA (Henry 2004) and has spread into southern BC (Scudder 2016). Its wide distribution in the Palearctic suggests it may also spread widely in North America and may eventually turn up on the prairies, especially in cities as it seems to be somewhat synanthropic.

**Taxonomy:** Tribe Rhyparochromini. Sp v - 2,5,6,7.

The large size and pale hemelytron with black membrane is distinctive within our fauna. The species *Xanthochilus saturnius* has established in CA and OR (Henry 2004). It is similar, but with two strongly contrasting black spots on each hemelytron.

**Measurements:** L = 6.5 to 8.3 mm (Henry 2004).

**Wing development:** Macropterous.

**Ecology:** In Europe the species occurs in forest edges, clearings, and mixed forests, parks, garden borders and other shaded biotypes. Adults and nymphs overwinter so there is a cold weather quiescence rather than diapause. Reported to feed on seeds of various plants including raspberry, nettles, sage, elms, poplar and other plants.

**Collecting:** The species should be looked for in southwestern Alberta, especially in urban areas.

Fig. C-34. *Rhyparochromus vulgaris*.

# *Trapezonotus arenarius* (Linnaeus)

AB SK MB CH PD PM PP

**Distribution:** 11. Holarctic. Northern North America, AK (Scudder & Sikes 2014), YK, NT, BC to QC and NS; northeastern US.

**Taxonomy:** Tribe Gonianotini. Spv - 2,3,5,6,7.

Sweet (1964b) discussed the status of European and North American populations and concluded that the North American population has not been introduced and because it seems to differ ecologically from what has been described for European species it may represent a separate species. Four other species of *Trapezonotus* occur in North America, in the southwestern US and north to BC (Scudder 2008b – included a key to species).

Color varying sexually: female with antennae, labium and legs fuscous and contrasting with orange coxal lamellae and trochanters; male with antennal segment 1, base of labium and base of femora and protibia, orange.

Profemur anterior-ventral margin with 1 prominent and 3 or 4 smaller setiferous teeth plus small denticles, posterior-ventral margin with 4-5 elongate setae; male with denticles more prominent.

**Measurements (n = 20):** L = 3.6 to 4.5 mm (♂ = 3.7 to 3.9 mm; ♀ = 3.6 to 4.5 mm); L/W = 2.13 to 2.33 (♂ = 2.22 to 2.26; ♀ = 2.13 to 2.33).

**Wing development:** Wing dimorphic, WL/AL brachypters = 0.75 to 0.83; macropters = 0.96 to 1.00. Sweet (1964b) found 11% macropterous. In Cypress Hills, SK, 1 specimen of 14 was macropterous; all specimens from lake drift (10) were macropterous.



Fig. C-35. *Trapezonotus arenarius*.

**Ecology:** Sweet (1964b) characterized the habitat as usually open sites on poor gravelly soil. Such sites have sparse, short vegetation and a thin litter layer.

Aside from specimens in drift, most southern SK specimens were found in Cypress Hills where they occurred in open, disturbed sites, hillsides and edges of fescue grasslands in areas of open, short vegetation and shallow litter. They were also common on a gravel driveway under mats of knotweed.

Sweet (1964b) found the species to be almost omnivorous on seeds.

The life cycle is univoltine with adult overwintering.

**Collecting:** Most specimens were collected in early spring (April, May) and fall (September, October), often running between clumps of vegetation on sunny days. Sweet (1964b) described a small 1st instar nabid (damselfly nymph) killing an adult *Trapezonotus* by climbing onto its back and stabbing it in the neck, presumably injecting poisonous saliva.

## *Peritrechus convivus* (Stål)

AB SK MB CH PD PM PP

**Distribution:** 11. Holarctic. AK, YT, and BC to NL, northern plains and western US south to CA, AZ, NM, ND, SD and northern Mexico.

**Taxonomy:** Tribe Rhyparochromini. Spv - 2,5,6,7.

Scudder (1999) placed *P. saskatchewanensis* Barber 1918 as a junior synonym. Scudder found the species to be quite variable in color and size, but in general specimens from northern latitudes are somewhat darker with the antennal segments completely fuscous, the lateral pronotal carina darkened and the wing membrane suffused with fuscous. Specimens from arid areas are paler and somewhat larger than those from humid areas.

Profemur ventrally with anterior margin with 2 or 3 prominent, but small setiferous teeth plus small denticles, posterior margin without elongate setae; male similar, but denticles more prominent.

Two additional species of *Peritrechus* occur in the interior of southern BC and should be watched for in the southwestern Prairies. These are *P. pilosulus* Scudder - characterized by dorsal surface with moderately long, dense erect setae; and *P. tristis* Van Duzee - small, L = 3.8 to 4.2 mm, antennal segments 2 and 3 robust, segment 3 widest in apical half and wider than segment 2.

**Measurements (n = 20):** L = 4.1 to 4.8 mm (♂ = 4.1 to 4.6 mm; ♀ = 4.3 to 4.8 mm) (Scudder 1999 gives L = 4.3 to 5.6 mm); L/W = 2.38 to 2.60 (♂ = 2.50 to 2.60; ♀ = 2.38 to 2.57).

**Wing development:** Macropterous, WL/AL = 1.00 to 1.10.

**Ecology:** This species shows a strong association with water and many specimens have been collected in lake drift as well as



Fig. C-36. *Peritrechus convivus*.

higher on the beach along old strand lines and early successional stages of plants on sandy to gravelly soils. They have also been found in deciduous litter along stream valleys, even within the usual flood zones. Specimens have been found away from water in the Great Sand Hills where they occur in swales or along paths where plant debris has blown and accumulated. The common factor is generally open areas where plant material has been deposited by wind or water, presumably rich sites of seed accumulation.

Beirne (1972) reported a case where this species destroyed a small acreage of flax, wheat, oats and barley.

Specimens have been collected from April 2 to October 22. Adults appear to be the overwintering stage; the number of generations is unknown.

**Collecting:** This is the most frequently collected rhyparochromid species along lake margins and flood flats of streams and rivers. Some of the specimens are probably due to dispersing bugs collecting in wash, but also this seems to be a major habitat of the species.

# *Peritrechus fraternus* Uhler



*Peritrechus fraternus*  
SK Larson Ranch, Hwy 21  
16 km S Maple Creek  
June 12, 2008 D. Larson  
L = 3.7 mm

Fig. C-37. *Peritrechus fraternus*.

AB SK MB CH PD PM

**Distribution:** 2. Nearctic, excluding Beringia. BC to QC, northeastern US, MO, KS, OK, CO, NM, CA and Mexico.

**Taxonomy:** Tribe Rhyparochromini. Sp v - 2,5,6,7.

Profemur ventrally with anterior margin with 2 or 3 prominent, but small setiferous teeth plus small denticles, posterior margin without elongate setae; male similar, but denticles more prominent.

See notes under *P. convivus* for recognition of additional species of *Peritrechus* from BC.

**Measurements (n = 20):** L = 3.8 to 4.5 mm (♂ = 3.8 to 4.4 mm; ♀ = 3.8 to 4.5 mm) (Scudder 1999, L = 3.8 to 5.3 mm); L/W = 2.44 to 2.83 (♂ = 2.65 to 2.83; ♀ = 2.44 to 2.64).

**Wing development:** Macropterous, WL/AL = 1.00 to 1.14

**Ecology:** Sweet (1964b: 124-130) described this as a common and widespread species in New England, but noted the majority of collections were from wash communities, such as the marine high tide strand line, and lake and stream margins. The species is most abundant in open or semi-open areas and where fresh litter has accumulated.

We have regularly collected specimens on the banks of reservoirs. Whether these are individuals that fell into the water in dispersal and washed up onto the shoreline or whether they represent a shoreline breeding population is unknown, but probably a combination of both.

The upper strand or wash line is rich in seeds and the bugs will feed on a variety of seed types. Sweet found millet to be the seed on which reared bugs did best.

The life cycle is univoltine with adults overwintering.

**Collecting:** Collected as early as April 28 on a snow bank.

#### D. Family Artheneidae – Cattail bugs

This family contains two introduced species in North America, both of which feed on the seeds of cattails (Wheeler 2002).

L = 3.0 to 4.5 mm, L/W = 2.44 to 2.70. Body relatively broad and depressed, elongate-oval and widest at about middle of length. Color dorsally yellow to ochreas with irregular coarse usually infuscate punctures, with variously developed fuscate pattern; ventral surface of head and thorax medially piceous; scutellum dark with a pale V-shaped mark; dorsal surface apparently glabrous with setae minute and inconspicuous. Head elongate, length from apex of clypeus to level of eyes about equal to width between eyes; mandibular plates nearly as long as clypeus and separated by fuscous grooves; antenna short, segment 1 not reaching apex of clypeus, segment 4 distinctly dilated and at middle about twice width of segment 3; ocelli large, situated at a distance of about equal to their own diameter from posterior margin of eye, not encircled by grooves or impression; head ventrally with bucculae very short, extended as a fine line along broad gular impression which reaches almost to hind margin of head; labium length various, short and reaching



Fig. D-1. Snug as a bug in a cattail rug, the overwintering site of cattail bugs.

procoxae or longer and extending to mesocoxae; thoracic sternae not impressed medially for reception of labium. Pronotum in dorsal aspect with anterior margin slightly concave, front angles protruding and not emarginate for reception of eye; anterior lobe of disc with more or less distinct, impunctate calli, transverse grooves absent; lateral margin with a translucent carina or flange along its entire length, noticeably broadened anteriorly and at impression between anterior and posterior lobes. Profemur not toothed ventrally. Wings full, basal half of costal margin explanate and transparent, with a prominent hypocostal ridge on ventral side, but this ending at about base of abdomen and distal half of wings contained within connexiva at rest; apex of corium straight. Ostiolar peritreme present as a simple vertical slit, not flared or modified dorsally. Abdominal venter with suture between sternae 4 and 5 straight and complete to lateral margin; segment 2 with spiracles dorsal, segments 3 to 7 with spiracles ventral.

This small family has a wide global distribution, but no species is native to North America. Two species have been introduced into North America. They are ecologically similar, living in the heads of cattails where they feed on the seeds (Fig. D-1). Hoffman (1996) reported both species are sexually dimorphic in both size and color: males about one quarter smaller than females and largely black ventrally; females lighter in color dorsally and ventrally only the meso- and metathorax darker brown. These differences are only weakly present in prairie populations.

#### Key to species of Artheneidae of North America (from Hoffman 1996)

1. Smaller, L = 3.0 to 3.5 mm. Pronotum with four more or less well-defined longitudinal smooth pale ridges; labium short, barely attaining front of procoxae, segment 2 not surpassing base of head. Dorsal surface dominantly light brown or yellowish-gray, little if at all infuscated; wing usually with only a posterior median diffuse brown spot present on corium; membrane without brown areas; head with paramedian dark stripes parallel and separated between eyes. ....  
..... *Holcocranum saturejae*
- 1'. Larger, L = 3.8 to 4.5 mm. Pronotum without four longitudinal smooth pale ridges; labium longer, reaching nearly to mesocoxae, over half of segment 2 surpassing base of head. Color darker, reddish brown, dorsally heavily infuscated with dark brown to black; wing membrane with diffuse brown areas; head with paramedian dark stripes converging between eyes. .... *Chilacis typhae* (Fig. D-2)

## *Holcocranum saturejae* (Kolenati)

**Distribution:** A European introduction. Not known from Canada. Widely distributed in US, but generally more southerly than *C. typhae*. State records extend from PA and NJ to FL (Hoffman 1996).

*Holcocranum saturejae* seems unlikely to be found in Canada, but it is included here to bring attention to its occurrence as it had been overlooked in the US under the assumption that bugs in cattail were *C. typhae*. Hoffman (1996) provided a habitus illustration.

**Measurements:** L = 3.0 to 3.5 mm (Hoffman 1996).

**Wing development:** Macropterous.

**Ecology:** This species feeds on seeds within the heads of cattails.

## *Chilacis typhae* (Perris)

AB SK

CH PD PM



*Chilacis typhae* (Perris)  
SK Battle Creek  
near Merry Flats  
Sept. 30, 2006  
D. Larson  
L = 4.1 mm

Fig. D-2. *Chilacis typhae*.

**Distribution:** 13. Introduced. A European introduction, first recorded from PA in 1986 (Wheeler & Fetter 1987). First Canadian record from BC (1999), now widely distributed, BC, AB, SK, ON, QC, NB, NS and PI. Also, in northern parts of eastern and western US (Wheeler 2002, Scudder 2010).

**Taxonomy:** A second species, *Holcocranum saturejae* (Kolenati), has also been introduced into North America, but seems unlikely to be found in Canada.

**Measurements (n = 20):** L = 3.8 to 4.5 mm ( $\sigma$  = 3.8 to 4.1 mm;  $\phi$  = 3.8 to 4.4 mm); L/W = 2.44 to 2.70 ( $\sigma$  = 2.48 to 2.70 ;  $\phi$  = 2.44 to 2.56).

**Wing development:** Macropterous.

**Ecology:** The ecology of this species in the northeastern US has been described by Wheeler & Fetter (1987). This species feeds on the heads of cattails. The bugs have a fondness, perhaps even dependency, for those heads fluffed out due to attack by the cattail caterpillar (*Limnaecia phragmitella* Stainton, Cosmopterygidae). The tunnelling of the caterpillars in the pistillate seed heads allows the bugs access to the tightly packed flowers and seeds on which they feed, and the webbing produced by the caterpillars holds the seedhead together overwinter so the seeds are available the next spring for the bugs to feed on. The bugs hibernate in the old, fluffed out seed head of cattails (Fig. D-1) (Wheeler & Fetter 1987, British Bugs 2013); we have found them there in early spring as well as in the leaf sheaths along with overwintering cattail caterpillars. Sunning and mating individuals have been observed on the sun-warmed side of seed heads as early as April 6 (Maple Creek, SK). Eggs are laid in the overwintered seed heads and nymphs develop in spring and early summer.

With the appearance of new flower heads, adults occur first on the new staminate parts then the lower pistillate parts later. In warmer areas of Europe two generations per year have been reported with nymphs overwintering in the seedheads along with adults. In the prairie region, diapausing adults are the predominant overwintering stage, but small numbers of large nymphs also overwinter. The number of prairie generations per year is not known.

**Collecting:** Overwintering specimens can be obtained by collecting cattail heads and bringing them indoors to encourage the bugs to emerge. However, be warned, it does not take much disturbance to cause the seeds to loosen and exponentially expand to fill containers, cars, etc. and to cover clothing. Thomas Henry (in litt., Jan. 2018) suggested placing infested seed heads in a clear plastic bag, then when the bugs emerge and crawl about the bag, they can be easily picked up or aspirated from the bottom of the bag. It is much more pleasant to pick the bugs off seed heads or staminate flowers in the spring. Southwood (1960) collected specimens in light traps in late summer, presumably when fight to new cattail occurs.

### E. Family Piesmatidae – Ash-gray Leaf Bugs

Small, length 2.0 to 3.5 mm. Body elongate-oval, depressed except pronotum, especially anteriorly, convex. Color pale gray to brown dorsally with head, pronotum medially and usually wings with brown to fuscous markings, ventral surface more extensively darkened; dorsal surface with very large, closely spaced punctures making surface alveolate, punctures not infuscate; surface glabrous. Antennae with segment 1 broad and granulate, segment 2 of about same length as 1 but narrower, segment 3 elongate and slender, segment 4 fusiform, shorter than to subequal in length to 3. Head dorsally with mandibular plates extending forward beyond clypeus as a pair of often distally upwards or inwardly curved horns; between eye and antennal socket with an anteriorly projecting antennal tubercle which is usually bifid; eye small, strongly convex and projecting laterally; ocelli present but often hidden beneath anterior margin of pronotum, situated in a groove that extends inwards from hind margin of eye then at ocellus curves forward towards base of antenna; ocelli smaller or obsolete in brachypters. Bucculae separated anteriorly, extending posteriorly to base of head and with areolate punctures; labium 4-segmented, short and barely extending beyond procoxae, prosternum deeply impressed and mesosternum shallowly impressed for its reception. Eye narrowly separated from pronotum and anterior margin of pronotum not impressed for its reception. Pronotum with lateral margin explanate, especially anteriorly, to form a **paranotum** (Drake & Davis 1958), paranotum ventrally with a deep longitudinal invagination laterad to procoxa (= propleural cavity, Drake & Davis 1958); pronotal collar absent; disc convex medially, anterior-medially with two or three longitudinal carina that cross stricture between anterior and posterior lobes, lateral to carina with smoother area (= callus or broad, poorly defined pronotal line). Scutellum relatively short and broad, its apex elevated and knob-like. Hemelytra completely covering abdomen, laterally costal margin with a sharp hypocostal ridge that clasps the sides of the abdomen; hemelytra of two forms: macropterous with hemelytron less convex laterally, more elongate and extending beyond apex of abdomen, with distinct clavus and claval suture and with membranous areas at apex overlapping, membranous area with four longitudinal veins, at the base of which and along costal margin wing coriaceous and areolate; and brachypterous with wing subequal in length to abdomen, more convex laterally, clavus and claval suture not evident, apical area coriaceous and areolate, without distinct membrane, and overlapping only at extreme tip. Profemur not swollen and not toothed ventrally; tarsi 2-segmented. Metathoracic scent gland auricle narrow, extending laterally to edge of wing. Abdomen with

suture between sterna 4 and 5 transverse and extending to lateral margin of abdomen; abdominal spiracles dorsal except those of segments 6 and 7 ventral, situated on low tubercles. Male with a stridulatory organ consisting of a stridulitrum on the under-surface of the cubital vein and a plectrum on terga 1 and 2 (Leston 1957, Drake & Davis 1958).

These small insects bear a resemblance to certain species of lacebugs (Tingidae) with which they share areolate sculpture, frontal projections on the head, and two-segmented tarsi. However, Drake & Davis (1958) reviewed the systematic position of the family Piesmatidae and concluded that similarities with the Tingidae are convergences and that their true position is with the lygaeoids, most closely related to the Cymidae. Henry (1997a) also supported this interpretation although Henry & Froeschner (1988) and Maw et al. (2000) placed the family in its own superfamily, Piesmatoidea, but within the Pentamorpha and close to the Lygaeoidea.

Both macropterous and brachypterous forms exist within the family. However, it is not clear if wing dimorphism occurs within any of the species. All specimens of the common species, *Parapiesma cinereum* and *Piesma explanatum*, are macropterous whereas all known specimens of *P. costatum* are brachypterous. Drake and Davis (1958) state that *P. patrule* occurs in both macropterous and brachypterous forms but did not give details on the frequency or provenance of the two forms. McAtee's (1919) types of *P. patrule* and the specimens we have examined are macropterous.

This small family is represented in North America by seven species which were keyed by McAtee (1919) and Drake & Davis (1958), all within the genus *Piesma*. Péricart (1974) subdivided the genus into *Parapiesma* Péricart which is Holarctic with one American species (*P. cinereum*), and *Piesma* s. str. which is also Holarctic and contains the other six American species.

These insects feed on plant fluids, apparently specializing in various genera of Chenopodiaceae and Amaranthaceae (Schaefer 1981). *Parapiesma cinereum* is a vector of the virus that causes Sugar Beet Savoy, which stunts sugar beet plants and reduces sugar yield (Drake & Davis 1958). However, there are no reports of this being a significant problem in Canada. Strickland (1953) reported *P. cinereum* in "moderate numbers" on alfalfa in Alberta and Blatchley (1926) gives records of feeding on other plants including a species of rush and grapes. All species apparently overwinter in the adult stage, on the ground in litter or plant debris or under bark of trees. Macropterous adults are common in lake drift in spring so flight dispersal to new hosts apparently occurs at this time.

**Key to species of Piesmatidae of the Prairie Provinces**

1. Metasternum broad and flat, anterior and posterior margins subequal in width, hind margin subequal in width to width of a metacoxa. .... *Parapiesma cinereum* (Fig. E-1)
- 1<sup>?</sup>. Metasternum somewhat triangular, anterior margin broader than posterior and somewhat concave with anterior-lateral angles projecting; hind margin about one half to two-thirds width of a metacoxa (Fig. E-2). .... 2
- 2(1). Pronotum with lateral margin broadly explanate, anterior paranotum with two more or less distinct rows plus intercalated areoles: antenna elongate, width head/length antennal segment 3 = 1.72 to 1.93. Larger, L = 2.7 to 3.3 mm..... *Piesma explanatum* (Fig. E-2)
- 2<sup>?</sup>. Pronotum with lateral explanation narrower, anterior paranotum with a single row of marginal areolae between lateral margin and convex disc; antenna short, width head/length antennal segment 3 = 2.17 to 2.75. Smaller, L = 2.0 to 2.8 mm. .... 3
- 3(2). Macropterous, body elongate; dorsal surface mainly ivory-colored with head, median area of pronotum and base of scutellum dark brown to piceous, ventral surface mainly pale yellowish with variably developed infuscation on mesosternum and abdomen; pronotum with a pair of short longitudinal carinae that barely span dorsal constriction between front and hind lobes..... *Piesma patrule* (Fig. E-3)
- 3<sup>?</sup>. Brachypterous, body more broadly ovate; dorsal surface dull white with darker spots along costal margin of hemelytron and vaguely showing elsewhere on hemelytron and ventral surface; pronotum disc with a median carina that extends almost its full length, a pair of slightly shorter and sinuate submedial carina and raised areas near lateral margin of middle and posterior portions of disc. .... *Piesma costatum* (Fig. E-4)

## *Parapiesma cinereum* (Say)

AB SK MB CH PD PM PP BP BS

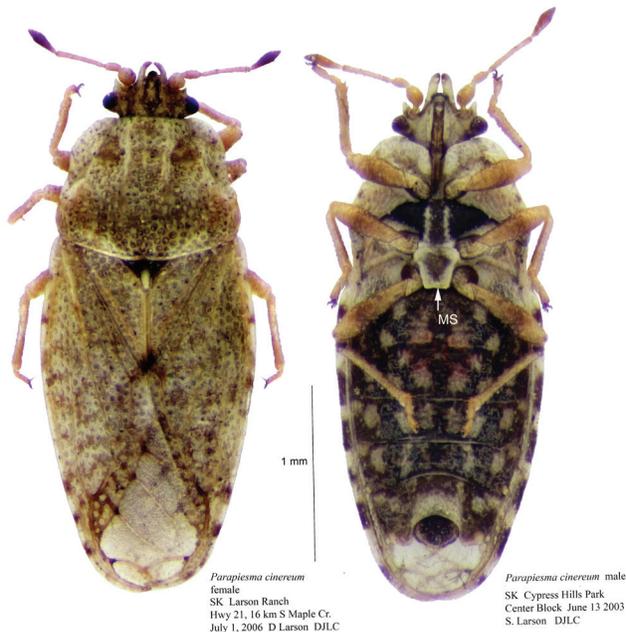


Fig. E-1. *Parapiesma cinereum*.

been collected several times under prostrate pigweed growing in vegetable gardens. Specimens have been collected from lake drift from June 4 to 18.

**Collecting:** When discovered on the ground these insects are rather sluggish and either remain immobile or move slowly, but they can take a collector by surprise for they can take wing and fly off very suddenly. Specimens are often abundant in lake drift. They are seldom taken by sweeping so they must spend most of their life on the ground surface.

**Distribution:** 10. Nearctic-Neotropical. YT and BC to QC. Throughout the US, south to Argentina and West Indies.

**Taxonomy:** The genus *Parapiesma* was proposed as a subgenus of *Piesma*. The broad, flat metasternum makes this species easily recognizable. The antennae are relatively elongate and the paranota are narrower than those of the similar *Piesma explanatum*.

**Measurements (n = 20):** L = 2.7 to 3.3 mm ( $\sigma^7$  = 2.7 to 3.3 mm;  $\sigma^8$  = 3.0 to 3.3 mm) (Drake & Davis 1958 – 3.50 mm); L/W = 2.33 to 2.62 ( $\sigma^7$  = 2.39 to 2.62;  $\sigma^8$  = 2.33 to 2.58). Antenna: length segment 3/length segment 4 = 1.21 to 1.54; width head/length antennal segment 3 = 1.67 to 1.88.

**Wing development:** Macropterous.

**Ecology:** Principal hosts are various species of the plant families Amaranthaceae and Chenopodiaceae, many of which are common introduced weeds of grassland areas. Specimens can often be found in spring and early summer under seedlings and small plants that are growing on light soil in open areas. The species has

## *Piesma explanatum* McAtee

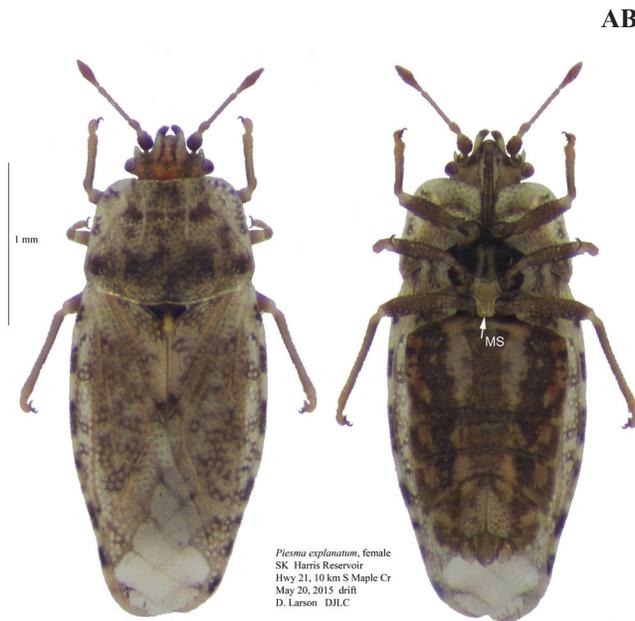


Fig. E-2. *Piesma explanatum*.

AB SK MB CH PD PM PP

**Distribution:** 5. Western Nearctic, excluding Beringia. BC to MB; recorded in the US from UT.

**Taxonomy:** This species is similar in size and color to *Parapiesma cinereum*, but the dorsal markings are generally more pronounced and specimens on average appear darker. The relatively elongate antenna, broad pronotum, the posteriorly narrowed metasternum and relatively large size of *P. explanatum* allow specimens to be easily recognized.

**Measurements (n = 10):** L = 2.7 to 3.3 mm ( $\sigma^7$  = 2.7 to 3.2 mm;  $\text{f}$  = 3.0 to 3.3 mm); L/W = 2.47 to 2.88 ( $\sigma^7$  = 2.58 to 2.88;  $\text{f}$  = 2.47 to 2.76). Antenna: length segment 3/length segment 4 = 1.23 to 1.38; width head/length antennal segment 3 = 1.72 to 1.93.

**Wing development:** Macropterous.

**Ecology:** Host plant data is not associated with any specimen examined.

**Collecting:** Most specimens have been collected from lake drift, May 20 to June 24. A specimen was collected while weeding a vegetable garden (June 12) and was probably under prostrate pigweed.

# *Piesma patruеле* McAtee

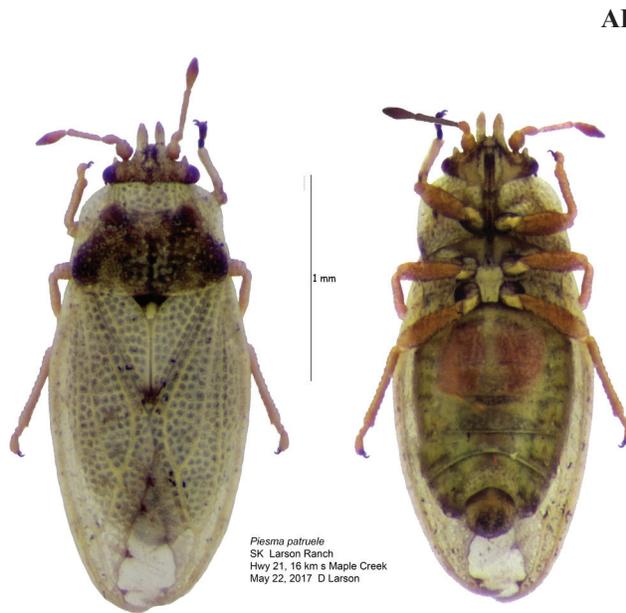


Fig. E-3. *Piesma patruеле*.

subapical area with somewhat obsolete veins is present and the hind wings are subequal to the abdomen, so it is likely the specimen could fly. Drake & Davies (1958) state both macropterous and brachypterous specimens occur but did not describe the brachypters or indicate where they were collected.

**Ecology:** Host plant, Lamb's-quarters (Drake & Davis 1958).

**Collecting:** One specimen was collected in lake drift (April 29) and two collected by sweeping mixed grassland (May 22).

AB SK CH PD

**Distribution:** 5. Western Nearctic, excluding Beringia. AB and SK (new record. Larson Ranch, Hwy 21, 16 km S Maple Creek, D. Larson, DJLC (May 22, 2017 (1♂), DJLC, June 7, 2018 (1♂)); Cypress Lake, dam, east end, drift, April 29, 2015, D. Larson. 1♀ DJLC. In US reported from AZ and TX.

**Taxonomy:** Generally recognized by small size, more or less bicolored body, fully developed wings and short antennae.

**Measurements (n = 4):** L = 2.0, 2.3, 2.8 mm (♂), 2.7 mm (♀) (McAtee 1919, 2.25 mm; Drake & Davis 1958, 2.25 to 2.75 mm); L/W = 2.19, 2.40, 2.52 (♂), 2.27 (♀). Antenna: length segment 3/length segment 4 = 1.09 to 1.20; width head/length antennal segment 3 = 2.17 to 2.50.

**Wing development:** Prairie specimens and types from AZ and TX are macropterous. Three prairie specimens have WL/AL = 1.13 to 1.23. A small ♂ (L = 2.0 mm) has distinctly shorter wings, WL/AL = 1.09, and in general body form is more ovate with the costal margin of the hemelytra more strongly convex. However, the hemelytra overlap apically, a small membranous

## *Piesma costatum* (Uhler)

AB SK

CH PD

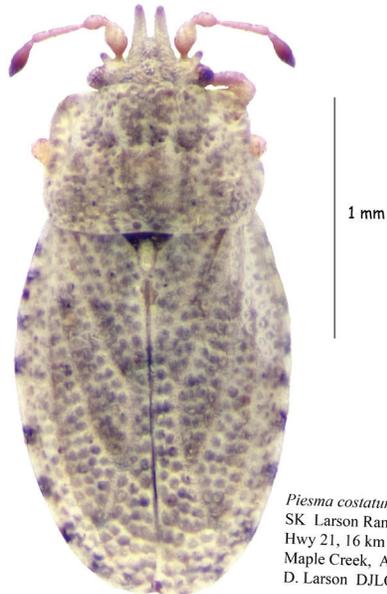


Fig. E-4. *Piesma costatum*.

**Distribution:** 5. Western Nearctic, excluding Beringia. AB and SK (new record, Larson Ranch, Hwy 21, 16 km S Maple Creek, April 14, 2012, D. Larson. 1♂; April 30 – May 2, 2018. Many. DJLC)). Western US, AZ, CA and CO.

**Taxonomy:** The only brachypterous specimens of piesmatids we have seen from the Prairie Provinces belong to this species. In some specimens, the cuticle surface is covered with a dense frosting of fine, white scales (observe at 100X) so appearing dull white with darker spots along the costal margin of the hemelytron and vaguely showing elsewhere on hemelytron and ventral surface beneath scales. This surface covering, possibly a wax exudate best seen at high magnification on ridges and veins, appears to be unique to the species although it is lacking in some specimens that may be older and rubbed.

**Measurements (n = 20):** L = 2.2 to 2.8 mm (♂ = 2.2 to 2.5 mm; ♀ = 2.4 to 2.8 mm) (McAtee 1919, 2 to 2.25 mm); L/W = 1.97 to 2.26 (♂ = 2.12 to 2.26; ♀ = 1.97 to 2.17). Antenna: length segment 3/length segment 4 = 1.00 to 1.20; width head/length antennal segment 3 = 2.50 to 2.75.

**Wing development:** Brachypterous. Forewings about equal in length to abdomen, their inner margins meeting in a straight line except the apices shortly overlapping, apical area coriaceous and punctate. Hind wing reduced to a small flap.

**Ecology:** Overwintering adult specimens have been collected in April and May from amongst litter under the prostrate branches of Nuttall's atriplex, a low-growing perennial shrub. This plant is common on dry, sparsely vegetated clay flats and alluvium of the dry prairie region.

**Collecting:** One specimen was collected by sweeping mixed grasslands (April 14), but all others have been found on the woody stems and surface roots of the host plant.

### F. Family Cymidae – Sedge Bugs

These bugs have a narrowly fusiform shape in which the body is more or less evenly widened from the narrowly pointed head to point of maximum width just behind middle then narrowed, but more bluntly rounded posteriorly.

Length 3.3 to 5.0 mm. Body elongate, fusiform. Color yellow to fuscous dorsally with at least wings yellow to brownish; dorsal surface coarsely punctate, but punctures not infuscate; setae short and inconspicuous dorsally, ventrally with longer, recurved white setae on head and thorax; these surfaces also gray pruinose (a hydrofuge surface?). Antennae with segments 2 and 3 elongate and slender, segment 4 shorter and medially broadened. Head dorsally with ocelli well removed from eye, each at the posterior end of an impressed line that extends from base of antenna back to encircle ocellus and branch laterally to inner margin of eye. Bucculae short and ovate with hind margin produced as a bluntly rounded or somewhat pointed lobe; labium length various, head ventrally and mesosternum grooved for its reception. Eye well separated from pronotum and anterior margin of pronotum truncate. Pronotum with lateral margin rounded or with a low, thick lateral ridge extending from front angle to just behind level of callus then obsolete posteriorly; disc of anterior lobe with an impunctate area each side of middle, without transverse impressed lines. Wings long and extending beyond apex of abdomen, laterally costal margin with a sharp hypocoastal ridge that clasps the sides of the abdomen; corium with apical margin more or less straight or shallowly emarginate near apical-lateral angle. Profemur not toothed ventrally. Metathoracic scent gland

auricle short, somewhat projecting as a rounded knob. Abdomen with suture between sterna 4 and 5 transverse and extending to lateral margin of abdomen; abdominal spiracles all dorsal except those of segment 7 ventral.

Henry (1997a) clearly showed that these bugs are lygaeoids and are the sister group to the malcid line, which includes the Berytidae as well as the exotic families Malcidae, Ninidae, and Colobathristidae.

Hamid (1975) reviewed the taxonomy of the group and provided keys to world genera and species. Three genera occur in North America, but only the genus *Cymus* occurs as far north as Canada. Five of the nine North American species of *Cymus* occur in Canada of which four have been found in the Prairie Provinces.

Hamid (1971) described the ecology of some northeastern United States species. These insects occur in wet areas along the edges of streams and ponds where their host plants, sedges, rushes and bulrush grow (Fig. F-1). Adults may feed across a range of host species, but Hamid (1971) found that the nymphs are more host specific. He also noted a difference in the life history phenology of co-occurring species. Adults overwinter and all species are univoltine. Mating and egg laying occur in the spring, but the nymphs of the different species apparently develop on the seed heads of the host plants at different times over the summer. Slater (1954) described the mating position as side by side as opposed to end to end as in the other Lygaeoidea.

Specimens are usually collected by sweeping host plants or by treading (depressing vegetation down into soft mud or water with one's foot so that insects are forced up to the surface of the mud or water). Specimens are



Fig. F-1. Lyons Creek, SK, a seasonal creek with bankside patches of rushes and sedges supporting *Cymus luridus* and *C. coriacipennis*.

often common in lake wash. The association with water may explain the hemelytral hypocostal ridge. This ridge allows the wings to closely clasp the side of the abdomen to produce a sub-hemelytral air space into which the dorsally situated abdominal spiracles open. This would keep the spiracles water-free in case of submergence which is very likely to occur in species living in marshes and adjacent to water.

The littoral habitat occupied by these insects is very unstable. Water levels and shorelines of prairie wetlands wax and wane seasonally, between years and even over the course of a few days in response to rainfall events. Survival of the bugs depends upon their ability to disperse in response to these changing conditions. Overwintering probably occurs in upland sites for the littoral zone of prairie wetlands and streams are typically covered by ice and water during spring runoff. As water levels stabilize

in the spring the bugs colonize emergent host plants then track suitable host patches as they dry out (or possibly flood) over the summer. The importance of flight in the life cycle of sedge bugs is indicated by the fact that brachyptery does not occur in the local fauna, the adult bugs, while not particularly active, do fly readily when captured in a sweep net, and the insects are often a major component of the lake wash fauna. Collecting labels on specimens of *Cymus* that we have examined indicate the bugs have been collected on an extremely wide variety of plants, ranging from fungi to trees to agricultural crops and ornamentals. This wide range of plant associations certainly doesn't indicate the host range which is quite definitely wetland monocots, but rather is a reflection of the vagility of specimens which results in specimens showing up almost anywhere.

**Key to species of Cymidae of the Prairie Provinces**

- 1. Clypeus greatly produced beyond anterior end of bucculae and extending well beyond apex of antennal segment 1; labium short, segment 2 extending slightly beyond anterior margin of pronotum and tip of labium ending on anterior portion of mesosternum; antenna segment 3 slightly longer than 2, ratio length 3/ length of 2 = 1.10 to 1.22; color pale brown to fuscous with wings uniformly pale yellow, antennal segments 2 and 3 and tibia and tarsi paler. L = 3.4 to 4.1 mm; L/W = 2.94 to 3.07..... *Cymus coriacipennis* (Fig. F-2)
- 1?. Clypeus with apex slightly produced forwards of bucculae, apex of clypeus at most extending slightly beyond apex of antennal segment 1; labium elongate, segment 2 extending considerably past anterior margin of prosternum and reaching or nearly reaching procoxa and tip of labium extending to hind portion of mesosternum or farther; relative length of antennal segments 2 and 3 various; color paler, yellow to pale brown with various development of brown to fuscous including on wing, with less color contrast between forebody and wings. .... 2
- 2(1). Antenna segment 3 elongate, ratio length segment 3/length segment 2 = 1.50; pronotum with lateral margin evenly rounded, disc of anterior lobe and scutellum with median ridge obsolete; scutellum dark brown. L = 3.7 to 4.5 mm. .... *Cymus angustatus* (Fig. F-3)
- 2?. Antenna with segments 2 and 3 subequal in length, length segment 3/ length segment 2 = about 1.0; pronotum lateral margin with a low, blunt lateral ridge along anterior lobe, disc of anterior lobe and scutellum with a distinct, paler longitudinal ridge. Length various. .... 3
- 3(2). Smaller, L = 3.3 to 3.6 mm; body slightly more ovate, L/W = 2.72 to 2.94; labium shorter, apex ending on posterior portion of mesosternum and not attaining metasternum; color generally paler, mainly testaceous to pale brown. .... *Cymus discors* (Fig. F-4)
- 3?. Larger, L = 4.0 to 5.0 mm; body more elongate, L/W = 3.00 to 3.25; labium more elongate, its apex reaching metasternum or even base of abdomen; color generally darker, reddish brown, pronotum and hemelytra usually with darker areas. .... *Cymus luridus* (Figs. F-5, F-6)

## *Cymus coriacipennis* (Stål)

SK

CH PD



*Cymus coriacipennis* (Stål)  
SK Larson Ranch, 16 km S  
Maple Creek June 8, 2004  
D. Larson  
L = 3.7 mm

**Distribution:** 5. Western Nearctic, excluding Beringia. This is primarily a western species known in Canada from BC and southwestern SK (Scudder 2010); in the western states from WA and ID to CA and NM.

**Taxonomy:** The species is distinctive on the basis of its dark color, prolonged snout (clypeus) and short labium. The lateral margin of the pronotum is rounded or with a faint, low longitudinal ridge, and the median ridge of the anterior pronotal lobe and scutellum is low.

**Measurements (n = 6):** L = 3.4 to 4.1 mm (♂ = 3.4 to 3.7 mm; ♀ = 3.4 to 4.1 mm); L/W = 2.68 to 3.07 (♂ = 2.94 to 3.07; ♀ = 2.68 to 2.97).

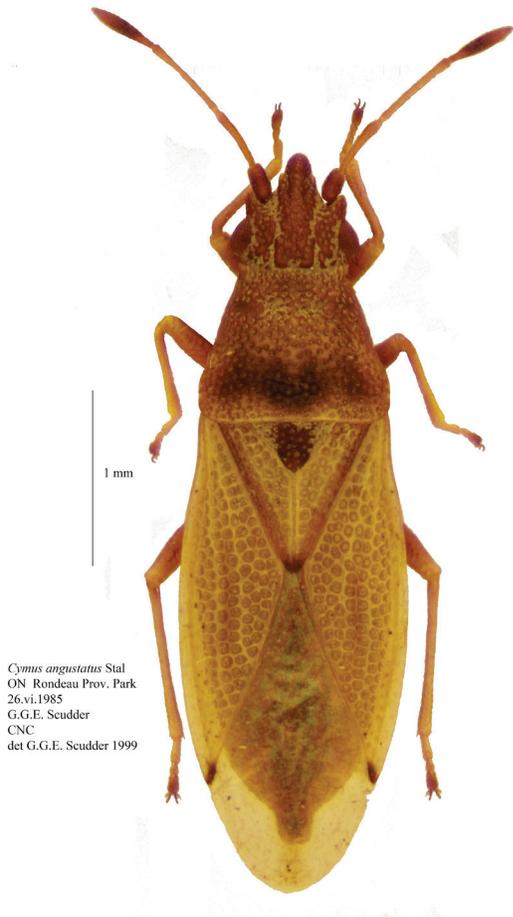
**Wing development:** Macropterous.

**Ecology:** Specimens have been collected by sweeping vegetation along the edges of permanent ponds and slow streams. Host plants are unknown, but they have been swept from pond margins where rushes were abundant.

**Collecting:** The species is uncommon. Specimens can generally be recognized in the field as they are usually smaller and darker than the much more common *C. luridus*.

Fig. F-2. *Cymus coriacipennis*.

# *Cymus angustatus* Stål



*Cymus angustatus* Stål  
ON Rondeau Prov. Park  
26.vi.1985  
G.G.E. Scudder  
CNC  
det G.G.E. Scudder 1999

Fig. F-3 *Cymus angustatus*.

AB MB PM

**Distribution:** 6. Eastern Nearctic. Eastern species, Maw et al. (2000) recorded it in Canada from MB to NS. Recorded from AB (Lethbridge: Strickland 1953, Slater & Baranowski 1990) but we have seen no AB specimens. MB specimens have been seen from Reynolds (AACS) and Seddon's Corner (MMMN). The species occurs throughout much of the US east of the Rocky Mountains, also in AZ and Mexico.

**Taxonomy:** Measurements are based on 3 ON specimens (CNC).

**Measurements (n = 3):** L = 4.1 to 4.3 mm (3.7 to 4.5 mm, Hoffman 1996); L/W = 2.97 to 3.29.

**Wing development:** Macropterous.

**Ecology:** Blatchley (1926) stated that *C. angustatus* occurs on various species of sedge and rush, whereas Slater (1952) said the food plant is *Scirpus atro-virens* and probably other species of rush and sedge. Hamid (1971) found adults on sedges, rushes and bulrush, but nymphs were only on sedges. When found with *C. luridus*, the nymphs of *C. angustatus* developed later in the season.

**Collecting:** Although the hosts are sedges, rushes and bulrush, specimens are often swept from other plants.

# *Cymus discors* Horváth



*Cymus discors* Horváth  
 ON One Sided Lake  
 1.VIII.60  
 Kelton & Whitney  
 CNC  
 det G.G.E. Scudder 1982

Fig. F-4. *Cymus discors*.

## MB

## BS

**Distribution:** 6. Eastern Nearctic. Canada from MB to NS. We have seen MB specimens from Falcon L (CNC) and Telford (CNC). In northeastern US east of Great Plains, south to NC, TN and GA and also reported from CO.

**Taxonomy:** Barber (1924) stated that antenna segment 2 is a very little longer than segment 3 which is subequal in length to 4. Hamid (1975) and Slater and Baranowski (1990) described antennal segment 2 as slightly longer than segment 3.

**Measurements (n = 2):** L = 3.3 to 3.6 mm; L/W = 2.72 to 2.94.

**Wing development:** Macropterous.

**Ecology:** Adults reported from sedges, rushes and bulrush. Nymphs develop late in the season on the seed heads of *Scirpus cyperinus* (L.) (Hamid 1971), a species not known from the prairies (Scoggan 1978).

**Collecting:** This is a common species of eastern Canada, but it only just enters the Prairie Provinces in southeastern MB. We have seen ON and QC specimens labelled as having been swept from a variety of plant species.

# *Cymus luridus* Stål

AB SK MB CH PD PM PP BP

**Distribution:** 2. Nearctic, excluding Beringia. NT and BC to NL. Northern US, extending south in the west to CA, AZ, NM and into Mexico.

**Taxonomy:** This species varies considerably in color from almost entirely yellow to extensively dark brown or fuscous. Antennal segments 2 and 3 are subequal in length. The length of the labium varies between specimens from just reaching the anterior margin of the metasternum to touching the base of the abdomen. Males generally have longer labia than females, but a specimen of each sex (SK, Harris Reservoir) has been seen with the long labium condition. These two specimens are at the smaller end of the length range (L = 4.0 and 4.3 mm; L/W = 3.05 and 3.18) and are relatively darkly pigmented, but do not seem to differ in any other way. The pale median longitudinal carina of the pronotum is quite distinct and extends posteriorly beyond the middle of the disk.

**Measurements (n = 20):** L = 4.0 to 5.0 mm (♂ = 4.0 to 4.5 mm; ♀ = 4.2 to 5.0 mm); L/W = 3.00 to 3.25 (♂ = 3.00 to 3.19; ♀ = 3.00 to 3.25).

**Wing development:** Macropterous

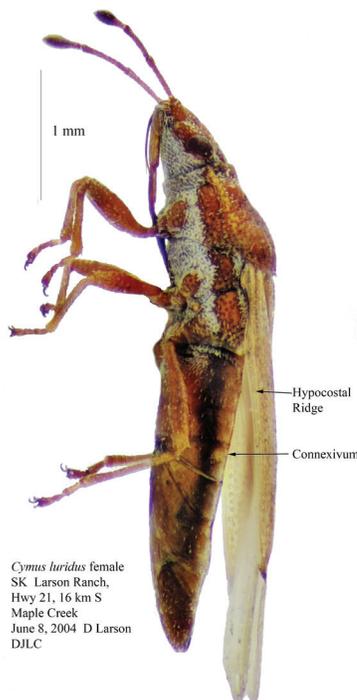
**Ecology:** The species is common on rushes and sedges growing in moist sites and at the edge of water. It has been reported to breed on *Carex vesicaria* L., but as this species does not occur within the area (Leighton 2012) there must be other hosts. Hamid (1971) reports that in CT, *C. luridus* first live on *Carex versicana* but later in the season switch to *Juncus brachycephalus* and *Scirpus lyparinus*.

**Collecting:** Commonly collected by sweeping vegetation along pond and stream shorelines as well as in wet areas, also often common in lake drift. Like the other species of *Cymus*, specimens have been recorded as having been swept from a diverse array of plant species.



*Cymus luridus* Stål  
SK Cypress Lake,  
east dam Sept. 24, 2006  
D. Larson  
L = 4.8 mm

Fig. F-5. *Cymus luridus*, dorsal.



*Cymus luridus* female  
SK Larson Ranch,  
Hwy 21, 16 km S  
Maple Creek  
June 8, 2004 D Larson  
DJLC

Fig. F-5. *Cymus luridus*, lateral.

### G. Family Pachygronthidae

The members of this family are characterized by being elongate to oblong and stout bodied, head short and inserted into thorax to level of eyes and anterior-lateral angle of thorax slightly concave for reception of eye; the front femur is very robust and armed beneath with many large spines, suture between abdominal sterna 4 and 5 not curved forwards laterally, and all abdominal spiracles ventral.

Two subfamilies, Pachygronthinae and Teracriinae, occur in North America. The members of these subfamilies are of quite different appearance, so the following more detailed description applies only to the prairie member of the family (*Phlegyas abbreviatus*, subfamily Teracriinae). Small to medium sized, L = 3.5 to 4.5 mm. Body subcylindrical, somewhat depressed. Body very coarsely punctate, punctures not infuscate; with patches of short, appressed whitish setae. Head short, front strongly sloped downwards and almost vertical in lateral aspect; eyes strongly convex, touching anterior margin of pronotum, ocelli in deep groove that extends in C-shaped arc from inner margin of eye; antenna short; antennal base separated from labium by a prominent rounded tubercle; bucculae short and rounded, labium short, reaching level

of mesocoxae, mesosternum only slightly impressed for its reception. Pronotum widest at middle, anterolateral angle shallowly emarginate to receive eye; hind angles flaring; division into anterior and posterior lobes vague, anteriorly without transverse grooves or well defined calli. Wing narrower and shorter than abdomen; clavus short, barely extending beyond apex of scutellum and commissure absent; corium with hind margin strongly emarginate. Profemur greatly enlarged, ventrally armed with a row of strong teeth along distal half of anterior-ventral margin. Scent gland orifice small and knob-like, without distinct evaporatorium. Abdomen with suture between sterna 3 and 4 obsolete laterally, suture between sterna 4 and 5 straight laterally and continuous to lateral margin; abdominal spiracles 3 to 7 ventral. Female with ovipositor dividing sternum 7.

Slater (1955) revised this mainly tropical to subtropical family. Seven species occur in North America north of Mexico, three of these in Canada, but only one, *Phlegyas abbreviatus*, is known from the Prairie Provinces. These insects breed on monocots; members of the subfamily Teracriinae on grasses whereas those of Pachygronthinae are on sedges and cyperus as well as some grasses.

### Key to genera and species of Pachygronthidae of Canada

(modified from Slater & Baranowski 1978, 1990)

1. Body elongate-ovate. Antenna elongate, segment 1 considerably exceeding apex of clypeus; mandibular plate raised into a carinate ridge along lateral margin; clavus wider especially near apex and its commissure distinct; color bright yellowish-brown with a pale medial stripe on pronotum, scutellum with a pale calloused stripe on each side. L = 6.0 to 6.5 mm. (Pachygronthinae).....*Oedancala dorsalis*
- 1'. Body robust, subcylindrical and somewhat dorsally depressed. Antenna short, segment 1 at most only slightly surpassing tip of clypeus; mandibular plate with lateral margin not raised and carinate; clavus narrow, apically not forming distinct commissure; color various, usually darker, pronotum without a pale median stripe, scutellum lacking a pale calloused stripe on each side. Smaller, L = 3.5 to 4.5 mm. (Teracriinae). ....*Phlegyas*, 2
- 2(1). Color reddish brown with darker fuscous to black markings; antenna with segment 2 twice length of segment 1, segment 2 at least 1.00 to 1.11 times length of segment 3. L = 3.5 to 4.5 mm, L/W = 2.40 to 2.55. ....*Phlegyas abbreviatus* (Fig. G-1)
- 2'. Color dull pale yellow with dark reddish markings; antennal segment 2 nearly 2.5 times length of segment 1, segment 2 at least 1.20 to 1.28 times length of segment 3. Measurements similar to *P. abbreviatus*.....*Phlegyas annulicrus*

## *Oedancala dorsalis* (Say)

**Distribution:** Not known from Prairie Provinces. Eastern Canada, ON and QC. Widely distributed in US east of Rocky Mountains, north on Great Plains to SD and NE.

**Taxonomy:** There are 3 additional, more southerly species of *Oedancala* in the US, which are keyed and described by Slater and Baranowski (1990).

**Measurements:** L = 6.0 to 6.3 mm (Froeschner 1944).

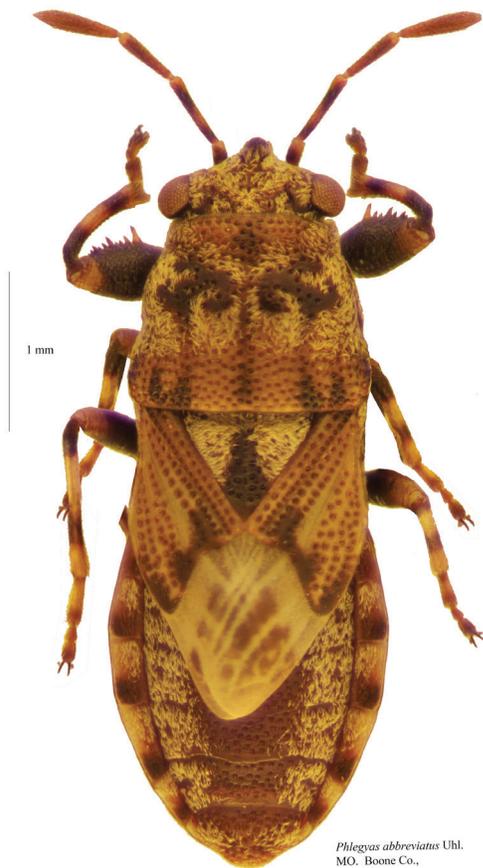
**Wing development:** Both macropterous and brachypterous.

**Ecology:** Reported as feeding on seed heads of bulrush and sedges in moist places.

## *Phlegyas abbreviatus* (Uhler)

MB

BS



*Phlegyas abbreviatus* Uhl.  
MO, Boone Co.,  
Columbia  
VII - 1979  
det G.G.E. Scudder 1986  
CNC

Fig. G-1. *Phlegyas abbreviatus*.

**Distribution:** 6. Eastern Nearctic. Eastern Canada, southeastern MB to NS. Widely distributed in US except for northern plains and Rocky Mountain states where most northerly records are for WY, NE and MN. The MB record is: Falcon Lake, Whiteshell Prov. Park (CNC).

**Taxonomy:** Measurements (n = 3 specimens from MB, ON, and MO): L = 3.5 to 4.5 mm (Froeschner 1944, 3 to 5 mm); L/W = 2.40 to 2.55.

**Wing development:** Both macropterous and brachypterous. WL/AL = 0.95 (macropterous) and 0.62 and 0.68 (brachypterous).

**Ecology:** A grass feeder, reported from moist grassy meadows, and especially on *Poa*. Blatchley (1926) stated the species could be taken from April to October by sweeping weeds and grass in meadows, pastures and waste places. Slater (1955), who also describes the species, reported it from big blue stem.

**Collecting:** We have not collected prairie specimens.

## *Phlegyas annulicrus* Stål

**Distribution:** Not known from Prairie Provinces. In Canada, only from southern BC. Western and southern US.

**Taxonomy:** Characters given above are based on the key and description of Slater and Baranowski (1990).

**Wing development:** Both macropterous and brachypterous.

**Ecology:** A grass-feeder like *P. abbreviatus*. In the south Okanagan of BC, the species breeds only on red three-awn grass. This grass occurs uncommonly on gravelly slopes in the southwestern part of the Prairie Provinces (Budd & Best 1969) where *P. annulicrus* should be looked for.

## H. Family Blissidae (Chinch bugs)

The smaller members of this family, genus *Blissus*, are known as chinch bugs.

Small to medium sized, length 2.0 to 5.0 mm, body elongate, parallel-sided and somewhat depressed. Color fuscous to black with wings paler, antenna variously infusate, legs reddish-yellow. Body setose with somewhat recurved shorter setae and often less dense long erect setae which are also present on base of wings. Coarse punctures reduced, but present at least medially or on basal lobe of pronotum and on scutellum, absent from wings or only weak along veins. Many specimens with surfaces of thorax dull and pruinose (dull matte surface formed of dense very small setae) with the extent and pattern of pruinosity differing among species. Head short, eyes prominent and separated from anterior margin of pronotum, frons without impressed lines and ocelli not in or encircled by lines; bucculae very short, labium length various, if elongate meso- and metasterna shallowly impressed for its reception. Pronotum with lateral margin smoothly rounded and without lateral carinae, anterior angles not emarginate for reception of eye; calli not evident, without transverse grooves. Wing dimorphism common, even macropters with folded wings narrow and lying between margins of abdomen; corium with apex slightly to distinctly emarginate near commissural angle. Profemur without ventral spines (present in some taxa from outside the region). Abdominal venter with suture between sterna 4 and 5 transverse and extending to lateral margin of abdomen; abdominal spiracles dorsal except those of segment 7 ventral.

Members of this family feed on sap of monocotyledonous plants (Fig. H-1). Species of *Ischnodemus*, which occur on stems and leaf sheaths, occur largely on grasses of marshy or wet areas

whereas those of *Blissus*, which occur more in the crown and bases of grasses, are in dryer, well drained habitats. Chinch bugs (*Blissus*) feed on the sap of grasses (Poaceae), both native and cultivated, and can sometimes occur in damaging numbers. They seem to be favored by warm, drier conditions so their numbers can fluctuate considerably depending upon weather as well as local site conditions. Adults overwinter then have an extended period of egg laying in late spring and early summer so that aggregations of bugs in various stages of development are often seen. There may be more than one generation per year, but the life history patterns for prairie populations are not known. Leonard (1966, 1968) found some species to be univoltine whereas others have continuous generations if conditions are suitable. In lab-based studies female *B. leucopterus* were found to lay an average of about 500 eggs with some laying up to 1000. With eggs laid over a long period of time it is difficult to identify the limits of the various generations on the basis of field collections. Nymphs that do not reach adulthood by fall do not survive the winter (Leonard 1966). Wing dimorphism occurs in all species although the degree and frequency of wing reduction differs between species. Macropterous specimens are often common in lake drift.

The taxonomy of the group is complex. Slater (1979) treated the world fauna with emphasis on the phylogenetic relationships within the group. The family is relatively poorly represented in North America where there are four genera containing about 30 species (Henry & Sweet 2015). The most diverse Nearctic genus, and the economically most important group of the Lygaeoidea, is *Blissus*, the chinch bugs. Leonard (1966, 1968) treated eastern North American species, but those of the west, including the Great Plains, need study. Henry and Sweet (2015) added a new genus and species and provided a key to separate the North American genera.



Fig. H-1. Bliss is grass to *Blissus*. *Blissus canadensis* has been found in such dense grasses, but are generally more common in short, more open grasses.

**Key to genera and species of Blissidae of the Prairie Provinces**

1. Rostrum short, its apex not extending beyond procoxae; procoxae closed posteriorly; larger species, body elongate and slender. L = 3.5 to 5.0 mm; L/W = 4.3 to 4.7 ..... *Ischnodemus hesperius* (Fig. H-2)
- 1'. Rostrum longer, reaching beyond mesocoxae; procoxae open posteriorly; smaller, body more robust. L = 2.1 to 4.0 mm; L/W = 2.8 to 3.1 ..... *Blissus*, 2
- 2(1). Macropterous specimens (wings more or less as long as abdomen)..... 3
- 2'. Brachypterous specimens (wings not extending posteriorly beyond hind margin of tergite 4)..... 4
- 3(2). Larger, L = 3.2 to 4.0 mm; antenna darker, pale basally with apex of segment 2 and almost all of segments 3 and 4 dark piceous; femora fuscous; head and anterior lobe of pronotum pruinose tending to make pronotum clearly two-toned..... *Blissus leucopterus* (see 4(2))
- 3'. Smaller, L = 2.8 to 3.5 mm; antenna paler, most specimens with only segment 4 piceous, some with segment 3 lightly infuscate; femora pale and ochraceous; pronotum with pruinosity extending onto posterior lobe which may be totally pruinose, pronotum not or less obviously two-toned. .... *Blissus canadensis* (see 4')
- 4(2). Larger, L = 3.2 to 3.6 mm; wing longer, usually extending to at least base of tergite 4 and covering narrow tergite 3, ratio of length of wing/length of abdomen = 0.39 to 0.48. .... *Blissus leucopterus* (Fig. H-4)
- 4'. Smaller, L = 2.1 to 2.8 mm; wing shorter, exposing narrow tergite 3, ratio of length of wing/length of abdomen = 0.21 to 0.28. .... *Blissus canadensis* (Fig. H-5)

# *Ischnodemus hesperius* Parshley

MB

PP



*Ischnodemus hesperius*  
Parshley, male  
(from Scudder 2014)

Fig. H-2. *Ischnodemus hesperius*.

**Distribution:** 6. Eastern Nearctic. In Canada confined to the tallgrass prairie areas of Manitoba, west to Horton (Scudder 2014b). US distribution in the middle and Great Lakes states, SD to KS and east to IL.

**Taxonomy:** A similar species, *I. falicus* (Say), occurs in eastern Canada, ON to NS, and much of the eastern US from New England to NC and TX. It is common on prairie cord grass (Paiero *et al.* 2010).

The keys to North American *Ischnodemus* presented by Torre-Bueno (1946) and Slater (1979) are difficult to interpret, but include the following characters to separate the two Canadian species.

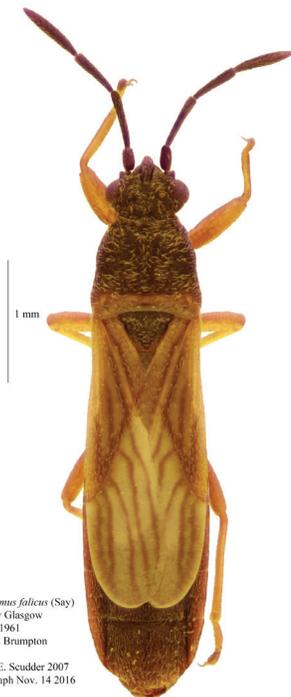
1. Macropterous or submacropterous (membrane slightly shortened); antenna with segment 2 longer than 3; veins of hemelytra darker brown and distinct from ground color; ventral pruinosity of thorax broader; L = 3.8 to 5.3 mm. ... *I. falicus* (Fig. H-3)
- 1'. Brachypterous, wing short and narrowly triangular; antenna with segment 2 subequal in length to 3; veins of hemelytra pale and indistinct, not contrasting with ground color; ventral pruinosity of thorax narrower; L = 3.5 to 5.0 mm. ... *I. hesperius* (Fig. H-2)

**Measurements:** L = 3.5 to 5.0 mm (Torre-Bueno 1946); L/W = 4.3 to 4.7.

**Wing development:** Brachypterous with wings narrow and apically pointed.

**Ecology:** Collected from tall-grass prairie.

**Collecting:** Specimens of *Ischnodemus* are usually collected by sweeping grasses growing in moist sites.



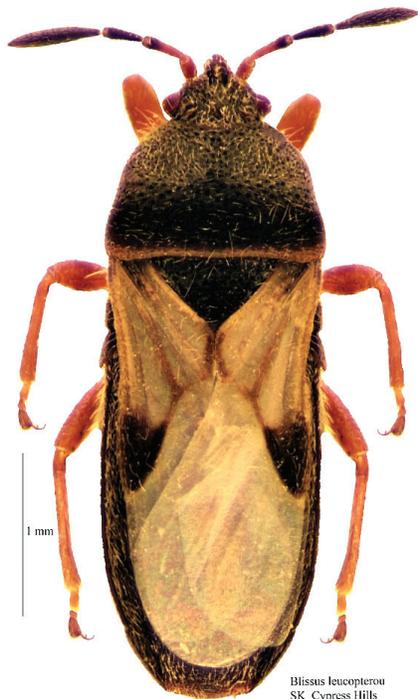
*Ischnodemus falicus* (Say)  
ON New Glasgow  
June 27, 1961  
Kelton & Brumpton  
CNC  
det G.G.E. Scudder 2007  
photograph Nov. 14 2016

Fig. H-3. *Ischnodemus falicus*.

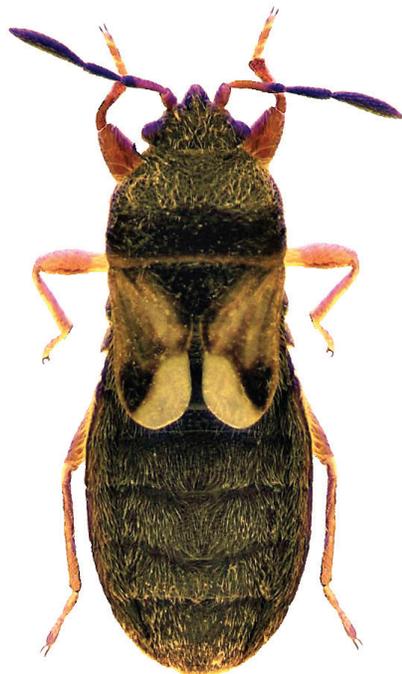
# *Blissus leucopterus* (Say)

SK

CH PD



*Blissus leucopterus*  
SK Cypress Hills  
PK Center Block L  
Levan drift Oct. 7  
D. Larson



*Blissus leucopterus hirtus*  
SK Larson Ranch, 16 km  
S Maple Creek June 12, 2008  
D. Larson

Fig. H-4. *Blissus leucopterus*, macropter (top) and brachypter (bottom).

**Distribution:** 6. Eastern Nearctic. The species has a wide distribution in eastern Canada (ON to NS and NF) and eastern US, south to SC, GA, TX and west to CO and WY. This is the first record for the species from the Canadian Prairie Provinces, all localities in southwestern SK in or adjacent to CH.

**Taxonomy:** Canadian specimens belong to the northern subspecies *B. l. hirtus* Montandon (common name – northern hairy chinch bug) which is characterized in part by dark ventral surface of the body and relatively high frequency of brachyptery.

**Measurements (n = 14):** Macropters (n = 8): L = 3.2 to 4.0 mm ( $\sigma$  = 3.2 to 3.6 mm;  $\phi$  = 3.5 to 4.0 mm); L/W = 2.85 to 3.03 ( $\sigma$  = 2.85 to 3.03;  $\phi$  = 2.86 to 2.97). Brachypters (n = 6): L = 3.2 to 3.6 mm ( $\sigma$  = 3.2 to 3.4 mm;  $\phi$  = 3.5 to 3.6 mm); L/W = 2.58 to 2.97 ( $\sigma$  = 2.81 to 2.97;  $\phi$  = 2.58 to 2.67).

**Wing development:** Wing length varied, brachypters predominant. WL/AL: macropters = 0.91 to 1.00 ( $\sigma$  = 0.92 to 1.00;  $\phi$  = 0.91 to 0.97); brachypters = 0.39 to 0.48 ( $\sigma$  = 0.43 to 0.48;  $\phi$  = 0.39 to 0.40).

**Ecology:** The distribution, life history and biology are described by Sweet (2000). This species feeds on various grasses, especially timothy, and has been reported as an important pest of lawns and pastures and sometimes also grain crops in Eastern Canada. It can be a serious pest in local areas. Because of a high egg-laying potential, populations can build up very quickly under favourable conditions. Beirne (1972) reported it as scarce where there is crop rotation, and some of the situations where it has been damaging occurred when the original habitat, such as a pasture or grain field, dried or was harvested and the bugs moved into an adjacent susceptible crop. Rain and wet weather greatly reduce populations. SK specimens have been found in association with smooth brome, timothy and blue grass growing on more mesic sites such as creek flats and irrigated areas. Adults hibernate and there are several generations per summer.

It is interesting that this well-known agricultural pest has not been reported previously from the Prairie Provinces. Perhaps it is a new introduction into the Cypress Hills area having been transported with hay which is brought into the area in large quantities for winter cattle feed.

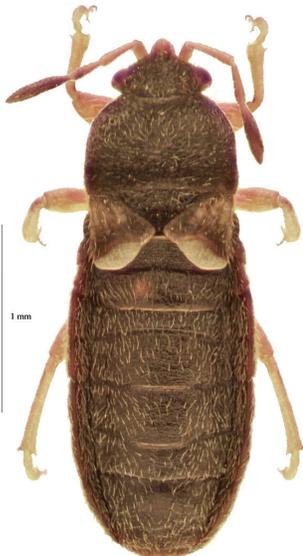
**Collecting:** These insects can be difficult to find in dense grass. Marshall (2006) suggests cutting the ends out of a large can, one end of which is forced down into the grass so that it is sealed by soil. When water is poured into the can enclosed bugs float to the surface. Macropters are often common in wash and are sometimes taken by sweeping grasses.

# *Blissus canadensis* Leonard

AB SK MB CH PD PM PP



*Blissus canadensis* Leonard  
SK Cypress Hills Center  
Block, Prairie Nature Trail  
June 25, 2006 D. Larson  
L = 3.3 mm



*Blissus canadensis* female  
SK Ahawan Dam  
49° 10'N 109° 55'W  
June 9 2015  
D. Larson

Fig. H-5. *Blissus canadensis*, macropter (top) and brachypter (bottom).

**Distribution:** 9. Great Plains-Prairies. Prairie records of *B. occiduus* Barber probably refer to this species (e.g., Strickland 1953). This species was described from specimens feeding on barley in southern AB and is known to occur across the Prairie Provinces and in MT (Leonard 1970).

**Taxonomy:** Records of *B. occiduus* from the Prairie Provinces (Walley 1934, Strickland 1953, Beirne 1972) most likely refer to *B. canadensis* (Leonard, 1970). Leonard (1970) described *B. canadensis* as similar to *B. occiduus*, but slightly longer, with longer antennae and labium and larger eyes. The two species are similar in possessing pale femora and a totally pruinose pronotum. *B. occiduus* is more western, from BC, CO, NM and Mexico.

**Measurements (n = 37):** Macropters (n = 17): L = 2.8 to 3.5 mm ( $\sigma$  = 3.2 to 3.3 mm;  $\phi$  = 2.8 to 3.5 mm); L/W = 2.69 to 3.07 ( $\sigma$  = 2.93 to 3.07;  $\phi$  = 2.69 to 3.07). Brachypters (n = 20): L = 2.1 to 2.8 mm ( $\sigma$  = 2.1 to 2.3 mm;  $\phi$  = 2.2 to 2.8 mm); L/W = 2.58 to 3.00 ( $\sigma$  = 2.82 to 3.00;  $\phi$  = 2.58 to 2.92).

**Wing development:** Wing length various, macropterous to extreme brachyptery. WL/AL: macropters = 0.88 to 1.04 ( $\sigma$  = 0.98 to 1.04;  $\phi$  = 0.88 to 1.03); brachypters = 0.21 to 0.28 ( $\sigma$  = 0.23 to 0.28;  $\phi$  = 0.21 to 0.27).

**Ecology:** Most local specimens have been collected from dry, mixed prairie where they occurred at the bases of clumps of needle grass and in patches of blue grama. They are usually on light, sandy-clay soil and often in areas with saline ponds or solenizic soils. Beirne (1972) regarded this as a sporadic pest that normally is of little economic significance, but it can cause serious damage to wheat and barley in limited areas. Damage to crops occurs mainly when populations in pasture land migrate into grain fields, and grain fields beside old pastures are especially susceptible. Outbreaks tend to occur after a series of dry years that were also times of grasshopper outbreaks. Beirne (1972) stated the nymphs hibernate amongst grass roots, but we have found only adults in very early spring and adult hibernation seems to be the rule in at least northern members of the genus. Leonard (1970) suggested that as some related species are univoltine, *B. canadensis* might also be univoltine.

**Collecting:** A population was found in April, 2016, on a dry, south-facing hillside where the soil was weathered friable clay and the insects were in the crowns of needle grass and blue grama grass. Individuals were very small and nymph-like due to their very short wings, but were actually mature brachypters. In May and June there were soaking rains following which the ground dried with a hard crust. No specimens were found after the soil hardened so soil porosity may be a limiting factor in the bug's distribution.

### I. Family Oxycarenidae

This family is represented in the Prairie Provinces by three species of similar habitus. The adult insects are small,  $L = 2.6$  to  $3.7$  mm, with a somewhat depressed, wedge-shaped body in which the head is somewhat pointed and the body widens more or less evenly to point of maximum width at or behind middle then the apex is broadly rounded. Color fuscous to black with variously developed pale areas on pronotum and wings. Dorsal surface coarsely punctate, punctures usually infuscate when on pale areas; with apically flattened, short whitish setae which may be sparse and inconspicuous to suberect and abundant. Pronotum rounded laterally, apical lateral margin not concave behind eye, disc without distinct calli or transverse grooves. Bucculae low, elongate and extending posteriorly to at least level of middle of eye or even hind margin of head; labium extending to about middle of mesosternum, sterna ventrally, especially mesosternum, often distinctly channelled for reception of labium. Wings fully developed, broader and longer than the abdomen; commissure present; corium with hind margin more or less straight. Profemur with one or two small, sharp ventral spines. Abdominal venter with suture between sterna 4 and 5 transverse and extending to lateral margin of abdomen; male pregenital sternum

with a transverse row or patch of erect setae (Fig. I-5); spiracles of segment 2 dorsal, those of segments 3 to 7 ventral.

This family is represented in North America by 10 species, all but one of which occur west of  $100^{\circ}$  W. Torre-Bueno (1946) provided a key to the North American species. Recently, Henry *et al.* (2015) reviewed the generic classification of the New World members of the family and placed the Canadian species in two genera, *Mayana* Distant and *Crophius* Stål.

The species are widely distributed, but are seldom collected so little is known of their biology. Adults have been collected in lake wash in early spring and by sweeping herbaceous vegetation in the fall so adult overwintering seems the norm. They are seed feeders, but host associations are not well known. It seems well established that *Crophius disconotus* is associated with goldenrod (Fig. I-1) and *Mayana ramosus* anecdotally associated with aster and sage, so members of the family may be mainly Asteraceae seed feeders although there are also records from Chenopodiaceae and Cruciferae. The male abdominal setal patch occurs on all species and probably secretes some form of pheromone (Aldrich 1988).

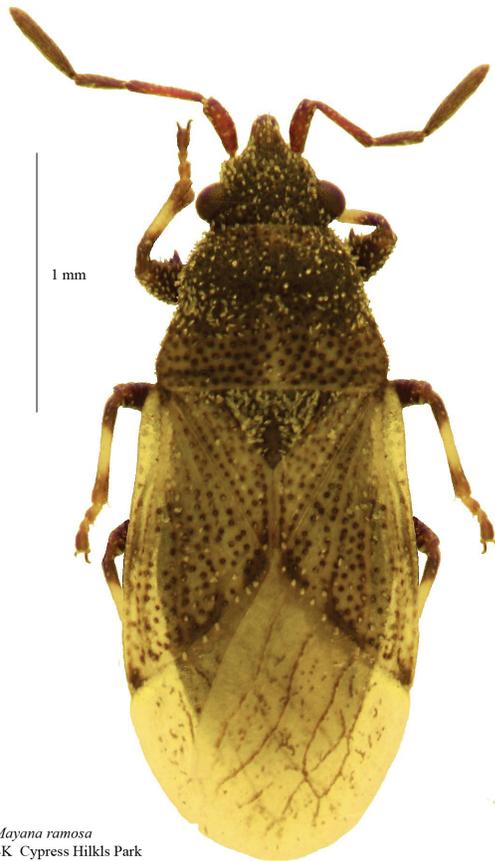


Fig. I-1. Fall is in the air and *Crophius* is on the goldenrod.

**Key to genera and species of Oxycarenidae of the Prairie Provinces**

1. Wing membrane with veins more or less straight and smooth and without anastomosing branches, membrane between major veins smooth and without pigmented tubercles or vein segments; pronotum color various, but mainly black with anterior margin and/or medial areas with pale markings; profemur usually with a single large subapical ventral tooth. .... 2
- 1?. Wing membrane with veins of somewhat irregular shape, sometimes branching or at least membrane between veins with irregular infuscated vein segments or tubercles; pronotum not black except for calli; profemur ventrally with a subapical tooth and a smaller more medial tooth on most specimens. .... *Mayana ramosus* (Fig. I-2)
- 2(1). Pronotum with anterior margin dark and concolorous with disc; legs reddish, tibia unicolorous white or slightly darkened basally and apically; wings whitish with darkened punctures and veins of membrane and corium fuscous, membrane medially infuscate. .... *Crophius disconotus* (Fig. I-3)
- 2?. Pronotum with anterior margin distinctly paler than disc; femora infuscated or black, at least above; wings whitish, slightly infuscated across middle of corium, darker on veins. .... *Crophius bohemani* (Figs. I-4, I-5)

## *Mayana ramosus* (Barber)



*Mayana ramosa*  
SK Cypress Hills Park  
Center Block, War Lodge Coulee  
Sept. 29, 2008 D. Larson  
DJLC

Fig. I-2. *Mayana ramosa*.

AB SK MC CH PD PM PP

**Distribution:** 4. Western Nearctic, including Beringia. The range is northwestern and western North America, recorded from AK, YT, BC, AB, SK, ID and UT.

**Taxonomy:** The presence of 2 teeth on the ventral surface of the profemur is used as a character to separate the genus from *Crophius* (Henry *et al.* 2015). However this character is unstable in the few specimens examined, varying from 0, 1 or 2. T. Henry (in lit., Jan. 2018) examined this character in a series of 30 specimens and found “all have at least one dominant spine and nearly all have a second, sometimes very tiny second spine, though in a couple of cases it does appear absent or as a nub”. The general duller color and the piceous and irregularly ramose and broken veins of the wing membrane are good characters for recognition (Barber 1938). The short, broad, erect setae are also more distinct in this species than on the other two members of the family.

**Measurements (n = 8):** L = 2.6 to 3.2 mm (♂ = 2.6 to 2.9 mm; ♀ = 3.0 to 3.2 mm); L/W = 2.16 to 2.55 (♂ = 2.19 to 2.55; ♀ = 2.16 to 2.29).

**Wing development:** Macropterous. WL/AL = 1.14 to 1.27.

**Ecology:** Barber (1938) and Torre-Bueno (1946) recorded specimens found on atriplex and tumbling mustard. Scudder (1993) reported specimens being collected in a sagebrush – antelopebrush association in dry grasslands of s BC; under pasture sage in grassland associations in YT, and (Scudder 1997) on low juniper, and on south facing sage slopes in YT.

**Collecting:** Specimens have been swept from mixed herbs and shrubs in coulees in the Cypress Hills. No specific plant association was established, but aster and sage were always present. The setae give the body a grayish appearance which matches the foliage color of both these possible host plants.

## *Crophius disconotus* (Say)

AB SK MB CH PD PM PP BP



Fig. I-3. *Crophius disconotus*.

**Distribution:** 1. Nearctic, including Beringia. The species has been recorded from YT and BC to LB and NB, and in northeastern US, New England south to DC, PA and MO, and in the west from WY, CO, UT and CA.

**Taxonomy:** The color along with the relatively narrow body allow this species to be easily identified. The veins of the wing membrane are simple and unbranched, frequently infuscate and the wide hyaline margin of the corium is immaculate (Barber 1938).

**Measurements (n = 20):** L = 2.8 to 3.4 mm ( $\sigma$  = 2.8 to 3.0 mm;  $\text{♀}$  = 2.85 to 3.4 mm) (Torre-Bueno 1946: 3.0 to 3.75 mm); L/W = 2.32 to 2.70 ( $\sigma$  = 2.44 to 2.70;  $\text{♀}$  = 2.32 to 2.59).

**Wing development:** Macropterous. WL/AL = 1.11 to 1.23.

**Ecology:** Van Duzee (1909) suggested goldenrod was the host and this has been repeated by subsequent authors. Most SK specimens have been swept from goldenrod as well as several specimens picked from senescent flower heads. A specimen was collected in litter on the upper beach of a reservoir (Cavan L. AB) where dead goldenrod stems were present. Scudder (1997) reported YT specimens from root mats of Jacob's ladder. Specimens have been collected from rabbitbrush in BC (Spencer Bridge, 30.ix.1988, G.G.E. Scudder). Several specimens SK were collected from common broomweed (Maple Creek, Sept 28, 2017, D.J. Larson) but this was during a very dry fall when broomweed was the only flowering plant in the area that was still green, so it may not represent a regular host. Adult specimens collected in May and September (majority of collections) suggest adult hibernation.

**Collecting:** Most specimens have been collected by sweeping.

# *Crophius bohemani* (Stål)

SK

CH PD



Fig. I-4. *Crophius bohemani*, dorsal.



Fig. I-4. *Crophius bohemani*, male, lateral.

**Distribution:** 4. Western Nearctic, including Beringia. This is a western species with the range extending from BC to CA and east to SK, WY, CO and AZ.

**Taxonomy:** The white anterior margin of the pronotum is a distinctive feature within the three prairie species but does not separate the species from the western *C. angustatus* Van Duzee (BC to CA, UT and CO) which also has the anterior of the pronotum whitish. The head is black or piceous and the veins of the wing membrane are unbranched at the apex, but are distinctly elevated and slightly fuscous (Barber 1938).

Specimens of *C. angustatus* can be recognized by: the more anteriorly narrowed shape in which the pronotum is subconical and strongly narrowed anteriorly; antennal segment 1 more elongate and distinctly exceeding the tip of the clypeus; head and legs paler, ferruginous; metasternum with medial sulcus obsolete; and size usually a little smaller, L = 3.0 to 3.5 mm (Van Duzee 1909, Torre-Bueno 1946).

**Measurements (n = 4):** L = 3.3 to 3.7 mm (♂ = 3.3 mm; ♀ = 3.4 to 3.7 mm) (Torre-Bueno 1946, L = 4 mm); L/W = 2.14 to 2.30 (♂ = 2.14; ♀ = 2.21 to 2.30).

**Wing development:** Macropterous. WL/AL = 1.19 to 1.26.

**Ecology:** There are no host records. Specimens have been collected from drift (April 29) on Cypress Lake, SK. Two specimens were swept from meadows at the edges of aspen bluffs in the Cypress Hills (September). The species is widely distributed in the southern half of BC where it has been collected in pitfall-traps in the bunchgrass and interior Douglas fir zones of the s Okanagan.

### J. Family Lygaeidae, Subfamily Lygaeinae – Milkweed Bugs

Henry (1997a) studied the phylogenetic relationships of family groups within the superfamily Lygaeoidea. He concluded that the members of Lygaeidae s. str., Orsillinae and Ischnorhynchinae share several apomorphic features and should be placed in the same family, Lygaeidae. Maw *et al.* (2000) adopted this classification and we follow it here, but treat each of these subfamilies in a separate section as each of these groups represent a distinct clade that shows unique biological characteristics. Sweet (2000) gave each of these groups full family ranking but did not give detailed reasoning behind this move and his proposal has not received general acceptance.

The subfamily Lygaeinae contains the milkweed bugs, some of the largest and most strikingly colored members of the superfamily, as well as a variety of smaller and less brightly colored forms.

Size moderate to large, L = 3.5 to 11.2 mm. Color generally dark, fuscous to black, and usually with showy red or orange aposematic markings; appendages fuscous to black. Coarse punctation reduced, dorsally restricted to anterior submarginal area of pronotum and often on hind lobe of pronotum on either side of raised median ridge, and ventrally on prosternum and propleuron; hemelytron lacking coarse punctation. Setae various, small and appressed to short and recurved, but sometimes with erect longer bristles on head and pronotum. Head short, postocular area wanting and eye impinging on anterior lateral angle of pronotum which in lateral aspect is concave for reception of hind margin of eye (in all species of the prairie fauna but not in *Oncopeltus* where the margin is broadly flattened); anterior lobe of pronotum with a shiny transverse groove behind each callus; scutellum usually impressed on each apical-lateral margin giving a raised T-shaped area consisting of a medial longitudinal ridge and a transverse sub-basal ridge. Wings usually full, but some species dimorphic; claval commissure present; corium with apical margin straight; membrane with a distinct cell; hind wing with subcostal vein and hamus. Profemur lacking ventral spines. Thorax ventrally not longitudinally grooved for reception of labium. Abdomen with suture between sterna 4 and 5 transverse and not curved forwards laterally; spiracles of abdominal segments 2 to 7 dorsal. Nymphs with two dorsal abdominal scent gland openings, namely between tergites 4/5 and 5/6.

A. Slater (1992) revised the western hemisphere genera and provided keys to the species. He noted that although there are distinct clades within the family, some of the genera are weakly differentiated. He stated “*Melacoryphus* species are difficult to separate

from those belonging to *Neacoryphus* on the basis of individual characters, but the overall appearance of members of the two genera is quite different. ... *Lygaeospilus* ... may simply be composed of very small species of *Melacoryphus*.” We follow A. Slater’s generic classification and assignment of species, but this requires dependence on characters of color and size.

Aside from *Lygaeus kalmii*, the species of this family are infrequently collected in the Prairie Provinces as the group, for the most part, is warm temperate and tropical in distribution. Several prairie species are widespread and common in the United States and these more southern insects just reach their northern range in southern Canada. Possibly prairie specimens of the less common species are vagrants into the area from the south, especially as some of the larger species fly readily and have been reported as being abundant at light. Little is known of the ecology of most local species. The large milkweed bug, *Oncopeltus fasciatus* (Dallas), belongs to this family. It is known for its large size (L = 17 to 18 mm), bright orange and black color, and especially because it is favorite laboratory insect for scientists. It feeds on dry milkweed (*Asclepias*) seeds and is easy to maintain for experimental work. Although milkweed (Fig. J-1) is common in moist places in the southern prairies, the species has not been found in the area with the closest records being southern ON and QC in Canada and SD and MN in the US.



Fig. J-1. Milkweed, *Asclepias speciosa*, host of colorful lygaeids.

The basic color of group members is black with variously developed contrasting red, orange or yellow markings. It has been demonstrated that these bold colors are associated with the insects possessing chemical protection which is obtained from toxic materials that they take up from feeding on host plants and sequester in their bodies. The bold colors warn potential predators of the inedibility of the prey and in this way by calling attention to themselves they gain protection. This works for predators that hunt by sight and can remember the outcomes of previous experiences - in other words birds. Color does not impress ants, but the bugs also retain the adult metathoracic glands and the nymphal abdominal glands, so they are also protected by anti-ant noxious chemicals. Such protected insects can live in the open and be gregarious for this makes it easier for predators to learn about the unpalatability of the bugs. In fact, many of

the lygaeid species are found in nymphal as well as adult aggregations. Within the prairies, the very common maple bug (also known as boxelder bug), *Boisea trivittata* (Say) (family Rhopalidae), is similarly colored and gregarious and has been shown to be well protected chemically. In this way these bugs together with other similarly colored and protected insects form a Mullerian mimicry group in which a predator need only learn the protected nature of one group member and then can apply the experience to all similar members. Part of the reason for the paucity of prairie records for the larger species of the group may be they are too similar to the ubiquitous maple bug and collectors dismiss any medium sized red and black bug without a second glance. One should take a close look at any red and black bug that is in an unusual habitat, i.e. anywhere, but in a maple grove or in a building, as they may be lygaeids.

**Key to genera and species of Lygaeidae, Lygaeinae, of the Prairie Provinces**

(based on keys in Slater 1992)

1. Large, L = 17 to 18 mm; color mainly black with two broad transverse orange bands basally and medially on hemelytra; scutellum swollen, median carina indistinct; pronotum with basal margin produced posteriorly at each side of scutellum. .... *Oncopeltus fasciatus* (Fig. J-2)
- 1<sup>?</sup>. Smaller, L less than 12 mm; color various but without two broad, transverse orange bands on hemelytra; scutellum not swollen, median carina distinct; pronotum not produced at each side of scutellum. .... 2
- 2(1). Pronotum with posterior lobe at most as high mesally as at lateral margin, disc flat or nearly so, median carina distinct on at least basal third; head entirely black. .... 3
- 2<sup>?</sup>. Pronotum with posterior lobe higher mesally than at lateral margin, disc distinctly convex, median carina obsolete; head black with an orange to red posterior medial spot. .... 6
- 3(2). Color mainly red with head, quadrate patches on anterior pronotal lobe, scutellum, wing membrane and appendages black; L = 7.0 to 9.5 mm. .... *Neacoryphus bicrucis* (Fig. J-3)
- 3<sup>?</sup>. Pronotum largely fuscous to black, posterior lobe with at least medial-lateral areas dark; clavus fuscous to black with adjacent areas of corium of similar color; size generally smaller, L = 3.5 to 8.5 mm. .... 4
- 4(3). Larger, L = 5.1 to 8.5 mm; body dorsally not conspicuously bristly, setae sparse and appressed; macropter with hemelytral membrane black with a white margin and sometimes with a white central spot. .... *Melacoryphus*, 5
- 4<sup>?</sup>. Smaller, L = 3.5 to 4.6 mm; body dorsally bristly with both erect and decumbent setae; macropter with hemelytral membrane usually with a large white spot or mottled with white. ....  
..... *Lygaeospilus tripunctatus* (Fig. J-4)
- 5(4). Hemelytron black with costal and apical portions of corium and commissural and inner claval margins red; membrane with a narrow white margin, but without a medial white spot; wing veins not strongly elevated; pronotum either side of postmedian ridge finely or obscurely punctate. .... *Melacoryphus admirabilis* (Fig. J-5)
- 5<sup>?</sup>. Hemelytron black with only costal margin red, membrane narrowly margined with white and sometimes with a lunate white spot near base; wing veins strongly elevated and more or less carinate; pronotum with sunken area on each side of postmedian ridge closely and coarsely punctate. .... *Melacoryphus lateralis* (Fig. J-6)
- 6(2). Small species, L = 4.1 to 6.0 mm. Pronotum entirely dark or sometimes with basal angles red .....  
..... *Melanopleurus*, 7
- 6<sup>?</sup>. Larger species, L = 9.5 to 11.5 mm. Pronotum black with a broad transverse red stripe or three large red patches across posterior lobe behind which the hind margin is chiefly black; wing membrane with a large white spot (divided into two parts by a dark vein in most specimens). .... *Lygaeus kalmii* (Figs. J-7, J-8, J-9)
- 7(6). Metathoracic scent gland auricle pale; hemelytra with clavus and corium dull red or sometimes lightly infuscate basal-medially, wing membrane black with broad whitish lateral margin; abdomen with basal sterna red medially and laterally, with a variably developed sublateral infuscate area. L = 5.6 to 6.0 mm; L/W = 2.58 to 2.81. .... *Melanopleurus pyrropterus* (Fig. J-10)
- 7<sup>?</sup>. Metathoracic scent gland auricle black; hemelytra dull reddish to ochraceous, without distinct darker patches, wing membrane black with margin very slightly paler; abdomen with basal sterna slightly rufous medially; brachypterous with wings reaching onto tergum 4 or macropterous with wings reaching about end of abdomen. L = 4.1 to 5.1 mm; L/W = 2.36 to 2.65. .... *Melanopleurus perplexus* (Fig. J-11)

## *Oncopeltus fasciatus* (Dallas)



Fig. J-2. *Oncopeltus fasciatus*.

**Distribution:** Not known from Prairie Provinces. Canadian records from southern ON and QC. In US widely distributed east of Rocky Mountains, north to MN and SD.

**Taxonomy:** This species, known as the large milkweed bug, is easily recognized by its large size and bold color.

**Measurements:** L = 17 to 18 mm (Slater & Baranowski 1978).

**Wing development:** Macropterous.

**Ecology:** These insects are milkweed specialists and occur on the flowers and seed pods of milkweed. Because they can be easily reared on dry milkweed seeds they have been much used in a variety of studies. The extensive bibliography of papers on this species that has been compiled by Slater and O'Donnell (1995) shows this to be one of the most intensively studied insect species.

Cultures can be purchased and therefore it is possible for specimens to turn up almost anywhere. The species should be looked for in southeastern Manitoba, but any purported record would need to be critically evaluated as to whether it represented a natural occurrence or an imported or cultured specimen.

## *Neacoryphus bicrucis* (Say)



Fig. J-3. *Neacoryphus bicrucis*.

Overwintering is by adults which are in a state of facultative reproductive diapause. Studies on aspects of adult ecology and reproduction include: McLain and Shure 1987 (courtship and territoriality), McLain 1984 (mimicry), and Solbreck 1978, 1979 (reproduction, flight ability).

**MB**

**PP**

**Distribution:** 2. Nearctic, excluding Beringia. Recorded from BC and ON, we have examined a specimen from MB (Carberry, 10.VIII.1953, Brooks – Kelton (AACS)). Throughout the US, on the US prairie north to SD and WY.

**Taxonomy:** This strikingly colored black and red, moderately large species is distinctive in: the black head; dull red posterior pronotal lobe and corium; and hemelytral membrane black without a white discal spot. The dorsal surface is almost glabrous.

Scudder (1965) described the genus *Neacoryphus* (type species = *Lygaeus bicrucis* Say) to include those New World species that had previously been placed in *Melanocoryphus* Stål, generally treated as a subgenus of *Lygaeus*, and restricted *Melanocoryphus* to the Old World. A. Slater (1992) subsequently moved most of these species, except for *M. bicrucis* and a Central American species, into a separate genus, *Melacoryphus* A. Slater 1988.

**Measurements:** L = 7.0 to 9.5 mm (Slater & Baranowski 1978).

**Wing development:** Macropterous although flight muscle histolysis has been reported during reproduction.

**Ecology:** Slater & Baranowski (1990) reviewed the ecology of the species. The insects occur in disturbed habitats that are in early stages of revegetation, e.g. weedy fields, roadsides and beaches.

The species has a narrow host range feeding mainly or only on species of groundsel and ragwort (*Senecio*) and is unpalatable to least some vertebrates as pyrrolizidine alkaloids are sequestered from the host plants (McLain & Shure 1985).

## *Lygaeospilus tripunctatus* (Dallas)

SK MB

PP



Fig. J-4. *Lygaeospilus tripunctatus*.

**Distribution:** 3. Nearctic, excluding the Western Cordillera and Beringia. SK, MB and QC. Widely distributed in eastern US, ME to FL, across east to SD, UT and CA and south into Mexico.

**Taxonomy:** Head entirely black; pronotum with anterior lobe black except anterior margin broadly pale or reddish; posterior lobe dark rufous to fuscous with pale areas on each hind angle and medially; corium with lateral margin dull reddish; metathoracic scent gland auricle black; pronotal disc with punctures coarser and denser, those of medial transverse band in a depression that is broken medially by a strong longitudinal carina; each pair of meso- and metacoxae relatively widely separated (in female by a distance equal to 4 to 5 times width of labium); labium long, reaching middle of sternum 2.

Scudder (1981) gave a key to the four species of *Lygaeospilus*. Two species occur in Canada, the western *L. brevipilus* Scudder (dorsum with only short semidecumbent setae; from BC, OR, ID and CA) and the eastern *L. tripunctatus* (dorsum with both long, erect setae and short semidecumbent setae). The wing membrane has a large white central spot that is connected by a narrow pale band to adjacent corial margin.

**Measurements (n = 3):** L = 3.6 to 4.6 mm (Blatchley 1926: 3.5 to 4.5 mm); L/W = 2.36 to 2.51.

**Wing development:** Occurs in both macropterous and brachypterous forms.

**Ecology:** Not known. Slater & Baranowski (1990) stated that in contrast to most other members of the family members of *Lygaeospilus* are ground, litter-living species. Specimens have been found associated with fleabane.

**Collecting:** A good series of this species was collected 8 mi. N Paynton, SK, by searching on the ground (23.viii.1963, G.G.E. Scudder).

## *Melacoryphus admirabilis* (Uhler)

SK

CH PD



Fig. J-5. *Melacoryphus admirabilis*.

**Distribution:** 3. Nearctic, excluding the Western Cordillera and Beringia. The only Canadian records are a female specimen from Grasslands National Park, SK, collected in sweep samples (Scudder 2010) and 2 male specimens from south of Maple Creek, SK (Larson Ranch, Hwy 21, 16 km S. Maple Creek, Sept. 28, 2017. DJLC). Mainly western in US, from ID, WY to CA, TX and Mexico. There are a few eastern US records, but they need confirmation (Slater & Baronowski 1990).

**Taxonomy:** This species was assigned to the genus *Melanocoryphus* Stål (e.g. J.A. Slater, 1964), placed in *Neacoryphus* Scudder by Scudder (1965, 1992) then moved to *Melacoryphus* Slater by A. Slater (1988, 1992) who included it in a key to the Western Hemisphere species.

**Measurements (n = 3):** L = 5.1 to 5.9 mm; L/W = 2.56 to 2.61.

**Wing development:** Macropterous. W L/AL = 1.09 to 1.10.

**Ecology:** The Grasslands Park specimen was collected on dry grasslands by sweep sampling, July 29-30, 2008. The specimens from Larson Ranch were swept from broomweed (Sept. 28, 2017) in mixed grassland. This collection was made during an unusually dry period when broomweed was the only plant that was still green and with some bloom, thus broomweed could be a host or could simply be a source of moisture in a very dry environment.

**Collecting:** This is a very uncommon species, collected only by sweeping in the driest mixed grasslands. In the western US the species is typically collected at higher elevations (over 2000 m)

## *Melacoryphus lateralis* (Dallas)

SK

PD

PP



Fig. J-6. *Melacoryphus lateralis*.

**Distribution:** 2. Nearctic, excluding Beringia. This species is known in Canada from BC, SK (Moose Mountain Park (SMNH), Val Marie (CNC)) and ON. US records are from MT, SD, NE, WY and OR to TX, NM, CA and Mexico (Scudder 2012).

**Taxonomy:** The generic placement of this species follows that of *M. admirabilis*. This species could be very easily confused with specimens of the maple bug, *Boisea trivittata* (Say) (family Rhopalidae). However, maple bugs are larger, broader and the membrane of the wing never has white edging or a basal spot and is crossed with numerous more or less parallel veins. The paucity of prairie records could be due to the abundance of maple bugs which induces one to dismiss any large, red and black bug as being commonplace.

**Measurements (n = 2, specimens from TX and WY):** L = 8.1 to 8.5 mm; L/W = 2.82 to 2.87.

**Wing development:** Macropterous.

**Ecology:** Slater and Baranowski (1978) stated this species is common in the US from the Great Plains westward and is often abundant at light. Scudder (1985) collected many specimens at light in Buffalo, Wyoming (WY, Buffalo, 12.ix.1963, GGES). The host plant has not been identified, but the presence of cardenolides in the body show evidence of feeding on milkweeds (Scudder 2008a).

# *Lygaeus kalmii* Stål

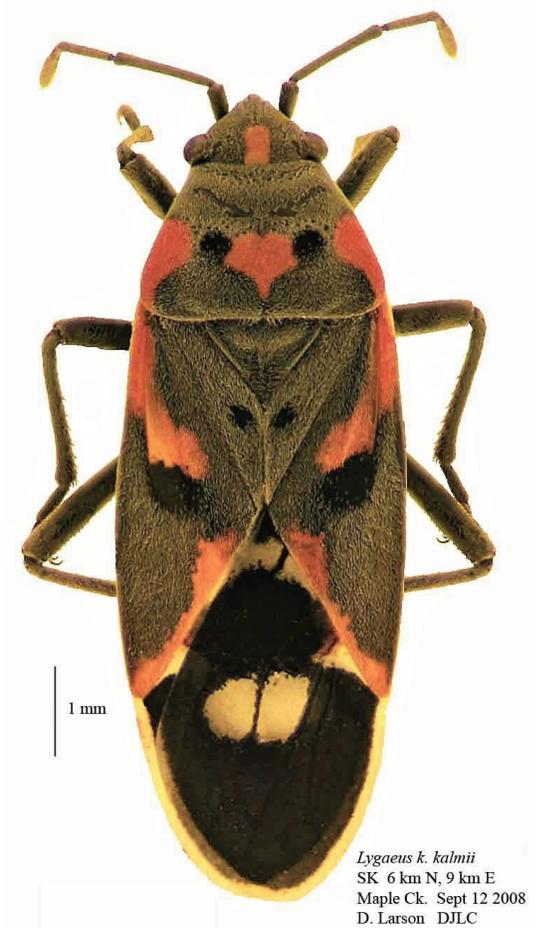


Fig. J-7. *Lygaeus kalmii kalmii*, dorsal.

AB SK MB MC CH PD PM PP BP

**Distribution:** Two subspecies occur in Canada: *L. k. kalmii* (Fig. J-7, J-8) - 5. Western Nearctic excluding Beringia, from BC to MB; western US, Mexico and Central America: *L. k. angustomarginatus* Parshley (Fig. J-9) - 6. Eastern Nearctic, from MB to QC; eastern US.

**Taxonomy:** This is a strikingly marked insect, but the color is somewhat subdued by the presence of a dusting of small, appressed white scales. There are three distinctive pairs of black spots where the scales are lacking, namely on pronotum, on clavi near tip of scutellum and midpoint on each corium. The northern portion of a well defined biotic suture zone, termed the eastern (humid)-western (arid) suture zone (Scudder 1979), exists near the 100th meridian of southern Manitoba (Scudder 2014a). In this area the western grassland biota meets the eastern biota. This pattern is well exemplified by the *L. kalmii* species complex. The species occurs throughout the US with *L. k. kalmii* west of the 100th meridian and *L. k. angustomarginatus* to the east (Parshley 1923). Slater and Knop (1969) attribute this pattern to postglacial dispersal of two separate refugial populations in postglacial times with the ecologically and morphologically differing descendants now meeting along the humid-arid suture zone.

The two subspecies of *L. kalmii* are separated based on the central white spot on the wing membrane: *L. k. kalmii* has a single large spot (may be divided by a dark vein); *L. k. angustomarginatus* lacks white spots or has a pair of small spots.

The species *L. turcicus* Fabricius (characterized by a large Y-shaped red or yellow stripe on the head) also has a wide range, but is more southerly reaching its northern limits in ON, QC, MN and SD. Four additional species of *Lygaeus* occur in the southern US.

**Measurements (n = 20, *L. k. kalmii*):** L = 9.5 to 11.2 mm (Blatchley 1926: 10 to 12 mm); L/W = 2.67 to 2.90.

**Wing development:** Macropterous.

**Ecology:** This species is commonly known as the little milkweed bug because it is often found feeding on milkweed (Blatchley 1926). These insects typically occur on the pods of milkweed and can be reared on dry milkweed seeds, but they then require an adequate water supply to help them liquify this dry diet. However, Wheeler (1983a) reviewed the species feeding habits and concluded it can not be considered a milkweed specialist. Milkweed is the favored host when pods are available, but it can breed successfully on a number of different plants which include yarrow and common groundsel as well as other composites and members of other plant families.

Adults overwinter. There is probably one generation a year, but the life cycle has not been studied in northern latitudes.

**Collecting:** The species is widespread and probably occurs wherever its host plants grow. However, most of our collections are of single specimens not associated with a particular host plant and are probably dispersing individuals. Several have been collected around house foundations where they may have been seeking hibernation sites.

# *Lygaeus kalmii* Stål (continued)

AB SK MB MC CH PD PM PP BP



Fig. J-7. *Lygaeus kalmii kalmii*, lateral.



Fig. J-7. *Lygaeus kalmii angustomarginatus*, dorsal.

## *Melanopleurus pyrropterus* (Stål)



Fig. J-10. *Melanopleurus pyrropterus*.

AB

PD

**Distribution:** 10. Nearctic-Neotropical. Recorded in Canada only from AB. A western species occurring from OR and MT to CA, TX and into Central America.

**Taxonomy:** The genus *Melanopleurus* is large, with 21 recognized species (Baranowski & Slater 2003). Scudder (1981) keyed the eight species of *Melanopleurus* then assigned to the genus, two of which occur in Canada.

Two subspecies of *M. pyrropterus* are recognized: the nominative subspecies *M. p. pyrropterus* is the northern form and has the clavus and corium red; *M. p. melanopleurus* (Uhler) occurs in southwestern US and has the clavus and corium gray, but apparently intermediate forms exist (Ashlock 1975).

**Measurements (n = 2 specimens from CO and Mexico (CNC)):**  
L = 5.6 to 6.0 mm; L/W = 2.58 to 2.81.

**Wing development:** Occurs in both macropterous and brachypterous forms.

**Ecology:** Not known.

**Collecting:** We have not collected this species. The only record we have for AB (AB, Medicine Hat, 27.VII.1924 (LEMU), Scudder 1985) is old.

## *Melanopleurus perplexus* Scudder

AB SK MB CH PP BP

**Distribution:** 5. Western Nearctic, excluding Beringia. Known only from western Canada, BC to MB.

**Taxonomy:** The type locality of *M. perplexus* is 8 mi W of Paynton, SK (Scudder 1981). Other Prairie records are from the parkland and southern boreal regions, the Cypress Hills, and the Peace River region of BC (Scudder 1986).

**Measurements (n = 3):** L = 4.1 to 5.1 mm; L/W = 2.36 to 2.65

**Wing development:** Wing length variable, macropterous and brachypterous.

**Ecology:** This seems to be a species of the parkland and southern boreal regions with an isolated population in the Cypress Hills. Scudder (1993) reported that in the prairies it was collected in a mixed prairie association, and in BC it was taken on south-facing slopes of the Peace River Canyon in an *Agropyron-Stipa* community.

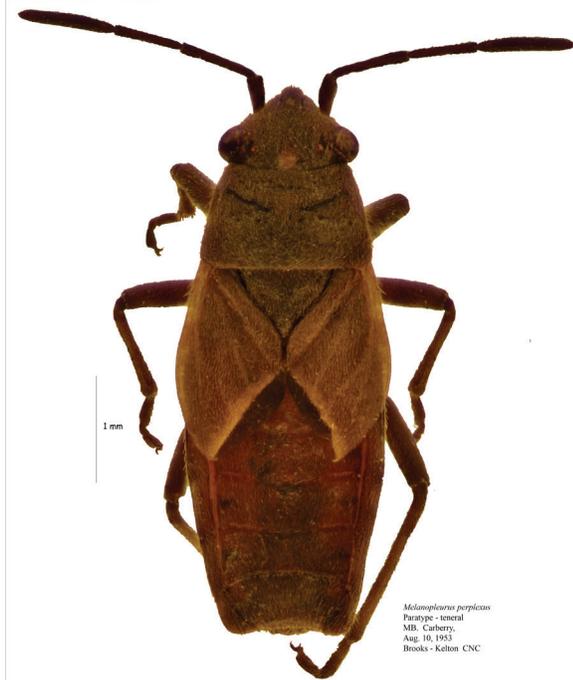


Fig. J-11. *Melanopleurus perplexus*.

### K. Family Lygaeidae, subfamily Orsillinae – False Chinch Bugs

This is a group of rather nondescript, ground-dwelling bugs. They are small to medium sized and dull gray or brownish color. However, they are well worth looking at closely for some species are of economic importance to field crops, whereas others occur in the most challenging environments occupied by any lygaeoid, from arctic and alpine regions to arid grasslands (Fig. K-1).

Small to medium size (L = 3.0 to 6.3 mm). Body elongate, subparallel to fusiform. Color pale gray to yellowish or pale brownish, with variously developed fuscous spots; legs largely pale, usually with fuscous spots which may be expanded to cover femora. Dorsal surface of pronotum and scutellum coarsely punctate, wing lacking coarse punctures; ventrally thoracic pleura coarsely punctate. Body dorsally with vestiture various, from small appressed setae to densely setose with elongate, erect setae. Rostrum long, reaching metasternum or base of abdomen; mesosternum with a shallow, broad median longitudinal impression. Head without dorsal lines or grooves, eye separated from anterior margin of pronotum. Pronotum in lateral aspect with anterior margin straight, not concave posterior to eye; anterior lobe with a transverse callus and a transverse groove on each side; lateral margin not carinate; profemur without ventral teeth (at least in the Canadian fauna); wings full; commissure present; hemelytron with apical margin of corium broadly emarginate near commissural angle; hind wing lacking subcostal vein, hamus present. Abdominal venter with suture between sterna 4 and 5 transverse and

not curved forwards laterally; segments 2 to 6 with inner latero-tergites; spiracles of abdominal segments 2 to 7 dorsal.

Barber (1947) revised the North American members of the family, all of which he placed in the genus *Nysius*. The present generic placement follows Ashlock (1967) with the addition of the subsequently described genus *Neortholomus* (Hamilton 1983). Members of *Nysius*, as here defined, are commonly called false chinch bugs. They have little in common with chinch bugs other than that they are often very common on the ground surface where they may reach minor pest status by feeding on a variety of plants.

The taxonomy of the genus *Nysius* is very complex. There is much synonymy and misidentification. For example, Ashlock & Slater (1988), in a note under *N. niger*, state “that records of this species are irrecoverably confused with those of *N. angustatus* Uhler; they are equally confused with those of *N. raphanus* Howard.” The problems arise from the species differing from one another mainly in subtle ways such as relative length of rostral segments, the bucculae, size, color and general body proportions; some of the species have very broad geographical ranges; and there is geographical variation in characters used for species recognition.

Maw *et al.* (2000) recorded 8 species from one or more of the Prairie Provinces. One of these species, *N. thymi* (Wolff), is not included here. *Nysius thymi* was described from Europe and is considered to have a wide Palearctic distribution from northern Europe to Siberia. Specimens from scattered northern North American



Fig. K-1. Oh give me a home where the Orsillidae roam ... Old-Man-On-His-Back, southwestern SK, where 6 species of Orsillidae, bison, deer and antelope still roam.

localities have been tentatively assigned to the species, but generally with a caveat such as “*Nysius angustatus*, *grandis* and *thymi* constitute a group of closely related species resembling each other superficially and not always easy to separate through reference to structure alone” (Barber 1947a: 359). Forty years later, Ashlock & Slater (1988: 205) did not find the status of *N. thymi* in North America any clearer and remarked “records of this species are confused with those of others in the genus”. Eric Maw (in litt. Nov. 1, 2016) wrote the Canadian National Collection does not have any North American material identified as *N. thymi*; probably most of what they had previously was *N. angustatus*. He also noted “there is another barcode cluster that likely represents a separate species sitting near *N. angustatus* and German *N. thymi*; it occurs in BC, MB and PEI at least, but does not yet have a name.” We did not investigate the status of this putative undescribed species, but because we can find no good evidence for the existence of North American *N. thymi*, we delete it from the Canadian list.

Information on the life history of these insects is about as confusing as their taxonomy and probably results from taxonomic confusion being compounded by variation in life history patterns over the species range. At the latitudes of the Canadian Prairie Provinces, the principal (perhaps only) overwintering stage is a diapausing egg. Most of our collections of adults have been made from late June into late September, with no records from April or May. Mating pairs of *Nysius* have been collected in August and September. This is consistent with eggs being the principal overwintering stage. Beirne (1972) on the other hand described the life history and economic importance of *N. ericae* (= *N. niger*) (possibly several species were included under this name, but they are similar ecologically) in Canada and stated adults overwintered under rubbish. There are reports of large mating aggregations of adults in early spring in more southerly locations (e.g. Kansas, Byers 1973) and for adults and nymphs of *N. raphanus* overwintering in CA (Haviland & Bentley 2010). There may be differences in life history patterns between species or even geographically within a species. The usual number of nymphal instars is 5, as in other lygaeoid bugs, but Millikin (1918) reported 4 to 6 nymphal instars and this is supported by Wei (2010), who observed similar variation in the New Zealand species, *N. huttoni* White. Wei found the number of instars was positively correlated to rearing temperature. There may be several generations produced over the summer. Dry locations and dry years on the prairies favour the insects and heavy rains have checked the development of infestations although in California wet, cool springs foster larger populations (Haviland & Bentley 2010). Adults are often abundant at light in August and September and

their pest status generally develops when adults fly from drying grasslands to crops.

The agricultural literature focuses on sap feeding noting blemishes, discoloration, necrosis and wilting associated with feeding on leaves and stems of a wide variety of plants including berries, ornamentals, vegetables, forages and grains. Warrick (2012) found that during outbreaks, *Nysius raphanus* significantly depressed survival of young saltbush, a shrub of California rangeland. The role of seeds as a food source is seldom mentioned and the impression given is that successive generations can develop on sap feeding alone. However, Burgess and Weegar (1986) developed a successful rearing system for *N. niger* that used hulled sunflower seeds and a source of moisture such as radish slices or mustard seedlings. As most economically important feeding damage occurs under dry conditions, sap feeding may be primarily for obtaining water and seeds may be the main source of nutrients. *Nysius groenlandicus* is a seed-feeder whose feeding on moss campion seeds has the unexpected effects of not significantly reducing seed viability while reducing germination times (Lundbye *et al.*, 2012) leaving doubt as to whether it is harmful or helpful to its host. Whenever feeding wounds occur there is the possibility of infection by pathogens and Burgess & Weegar (1986) state that *Nysius niger* feeding is important in transmission of yeast infection in mustard crops.

The bucculae of the mouthparts have been used extensively in the following key to species. In lateral aspect the bucculae may be somewhat rounded and short and not extending posteriorly past the middle of the ventral surface of the head, or they may be narrower and extend posteriorly almost to the back of the head. In the later case they may be evenly narrowed posteriorly and merge smoothly with the head capsule or their posterior end may be rather abrupt so there is a distinct angulation where the ventral margin curves up to the head capsule. The length of segment 1 of the labium relative to the posterior end of the bucculae is also a very useful character: it may extend well past the bucculae, a short distance past (distance about equal to width of labium), be subequal to bucculae or be slightly shorter. The species of *Nysius* differ in several ways including size, shape, color and vestiture. However, all these differences are qualitative and subject to individual, sexual and interpopulation variation as well as interspecific variation and this has caused much of the confusion regarding species limits. Body proportions offer some valuable characters and very likely a careful multivariate analysis of body form would resolve many of the taxonomic problems. Genetic analysis through DNA barcode analysis also looks very promising in identifying groups within the genus.

**Key to genera and species of Lygaeidae, Orsillinae, of the Prairie Provinces**

1. Bucculae short, posterior end about level with front margin of eye; labium segment 1 extending well beyond end of bucculae; hemelytron with lateral margin straight or broadly arcuate from near base to apex of corium; larger species, L = 4.9 to 6.3 mm. .... 2
- 1<sup>?</sup>. Bucculae longer, at least extending past level of mid-point of eye and on many specimens ending near posterior margin of head; labium segment 1 shorter than to slightly longer than bucculae; hemelytra with lateral margins straight and subparallel at base, at level of middle to apex of scutellum curved outwards and evenly convexly curved to apex of corium; smaller species, L = 3.0 to 5.6 mm. .... *Nysius*, 3
- 2(1). Corium with lateral margin (costal margin) straight throughout entire length and not expanded beyond lateral margin of abdomen, usually lying mesad to outer margin of abdominal connexivum; costal edge of corium and metafemur not modified as a stridulatory organ; dorsal surface of body with short, erect pale setae, clavus and corium with dense pile of golden to brown, appressed setae; corium uniformly pale or at most vaguely mottled with its distal angle distinctly reddish; membrane with a few brown to fuscous blotches. ....  
..... *Neortholomus scolopax* (Figs K-2, K-3)
- 2<sup>?</sup>. Corium with costal margin explanate, curving outwards shortly behind humerus and extending laterally as a narrow flange beyond lateral margin of abdomen, connexivum not visible in dorsal aspect; wing stridulatory organ present as a very fine file along costal margin across which rows of fine pegs on an elevated, pigmented anterior-ventral lobe of metafemur can be drawn; dorsal surface of body lacking erect setae, with sparse short, recurved silvery setae; corium variously pigmented, but veins usually with fuscous spots and apical margin with two to four fuscous spots, distal angle not reddish. .... *Xyonysius californicus* (Figs. K-4, K-5)
- 3(2). Rostrum segment 1 slightly exceeding length of bucculae; pigmentation of costal margin, hemelytral veins and apex of corium more or less continuous giving a vittate pattern; femora usually fuscous except for paler apex but on some specimens paler with distinct fuscous spots; male genital capsule black; metathoracic evaporatorium black or slightly rufescent near coxal lamella. .... 4
- 3<sup>?</sup>. Rostrum segment 1 equal to or shorter in length than bucculae, not extending beyond hind margin of bucculae; hemelytron with pigmentation less extensive, usually broken into a series of spots along veins and apical margin of corium, sometimes lacking; leg color various, usually femora yellowish with fuscous spots that may be variously coagulated; male genital segment and metathoracic evaporatorium variously pigmented. .... 5
- 4(3). Rostrum extending between metacoxa onto base of abdomen; larger, L = 4.4 to 6.3 mm. ....  
..... *Nysius fuscovittatus* (Figs. K-6, K-7)
- 4<sup>?</sup>. Rostrum shorter, not extending onto abdomen; smaller, L = 3.5 to 4.5 mm. ....  
..... *Nysius groenlandicus* (Figs. K-8, K-9)
- 5(5). Bucculae slightly narrowing posteriorly with posterior end abruptly truncated or even forming a small, but distinct rounded to subangulate point; labium segment 1 slightly shorter than bucculae; labium short, its tip ending on anterior half of metasternum; pronotum narrow, PW/PL = 1.43 to 1.82; male genital segment black with margins lateral to and behind (usually) medial fovea yellow, posterior sterna with median flavescent areas; metathoracic evaporatorium pale with a longitudinal sublateral fuscous stripe; scutellum with lateral pale areas; antenna with segment 2 longer than 4. L = 3.6 to 4.7 mm. .... *Nysius angustatus* (Figs. K-10, K-11)
- 5<sup>?</sup>. Buccula gradually narrowing posteriorly and merging smoothly with gula before base of head, or if more abruptly terminated then apical angle obtuse and never produced; labium segment 1 subequal to bucculae, labium longer and apically reaching or exceeding end of metasternum; color various, male genital capsule color various. Measurements various. .... 6

- 6(5). Antenna segment 2 elongate, longer than 4 (ratio 2/4 = 1.17 to 1.33); segment 1 extending beyond apex of clypeus by one third to one half its length; pronotum relatively flat, in lateral aspect its dorsal profile almost straight. Larger, L = 3.8 to 5.3 mm. .... 7
- 6<sup>7</sup>. Antenna segment 2 subequal to or shorter than segment 4 (ratio 2/4 = 0.88 to 1.07); segment 1 extending beyond apex of clypeus by less than one third of its length; pronotum in lateral aspect with dorsal profile more or less convex, especially posterior lobe. Smaller, L = 3.4 to 4.6 mm. .... 8
- 7(6). Color darker, antenna black or with segment 1 and base of 2 rufous; antenna more conspicuously bristly, especially segment 3 with relatively strong, dark suberect setae; legs with spots of femora contiguous or at least intervening spaces darkened and spots not conspicuous; corium darker, with extensive fuscous mottling, wing membrane with fuscous pattern; scutellum black; male genital capsule black except posterior margin narrowly pale, parameres black. L = 3.8 to 5.3 mm, L/W = 2.52 to 2.92. .... *Nysius grandis* (Figs. K-12, K-13)
- 7<sup>7</sup>. Color paler, antenna segments 2 and 3 and much of 1 reddish; antenna with setae paler, finer and more appressed so segment 3 especially less bristly; legs with femora yellow and discretely spotted; clavus and corium pale yellow-brown with small brown spots mainly along veins, membrane with light fuscous spots or mottling between veins; scutellum black or with small pale spots; male genital capsule black with posterior margin pale, parameres reddish medially. L = 4.5 to 5.3 mm. .... *Nysius paludicola* (Fig. K-14)
- 8(6). Hemelytra basally narrow, costal margin slightly diverging at level of apex of scutellum, this basal area without conspicuous erect lateral setae; buccula slightly narrowing along length, but posteriorly somewhat abruptly terminated with apex bluntly convex to subtruncate; color pale yellow testaceous, punctures for most part not infuscate, hemelytra with pigment reduced to several spots on hind margin of corium, membrane translucent; scutellum yellow, basally darker; metathoracic evaporatorium mainly yellow with a diffuse darker medial longitudinal band; male genital capsule yellow. Small, slender, L = 3.5 to 4.1 mm; L/W = 2.91 to 3.13. .... *Nysius tenellus* (Figs. K-15, K-16)
- 8<sup>7</sup>. Corium with straight basal section of lateral margin bearing distinct, erect setae; buccula gradually narrowing posteriorly and merging smoothly with gula before base of head; color various, but generally darker, male genital capsule black with or without pale lateral and apical margins. .... 9
- 9(8). Larger, 3.4 to 4.7 mm and more robust, L/W = 2.71 to 3.25; pronotum short, PW/PL = 1.56 to 2.00; dorsally surface bristly, especially scutellum, clavus and corial veins basally, with distinct erect setae. Color relatively pale, antenna with segments 2 and 3 usually pale; legs pale with fuscous spots on femora; corium pale with darker spots mainly on veins and along apical border; membrane pale or very slightly darkened; scutellum black without yellow sublateral areas; metasternal evaporatorium black with inner angle reddish; male genital capsule entirely black, abdominal venter black or segment 5 sometimes with small medial-lateral rufescent areas. .... *Nysius niger* (Figs. K-17, K-18)
- 9<sup>7</sup>. Smaller, L = 3.0 to 3.8 mm, more slender, L/W = 2.91 to 3.40; pronotum more elongate, PW/PL = 1.59 to 1.78; dorsal surface with erect setae small, sparse and inconspicuous; color darker, punctures infuscate with pigmented areas fusing to make parts of body largely dark, hemelytra with spotting along wing veins as well as with four spots on corial apex, membrane slightly infuscate medially; legs with femora strongly spotted or spots fused and femora mainly dark; scutellum black; metathoracic evaporatorium black with paler area near coxal lamella; male genital capsule black, abdominal sterna black. .... *Nysius raphanus* (Figs. K-19, K-20)

# *Neortholomus scolopax* (Say)

AB SK MB CH PD PM PP BP

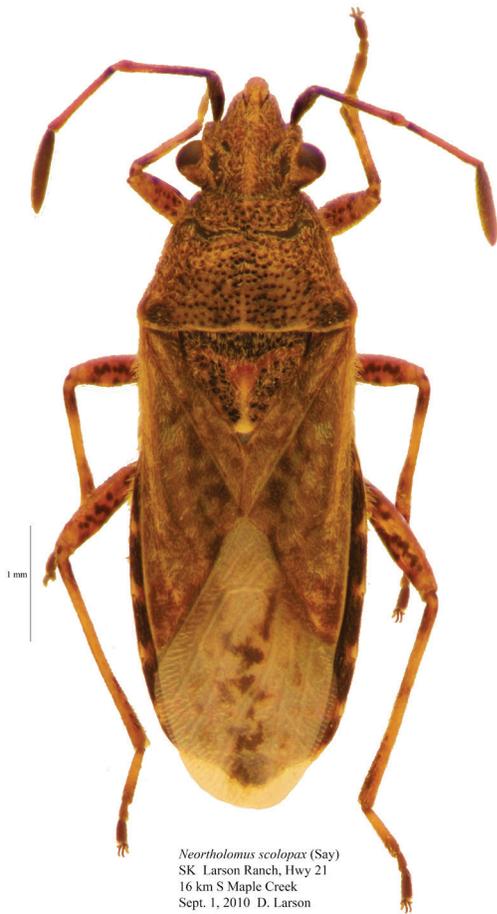


Fig. K-2. *Neortholomus scolopax*.

**Distribution:** 10. Nearctic-Neotropical. Canadian distribution from NT and BC to PE and NS. Recorded from most northern and central US states, but uncommon in the southeast and no records from the southern mountain states. South into Mexico and Guatemala.

**Taxonomy:** Largest species of the family within the area, but size as well as shape varying sexually (see measurements). Color dull greyish-brown, pronotum and scutellum mainly testaceous with punctures variously infuscate, scutellum mainly pale or with infuscation of punctures expanded and more or less confluent.

**Measurements (n = 14):** L = 4.9 to 6.3 mm (♂ = 5.0 to 5.5 mm; ♀ = 4.9 to 6.3 mm); L/W = 2.75 to 3.57 (♂ = 3.26 to 3.57; ♀ = 2.75 to 3.38).

**Wing development:** Macropterous, WL/AL = 1.00 to 1.17.

**Ecology:** Slater and Baranowski (1990) stated the species is common in weedy fields. Prairie specimens have been collected from weedy fields, along road allowances and other somewhat disturbed sites where there is a variety of grasses and herbaceous vegetation. Specimens were found to be common in a dry field that was reverting from crested wheatgrass to natural vegetation.

It is reported to be a general feeder with recorded hosts spanning 13 plant families (Hamilton 1983). Plant association records for specimens we have examined include: alfalfa, alsike, apple, blueberry, evening-primrose, goldenrod, lupine, rose, spruce, Viper's bugloss, willow and yarrow. Adults have been collected from July 10 to late fall with the majority taken in August and September, suggesting egg overwintering and a univoltine life cycle.

**Collecting:** Almost all specimens have been collected by sweep net.



Fig. K-3. *Neortholomus scolopax*, forebody, lateral.

# *Xyonysius californicus* (Stål)

AB SK MB CH PD PM PP



*Xyonysius californicus* (Stål)  
SK Larson Ranch, Hwy 21  
16 km S Maple Creek  
Aug. 8 2016 D. Larson

Fig. K-4. *Xyonysius californicus*.

**Distribution:** 10. Nearctic-Neotropical. Canadian records extend from BC to ON. Recorded from almost all conterminous US states, south into Mexico, South America and the West Indies.

**Taxonomy:** The nominative subspecies *X. c. californicus* occurs in Canada only in BC. Specimens from AB to ON are assigned to *X. c. alabamensis* (Baker) (Maw *et al.* 2000). The main difference between the two is size, which varies clinally becoming smaller towards the east (Barber 1947a, who gave species size range as 3.5 to 6.0 mm) although specimens from FL are the largest reported (4.7 to 7 mm, Slater & Baranowski 1990). The argument for recognition of subspecies is not very persuasive (Ashlock and Slater 1988) and prairie specimens are of intermediate size.

**Measurements (n = 7):** L = 5.2 to 5.8 mm; L/W = 2.80 to 2.94.

**Wing development:** Macropterous, WL/AL = 1.09 to 1.21. Besides dispersal considerations, the possession of a wing stridulatory organ would set limits on how much the wing could be reduced before stridulation is imperilled.

**Ecology:** Specimens have been collected from mixed prairie by sweeping areas where there had been disturbance and overgrazing by livestock followed by revegetation with sparse grasses and low herbs. Also, specimens have been collected from undisturbed, but dry fescue-cinquefoil grasslands. Host records for specimens we have examined are: baby's-breath, mustard, oriental mustard, wild mustard and snowberry. Both sexes have the most exquisite stridulatory organ, but there is no record of anyone hearing sound.

**Collecting:** Most specimens have been collected by sweep net.



*Xyonysius californicus* (Stål)  
SK Larson Ranch, Hwy 21  
16 km S Maple Creek  
Aug. 27 2016 D. Larson

Fig. K-5. *Xyonysius californicus*, forebody, lateral.

# *Nysius fuscovittatus* Barber

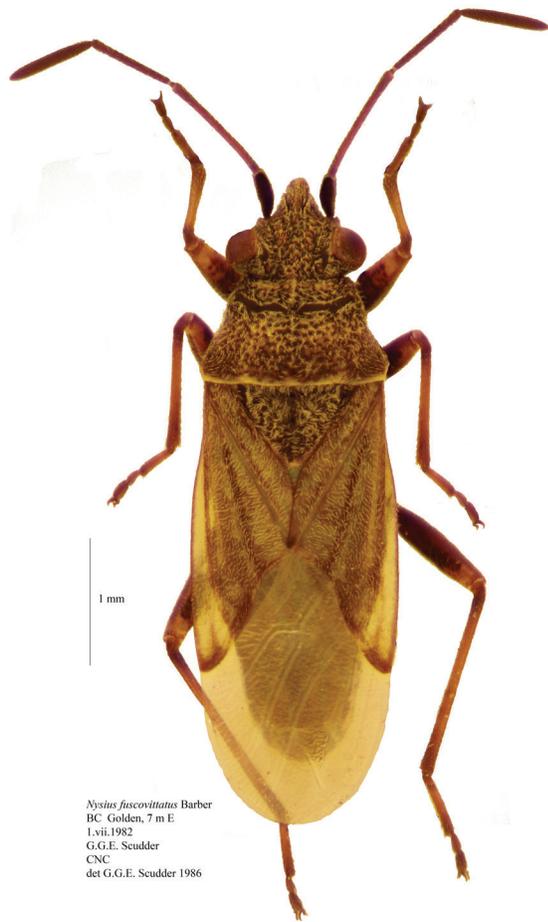


Fig. K-6. *Nysius fuscovittatus*.



Fig. K-7. *Nysius fuscovittatus*, forebody, lateral.

AB

MC

**Distribution:** 7. Western Cordilleran, including Beringia. AK, YT, BC and AB. Described from AK with a paratype from Jasper, AB (Barber 1958). AB localities extend along the Rocky Mountains from Wasootch Creek and Spray Lake, Kananaskis area, north to Hinton and Jasper.

**Taxonomy:** This species is easily recognized by the elongate labium which extends between the metacoxa and reaches the level of sternum 3. It is like a large form of *N. groenlandicus* in that segment 1 of the labium distinctly extends beyond the apex of the buccula and the color is dark with corial markings fused along veins and apex to form vittate markings. The hemelytron of *N. fuscovittatus* has the erect setae less dense, shorter and more distinctly curved than those of *N. groenlandicus*. The ventral surface of the body is very dark: the femora are usually fuscous except at apex, abdominal segments are black without defined pale spots and male genital capsule is black.

Barber (1958) states the species is very close to *N. paludicola* Barber, differing “in having less elevated bucculae, antennae somewhat shorter, corium very little longer than membrane and posterior margin with an unbroken fuscous line.” However, the affinities of *N. fuscovittatus* are more with *N. groenlandicus* whereas *N. paludicola* is most similar to *N. grandis* as discussed below.

**Measurements (n = 12):** L = 4.4 to 5.6 mm ( $\delta$  = 4.4 to 5.1 mm;  $\text{♀}$  = 4.8 to 5.6 mm) (Barber 1958: 6.3 mm); L/W = 2.81 to 3.21; Pronotum W/Pronotum L = 1.56 to 1.85.

**Wing development:** Macropterous, LW/LA = 1.07 to 1.17.

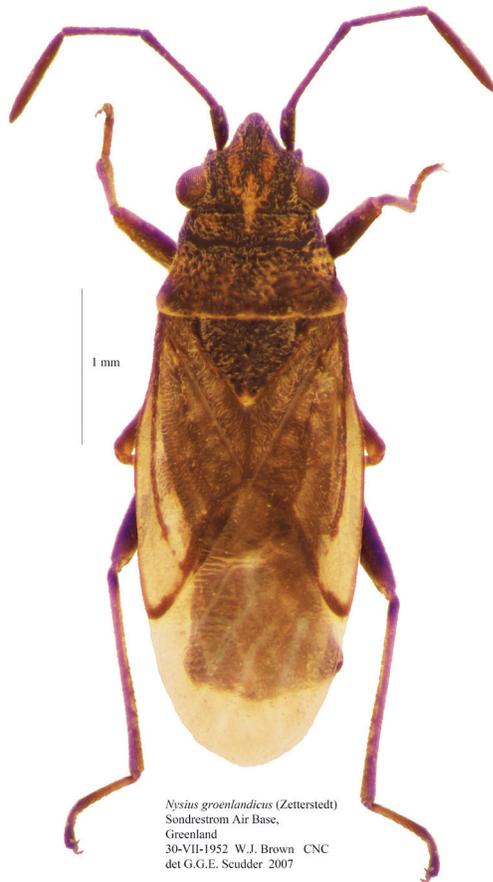
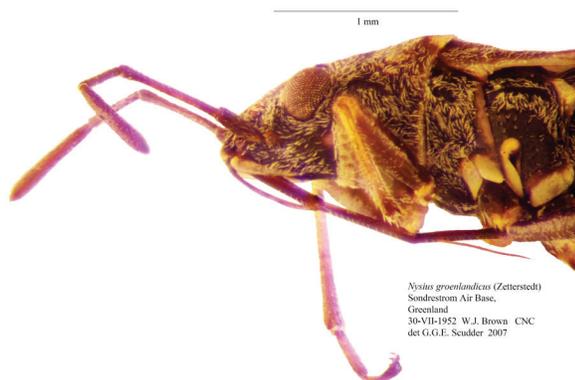
**Ecology:** All specimens with habitat data were found in association with mountain avens. Specimens were collected from the seed heads as well as under or beside the mats of leaves. The life history is not known, but probably univoltine with egg overwintering.

**Collection:** The habitat of mountain avens is described as dry stony or gravelly ground such as calcareous cliffs, talus, and river bars and flats (Cormack 1967, Scoggan 1978) of alpine and subalpine areas of montane regions so this is probably a good description of the general habitat of *N. fuscovittatus*.

# *Nysius groenlandicus* (Zetterstedt)

MB

BS

Fig. K-8. *Nysius groenlandicus*.Fig. K-9. *Nysius groenlandicus*, forebody, lateral.

**Distribution:** 11. Holarctic. Circumboreal. Greenland and Europe to Siberia and recorded in North America from: AK, YK, MB, ON, QC, PE, NL. We have seen specimens from the Churchill, MB, area (AACS, JBWM).

**Taxonomy:** The records of *N. groenlandicus* from Manitoba are quite old (Barber 1947a, b) and many of those from other parts of North America are likewise old records (see Slater 1964 for references). These old records are frequently repeated in the more recent literature, such as noted by Danks (1981, p. 425 footnote). Böcher (1976, 1978) stated that Ashlock (1967) doubted the presence of true *N. groenlandicus* in North America. Scudder (1997) discussed the identity of North American specimens. AK, YT, MB and QC specimens seem similar to each other, but they may not be conspecific with Palearctic *N. groenlandicus*. Scudder noted that North American specimens have the corium with erect setae as well as dense appressed pubescence, agreeing with specimens examined from Greenland.

**Measurements (n = 5, Greenland):** L = 3.4 to 4.5 mm (4.1 to 4.5 mm, Barber 1947a); L/W = 2.71 to 2.93.

**Wing development:** Macropterous, LW/LA = 0.99 to 1.19.

**Ecology:** This is an arctic-alpine species that prefers well drained, sun exposed sites. Specimens have been collected from the seedheads of avens spp., but it is reported to feed on seeds of moss campion as well as other plants. The species has been intensively studied in Greenland by Böcher (1972, 1975). There it is univoltine with overwintering in the egg stage. Even in the cold climate of northern Greenland this species retains the capacity for flight even though they can fly only at temperatures of 30°C and then for distances of only about 1 m. However, they do show a habit of laying eggs on seeds and fruits adapted to wind dispersal (Böcher & Nachman 2010).

The sex ratio of Greenland populations varies in ways related to temperature and precipitation and some populations in the most continental environments are parthenogenetic (Böcher & Nachman 2010, 2011).

**Collection:** We have not collected North American specimens, but one would suspect they occur in protected, sun-warmed sites at the side of plant tussocks and hummocks on well drained soils.

## *Nysius angustatus* Barber

AB SK MB CH PD PM PP

**Distribution:** 2. Nearctic, excluding Beringia. Recorded from AK (Scudder and Sites 2014), NT and BC to NB. Recorded from many US states, but some of these records may be based on misidentifications (Ashlock & Slater 1988).

**Taxonomy:** The mouthpart characteristics, i.e. the abruptly truncated or even slightly protruding posterior end of the buccula which is slightly longer than labium segment 1, are distinctive. Color relatively pale, but corium with small, but distinct fuscous spots on veins and apical margin; male abdominal venter and genital capsule with pale areas; female abdomen with pregenital segments broadly pale medially. The species is similar to *N. niger* with which it commonly co-occurs, but *N. niger* is usually easily recognized by the more bristly body and shorter pronotum and in both sexes the costal margin of the corium is more convex in *N. angustatus* than in *N. niger*; male genital capsule and preceding abdominal sterna (sometimes segment 6 with small submedial pale areas) of *niger* are entirely black.

**Measurements (n = 30):** L = 3.6 to 4.7 mm ( $\sigma$  = 3.6 to 4.1 mm;  $\text{♀}$  = 3.9 to 4.7 mm); L/W = 2.59 to 3.24 ( $\sigma$  = 2.65 to 3.24;  $\text{♀}$  = 2.59 to 3.14). Pronotum W/Pronotum L = 1.43 to 1.82; Head W / Pronotum W = 0.84 to 0.90.

**Wing development:** Macropterous. LW/LA = 1.00 to 1.24.

**Ecology:** This is a common species of pastures, disturbed areas of grasslands and old fields. It often co-occurs with *N. niger* but is usually the more abundant species in drier sites such as short-grass and mixed prairie. Collection labels record the following plant associations: pasture grasses, brome, crested wheat grass, barley, oats, wheat, alfalfa, leafy spurge, oriental mustard, prairie rocket as well as the following trees, larch, jack pine, juniper, larch and Manitoba maple. Adults have been collected from June 27 to early October. Diapausing eggs are the probable overwintering stage, the number of generations per year is unknown.

**Collecting:** Most specimens have been collected by sweeping dry, mixed prairie.

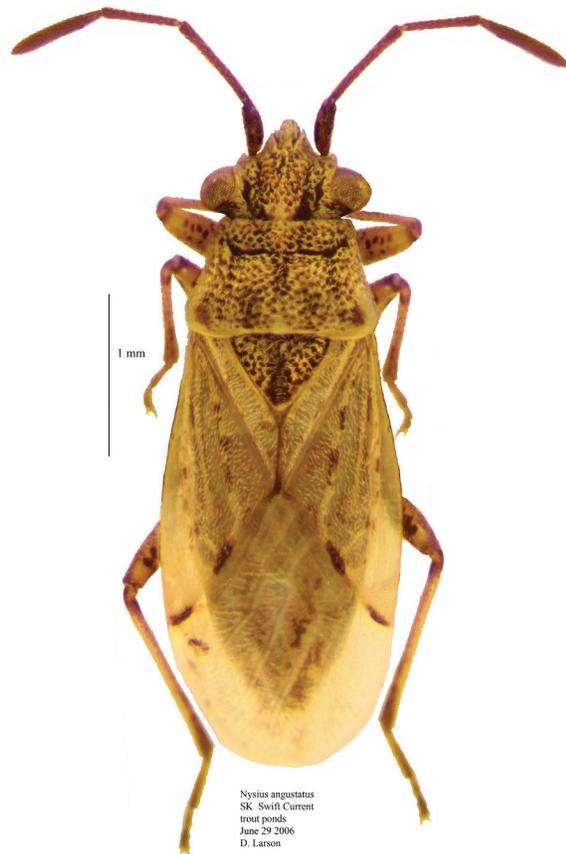
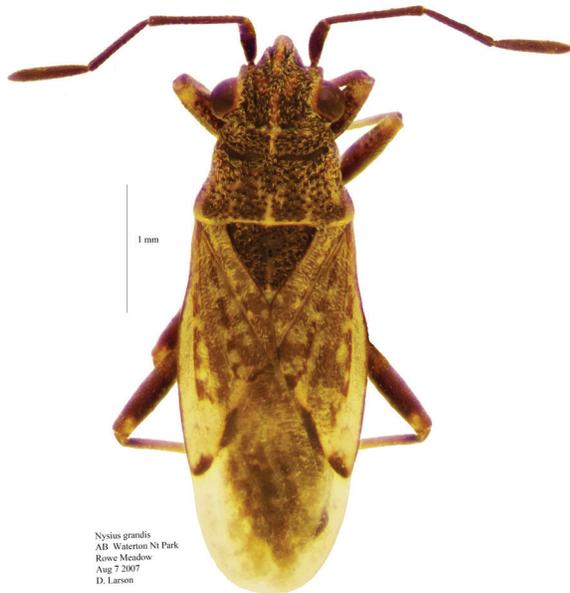


Fig. K-10. *Nysius angustatus*.



Fig. K-11. *Nysius angustatus*, forebody, lateral.

# *Nysius grandis* Baker



*Nysius grandis*  
 AB Waterton NI Park  
 Rowe Meadow  
 Aug 7 2007  
 D. Larson

Fig. K-12. *Nysius grandis*.

AB MB MC TS?

**Distribution:** 8. Western Cordilleran, excluding Beringia. Described by Baker (1906) from higher elevations in CO who also stated it occurs in high elevations in AZ, Mexico and Panama. Recorded from AB and MB (Churchill, Barber 1947a, b) but the Churchill record probably refers to another species.

**Taxonomy:** Barber (1947) gave length as 4.8 to 5.0 mm, however males especially tend to be much smaller

**Measurements (n = 24):** L = 3.8 to 5.3 mm (♂ - 3.8 to 4.4 mm; ♀ - 4.2 to 5.3 mm); L/W = 2.52 to 2.92; Pronotum W / Pronotum L = 1.55 to 1.79; Head W / Pronotum W = 0.76 to 0.85.

**Wing development:** Macropterous, LW/LA = 0.94 to 1.22.

**Ecology:** Specimens have been collected on talus slopes and moraine in subalpine sites in Waterton Lakes National Park, and in the Highwood Pass (Kananaskis area), AB. The insects were generally under rosettes of short, sparse vegetation in open places near small meltwater stream or where the soil was moist. Specimens were also collected by sweeping mountain avens and yarrow that were in seed. Teneral adults were found Aug. 7 in a site which was probably snow-covered until late June. The species probably overwinters as a diapausing egg and in the subalpine/alpine zone there is time for only one generation per summer.

**Collecting:** On a sunny summer day the insects are very active and fast moving and can be quite challenging to collect from amongst the short, wiry alpine vegetation and the gravelly soils.

*Nysius grandis* Baker  
 AB Waterton National Park  
 Rowe Meadow  
 Aug. 7 2007  
 D. Larson



Fig. K-13. *Nysius grandis*, forebody, lateral.

## *Nysius paludicola* Barber



Fig. K-14. *Nysius paludicola*.

AB

ME

**Distribution:** 8. Western Cordilleran, excluding Beringia.

Barber (1949) included a male from AB (Jasper, Aug. 8, C.T. Rawson) as a paratype, however Barber (1958) recognized this specimen is actually *N. fuscovittatus*, and in fact, included it as a *N. fuscovittatus* paratype. We follow Maw *et al.* (2000) and delete the AB record. Recorded from BC and WA (Ashlock & Slater 1988). The species is included here as an aid in identifying western Canadian members of *Nysius*.

**Taxonomy:** *Nysius paludicola* resembles *N. grandis* in most features except it is paler in color, the antennae are less conspicuously bristled, and the costal margin of the hemelytron is more convex. Although the distributions of the two species are not well known, *N. paludicola* appears more western and coastal whereas *N. grandis* is a species of the Rocky Mountains. It is not unlikely they are geographical forms of the same species, in which case the name *grandis* Baker has priority.

**Measurements (n = 3):** L = 4.5 to 5.3 mm; L/W = 2.38 to 2.58; Pronotum W/Pronotum L = 1.56 to 1.61; Head W / Pronotum W = 0.81 to 0.83.

**Wing development:** Macropterous, LW/LA = 1.05 to 1.07.

**Ecology:** This seems to be a species of cooler, damper environments such as maritime and montane areas.

# *Nysius tenellus* Barber

AB SK

CH PD

**Distribution:** 10. Nearctic-Neotropical. This primarily western species has been recorded from BC, AB (Medicine Hat, Scudder 2012), and SK (Jones' Peak near Eastend, Scudder, 2010). It has a wide range in western US from WA and ID to CA and TX, also Mexico, Central America and West Indies.

**Taxonomy:** The species can be recognized most readily by the lack of erect setae on the basal part of the costal margin of the corium plus the more or less truncated posterior end of the bucculae. Useful field characters are its small size, elongate shape and generally pale color. The corium of some specimens lacks fuscous spots on veins, but the spots along its border with the membrane are distinct. The scutellum is pale laterally and the male genital capsule is pale ventrally.

**Measurements (n = 3 BC (Osoyoos)):** L = 3.5 to 4.1 mm, L/W = 2.91 to 3.1; Pronotum W/Pronotum L = 1.56 to 1.60; Head W / Pronotum W = 0.72 to 0.78.

**Wing development:** Macropterous

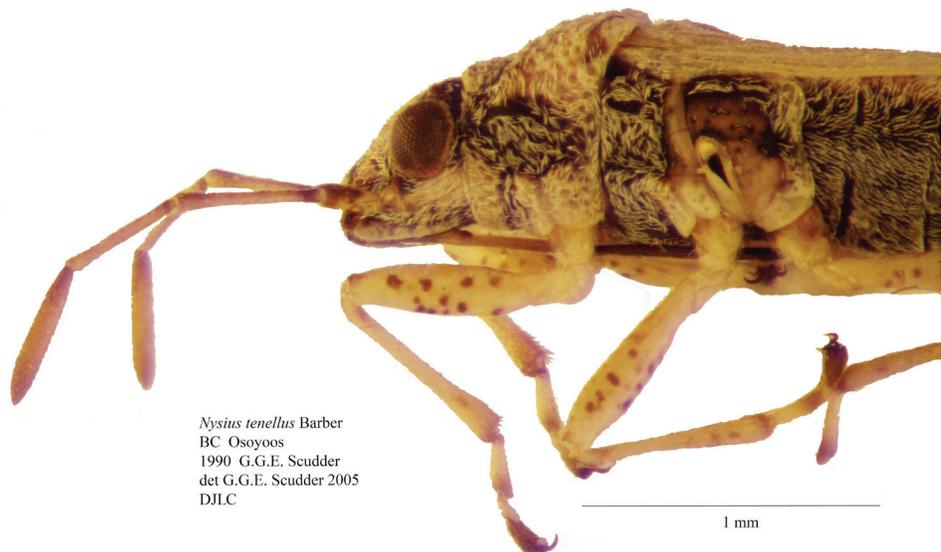
**Ecology:** The SK specimen was collected by sweeping dry, mixed prairie in an area of eroding sandstones and shale, so the soil was sandy and light. Plant association records based on specimen labels include: goldenrod, hairy golden-aster, greasewood, needle and thread grass, pearly everlasting, rabbitbrush, sagebrush, and sand dropseed. It is likely that only the grasses are true breeding hosts.

**Collecting:** Most specimens have been collected by sweeping dry grasslands, but specimens have been collected in pitfall traps in BC.



*Nysius tenellus* Barb.  
det G.G.E. Scudder  
BC Osoyoos 1990  
G.G.E. Scudder

Fig. K-15. *Nysius tenellus*.



*Nysius tenellus* Barber  
BC Osoyoos  
1990 G.G.E. Scudder  
det G.G.E. Scudder 2005  
DJLC

Fig. K-16. *Nysius tenellus*, forebody, lateral.

# *Nysius niger* Baker

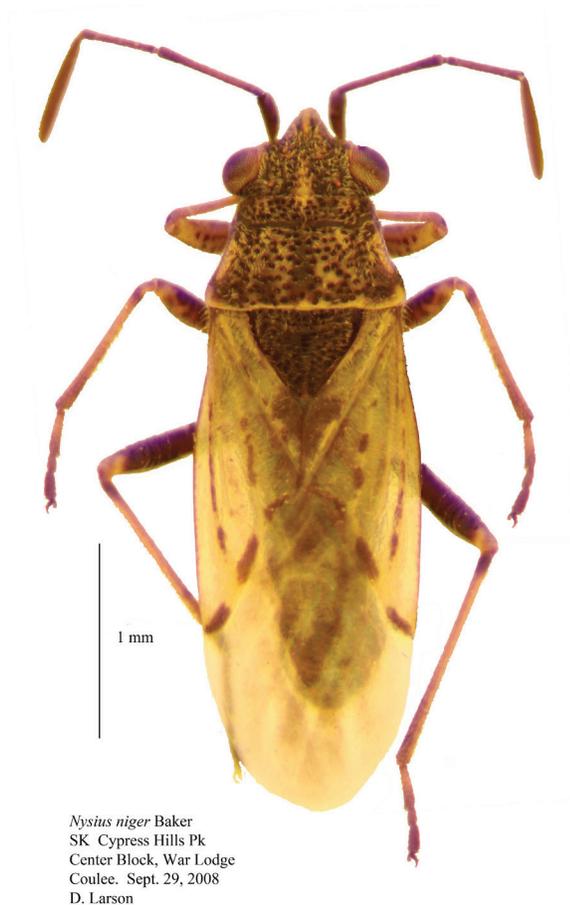


Fig. K-17. *Nysius niger*.

AB SK MB MC CH PD PM PP BP BS TP TS

**Distribution:** 2. Nearctic, excluding Beringia. A northern species, AK, YT, NT and BC to NL. Probably widely distributed in northern US, but much confused with other species.

**Taxonomy:** All North American records of *N. ericae* (Schilling) are based on misidentifications and probably refer to *N. niger* (Ashlock 1977).

The species is similar to *N. angustatus* and the two often co-occur although *N. angustatus* is the dominant species on dry grasslands. In addition to differences in the bucculae and color of the male genital capsule, the costal margin of the hemelytron of *N. niger* is less convex than in *N. angustatus* and the dorsal surface of the hemelytra and scutellum of *N. niger* are conspicuously bristly. The limits against *N. raphinus* are much less clear as discussed under that species.

All specimens of *N. niger* that we have collected in southwestern SK and adjacent AB are female (over 200 specimens in DJLC). Other authors have described males and have not commented on a skewed sex ratio and DJL has recently collected a series of over 200 specimens in southwestern AB within which the sex ratio is approximately even. Further investigation is required to determine if the apparent lack of males in dry prairie is a collecting artifact or if, like *N. groenlandicus*, some populations are parthenogenetic.

**Measurements on specimens from two areas are:**

**Western AB (n = 20):** L = 3.4 to 4.7 mm (♂ - 3.4 to 4.0 mm; ♀ - 3.6 to 4.7 mm); L/W = 2.72 to 3.25; Pronotum W/L = 1.56 to 1.81; WL/AL = 1.00 to 1.24.

**Southwestern SK (♀ only, n = 20):** L = 4.0 to 4.6 mm; L/W = 2.71 to 3.05; Pronotum W/L = 1.73 to 2.00; WL/AL = 1.15 to 1.33.

(Barber 1947a gives L = 3.25 - 3.70 mm (as *N. ericae*, see Taxonomy)

**Wing development:** Macropterous, wings long, WL/AL = 1.00 to 1.33, tending to be longer on specimens from prairie as compared to mountain specimens.

## *Nysius niger* Baker (continued)



Fig. K-18. *Nysius niger*, forebody, lateral.

AB SK MB MC CH PD PM PP BP BS TP TS

**Ecology:** Beirne (1972), under the name *N. ericae*, reviewed the literature on the pest status of this species. This review is summarized here with the realization several species are probably involved and thus there may be details that are incorrect.

The insect is a minor pest of a wide variety of crops, including grains, field and garden vegetables and various garden flowers. Feeding punctures cause local discoloration to the plant, withering of leaves and shrivelling of seeds. Damage is usually significant only when populations reach high levels. This occurs in dry places and in dry summers when populations build up in pastures and weedy areas and move into crops. Heavy rains and cool, wet weather check infestations. The statement that adults overwinter hiding under rubbish is probably incorrect; egg diapause is more likely. There may be 3 to 5 generations per summer. Adults fly readily and may be abundant at light during mid-summer. Sweet (2000) considered the distribution, life history and biology.

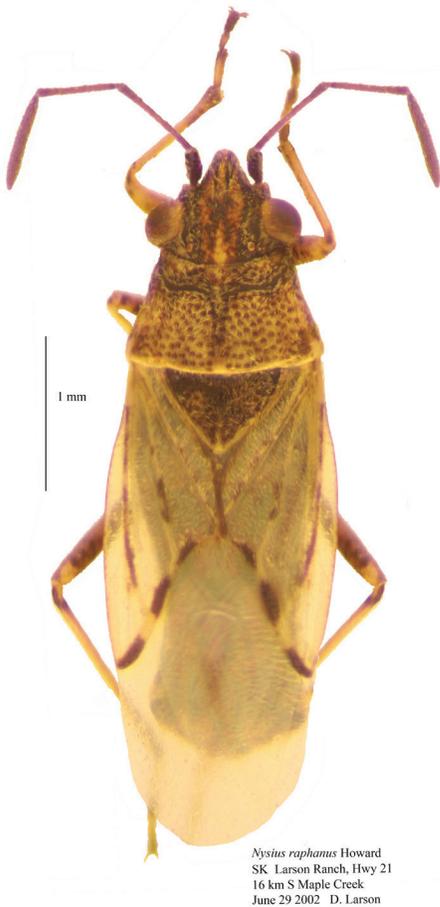
The species has been reported from many plants. For example, label data on prairie specimens we have examined include the following plant records: alfalfa, choke cherry, leafy spurge, oriental mustard, range grass, stinkweed, sugar beet, wild mustard and wild rye. However, like Beirne's (1972) list of attacked plants, many of these associations probably do not represent breeding host records. GGES has association records for over 40 plant species in BC, but most fall records (a likely egg-laying period) are for adults on seed plants such as clematis, wild rye, leafy spurge, rabbitbrush, oriental mustard, stinkweed, pearly everlasting, wild mustard, and sagebrush. Prairie specimens have been regularly captured by sweeping dry, mixed grassland where broomweed was common. Many specimens have been swept off mountain avens in subalpine areas of BC and western AB. L. Burgess (pers. com. Nov. 2017) in his studies of *N. niger* on mustard, found nymphs and adults fed readily on the dry seeds of flaxweed.

**Collecting:** Most specimens have been collected by sweeping. Specimens from the vicinity of Churchill, MB, were collected in pitfall traps (CNC).

# *Nysius raphanus* Howard

AB SK

CH PD

Fig. K-19. *Nysius raphanus*.Fig. K-20. *Nysius raphanus*, forebody, lateral.

**Distribution:** 10. Nearctic-Neotropical. Recorded in Canada from BC, AB, SK and ON. Ashlock & Slater (1988) gave records from throughout the US whereas Slater & Baranowski (1990) regarded it as a more southern species occurring from VA to CA and into Mexico. The confused taxonomy of the genus makes distribution records suspect.

**Taxonomy:** As recognized here this is a small, dark, slender species, similar to *N. niger* in form of bucculae, but with dorsal surface lacking erect setae on scutellum, clavus and base of corial veins, or at least such setae sparse and inconspicuous so that the body appears less bristly. Along with small size, the best character for recognizing the species is the straight costal margin in the male, less straight in female.

**Measurements:** (n = 10). TL = 3.0 to 3.8 mm (Barber 1947a: L = 3.10 to 4.00), L/W = 2.91 to 3.40; pronotum W/L = 1.59 to 1.78.

**Wing development:** Macropterous with wings relatively long, WL/AL = 1.10 to 1.32

**Ecology:** Sweet (2000) discussed the distribution, life history and biology. There is evidence in US populations for overwintering as eggs and small nymphs as well as by adults (Slater & Baronowski 1990). SK records for adults are June 29 to September 29. The species is uncommon in mixed grasslands and no definite plant association has been determined within the study region. However, the species has been collected abundantly in southern BC, with a wide range of plant associations. Some of the more frequently listed are with pearly everlasting, sagebrush, hoary-alyssum, hairy golden-aster, rabbit brush, greasewood, mustard, goldenrod, sand dropseed and needle & thread grass.

**Collecting:** All specimens have been taken by sweeping herbaceous vegetation. The species is not common and generally specimens have been found in more mesic sites than those in which *N. angustatus* and *N. niger* occur, namely along grassland draws, at the base of hills and in dense vegetation along edges of reservoirs and lakes. The insects are active and fly readily so that this coupled with their small size probably results in many specimens being missed in collections contributing to their apparent scarcity.

**L. Family Lygaeidae, subfamily Ischnorhynchinae – Catkin Bugs**

This is a small group of reddish colored bugs that feed on the flowers and seeds of various trees and shrubs.

Small species, 4.0 to 5.0 mm. Body form characteristic, dorsally flattened, shape ovate with forebody narrow and widening to near or slightly behind middle then more broadly rounded posteriorly. Dorsal color mainly yellow to reddish-brown, punctures not or only lightly darkened; corium with darker brown spots, two medially and two or three along border with membrane, membrane translucent; legs largely pale, with or without fuscous spots. Dorsal surface of pronotum, scutellum and clavus rather shiny and coarsely punctate; ventrally thoracic pleura coarsely punctate, head and thorax pruinose; body dorsally with setae short, appressed and not or barely extending beyond their respective punctures. Bucculae short, gula long and broad, ending bluntly shortly before hind margin of head; labium long, reaching abdomen; thorax ventrally not grooved for reception of labium. Pronotum with anterior lobe broadly, transversely depressed, on each side with a transverse groove; in lateral aspect with anterior margin straight, not concave posterior to eye; lateral margin distinctly angulate on anterior lobe, angulation becoming obsolete posteriorly. Wings full, longer and broader than

abdomen; corium with apical margin straight. Profemur without ventral spines. Abdominal venter with suture between segments 4 and 5 transverse to lateral margin; spiracles of segments 2 to 7 located dorsally.

Scudder (1962) reviewed Ischnorhynchinae of the World and Barber (1953) revised the North American species of *Kleidocerys*. The family is represented in Saskatchewan by two species of the genus *Kleidocerys*.

Scudder (1962) described the life history of species that live in north temperate regions as being univoltine with overwintering in the adult stage, usually on conifers. On the prairies, overwintering adults are generally found in leaf litter or debris under the host trees. These insects feed on the flower catkins and seed cones of trees and shrubs of the families Betulaceae (Fig. L-1) and Myricaceae as well as some records of occurrence in cattails (Wheeler & Fetter 1987). Marshall (2006) stated these bugs have a really bad smell which would give them good protection from some predators. Adults possess a stridulatory organ formed from a file on a vein of the hind wing that rubs against a plectrum on the front wing (Southwood and Leston 1959) and both sexes have been heard to stridulate in the spring when reproduction occurs, as well as when they are distressed.

**Key to species of Lygaeidae, Ischnorhynchinae, of the Prairie Provinces**

- 1. Antenna reddish-yellow with segments 1 to 3 slightly darkened, segment 4 fuscous except at base; head basally and pronotal grooves reddish brown and usually not contrasting with surrounding sclerite; body ventrally black medially with extensive reddish areas on head lateral to gula, thoracic pleura and apical half of abdomen reddish. .... *Kleidocerys ovalis* (Fig. L-2)
- 1'. Antenna segment 1 piceous, segments 2 and 3 yellow medially, infusate basally and apically and segment 4 largely lightly fuscous; head basally and pronotal grooves piceous and contrasting with rest of dorsum; body ventrally mainly black. .... *Kleidocerys resedae* (Fig. L-3)



Fig. L-1. Black birch catkins, the host of *Kleidocerys ovalis*.

## *Kleidocerys ovalis* Barber

AB SK MB CH PD PM PP BP BS

**Distribution:** 2. Nearctic, excluding Beringia. Recorded in Canada from BC to QC (Scudder 2008a). Across northern US from WA to ME, south to CA, AZ, CO, SD, MN, MI and NY.

**Taxonomy:** Keys for species recognition are given in Barber (1953) and Scudder (1962). Generally, the two prairie species can be easily recognized by antennal color. However, some specimens of *K. ovalis* are darker than average and these have the base and apex of antennal segment 1 (and sometimes also 3) darkened as well as having the head, pronotal grooves and ventral surface of body darker brown. Such specimens have been identified by their association with the more abundant typically colored specimens.

**Measurements (n = 20):** L = 4.1 to 4.7 mm ( $\sigma$  = 4.1 to 4.6 mm;  $\text{♀}$  = 4.3 to 4.7 mm) (Barber 1953 – 5 mm); L/W = 2.24 to 2.47 ( $\sigma$  = 2.24 to 2.47;  $\text{♀}$  = 2.27 to 2.39).

**Wing development:** Macropterous, wing longer and broader than abdomen. LW/LA = 1.16 to 1.50.

**Ecology:** Sweet (1960) described the biology of this species. This species is abundant on the catkins of black birch growing along banks of prairie streams. Scudder (2008) recorded the following plant associations: alpine fir, alder sp., black birch, paper-birch, apple and ponderosa pine in BC, and in MB with dwarf birch and paper birch. Recent records now include balsam fir and spruce in MB. Life history univoltine with adults overwintering.

**Collecting:** These insects can usually be taken in numbers by sweeping catkin-bearing birch. From fall to spring they can be sifted from litter beneath the host tree.



Fig. L-2. *Kleidocerys ovalis*.

## *Kleidocerys resedae* (Panzer)

AB SK MB PD PM PP BP BS

**Distribution:** 11. Holarctic. Europe to Siberia. In North America from AK to NL south to NY, SD and CO. Prairie specimens belong to the subspecies *K. r. resedae* which is holarctic and occurs across Canada and the northern US.

**Taxonomy:** Scudder (1963) keyed the species, but subsequently (Scudder 1997) cautioned there may be a number of sibling species involved as the diverse host records in Europe are attributable to other *Kleidocerys* species.

**Measurements (n = 5):** L = 4.1 to 4.5 mm (Barber - 4.5 to 5.1 mm); L/W = 2.09 to 2.35.

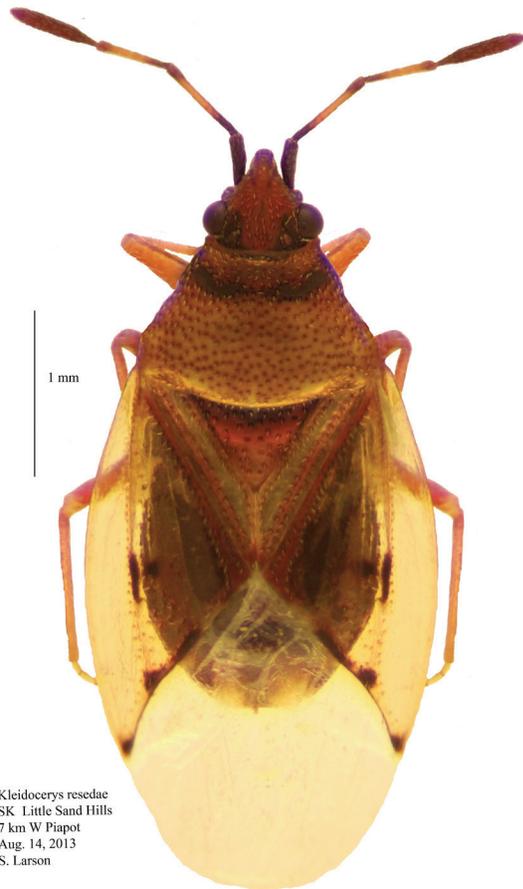
**Wing development:** Macropterous and the insects fly readily.

**Ecology:** This insect feeds on the catkins of trees and bushes of the families Betulaceae and Myricaceae. The common name is birch catkin bug reflecting a common host. Other host plants are sweet gale and alder, but they are also known from the seed heads of cattails (Wheeler & Fetter 1987). Specimens have been collected by sweeping black birch along prairie streams and in sand hills, where they occur with, but never as common as, *K. ovalis*.

There are numerous other plant association records, some of which probably represent breeding hosts. Some of these, by province, are: BC – rhododendron seed pods, Douglas fir cones, sagebrush, rib grass (abundant), seaside plantain, ninebark, ocean spray, soft rush, pearly everlasting, bog laurel; MB – larch, white spruce, birch, paper birch, trembling aspen; NT – larch; ON – white birch; QC – green alder, speckled alder, beaked willow, hardhack; SK – spiraea, Labrador tea, green alder, black spruce, paper birch, tamarack cones; YT – alder.

Adults overwinter, often in leaf litter under host trees.

**Collecting:** Best collected by sweeping the host trees, especially those with mature catkins.



*Kleidocerys resedae*  
SK Little Sand Hills  
7 km W Piapot  
Aug. 14, 2013  
S. Larson

Fig. L-3. *Kleidocerys resedae*.

### Afterwords and Acknowledgements

There was no initial plan to write a manual on the lygaeoid fauna of the Prairie Provinces. It started as part of a general interest in the natural history of the environment in which one lived. Initial passing curiosity led to a realization that there was more to the seed bug fauna than just a few grayish bugs living in the weedy parts of the garden. Attempts to identify them revealed that not all was known about the regional fauna and its distribution and thus began a journey to learn more about these insects. It was also encouraged by the fact that as the prairie dries out over the course of a summer, many insects disappear but not the seed bugs, they flourish in the dry conditions of late summer and fall providing more opportunity for their study. Over several seasons, a collection was developed and photos and notes on southwestern Saskatchewan seed bugs accumulated. This material forms the core of the study but as it was discovered that most species in the Canadian Prairie fauna were included within this regional study, it was decided to broaden the geographic scope to include the entire Prairie Provinces. This was only possible through the assistance of other collectors and curators of collections. Collections from which specimens were examined have been listed above. We thank these institutions and people for access to this resource. We especially thank David Langor and Greg Pohl (Natural Resources Canada, Edmonton) for assistance in photography and provision of specimens. Eric Maw and R. Footitt (CNC, Ottawa) promptly supplied specimens and information in response to our many requests. Corey Sheffield (SMNH, Regina) provided a database of the museum holdings and Matthias Buck (PMAE) lent many specimens collected during the museum's grassland studies. Cedric Gillotte and Larry Burgess (Regina) provided observations and experiences with prairie bugs. Thomas Henry (USDA, Washington) did a very thorough review of an earlier draft of the manuscript and offered many comments and suggestions that brought it up to publishable standards.

The project evolved in a way that there was no clear vision of the final product and it didn't fit the format or audience of most outlets. However, when Steve Marshall (U. of Guelph) was approached regarding publication in CJAI, he was very positive about the manuscript and did much to help us meet the Journal's requirements. Heather Proctor (U. of Alberta), Colin Favret (U. of Montreal) and Morgan Jackson (University of Guelph) continued in this vein and we are most grateful for their assistance and guidance.

About the time this study started to take form, the Biological Survey of Canada had a project on the Arthropods of Canadian Grasslands. Although Lygaeoid

bugs are very much grassland insects, this study was not far enough along or clearly focussed enough to contribute to the final published series on Grassland Insects. However, belatedly we would like to offer this in support of, and as a contribution to, the Biological Survey's Arthropods of Canadian Grasslands.

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**Appendix 1. Common and Scientific names of Plants.**

Common Name	Scientific Name
Alder	<i>Alnus w</i>
Alfalfa,	<i>Medicago sativa L.</i>
Alpinr fir	<i>Abies lasiocarpa</i> (Hook.) Nutt,
Alsike clover	<i>Trifolium hybridum L.</i>
Antelope-brush	<i>Purshia tridentata</i> (Pursh) DC
Apple	<i>Malus</i>
Aster	<i>Aster</i>
Atriplex	<i>Atriplex</i>
Avens	Dryas
Baby's-breath,	<i>Gypsophila paniculata L.</i>
Balsam fir	<i>Abies balsamea (L.) Mill.</i>
Barley	<i>Hordeum</i>
Beaked willow	<i>Salix bebbiana Sarg.</i>
Big bluestem	<i>Andropogon gerardi</i> Vitman
Birch	<i>Betula</i>
Black birch	<i>Betula occidentalis Hook,</i>
Black spruce	<i>Picea mariana</i> (Mill.) BSP,
Blue grama grass	<i>Bouteloua gracilis</i> (HBK.) Lag.
Blue grass	<i>Poa</i>
Blueberry	<i>Vaccinium</i>
Bluestem grass	<i>Andropogon</i>
Bog laurel	<i>Kalmia occidentalis Small</i>
Brome	<i>Bromus</i>
Broomweed	<i>Gutierrezia diversifolia</i> Greene
Buffalo grass	<i>Buchloe dactyloides</i> (Nuttall)
Bugloss	<i>Lycopsis arvensis L.</i>
Bulrush	<i>Scirpus</i>
Canada fleabane	<i>Erigeron canadensis L.</i>
Canada goldenrod	<i>Solidago canadensis L.</i>
Canada thistle	<i>Cirsium arvense (L.) Scop.</i>
Caragana	<i>Caragana arborescens</i> Lam.
Catchfly	<i>Silene</i>
Cattail	<i>Typha latifolia L.</i>
Chickweed	<i>Cerastium</i>
Chickweed, common	<i>Stellaria media (L.) Cyrill.</i>
Choke cherry	<i>Prunus virginiana L.</i>
Cinquefoil	<i>Potentilla</i>
Cleavers	<i>Galium aparine L.</i>

Common Name	Scientific Name
Clematis	<i>Clematis</i>
Clover	<i>Trifolium</i>
Club moss	<i>Selaginella densa</i> Rydb.
Cocklebur	<i>Xanthium italicum</i> Moretti
Common groundsel	<i>Senecio vulgaris L.</i>
Crested wheat grass	<i>Agropyron cristatum (L.) Grtn.</i>
Cyperus	<i>Cyperus</i>
Dandelion	<i>Taraxacum</i>
Diffuse knapweed	<i>Centaurea diffusa</i> Lam.
Dock	<i>Rumex</i>
Douglas fir	<i>Pseudotsuga menziesii</i> (Mb.) Fr.
Dwarf birch	<i>Betula glandulosa Michx.</i>
Elm	<i>Ulmus</i>
Enchanter's nightshade	<i>Circaea</i>
Evening-primrose	<i>Oenothera</i>
Everlasting	<i>Antennaria</i>
Fescue	<i>Festuca</i>
Fleabane	<i>Erigeron</i>
Flixweed	<i>Desurainia sophia (L.) Webb.</i>
Foxtail	<i>Setaria</i>
Geranium	<i>Geranium</i>
Goldenrod	<i>Solidago</i>
Grama	<i>Bouteloua gracilis</i> (HBK) Lag.
Greasewood	<i>Sarcobatus vermiculatus</i> (H.) To
Green alder	<i>Alnus crispa</i> (Ait.) Pursh
Groundsel	<i>Senecio</i>
Gumweed	<i>Grindelia squarrosa</i> (Push) Dun
Hairy golden-aster	<i>Chrysopsis villosa</i> (Pursh.) Nutt.
Hardhack	<i>Spiraea tomentosa L.</i>
Hawkweed	<i>Hieracium</i>
Hemlock	<i>Tsuga</i>
Hoary-alyssum	<i>Berteroa incana (L.) DC.</i>
Horse weed	<i>Conyza canadensis L.</i>
Hypericum	<i>Hypericum</i>
Jack pine	<i>Pinus banksiana Lamb.</i>
Jacob's-ladder	<i>Polemonium</i>
Juniper	<i>Juniperus</i>
Knapweed	<i>Centaurea</i>
Knotweed	<i>Polygonum</i>
Kochia	<i>Kochia scoparia (L.) Schrad.</i>

Common Name	Scientific Name	Common Name	Scientific Name
Labrador tea	<i>Ledum groenlandicum</i> Oeder,	Rabbit-brush	<i>Ericameria nauseosus</i> (P. ex P.)
Lamb's-quarters	<i>Chenopodium album</i> L.	Ragweed	<i>Ambrosia</i>
Larch	<i>Larix</i>	Ragweed, common	<i>Ambrosia artemisiifolia</i> L.
Leafy spurge	<i>Euphorbia esula</i> L.	Ragwort	<i>Senecio</i>
Little bluestem grass	<i>Andropogon scoparius</i> Michx.	Raspberry	<i>Rubus</i>
Lodgepole pine	<i>Pinus contorta</i> Dougl.	Red samphire	<i>Salicornia rubra</i> A. Nels.
Low juniper	<i>Juniperus communis</i> L.	Red three-awn grass	<i>Aristida purpurea longiseta</i> (Sd)
Lupine	<i>Lupinus</i>	Rhododendron	<i>Rhododendron</i>
Manitoba maple	<i>Acer negundo</i> L.	Rib grass	<i>Plantago lanceolatum</i> L.
Maple	<i>Acer</i>	Rose	<i>Rosa</i>
Milkweed	<i>Asclepias</i>	Rudbeckia	<i>Rudbeckia</i>
Millet	<i>Panicum</i>	Rush	<i>Juncus</i>
Mint	<i>Mentha arvensis</i> L.	Sage	<i>Artemisia</i>
Moss campion	<i>Silene acaulis</i> L.	Sagebrush, Common	<i>Artemisia tridentata</i> Nutt.
Moss phlox	<i>Phlox hoodii</i> Richards	Sagebrush, Silvery	<i>Artemisia cana</i> Pursh
Mountain avens	<i>Dryas drummondii</i> Richards	Saltbush	<i>Atriplex argentea</i> Nutt.
Mullein	<i>Verbascum thapsus</i> L.	Sand dropseed	<i>Sporobolus cryptandrus</i> (T) Gr.
Mustard	<i>Brassica</i>	Seaside plantain	<i>Plantago maritima</i> L.
Needle & thread grass	<i>Stipa comata</i> Trin. & Rupr.	Sedge	<i>Carex</i>
Needle grass	<i>Stipa</i>	Shrubby cinquefoil	<i>Potentilla fruticosa</i> L.
Nettle	<i>Urtica</i>	Silverweed	<i>Potentilla anserina</i> L.
Ninebark	<i>Physocarpus</i>	Smooth brome	<i>Bromus inermis</i> Leyss
Nuttall's atriplex	<i>Atriplex canescens</i> (Pursh.)	Snowberry	<i>Symphoricarpos occidentalis</i> Hk
Oats	<i>Avena</i>	Soft rush	<i>Juncus effusus</i> L.
Ocean spray	<i>Holodiscus discolor</i> (Pursh) Mx	Speckled alder	<i>Alnus rugosa</i> (Du Roi) Spreng.
Oriental mustard	<i>Brassica juncea</i> (L.) Cosson	Speedwell	<i>Veronica</i>
Oxeye daisy	<i>Chrysanthemum</i>	Sphagnum	<i>Sphagnum</i>
Paper-birch	<i>Betula papyrifera</i> Marsh.	Spirea	<i>Spirea</i>
Pasture sage	<i>Artemisia frigida</i> Willd.	Spotted knapweed	<i>Centaurea maculosa</i> Lam.
Pearly everlasting	<i>Anaphalis margaritacea</i> (L.) Clk	Spruce	<i>Picea</i>
Pigweed	<i>Amaranthus</i>	St. John's wort	<i>Hypericum</i>
Ponderosa pine	<i>Pinus ponderosa</i> Dougl.	Stinkweed,	<i>Thlaspi arvense</i> L.
Poplar	<i>Populus</i>	Sunflower	<i>Helianthus</i>
Povertyweed	<i>Iva axillaris</i> Pursh.	Swamp birch	<i>Betula pumila</i> L.
Prairie cord grass	<i>Spartina pectinata</i> Link	Sweet clover	<i>Melilotus</i>
Prairie muhly	<i>Muhlenbergia cuspidata</i> (T) Ryb	Sweet gale	<i>Myrica gale</i> L.
Prairie rocket	<i>Erysimum inconspicuum</i> (Wats.)	Tall buttercup	<i>Ranunculus acris</i> L
Primrose	<i>Primula</i>	Tamarack	<i>Larix laricina</i> (Du Roi) Koch
Prostrate pigweed	<i>Amaranthus graecizans</i> L.	Tansy	<i>Tanacetum vulgare</i> L.
Purslane	<i>Portulaca oleracea</i> L.	Three-awn grass	<i>Aristida</i>

Common Name	Scientific Name
timothy	<i>Phleum pratense</i> L.
Trembling aspen	<i>Populus tremuloides</i> Michx
Triple-awned grass	<i>Aristida longiseta</i> Steud)
Tumbleweed	<i>Amaranthus albus</i> L.
Tumbling mustard	<i>Sisymbrium altissimum</i> L.
White birch	<i>Betula papyrifera</i> Marsh.

Common Name	Scientific Name
White spruce	<i>Picea glauca</i> (Moench) Voss,
Wild mustard	<i>Sinapis arvensis</i> L.
Wild rye	<i>Elymus</i>
Willow	<i>Salix</i>
Yarrow	<i>Achillea</i>