DIVERSITY AND ZOOGEOGRAPHY OF BRACHYCERA (DIPTERA) IN DISJUNCT GRASSLANDS OF THE SOUTHERN YUKON

Stéphanie Boucher
Department of Natural Resource Sciences
McGill University, Montreal
November 1998

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements of the degree of
Master of Science

0-612-50724-6

Frontispiece. South-facing slope near Carcross, Yukon

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The diversity and zoogeography of Diptera (Brachycera) of disjunct xeric grasslands in the southern Yukon were studied. Over 20,000 flies were collected representing 32 families and 213 species. In terms of abundance, the predacious guild dominated (54% of total specimens) due mostly to the family Chamaemyiidae which represented 45% of all specimens. In terms of diversity, the phytophagous and parasitoid guilds were dominant (25.5% of total species each). The most diverse families were Agromyzidae (32 species), Chloropidae (31 species), Tachinidae (23 species) and Pipunculidae (20 species). Thirty-four undescribed species were collected and 58 species were recorded for the first time in the Yukon. Zoogeographic analysis indicates that the Diptera fauna of these grasslands is dominated by widespread Nearctic or Holarctic species, but the fauna also includes southern grassland species with disjunct distributions, and species endemic to Beringia. The presence of endemic and disjunct species suggests that these grasslands were present in Beringia during the Wisconsinan and acted as a refugium for grassland Diptera.

RÉSUMÉ

On trouvera ici une étude sur la diversité et la zoogéographie des diptères (Brachycera) associés avec les prairies reliques du sud du Yukon. Plus de 20 000 spécimens de brachycères ont été collectés comprenant 32 familles et 213 espèces. En terme d'abondance, les prédateurs dominaient (54% de tous les spécimens), dû essentiellement à la famille Chamaemyiidae (45% de tous les spécimens). Au niveau de la diversité, les phytophages et les parasites dominaient, représentant chacun 25.5% de toutes les espèces. Les familles les plus diversifiées étaient les Agromyzidae (32 espèces), Chloropidae (31 espèces), Tachinidae (23 espèces) et Pipunculidae (20 espèces). Trente-quatre espèces non décrites ont été collectées et 58 espèces ont été pour la première fois recensées au Yukon. L'analyse zoogéographique indique que la faune diptérienne de ces prairies est dominée par des espèces répandues dans la zone néarctique ou bien holarctique. De plus, certaines espèce ont une distribution discontinue avec celles des prairies du sud, et d'autres sont endémiques a la Béringie. La présence des ces espèce suggère que les prairies reliques du Yukon étaient présentes en Béringie pendant le Wisconsinien et qu'elles ont offert un refuge aux diptères adaptées aux prairies.

ACKNOWLEDGEMENTS

I am extremely grateful to my supervisor, Dr. Terry A. Wheeler, for his assistance throughout this project. I would like to thank him particularly for always being available for the past two years, and for his constructive comments and advice with this thesis. I also really appreciated his assistance collecting in the Yukon, he was a valued field partner, and his amazing knowledge about insects and so many other things made our daily conversation really enriching. I am also very grateful to him for taking students to conferences, and making sure that we are exposed to the scientific world. Dr. Wheeler's contagious enthusiasm and passion for insects have always been a source of motivation for me, and he is the one who encouraged me to do a Master's in entomology. I thank him for believing in me and giving me the chance to do this Master's with him.

I am also thankful to my committee members, Dr. D. J. Lewis for reviewing this manuscript and providing thoughtful comments, and Dr. J. M. Cumming for giving me access to the Canadian National Collection in Ottawa, for providing identifications of the Empididae and for his hospitality and encouragement.

Other scientists who provided identifications are R. A. Cannings (Royal British Columbia Museum), S. D. Gaimari (University of Illinois), S. A. Marshall (University of Guelph), A. L. Norrbom (Smithsonian Institution), J. R. Vockeroth (Agriculture and Agri-Food Canada), T. A. Wheeler (McGill University) and D. M. Wood (Agriculture and Agri-Food Canada). To these individuals I express my greatest appreciation. I also thank Doug Kritsch (Agriculture and Agri-Food Canada) who helped with critical point drying of my flies and all the entomologists at the Canadian National Collection for discussions and advice. I would also like to acknowledge the Heritage Branch, Yukon Territorial Government for providing a Scientists and Explorers License to collect in the Yukon.

The following organizations provided financial support: the Arctic Institute of North America (Jennifer Robinson Memorial Scholarship); the Northern Scientific Training Program; the Dipterology Fund; McGill University (Walter M. Stewart Scholarship and E. Melville Duporte Award). I also received support from NSERC and FCAR (Quebec) research grants to Dr. T. A. Wheeler.

I really enjoyed working in the Lyman Museum due to the atmosphere created by Dr. T. A. Wheeler, Dr. V. R. Vickery, Dr. C. C. Hsiung, Frédéric Beaulieu, Patrice Bouchard, Scott Brooks, Vanessa Crecco, Tilly Gaoh, Cory Keeler, Joanne Mudd, Joëlle Pérusse, Cyrena Riley , Jade Savage and Spyros Skareas. I have good memories of early morning conversations with Cyrena and Jade while making our special blend coffee, Joanne's high energy level, Vanessa's morning cakes, scientific discussions with Pat, fly talks with Fred and the "discussions" with Joëlle and Scott about music for the lab. Thank you all for being there and being fun.

J'aimerais également remercier mon frère Stéphane et son épouse Cammie pour leurs encouragements. Finalement je voudrais exprimer ma reconnaissance à mes parents Lise et Gérard pour m'avoir toujours appuyée et encouragée dans tout ce que j'ai entrepris. Leur confiance en moi et leur support moral a été et sera toujours d'une grande importance dans la réalisation de mes projets.

1. INTRODUCTION AND LITERATURE REVIEW

One of the most unique, but overlooked, habitats in the Yukon Territory is characterized by a community of xeric-adapted plants dominated by sage (*Artemisia* spp.; Asteraceae) and several genera of grasses on warm south facing slopes and river valleys. These south-facing slopes are found mostly in southern and central Yukon, particularly along the Yukon River (Fig. 1) (Scudder 1997a). Further north, near Old Crow and on the Firth River, these grassland patches are more scattered and are present only on the steeper south-facing slopes. These habitats are also present in the interior valleys of British Columbia, in the Peace River region of Alberta, and in Alaska and northeastern Russia (Moss 1952; Yurtsev 1982; Lafontaine and Wood 1988; Scudder 1993).

There are two possible origins for this *Artemisia*-grass community in the Yukon Territory. It may represent a remnant of a Beringian steppe community that occurred in a tundra-steppe mosaic in the late Pleistocene (Matthews 1982). These habitats may also be the result of northward expansion of xeric prairie vegetation during the Hypsithermal warming interval that followed the Wisconsinan glaciation, as Moss (1952) proposed for the Peace River grasslands of Alberta. To understand the possible origins of these grasslands, the glacial and postglacial history of northwestern North America must be reviewed briefly.

1.1. Quaternary Glacial and Vegetational History

The Quaternary (Pleistocene plus Holocene) has been characterized by many drastic climatic changes, with four major glaciations (Nebraskan, Kansan, Illinoian, and Wisconsinan) during which Canada was almost entirely glaciated, separated by three major interglacials (Aftonian, Yarmouthian, Sangamon). The Wisconsinan is the most recent glaciation and the one that has had the greatest impact on the present distribution of North American insects (Howden 1969; Matthews 1979).

During the late Wisconsinan glacial maximum, about 20,000 B.P. (years before present), most of Canada was covered with ice sheets. The Laurentide ice sheet originated in uplands east and west of Hudson Bay and extended over most of Canada, and the north-central and north-eastern United States. The Cordilleran ice sheet covered almost all of British Columbia, southern Yukon Territory, and southern Alaska, and extended south into the northwestern United States covering northern Washington, Idaho and Montana (Clague 1989a; Scudder 1993, 1997a). At times during various glacial advances, the growth of the ice sheets was out of phase (Clague 1989b), forming an ice-free corridor from the Yukon in the north, south to the Great Plains of southern Alberta and Montana. There is evidence that during the end of the Wisconsinan there was a migration of plants through the ice-free corridor, but it is not known how many animals used this corridor for dispersal (Schweger 1989).

As the continental ice sheets expanded, tundra, forest and grassland communities, as well as many insects and other animals, were pushed southward. This area south of the ice sheets is considered the most important refugium for Nearctic species (Matthews 1979; Morgan and Morgan 1980). During late Wisconsinan time, the spruce forest south of the ice sheet occupied the Great Plains region and extended as far south as northeast Kansas and east through Illinois to the eastern Great Lakes region. Tundra was present in the zone between the glaciers and the spruce forests. Grasslands were present in the west during early and middle Wisconsinan time but during the Wisconsinan maximum they were present only on the Texas-Mexico border (Dillon 1956; Ritchie 1975). The final retreat of the ice sheets started 12,000-14,000 B.P. during a period of rapid climatic warming; this was followed by the Hypsithermal warming interval when the climate was warmer and drier than today (Flint 1957). The Hypsithermal occurred between 8000-6000 B.P. for central and southern parts of North America and from about 11,000-9000 B.P. in the northern Yukon Territory (Anderson et al. 1989).

1.2. Origin of Yukon Grasslands: A Beringian Source

Beringia was the largest refugium in the north. Central and northern Yukon, interior Alaska and most of eastern Siberia east of the Kolymia River remained unglaciated throughout the Pleistocene, and together with the exposed floors of the Bering and Chukchi Seas, formed the Beringian refugium (Matthews 1979). The Bering-Chukchi land bridge existed throughout the Wisconsinan and probably at many other times during the Pleistocene (Matthews 1982). This connection allowed an exchange of flora and fauna between Siberia and Alaska (Howden 1969). About 15,500 B.P. the land bridge started to be flooded, and the final separation of Siberia and Alaska occurred about 14,400 B.P. (Hopkins 1982). The unglaciated part of the Yukon consisted of most of the Klondike, Porcupine and Arctic plateaus, the Porcupine Basin, parts of the Ogilvie, Wernecke and British Mountains, and the western slopes of the Richardson Mountains (Fig. 2) (Scudder 1997a). This area was isolated from the rest of North America by the ice sheets on the east and the south for thousands of years.

There is still some argument about the nature of Beringia during the Wisconsinan. One hypothesis is that the fauna of large herbivores that existed during the Pleistocene must have been supported by a productive arctic steppe or grassland habitat (also called mammoth steppe). This environment would have been present during late Pleistocene time and the vegetation would have been different from the present day tundra. This hypothesis is supported by plant and insect fossils that show evidence of a steppe-like environment (Guthrie 1982; Matthews 1982). Another hypothesis is that during the late Wisconsinan (after 30,000 B.P.) the arctic steppe biome was replaced by vegetation similar to what exists now in montane and high-arctic regions (fell-field tundra) (Cwynar and Ritchie 1980; Giterman et al. 1982; Ritchie and Cwynar 1982). Schweger (1982) pointed out that the situation is probably not this simple, and that the vegetation of Beringia was probably a complex tundra-steppe mosaic. Whenever the arctic steppe biome was present or dominant during the Pleistocene, the *Artemisia*-grass communities on south facing slopes might be remnants of this type of vegetation (Scudder 1997a). If this is the case, these habitats would have to have spread southward postglacially to colonize the slopes in the previously glaciated part of the southern Yukon. The Hypsithermal would have been a period when the range of these habitats could have expanded more easily, while the distribution of the boreal forest was contracting.

1.3. Origin of Yukon Grasslands: A Southern Source

As mentioned previously, the warm and dry conditions during the Hypsithermal resulted in contraction of the boreal forest and parkland and expansion of prairie vegetation beyond its present range (Moss 1952; Ritchie 1975; Matthews 1979; Anderson et al. 1989). In the cooling period following the Hypsithermal, boreal forest and parkland expanded southward to their present limits (Hansen 1949; Ritchie 1989), pushing the grasslands further south. However, disjunct pockets of grassland may have survived on warm, south-facing slopes in the northwest where forest could not become established. There is still some controversy about how far north the range of the grasslands expanded. They might have reached as far north as the Peace River near 56°N (Moss 1952; Anderson et al. 1989), or possibly as far north as the Yukon. This second hypothesis has been ignored or rejected by many authors, although some insect distributions seem to support it (e.g. Lafontaine and Wood 1988; Wood 1994; Finnamore 1997).

1.4. Insects of Yukon Grasslands

Although the plant flora of these disjunct grasslands has been well studied because of the high number of rare and disjunct species in the habitat (see Scudder 1997a for review), only a few authors have studied the zoogeographic patterns of the insects. *The Insects of The Yukon* (Danks and Downes 1997) provided a comprehensive summary of the state of knowledge of many insect taxa in the Yukon. Although no chapter in that book deals specifically with the xeric grasslands, many of the authors discuss orders or families that are diverse in this habitat.

Hilchie (1985) studied the tiger beetles (Coleoptera: Carabidae) of Alberta and although he did not refer specifically to south-facing slopes, he found that three species or subspecies of "southern grassland" tiger beetles also occur in the disjunct grasslands of the Peace River region and two of these occur in the grasslands of the southern Yukon.

Lafontaine and Wood (1988) summarized the zoogeography of Beringian noctuid moths (Lepidoptera: Noctuidae) found in six different habitats (wet tundra, dry tundra, dunes, southern steppe or prairie, taiga, boreomontane forest) from the Yukon, Alaska, and the Magadan Region (Magadanskaya Oblast') of Siberia. Of a total fauna of 245 species, 22 species (9%) were recorded in the southern steppe habitat on south-facing hillsides. Fifteen of these species are disjunct northern populations of species found further south, two species are endemic to East Beringia, there is one Palearctic/Nearctic sister-species pair and three Holarctic species. Because of close phylogenetic relationships to species found in similar habitats further south, and the low endemism in Beringia, Lafontaine and Wood concluded that the noctuid fauna has entered the Beringian area postglacially. Lafontaine and Wood (1997) expanded the zoogeographic analysis to include all 518 species of Lepidoptera known from the Yukon, including 45 species collected in the dune/steppe habitat. This habitat category includes open active dunes, such as those found in the Carcross Desert, as well as the *Artemisia*-grass community on south-facing slopes. This habitat has been fairly well collected for all groups of Lepidoptera except Microlepidoptera, which represent only 4 of the 45 species collected. The Lepidoptera fauna in the dune-steppe habitat is dominated by Nearctic species that are widespread in the Great Plains or Great Basin to the south and many of these species have a disjunct distribution. Three species in this habitat are Beringian endemics, including the two endemic noctuids discussed by Lafontaine and Wood (1988) plus an additional East-West Beringian endemic, and eight species are shared with steppe habitats in the Palearctic.

Scudder (1993) reviewed the geographic distribution of eight xeric grassland-adapted species of seed bugs (Heteroptera: Lygaeidae). Four of these species occur in the southern prairie grasslands and have a disjunct distribution with populations present on south-facing *Artemisia*-grass slopes in the southern Yukon. Scudder suggested that these insects survived the Wisconsinan glaciation both in Beringia and the southern refugium. He did not discuss the possibility of postglacial movement northward during the Hypsithermal. Because there are no Lygaeidae endemic to Beringia, it is likely that no species survived the Pleistocene in this refugium alone.

Scudder (1997b) reviewed the distribution of 216 species of Heteroptera known from the Yukon, and found that most of the species associated with the *Artemisia*-grassland community on south-facing slopes are widespread, either circumboreal, western Nearctic or widespread Nearctic. Scudder identified only two species of Heteroptera endemic to East Beringia, neither of which is associated with grasslands.

Hamilton (1997) studied the geographic patterns of the 145 species of leafhoppers (Homoptera: Cicadellidae) known from the Yukon. One of these, later described as as *Chlorita nearctica* (Hamilton 1998) has an East Beringian distribution and is presently known only from south-facing slopes in the Yukon. Another leafhopper collected on *Artemisia frigida* in the same habitat may represent an undescribed subspecies of *Empoasca nigroscuta* Gillette and Baker endemic to East Beringia. Six prairie species reach their northern limits on south facing slopes of the Yukon.

Anderson (1997) reviewed the weevils (Coleoptera: Curculionidae) of the Yukon; of a total of 64 species, eight are associated with south-facing *Artemisia* slopes or xeric slopes (southern steppe). Three species are East Beringian, one has an East-West Beringian distribution and the other four species are either Holarctic (one species), widespread Nearctic (one species) or western Nearctic (two species).

Finnamore (1997) reviewed the aculeate Hymenoptera of the Yukon (not including Formicidae). He found that the fauna of south-facing slopes was more diverse, probably because of increased solar radiation. Of a total of 153 species in the Yukon, 49 species, nearly one third of the fauna, have disjunct distributions with populations found further south. Many of these species occur at lower elevation on south- and southwest-facing slopes and Finnamore suggested that these species may have colonized the Yukon during the Hypsithermal.

Most of the previous authors found extensive connections between Beringia and other regions and few examples of Beringian endemics. However, there are some examples of endemic

Beringian species associated with relict grasslands. Anderson (1984) described a new genus and species of weevil, *Connatichela artemisiae* (Coleoptera: Curculionidae), from *Artemisia* plants on south facing slopes in the Yukon. Fossil specimens of *C. artemisiae* of mid-Wisconsinan age are known from the Yukon Territory, extreme western Northwest Territories, and Alaska. This species is presently known only from East Beringia and is assumed to be endemic to that region. The endemic leafhopper *Chlorita nearctica* Hamilton, known only from south facing slopes with *Artemisia* and grasses, has already been discussed. The only species of Orthoptera endemic to the Yukon, *Bruneria yukonensis* Vickery (Acrididae), was described from dry grassy areas in the southern Yukon (Vickery 1997) and may be restricted to this habitat (V. R. Vickery pers. comm.).

1.5. Diptera of Yukon Grasslands

Despite their status as the most diverse order of insects in Canada (Danks 1979) there has been very little research on the flies of the Yukon.

Wood (1994) separated the Beringian Tachinidae (Diptera) into the same six habitat categories as Lafontaine and Wood (1988). About 20 tachinid species have been collected in steppe or prairie habitats in Alaska and the Yukon; none of these species are restricted to Beringia and all are Nearctic. Wood concluded that the steppe species have invaded Beringia from the south, probably postglacially.

Only five families of Diptera were discussed in Danks and Downes (1997). Of these, two (Simuliidae and Chironomidae) are mainly aquatic. The only primarily terrestrial families covered are the Asilidae (Cannings 1997), Sphaeroceridae (Marshall 1997), and Anthomyiidae (Griffiths 1997). The Asilidae is the most diverse of these families in xeric habitats. There are seven asilid species in the Yukon associated with south-facing slopes, including three East Beringian species; the other four species are boreal or cordilleran (Cannings 1997). Neither the Sphaeroceridae or Anthomyiidae was considered very diverse or abundant in the xeric grasslands because they tend to be associated with habitats with more moisture or with a more diverse community of plants. Marshall (1997) pointed out that steppe species make up a small proportion of the Yukon Sphaeroceridae. Only one species (*Spelobia* n.sp. near *semioculata* Richards) may be characteristic of southern steppe in the Yukon.

1.6. Objectives

Given the lack of available information on the Diptera of the southern Yukon grasslands, and the lack of knowledge of Yukon Diptera in general, I decided to study the Diptera associated with xeric *Artemisia*-grass communities on warm, south facing slopes in the southern Yukon. The objectives of my project were to conduct a faunal inventory of the higher Diptera (suborder Brachycera) of the disjunct xeric grasslands in the southern Yukon and to establish the zoogeographic affinities of the fauna. My zoogeographic analysis is a test of the hypothesis that the Diptera fauna of this habitat is a composite, made up of widespread boreal and western species, Beringian species that survived the Wisconsinan glaciation in that refugium, and southern grassland species that colonized the region postglacially during the Hypsithermal.

2. MATERIALS AND METHODS

2.1. Study Sites

The primary study sites included six grassland sites on south and south-west facing slopes between Carmacks and Carcross in the southern Yukon Territory (Fig. 3). Two other sites were visited on an irregular basis during the first season only. Each site was identified by reference to the distance from the nearest community or highway landmark, but precise latitude and longitude for each site were also included on specimen labels for use in future database entry. Latitude and longitude for study sites were taken using a Garmin GPS-12 Global Positioning System unit. The general topography and the diversity and relative abundance of vegetation at each site was also recorded. Classification of plants used in site descriptions and the list of plants at each site (Table 1) follows Cody (1996).

In the following site descriptions, each site is identified by a site number, used in the Annotated List of Species, and a site name in bold face, used elsewhere in the text.

2.1.1. Location of Study Sites

Site 1 (Takhini): Yukon Territory: Alaska Highway, 13.1 km west of Takhini River crossing (60°48.9'N, 135°58.2'W), south facing slope (Primary Site).

Site 2 (Little Atlin): Yukon Territory: 5 km south of Jakes Corner, Mount White above Little Atlin Lake (60°17.8'N, 133°59.0'W), southwest facing slope (Primary Site).

Site 3 (Nares): Yukon Territory: 4 km east of Carcross, slope above Nares Lake (60°10.1'N, 134°38.7'W), south facing slope (Primary Site).

Site 4 (Conglomerate): Yukon Territory: Klondike Highway, 8.8 km south of Twin Lakes, Conglomerate Mountain (61°37.9'N, 135°53.1'W), southwest facing slope (Primary Site).

Site 5 (Carmacks): Yukon Territory: Klondike Highway, 26.3 km south of Carmacks (61°52.6'N, 136°06.9'W), southwest facing slope (Primary Site).

Site 6 (Bushy Mountain): Yukon Territory: Klondike Highway, 15 km south of Carmacks, Bushy Mountain (61°58.2'N, 136°12.2'W), southwest facing slope (Primary Site).

Site 7 (Marsh Lake): Yukon Territory: Alaska Highway at Marsh Lake, 7.7 km southeast of M'Clintock River crossing (60°31.9'N, 134°22.4'W), south facing slope (Secondary Site).

Site 8 (Montague Roadhouse): Yukon Territory: Klondike Highway, 34 km south of Carmacks at Montague Roadhouse site (61°48.9'N, 136°03.5'W), south facing slope (Secondary

Site).

2.1.2. Description of Primary Study Sites

Takhini: This site had an inclination of about 25-30° and was about 1.0 km from the Alaska Highway. The soil was rocky, but compact, with a few large exposed boulders on the slope. The vegetation was relatively patchy but diverse. Dominant plants included *Festuca* sp. and *Artemisia frigida* L., with scattered large patches of *Juniperus horizontalis* Moench and *Arctostaphylos uva-ursi* (L.); several other species of herbaceous plants were present but less abundant on the site (Table 1). A few species of lichens were present on the rocks and the soil surface, indicating that the soil surface remains relatively undisturbed. This was the only site which was more than 1 km away from a lake, river or wetland. There were some scattered ground squirrel burrows on the slope and tracks and droppings of deer or elk.

Little Atlin: This site had an inclination of about 40-45° and was about 0.5 km east of an unpaved road. The soil was loose and rocky, with a few larger rocks projecting. There were several patches of bare soil and vegetation was relatively sparse. Dominant plants included *Festuca* sp. and *Artemisia frigida*; a few other species of grass and some herbaceous plants were present but relatively uncommon (Table 1). Some lichens were present on the rocks and in small patches of the soil surface. The site was about 0.5 km east of the north end of Little Atlin Lake. There were very few ground squirrel burrows at the site and no sign of other mammal activity on the slope.

Nares: This site had an inclination of about 20-25° and was about 1 km from the end of a narrow unpaved road. The soil was rockier than at other sites and loose with few large rocks. The vegetation was sparse and much more patchy, with no plants really dominant as at the other sites. There were large patches of *Juniperus horizontalis* and *Festuca* sp. was abundant, but *Artemisia frigida* was less abundant than at other sites. Several other species of plants were present at the site, including some that were rare or absent at most other sites (Table 1). Lichens were diverse and relatively common on rocks and the soil surface. This site was about 1 km north of Nares Lake. There was no sign of ground squirrels or other mammal activity on the slope.

Conglomerate: This site had an inclination of about 40-45° and was about 0.75 km east of the Klondike Highway and above an old gravel pit. The soil was red, sandy and loose with some small rocks. The vegetation was sparse, with a lot of open soil. The dominant plants were *Artemisia frigida*, *Calamagrostis* sp. and *Festuca* sp., with very few other plant species present (Table 1).

There was little lichen growth on the rocks and soil surface, suggesting that the soil was less stable than at most other sites. This site was within 1 km of Klusha Creek and some scattered wetlands. There were a few ground squirrel burrows on the slope but no sign of other mammals.

Carmacks: This site had an inclination of about 30-35° and was about 0.75 km east of the Klondike Highway with a hydro line crossing the slope above the sampling area. The soil was sandy and compact, with more rocks than at the other sites in the Carmacks area (Conglomerate, Bushy Mountain). The dominant plants were *Artemisia frigida*, *Calamagrostis* sp. and *Festuca* sp. There were many other species of herbaceous plants present at this site, including some that were absent at other sites (Table 1). Lichens were diverse and common on rocks and the soil surface. The site was within 1 km of some disturbed wetlands along the highway. There were a few ground squirrel burrows on the slope but no sign of other mammals.

Bushy Mountain: This site had an inclination of about 40-45° and was about 0.75 km east of the Klondike Highway. The soil was red, sandy and loose with some small rocks. The vegetation was sparse, with a lot of open soil. The dominant plants were *Artemisia frigida*, *Calamagrostis* sp. and *Festuca* sp., with very few other plant species (Table 1). There was little lichen growth on the rocks and soil surface, suggesting that the soil was less stable than at most other sites. This site was within 1 km of the Nordenskiold River and a large expanse of wetlands. There were a few ground squirrel burrows on the slope but no sign of other mammals.

General comments on study sites: *Festuca* and *Calamagrostis* were the two genera of grasses shared by all the primary sites, and all sites also had *Artemisia frigida*; these three plants were usually dominant at the sites. Several other species of plants were found in lower abundance at all the sites (Table 1). The Bushy Mountain and Conglomerate sites were most similar in their overall appearance, with the same dominant plants, and taller, more uniform vegetation. The soil was also sandy and looser. The Carmacks site was similar to these two, but had a greater diversity of plants. The Carmacks, Takhini and Nares sites had the greatest diversity of plants, and the species were more evenly distributed.

Of the two secondary sites, Montague Roadhouse site was very similar in terms of vegetation and soil type to the Bushy Mountain and Conglomerate sites, although it was slightly steeper. The Marsh Lake site had similar topography and vegetation to the Nares site, but was a lot more disturbed, because it was located very close to a gravel pit. *Artemisia frigida* was very rare on the site.

2.2. Collecting Techniques

Flies were collected from 02 June to 10 July 1997 and from 02 to 26 July 1998. Flies were collected using pan traps and sweeping. Five to ten yellow pan traps were used on each primary site. The pan traps were 355ml plastic bowls, 15cm in diameter and 4cm deep, buried in the soil until their upper rim was flush with the soil surface. Traps were set at about 5 m intervals in a roughly diagonal line up and across each slope. Propylene glycol (purchased as low-toxicity radiator anti-freeze and diluted with equal parts of tap water) was used as the preserving fluid in the traps and a drop of dish detergent was added as a wetting agent to break the surface tension. Traps were serviced every 4-6 days. Specimens from each trap were removed with a small aquarium net and then rinsed with tap water. Traps were re-set and fluids were added as necessary. Specimens from all traps at the same site and date were pooled. Samples were cleaned to remove debris and sorted to the order level on the same day as the traps were serviced and all specimens were preserved in 70% ethanol.

The vegetation at each site was swept using an aerial net every 4-6 days for a period of about two hours. On visits to the sites, specimens were also aspirated or hand collected directly from the surface of the vegetation and the ground. Larger flies were killed using ethyl acetate and smaller flies were killed and preserved in 70% ethanol.

2.3. Specimen Preparation and Identification

Larger flies that were killed using ethyl acetate were pinned in the field. All flies in 70% ethanol were transported to the university for processing. Specimens were dried using a critical point drier and liquid CO_2 or a chemical drying technique that uses 1,1,1,3,3,3 - hexamethyldisilizane (HMDS) (Brown 1993). Dried specimens were mounted on points and labelled. All specimens have been deposited in the collection of the Lyman Entomological Museum and Research Laboratory, McGill University, Ste-Anne-de-Bellevue, QC.

Mounted specimens were identified to family and genus using the Manual of Nearctic Diptera (McAlpine et al. 1981, 1987), and to species level using various taxonomic papers and with the help of collaborating specialists (Table 2). All specimens identified to species by me and not sent to collaborating specialists for confirmation were confirmed by T. A. Wheeler (McGill University). Specimens in several families have not been identified to species level yet, for various reasons. Most specimens of Phoridae, Therevidae and *Leucopis* (Chamaemyiidae) are currently being examined by specialists. Specimens of Anthomyiidae, Muscidae and Fanniidae have not yet been identified because there are no reliable keys to species and specialists have not been found for identification, and those families are not included in the analysis. Some species in other families could only be identified to the genus level, because there are no keys to species or specialists available. In that case, these species are counted in the Results and Discussion as a single species within the genus, even though more than one species may be present in the series.

2.4. Ecological Patterns

The Diptera collected in this study were classified into five guilds:

Phytophagous: These insects feed on living vegetation. This category includes flies that feed directly on leaves, seeds or roots, leaf miners, stem or shoot borers; some feed by sucking sap from the leaves or other parts of the plant (Ferrar 1987).

Saprophagous: These are the insects that feed on dead or decaying organic materials, such as carrion, dung, leaf litter, decaying fruit, etc. Many flies do not feed on the material itself but on the microorganisms present (Borror et al. 1989). Some insects are secondary invaders of damaged plants, in which case they may be considered either saprophagous or phytophagous depending on whether the larvae eat the damaged parts of the plants or the living tissues that are exposed.

Predacious: These are the insects that catch and kill their prey. Some predators are specialists on various developmental stages of insects and some are specialists on one or a few taxa of insects, but others are more generalized.

Parasitoid: These insects have the larval stage developing and feeding on or within a living arthropod host. The host is almost always killed by the parasitoid larva (Finnamore 1997).

Kleptoparasite: These insects have the larval stage developing by feeding on provisions kept for the development of larvae of another insect species (Finnamore 1997).

The guild that a species belongs to usually depends on the habits of the larva, which is often the major feeding stage of the life cycle. In some cases the adult will have the same habits and occur in the same habitat as the larva (especially in the case of predators), but often the adult will feed on nectar or pollen at flowers.

2.5. Zoogeographic Patterns

The geographic distribution of each species was determined using published records in the taxonomic literature and catalogs, and unpublished information available from specialists on the group and on specimens in museum collections that have major holdings of Canadian Diptera. These museums were the Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, ON (CNC) and the Lyman Entomological Museum and Research Laboratory, McGill University, Ste-Anne-de-Bellevue, QC (LEMQ).

The zoogeographic patterns of the flies identified in my study were classified into eight categories, defined in part according to Danks (1994) and Scudder (1997a). The following patterns were used:

Palearctic-Widespread Nearctic: Species present in the Palearctic region and widely distributed in the Nearctic region; some of these species are also present in other realms.

Palearctic-Western Nearctic: Species widespread in the Palearctic region or only in Europe or Asia, and confined in the Nearctic to western North America from 95°W longitude west to the Pacific Ocean (Fig. 4).

Palearctic-Widespread Nearctic Disjunct: Species present in the Palearctic region and widely distributed in North America, but with a clear gap between the southern population and populations found further north in the Nearctic.

East Beringian: Species occurring in unglaciated parts of Alaska and Yukon, extending southward no further than 60°N. Some of these species may extend into the far western part of the Northwest Territories.

Widespread Nearctic: Species that are widely distributed in North America.

Widespread Nearctic Disjunct: Species that are widely distributed in North America, but with a clear gap between the southern population and populations found further north.

Western Nearctic: Species that are confined to the western part of North America, from 95°W longitude west to the Pacific Ocean (Fig. 4).

Western Nearctic Disjunct: Species that are confined to the western part of North America, from 95°W longitude west to the Pacific Ocean (Fig. 4), with a clear gap between the southern population and populations found further north.

According to Danks et al. (1997), a Beringian species is a species which occurs only in unglaciated northwestern parts of North America. Because my sites were glaciated none of the species present at my sites could have a Beringian distribution according to this definition. I followed other recent authors (e.g., Wiggins and Parker 1997; Cannings 1997) and considered a species as East Beringian, even if it is present only in the previously glaciated part of the Yukon. It is assumed that such species would have survived the last glaciation in Beringia and then colonized the southern Yukon.

I did not recognize a separate category for Cordilleran species as most of the authors in Danks and Downes (1997) did, since the exact collecting localities for flies are often not included in published catalogs. Because of this it is impossible to know if the specimens have been collected in the mountains or in lowlands. For the purpose of this study I combined the Cordilleran species with the western Nearctic species.

In most recent catalogs of North American Diptera (e.g., Stone et al. 1965) the distribution of Canadian species is broadly defined. Only the provinces and territories in which the species have been collected are mentioned, without giving the exact localities. More detailed distributional information might help to distinguish some widespread species from widespread disjunct species. Based on the information in catalogs, I had to assume that these species are widespread in the province unless more detailed information was available from taxonomic publications or museum specimens, in which case the distribution was based on these records.

3. RESULTS

3.1. Annotated List of Species

The following annotated list summarizes the abundance, distribution and biology of each species identified in my study. Families are in phylogenetic order following the classification of McAlpine (1989); species within each family are in alphabetical order, and each species is numbered for reference later in the text. Species that are definitely undescribed are identified as "n.sp.1", "n.sp.2", etc. within each genus. Unnamed species that may or may not be described are identified as "sp.1", "sp.2", etc. within each genus. In genera where there may be more than one species in my collection, specimens are identified as "spp."

For each species, the known distribution is given, with new Yukon records identified. Where the distribution is based on published records in the literature, the author is cited; where additional distributional records are based on museum specimens, the museum is identified. The sites where specimens were collected (identified by site number), the number of specimens collected at each site and the dates for the earliest and latest specimens collected is given for each year of the study. Comments on the ecology, habitat preferences, geographic distribution and taxonomy of each species are given where appropriate.

Family Stratiomyidae

Adult Stratiomyidae (soldier flies) are usually found resting on vegetation or feeding on flowers. Larvae of most subfamilies are terrestrial, and breed mostly in decaying plant and animal matter, but the Stratiomyinae are aquatic. Some stratiomyid larvae are predacious and others are phytophagous (James 1981). There are 254 species known in North America (James 1981). Five species were collected at my sites.

1. *Nemotelus (Camptopelta) beameri* James Widespread Nearctic disjunct

Distribution: MT to IL south to AZ (James 1965); MB (Whitewater), AB (Lancaster Park, McMurray, Scandia, Victoria Glacier) (CNC); YT.

Specimens collected 1997: Site 6 (1), (03.vii).

Specimens collected 1998: Site 6 (1), (03-08.vii).

Comments: The larvae of *Nemotelus* are saprophagous. This is the first record in the Yukon.

3. *Nemotelus (Camptopelta)* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 6 (1), (08.vii).

Specimens collected 1998: Site 6 (1), (19.vii).

Comments: The larvae of *Nemotelus* are saprophagous. The specimens are females that key to a couplet that includes *nigrinus* Fallén, *centralis* Hanson and *picinus* Hanson. *Nemotelus nigrinus* is a Holarctic species that is widespread in North America; *N. centralis* and *N. picinus* are found only in eastern North America (James 1965). Given the distributions, my species are probably *N. nigrinus*, but a precise identification is impossible without male specimens.

3. *Nemotelus (Camptopelta)* sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 5 (1), (29.vi).

Specimens collected 1998: None.

Comments: The larvae of *Nemotelus* are saprophagous. The specimen is a female that keys to either *communis* Hanson, *arator* Melander, or *politus* Hanson. All three species are western Nearctic, but none has been recorded in the Yukon. The northernmost published record for any of the three species is Washington (James 1965), but there are specimens of *N. communis* from southern Alberta in the CNC, and specimens of *N. politus* from northern British Columbia (King Salmon Lake, Telegraph Creek, Atlin) in the CNC. A precise identification of the species is impossible without male specimens.

4. *Nemotelus (Nemotelus) montanus* James Western Nearctic

Distribution: YT to CO and CA (James 1965).

Specimens collected 1997: Site 4 (1), (29.vi-03.vii).

Specimens collected 1998: None.

Comments: The larvae of *Nemotelus* are saprophagous.

5. *Stratiomys* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), (03-08.vii).

Comments: The larvae of *Stratiomys* are saprophagous in mud along stream and pond margins.

Family Bombyliidae

The larvae of Bombyliidae (bee flies) are parasitoids of immature stages of other insects (Coleoptera, Diptera, Hymenoptera, Lepidoptera, Neuroptera) or predacious on grasshopper eggs; the adults are flower-feeders. There are approximately 800 species and subspecies in North America (Hall 1981). Four species were collected at my sites.

6. *Anastoechus barbatus* Osten Sacken Widespread Nearctic

Distribution: YT, NT, AB to MA, south to OR, CA, TX and MD (Painter and Painter 1965).

Specimens collected 1997: Site 1 (2), site 2 (28), site 3 (2), site 4 (8), site 6 (74), (24.vi-08.vii).

Specimens collected 1998: Site 1 (11), site 3 (22), site 4 (86), site 5 (22), site 6 (94), (03-25.vii).

Comments: The larvae are predators of grasshopper egg pods (Painter 1962).

7. *Anthrax albofasciatus picea* Marston Widespread Nearctic

Distribution: AK to QC, south to OR, MT, NH (Marston 1963).

Specimens collected 1997: Site 4 (1), site 6 (1), (24-29.vi).

Specimens collected 1998: Site 6 (1), (08-15.vii).

Comments: Larvae of *Anthrax* species are parasitoids of holometabolous insect larvae (Marston 1970). *Anthrax albofasciatus picea* is a northern subspecies that usually occurs in areas dominated by spruce-fir forests. It is found in the continental United States only where these forests occur in mountain ranges along the Canadian border (Marston 1963).

8. *Conophorus fallax* (Greene) Western Nearctic disjunct

Distribution: Southern BC to SK, south to CA and NM (Painter and Painter 1965), YT.

Specimens collected 1997: Site 1 (1), site 4 (1), (08-24.vi).

Specimens collected 1998: None.

Comments: The larval habits are unknown, but like other Bombyliidae the larvae are probably predators or parasitoids of immature insects (Priddy 1958). This is the first record in the Yukon.

9. *Hemipenthes* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 5 (1), (15-19.vii).

Comments: There is no recent key for identification of *Hemipenthes* species.

Family Therevidae

Larval Therevidae (stiletto flies) are predacious on larvae of other arthropods, usually Coleoptera; they occasionally feed on non-arthropods such as earthworms. Little is known of the feeding habits of the adults; some species feed on nectar, plant exudates or insect secretions, but it has been proposed that they might be phytophagous. The adults are usually found in dry open areas such as meadows and beaches (Irwin and Lyneborg 1981). There are approximately 129 species in North America (Irwin and Lyneborg 1981). Two species were collected at my sites.

10. *Pandivirilia* sp. 1

Distribution: Unknown.

Specimens collected 1997: 20 specimens.

Specimens collected 1998: Site 4 (4), site 5 (2), site 6 (7), (03-19.vii).

Comments: The specimens are currently being identified by M. E. Irwin (University of Illinois), so locality data for the 1997 specimens were not available. All the specimens belong to a single species (M. E. Irwin pers. comm.).

11. *Thereva* sp. 1

Distribution: Unknown.

Specimens collected 1997: 2 specimens.

Specimens collected 1998: None.

Comments: The specimens are currently being identified by M. E. Irwin, so locality data for the specimens was not available. Both specimens belong to a single species (M. E. Irwin pers. comm.).

Family Asilidae

Adult Asilidae (robber flies) are predators of other flying insects. The larvae are predacious on the eggs, larvae and pupae of other insects in the soil or in rotting wood. There are 983 species in North America (Wood 1981). Four species were collected at my sites.

12. *Cyrtopogon banksi* Wilcox and Martin Western Nearctic

Distribution: Southern YT south through BC to CO, UT, and the Sierra Nevada of CA (Cannings 1997).

Specimens collected 1997: Site 1 (3), (19-27.vi).

Specimens collected 1998: None.

Comments: In the Yukon this species is widespread in wooded areas and riparian habitats along streams. It is also common in dry, open environments dominated by lodgepole pine, white spruce or trembling aspen (Cannings 1997).

13. *Cyrtopogon bimacula* Walker Widespread Nearctic

Distribution: AK east through YT, southwestern NT, forested parts of AB, SK and MB to ON, QC, NB and NS, south to mountains of NM, east to NH (Cannings 1997).

Specimens collected 1997: Site 3 (1), (26.vi).

Specimens collected 1998: None.

Comments: This species is found on most of the dry south-facing slopes dominated by grasses and *Artemisia*, from Sheep Mountain at Kluane to the bluffs of the Porcupine River at Old Crow (Cannings 1997). This species is widespread in the Yukon as far north as Old Crow. For other localities in the Yukon see Cannings (1997).

14. *Cyrtopogon glarealis* Melander Western Nearctic

Distribution: Southern YT through BC and western AB to CA and WY (Cannings 1997).

Specimens collected 1997: Site 3 (1), (30.vi).

Specimens collected 1998: None.

Comments: This species is known from forest habitats in the western mountains. It was previously known from only one record in the Yukon, from *Artemisia*-grassland slopes at Pelly Crossing (Cannings 1997).

15. *Lasiopogon canus* Cole and Wilcox East Beringian

Distribution: Western AK east through YT to the Tuktoyaktuk Peninsula of NT (Cannings 1997) (Fig. 5).

Specimens collected 1997: Site 1 (1), site 2 (1), (04.vi-01.vii).

Specimens collected 1998: None.

Comments: This species is found in many habitats: riverbanks in moist riparian woods; aspen woodland; dry spruce forest; lodgepole pine parkland; willow scrub; tundra and south-facing slopes dominated by *Artemisia* and grasses. This species was also collected on south-facing slopes along the Porcupine River at Old Crow (Cannings 1997). *Lasiopogon canus* is the most widespread and frequently collected robber fly in the Yukon. For other locations in the Yukon see Cannings (1997). My sites are at the southern limit of the range of *L. canus*.

Family Empididae

Adult Empididae (dance flies) are predacious on smaller insects, often on swarming or emerging Diptera; some species also feed on nectar. The larvae are all predacious, and occur in soil, decaying organic material, under bark or in water. There are more than 725 described North American species (Steyskal and Knutson 1981). Fourteen species were collected at my sites.

16. *Drapetis* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 2 (1), (18-25.vi).

Specimens collected 1998: None.

Comments: This is an undescribed species in the Holarctic *exilis* group and is the northernmost record of the genus *Drapetis* (sensu stricto) in the Nearctic and the northernmost record of the *D. exilis* group in the Holarctic region (J. M. Cumming pers. comm.).

17. *Hilara* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (09.vii).

Specimens collected 1998: None.

Comments: Specimens of *Hilara* are usually associated with moist habitats (J. M. Cumming pers.

comm.).

18. *Hilara* sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 6 (1), (11.vi).

Specimens collected 1998: None.

Comments: Specimens of *Hilara* are usually associated with moist habitats (J. M. Cumming pers. comm.).

19. *Hilara* sp. 3

Distribution: Unknown.

Specimens collected 1997: Site 4 (1), (29.vi-03.vii).

Specimens collected 1998: None.

Comments: Specimens of *Hilara* are usually associated with moist habitats (J. M. Cumming pers. comm.).

20. *Iteaphila orchestris* Melander Western Nearctic

Distribution: Widespread in BC, AB, WA, OR, WY, ID, CO, NM (J. M. Cumming pers. comm.), YT.

Specimens collected 1997: Site 1 (5), site 2 (15), site 3 (9), (06.vi-04.vii).

Specimens collected 1998: Site 1 (1), site 3 (2), (04-22.vii).

Comments: Adults are nectar-pollen feeders (J. M. Cumming pers. comm.). This is the first record in the Yukon.

21. *Oedalea* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (06.vii).

Specimens collected 1998: None.

Comments: This is a distinctive new species not related to the other Nearctic species. It is probably most closely related to a Palearctic species (J. M. Cumming pers. comm.).

22. *Platypalpus* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (06.vii).

Specimens collected 1998: Site 4 (1), (08.vii).

Comments: All the specimens of *Platypalpus* collected at my sites are females (see also species #23-25) and could not be identified to the species level because most North American species of *Platypalpus* are undescribed. Parthenogenetic species or populations are prevalent in *Platypalpus*, especially in grassland associated species (J. M. Cumming pers. comm.).

23. *Platypalpus* sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 6 (1), (03-08.vii).

Specimens collected 1998: None.

Comments: See comments under species #22.

24. *Platypalpus* sp. 3

Distribution: Unknown.

Specimens collected 1997: Site 4 (1), (24-29.vi).

Specimens collected 1998: None.

Comments: See comments under species #22.

25. *Platypalpus* sp. 4

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), site 2 (1), site 4 (1), site 5 (1), (06-29.vi).

Specimens collected 1998: None.

Comments: See comments under species #22.

26. *Rhamphomyia* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 7 (1), (12.vi).

Specimens collected 1998: None.

Comments: This is an undescribed species in the *piligeronis* group, a group of 14 known species primarily in the western Nearctic. Only 2 species occur in eastern North America. Two of the western species are northern, with records from Alaska and northern British Columbia (J. M. Cumming pers. comm.).

27. *Rhamphomyia* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (6), site 4 (1), site 5 (1), site 7 (1), (08-24.vi).

Specimens collected 1998: None.

28. *Rhamphomyia* sp. 2

Distribution: Unknown

Specimens collected 1997: None

Specimens collected 1998: Site 3 (1), (09-13.vii).

29. *Tachypeza binotata* Western Nearctic disjunct

Distribution: WA, CA (Melander 1965); YT.

Specimens collected 1997: Site 4 (1), (15.vi.).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon.

Family Dolichopodidae

The adults and most larvae of the Dolichopodidae (long-legged flies) are predacious. Most species occur along margins of streams or lakes on soil or vegetation, although some species of *Medetera* occur in dry sites. There are more than 1230 North American species (Robinson and Vockeroth 1981). At least four species were collected at my sites.

30. *Chrysotus* spp.

Distribution: Unknown.

Specimens collected 1997: Site 6 (22), (24.vi-08.vii).

Specimens collected 1998: Site 3 (1), site 4 (1), site 5 (2), site 6 (17), (03-25.vii).

Comments: This is a widespread genus, and specimens of *Chrysotus* occur in a wide range of habitats, especially wet areas (Foote et al. 1965). There are at least three species of *Chrysotus* in my samples but the genus is very diverse, with over 100 Nearctic species, there are no recent keys, and there are no specialists working on the genus.

31. *Dolichopus* sp.1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (02-07.vii).

Comments: Specimens of *Dolichopus* are usually found in moist areas near bodies of water. The specimen is a femaleand cannot be identified to species with existing keys to *Dolichopus*.

32. *Hercostomus unicolor* (Loew) Widespread Nearctic

Distribution: AK, YT east to QC and south to CA (Corpus 1989).

Specimens collected 1997: Site 1 (4), site 4 (1), (08.vi-06.vii).

Specimens collected 1998: Site 1 (6), (02-26.vii).

Comments: This is the most widespread and frequently collected species of *Hercostomus* in North America (Corpus 1989). Nothing is known about the immature stages or biology of any Nearctic *Hercostomus* species (Corpus 1989).

33. *Medetera veles* Loew Palearctic-Widespread Nearctic

Distribution: AK, YT, NT east to NS, south to CA, TX, FL, Mexico; widespread in Palearctic (Bickel 1985).

Specimens collected 1997: Site 1 (505), site 2 (228), site 3 (27), site 4 (461), site 5 (13), site 6 (167), site 7 (5), site 8 (7), (02.vi-09.vii).

Specimens collected 1998: Site 1 (48), site 3 (25), site 4 (95), site 5 (4), site 6 (6), (03-25.vii).

Comments: This species is most abundant in open and dry habitats, and is often taken in large number in agricultural fields. The adults also occur on tree trunks, large rocks and bare soil, and feed on a variety of soft-bodied arthropods (Bickel 1985). Although this species is very common, nothing is known about the immature stages. Bickel (1985) suggested that the larvae might be associated with immature scolytid beetles (Coleoptera).

Family Platypezidae

Larvae of Platypezidae (flat-footed flies) feed on fungi and adults feed on honeydew and possibly nectar; they occur mostly in forest and damp woods. There are 71 species in North America (Kessel 1987). Only one species was collected at my sites.

34. *Microsania* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), (03-08.vii).

Comments: Adults of *Microsania* are commonly called smoke flies because they are attracted to the odour of smoke. Most specimens in insect collections were collected in the smoke from campfires or barbecues and specimens are rarely collected in other situations (Kessel 1987). There was a large forest fire burning a few kilometers south of my sites 4,5 and 6 for most of the 1998 season and smoke from the fires was occasionally blown to my sites. This specimen might have been attracted by the odour of the smoke or carried by the wind from a nearby forested area. There is no up to date key to identify North American species of *Microsania*.

Family Phoridae

Phoridae (humpbacked flies) are abundant in many habitats but the biology and life history are known for only a few species. Most phorid larvae are saprophagous in many kinds of decaying organic materials, some are parasitoids or predators of other insects and of spider and mollusc eggs, and some are associated (as parasites or commensals) with the nests of ants and termites (Ferrar 1987). Adults are usually found in damp places on or near decaying organic material. There are approximately 356 described species in North America, mostly in the genus *Megaselia* (Peterson 1987). At least five (and possibly many more) species were collected at my sites.

35. *Aenigmatias* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (5), site 5 (1), (24.vi-09.vii).

Specimens collected *1998:* Site 3 (1), (04-09.vii).

Comments: Larvae are parasitoids of ant pupae and adult females are wingless and restricted to ant nests (Ferrar 1987). All specimens collected at my sites were males, which are fully winged. The specimens are currently being identified by B. V. Brown (Natural History Museum of Los Angeles County).

36. *Anevrina* sp. 1

Distribution: Unknown

Specimens collected 1997: Site 1 (1), (25.vi-01.vii).

Specimens collected 1998: None.

Comments: Pupae of *Anevrina* have been collected in the nests of small mammals and the larvae are believed to feed on carrion (Ferrar 1987). My specimens are currently being identified by B. V. Brown (Natural History Museum of Los Angeles County).

37. *Beckerina* spp.

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 3 (1), site 4 (3), site 6 (4), (03-25.vii).

Comments: The specimens are currently being identified by B. V. Brown (Natural History Museum of Los Angeles County).

38. *Megaselia* spp.

Distribution: Unknown.

Specimens collected 1997: Site 1 (205), site 2 (4), site 3 (111), site 4 (73), site 5 (33), site 6 (27), site 7 (6), site 8 (2), (08.vi-08.vii).

Specimens collected 1998: Site 1 (61), site 3 (139), site 4 (54), site 5 (48), site 6 (141), (03-26.vii).

Comments: Species of *Megaselia* are primarily saprophagous, but live in a wide range of substrates and habitats. Many species are also apparently predacious or parasitic in association with a wide range of insect orders (Ferrar 1987). There are almost 200 described species of *Megaselia* in North America (Peterson 1987) and probably many more undescribed. There is no key for the identification of the species and no specialist working on the genus in North America. There were apparently several species of *Megaselia* at my sites.

39. *Phora* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (4), site 7 (1), (08.vi-04.vii).

Specimens collected 1998: Site 1 (1), site 3 (1), site 4 (1), site 5 (1), (07-15.vii).

Comments: One species of *Phora* has been recorded in association with ant nests; another species is predacious on root-feeding aphids in the soil (Ferrar 1987). My specimens are currently being identified by B. V. Brown (Natural History Museum of Los Angeles County).

Family Syrphidae

The larvae of Syrphidae (flower flies) have a wide variety of habitats and food. Larvae of most Nearctic species are predacious, mostly on aphids, some are scavengers in decaying material, some are phytophagous (usually as secondary invaders), and some are specialized scavengers in ant nests. Most of the adults feed on pollen and nectar (Vockeroth 1992). There are 870 species of syrphids recorded in North America (Vockeroth and Thompson 1987). Twelve species were collected at my sites.

40. *Chrysotoxum fasciatum* (Muller) Palearctic-Western Nearctic

Distribution: YT, BC, AB, MB south to CA and NM; Europe (Vockeroth 1992).

Specimens collected 1997: Site 4 (1), (16-24.vi).

Specimens collected 1998: None.

Comments: Larvae and pupae of *Chrysotoxum* have been found in ant nests, compost, under stones and in turf. The structure of the larval mouth parts suggests that they are predacious (Vockeroth 1992).

41. *Dasysyrphus venustus* (Meigen) Palearctic-Widespread Nearctic

Distribution: AK to NF (Labrador), south to CA, NM and NC; Europe; Asia (Vockeroth 1992).

Specimens collected 1997: Site 3 (1), (30.vi).

Specimens collected 1998: None.

Comments:. The larvae are predacious on aphids, and might also feed on other insects (Vockeroth 1992).

42. *Eristalis brousii* Williston Widespread Nearctic

Distribution: AK to NS south to BC, NM and VA (Wirth et al. 1965).

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), (08-15.vii).

Comments: Larvae of this genus are the saprophagous "rat-tailed maggots", feeding on detritus and microorganisms in aquatic or semi-aquatic media (Ferrar 1987).

43. *Eristalis anthophorinus (Fallen)* Palearctic-Widespread Nearctic

Distribution: AK to ME, south to CA, NM and MA; Europe (Wirth et al. 1965).

Specimens collected 1997: None.

Specimens collected 1998: Site 6 (1), (08-15.vii).

Comments: See comments under species #42.

44. *Paragus haemorrhous* Meigen Palearctic-Widespread Nearctic

Distribution: YT to NF, south to Mexico, Costa Rica; Europe; Asia; Africa (Vockeroth 1992).

Specimens collected 1997: Site 1 (3), site 2 (5), site 6 (4), site 7 (1), (11.vi-09.vii).

Specimens collected 1998: Site 4 (10), site 5 (5), site 6 (1), (08-25.vii).

Comments: The larvae are predacious on aphids (Vockeroth 1992).

45. *Paragus (Paragus)* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (22-26.vii).

Comments: Larvae of *Paragus* are predacious on aphids (Vockeroth 1992).

46. *Platycheirus concinnus* (Snow) Western Nearctic

Distribution: YT, BC, AB, MB south to CA, NM and IA (Vockeroth 1992).

Specimens collected 1997: Site 2 (1), (25.vi).

Specimens collected 1998: None.

Comments: The larvae are predacious on aphids (Vockeroth 1992).

47. *Platycheirus* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 2 (1), (12-18.vi).

Specimens collected 1998: Site 1 (1), site 4 (1), (11-25.vii).

Comments: Larvae of *Platycheirus* feed primarily on aphids but are also facultatively phytophagous (Vockeroth 1992). These specimens are females and could not be identified to species without associated males.

48. *Sphaerophoria contigua* Macquart Widespread Nearctic disjunct

Distribution: YT, southern BC to NS, south to CA, FL, Mexico (Vockeroth 1992).

Specimens collected 1997: Site 2 (1), site 3 (1), site 4 (1), (07.vi-04vii).

Specimens collected 1998: Site 5 (1), (08.vii).

Comments: The larvae are predacious on aphids (Vockeroth 1992).

49. *Sphaerophoria philanthus* (Meigen) Palearctic-Widespread Nearctic

Distribution: AK to NF, south to CA, TX and FL; Europe; Asia (Vockeroth 1992).

Specimens collected 1997: Site 4 (1), (08.vii).

Specimens collected 1998: None.

Comments: The larvae are predacious on aphids (Vockeroth 1992).

50. *Sphaerophoria* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 5 (1), (15.vi).

Specimens collected 1998: None.

Comments: The specimen is a female and could not be identified without associated males.

51. *Volucella bombylans* (Linnaeus) Palearctic-Widespread Nearctic

Distribution: AK to NF, south to CA and GA; Europe (Wirth et al. 1965).

Specimens collected 1997: site 1 (1), (01.vii-06.vii).

Specimens collected 1998: None.

Comments: Larvae of *Volucella* are saprophagous in wasp and bee nests, in locust egg pods, and in rotting cactus (Ferrar 1987; Vockeroth 1987).

Family Pipunculidae

Larvae of Pipunculidae (big-headed flies) are parasitoids of Homoptera, especially leafhoppers and planthoppers. The adults are frequently seen hovering in and over vegetation. About 105 species are known from North America (Hardy 1987; De Meyer 1989). At least 20 species were collected at my sites.

52. *Cephalops* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 5 (1), site 6 (1), (16-29.vi).

Specimens collected 1998: None.

Comments: I collected one male and one female, which appear to belong to the same species. The specimens belong to the *Cephalosphaera*-group of DeMeyer (1989) but they do not key out to any of the included species. The male and female genitalia do not correspond to any of the described Nearctic species and I consider them a new species, so far known only in the Yukon.

53. *Cephalops furnaceus* de Meyer Western Nearctic disjunct

Distribution: AK, southern BC to southern SK (De Meyer 1989); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (02-07.vii).

Comments: This is the first record in the Yukon.

54. *Cephalops mainensis* de Meyer Widespread Nearctic

Distribution: AK, BC, AB, ON and ME, south to AZ, CO and NC (De Meyer 1989); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), site 5 (1), (03-19.vii).

Comments: This is the first record in the Yukon.

55. *Dorylomorpha* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (2), site 3 (1), (13.vi-09.vii).

Specimens collected 1998: Site 1 (2), site 4 (1), (02-11.vii).

Comments: This species does not key to any of the described Nearctic species of *Dorylomorpha*. The male genitalia are asymmetrical and do not correspond to those of any described species. I consider this a new species so far known only from the Yukon.

56. *Eudorylas affinis* (Cresson) Widespread Nearctic

Distribution: BC to NS, south to CA, OK and NC (Hardy 1965); YT.

Specimens collected 1997: Site 6 (1), (11.vi).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon.

57. *Eudorylas* spp.

Distribution: Unknown.

Specimens collected 1997: Site 6 (2), (11-24.vi).

Specimens collected 1998: Site 3 (1), site 4 (2), (08-24.vii).

Comments: The specimens are all females and cannot be identified without associated males.

58. *Eudorylas stigmaticus* (Malloch) Widespread Nearctic

Distribution: BC, QC, MI, VA (Hardy 1965); YT.

Specimens collected 1997: Site 4 (7), site 6 (1), (08.vi-08.vii).

Specimens collected 1998: Site 6 (1), (08-15.vii).

Comments: This is the first record in the Yukon.

59. *Eudorylas subopacus* (Loew) Widespread Nearctic

Distribution: AB and WA to NH, south to NM, KS and NC (Hardy 1965); YT.

Specimens collected 1997: Site 1 (4), site 2 (1), site 4 (5), site 5 (5), site 6 (17), (02.vi-08.vii).

Specimens collected 1998: Site 1 (5), Site 4 (3), site 5 (3), site 6 (9), (05-26.vii).

Comments: This is the first record in the Yukon.

60. *Pipunculus alpinus* Cresson Widespread Nearctic disjunct

Distribution: QC, VT, ME, NH and UT (Hardy 1965); YT.

Specimens collected 1997: Site 1 (2), (25.vi-01.vii).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon and represents a major range extension from Utah and Quebec.

61. *Pipunculus ater* (Meigen) Palearctic-Widespread Nearctic disjunct

Distribution: QC and ND, south to CA, TX and GA; Europe (Hardy 1965). YT.

Specimens collected 1997: Site 3 (1), (26-30.vi).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon and a major range extension.

62. *Pipunculus fuscus* Loew Widespread Nearctic

Distribution: BC to ON, south to CA, KS and FL (Hardy 1965); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (02-07.vii).

Comments: This is the first record in the Yukon.

63. *Tomosvaryella agnesea* Hardy Western Nearctic disjunct

Distribution: WA and ID, south to CA, NM and KS (Hardy 1965); YT.

Specimens collected 1997: Site 1 (1), (13-19.vi).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon and the first record in Canada. It also represents a major range extension.

64. *Tomosvaryella lepidipes* Hardy Widespread Nearctic

Distribution: BC to SK and PA, south to CA and TX; South America (Hardy 1965); YT.

Specimens collected 1997: Site 1 (2), site 4 (16), site 5 (38), site 6 (81), site 8 (34), (11.vi-09.vii).

Specimens collected 1998: Site 1 (8), site 4 (11), site 5 (6), site 6 (11), (05-25.vii).

Comments: This is the first record in the Yukon.

65. *Tomosvaryella sylvatica* (Meigen) Palearctic-Widespread Nearctic

Distribution: BC to QC, south to CA and GA; Europe (Hardy 1965); YT.

Specimens collected 1997: Site 1 (14), site 3 (1), site 4 (1), site 5 (11), site 6 (21), site 7 (1), (08.vi-10.vii).

Specimens collected 1998: Site 1 (4), site 6 (1), (03-18.vii).

Comments: This is the first record in the Yukon.

66. *Tomosvaryella* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 3 (1), site 4 (2), site 5 (21), site 6 (25), (16.vi-08.vii).

Specimens collected 1998: Site 1(1), site 5 (3), site 6 (4), (03-19.vii).

Comments: The genitalia of this species are quite distinctive and do not correspond to any of the described species of the genus.

67. *Tomosvaryella n.sp. 2*

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 6 (1), (03.vii).

Comments: The genitalia of this species do not correspond to those of any described species of *Tomosvaryella*.

68. *Tomosvaryella n.sp. 3*

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (6), (05-18.vii).

Comments: The genitalia of this species do not correspond to those of any described species of *Tomosvaryella*.

69. *Tomosvaryella* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (16), site 6 (5), (05-18.vii).

Comments: All the specimens are females and cannot be identified without associated males.

70. *Verrallia (Jassidophaga)* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (4), site 6 (1), (14.vi-06.vii).

Specimens collected 1998: Site 4 (1), (03-08.vii).

Comments: These specimens do not key to any of the described Holarctic species of the subgenus. They represent an undescribed species, based on differences in the wing venation and female genitalia. The female genitalia correspond most closely to the Palearctic species *V. (J.) villosa* von Roser, but the Yukon specimens disagree in other characters.

71. *Verrallia (Verrallia)* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 6 (1), (16.vi).

Specimens collected 1998: None.

Comments: This specimen does not key to any of the described Holarctic species of the subgenus. Based on differences in wing venation, leg colour and female genitalia, the specimen represents an undescribed species.

Family Conopidae

Known larvae of most Conopidae (thick-headed flies) are internal parasitoids of aculeate Hymenoptera. Adults feed at flowers. There are 66 species known from North America (Smith and Peterson 1987). One species was collected at my sites.

72. *Thecophora sp.*

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), (19-25.vii).

Comments: This species belongs to the subfamily Myopinae which are all internal parasitoids of Hymenoptera (Smith and Peterson 1987).

Family Psilidae

All the larvae of the family Psilidae (rust flies) are phytophagous; they live in the roots and stems of plants and under the bark of trees. The adults are often found on vegetation. There are about 30 species in North America (Steyskal 1987a). Two species were collected at my sites.

73. *Psila microcera* Melander Western Nearctic disjunct

Distribution: Southern AB, SK, WA to CA, UT (Shewell 1965a); YT (Burwash Landing) (CNC).

Specimens collected 1997: Site 1 (1), site 6 (1), (26.vi-08.vii).

Specimens collected 1998: Site 4 (1), site 6 (2), (03-25.vii)

Comments: The species is phytophagous but the host is unknown.

74. *Psila washingtona* Melander Western Nearctic

Distribution: AK to WA (Shewell 1965a).

Specimens collected 1997: Site 5 (1), (29.vi-03.vii).

Specimens collected 1998: None.

Comments: The species is phytophagous but the host is unknown.

Family Tephritidae

Almost all known larvae of Tephritidae (fruit flies) are primary invaders of plant tissues. They feed in fleshy fruits, and flowering heads of plants (especially Asteraceae), but also in leaves, stems and roots; some species induce gall formation (Ferrar 1987; Foote et al. 1993). The adults are found on flowers or vegetation. There are about 290 North American species (Foote et al. 1993). Six species were collected at my sites.

75. *Campiglossa farinata* Novak Widespread Nearctic

Distribution: AK to MN, south to CA and TX (Foote et al. 1993).

Specimens collected 1997: Site 1 (47), site 3 (1), site 4 (4), site 5 (5), site 6 (4), (08.vi-10.vii).

Specimens collected 1998: Site 1 (17), site 4 (1), site 5 (8), site 6 (3), (08-26.vii).

Comments: Although this species has been associated with several species of Asteraceae, no plant species has been confirmed as a host (Foote et al. 1993).

76. *Neaspilota viridescens* Quisenberry Western Nearctic disjunct

Distribution: AK, YT, southern BC and southern SK, south to CA and CO (Foote et al. 1993).

Specimens collected 1997: Site 6 (1), (11.vi).

Specimens collected 1998: None.

Comments: This species has been reared from host plants in at least eight genera of Asteraceae (Foote et al. 1993).

77. *Oxyna aterrima* (Doane) Western Nearctic disjunct

Distribution: Southern AB, southern SK, OR, CA, UT, CO, ND (Foote et al. 1993); central AB (Dunvegan) (LEMQ); YT (Fig. 6).

Specimens collected 1997: Site 1 (8), site 2 (6), site 4 (31), site 5 (23), site 6 (47), site 8 (2), (08.vi-08.vii).

Specimens collected 1998: Site 1 (3), site 4 (7), site 6 (5), (02-25.vii).

Comments: The host of this species was previously unknown. Other species of *Oxyna* have been reared from various species of *Artemisia* and most of my specimens were swept from *Artemisia frigida*, which suggests that this might be the host plant. The northernmost published record of this species is in southern Alberta and it is rarely collected throughout over its range (Foote et al. 1993). This is the first record of the species in the Yukon. I also collected some specimens of *O. aterrima* at Dunvegan, AB in 1997 on south-facing *Artemisia*-grassland slopes along the Peace River.

78. *Rhagoletis juniperina* Marcovitch Western Nearctic disjunct

Distribution: OR, CA, ID, UT, AZ, TX, southern MB, NY and MA (Foote et al. 1993); YT (Fig. 7).

Specimens collected 1997: Site 1 (2), site 2 (2), site 3 (7), (25.vi-06.vii).

Specimens collected 1998: Site 1 (1), site 3 (5), (04-20.vii).

Comments: Two species of *Juniperus* in the Section *Sabina* have been recorded as hosts for this species. The presence of *R. juniperina* beyond the range of the known host plants suggests that this species infests other species of *Juniperus* (Bush 1966). This is the first record of *R. juniperina* in the Yukon and represents a major range extension.

79. *Tephritis leavittensis* Blanc Western Nearctic disjunct

Distribution: MT, OR, CA, NV, UT and SD (Foote et al. 1993); YT (Fig. 8).

Specimens collected 1997: Site 1 (1), site 2 (1), site 5 (44), site 6 (13), (08.vi-08.vii).
Specimens collected 1998: Site 1 (2), site 5 (5), site 6 (1), (03-26.vii).
Comments: This species has been collected in association with species of Asteraceae but there are no confirmed host records (Foote et al. 1993). This is the first record in the Yukon, and the first record in Canada, and represents a major range extension.

80. *Tephritis araneosa* (Coquillett) (*s.l.*) Widespread Nearctic
Distribution: BC, NT east to ON, south to CA, NM, SD, NC (Foote et al 1993); YT.
Specimens collected 1997: Site 3 (1), site 4 (2), site 5 (119), site 6 (5), (11.vi-08.vii).
Specimens collected 1998: Site 5 (1), (19.vii).
Comments: This widespread species probably represents a complex of closely related species. Specimens have been reared from at least seven genera of Asteraceae (Foote et al. 1993). This is the first record from the Yukon.

Family Piophilidae

Both the larvae and adults of the family Piophilidae (skipper flies) are scavengers; the larvae develop in decaying organic material, usually carrion and adults are found on carrion, bones, garbage, dung, sewage, etc. There are about 60 species in North America (McAlpine 1977). One species was collected at my sites.

81. *Parapiophila atrifrons* (Melander and Spuler) Widespread Nearctic
Distribution: WA, ID and ME (Steyskal 1965); YT, NT, BC (widespread), southern AB, SK (CNC).
Specimens collected 1997: site 1 (1), site 2 (1), site 8 (1), (11-27.vi).
Specimens collected 1998: None.
Comments: The immature stages and biology of most species in this genus are unknown but they are probably saprophagous (McAlpine 1977). All members of the genus *Parapiophila* are restricted to northern North America and Eurasia and many of them have Holarctic distributions (McAlpine 1977).

Family Lauxaniidae

Most larvae of the family Lauxaniidae (lauxaniid flies) are saprophagous, they live in fallen leaves, straw, rotting wood, bird nests and decaying vegetation, but a few species have been reported as phytophagous (Miller 1977a, 1977b). The adults occur in many habitats from deciduous forests to grasslands and sand dunes; they are usually found resting on low vegetation (Shewell 1987a). There are more than 150 described species of Lauxaniidae in North America (Shewell 1987a). Two species were collected at my sites.

82. *Homoneura melanderi* Johnson Widespread Nearctic

Distribution: AK to QC, south to BC, CO, SD and NJ (Miller 1977a).

Specimens collected 1997: Site 1 (83), site 3 (33), (13.vi-10.vii).

Specimens collected 1998: Site 1 (11), site 3 (1), site 5 (1), (02-26.vii).

Comments: Species of this genus are associated with fallen leaves of deciduous trees (Miller 1977b).

83. *Lauxania cylindricornis* (Fabricius) (*s.l.*) Palearctic-Widespread Nearctic

Distribution: AK to NF, south to AZ and FL; Europe (Shewell 1965).

Specimens collected 1997: Site 1 (3), site 4 (1), site 6 (1), (08.vi-09.vii).

Specimens collected 1998: Site 3 (1), site 4 (3), site 5 (1), (04-25.vii).

Comments: The larvae feed on decaying organic material (Miller 1977b). The species usually identified as *L. cylindricornis* in the Nearctic may not be conspecific with the Palearctic species, and could represent several new species in North America (Miller 1977b). The Nearctic *Lauxania* are currently being revised by J. Perusse and T. Wheeler (McGill University) but for now, I consider the species as *L. cylindricornis* (sensu lato).

Family Chamaemyiidae

Larvae of the family Chamaemyiidae (aphid flies) are predators on several families of Homoptera including aphids, adelgids and scale insects. There are an estimated 100-150 species in North America, of which about half are undescribed (McAlpine 1987). This family was the most abundant at my sites, representing half of all specimens collected, and 12 species have been identified to date. Many specimens or the genus *Leucopis* have not been identified yet so the total number of species may be higher.

84. *Chamaemyia herbarum*, Robineau-Desvoidy Palearctic-Widespread Nearctic

Distribution: BC to PEI, Europe (McAlpine 1965), south to AZ (CNC); YT.

Specimens collected 1997: Site 1 (3482), site 2 (64), site 3 (92), site 4 (1798), site 5 (185), site 6 (833), site 8 (5), (08.vi-08.vii).

Specimens collected 1998: Site 1 (1307), site 3 (5), site 4 (52), site 5 (37), site 6 (12), (02-26.vii).

Comments: This species is a predator of mealybugs (Homoptera) feeding on monocots (S. D. Gaimari pers. comm.) and was the most abundant species of Diptera at my sites. This is the first record in the Yukon.

85-94. Genus *Leucopis* Meigen

Comments: Ten species of *Leucopis* have been identified to date at my sites, based on examination of specimens from 1997 by S. D. Gaimari (University of Illinois). However, almost 300 specimens of *Leucopis* from 1997 and 1998 have not yet been identified, so it is impossible to say how many species, and how many specimens of each species, were collected at each site. I have listed the species identified to date, with comments on each subgenus or species group.

85. *Leucopis* (*Leucopis*) sp. 1

86. *Leucopis (Leucopis)* sp. 2

87. *Leucopis (Leucopis)* sp. 3

88. *Leucopis (Leucopis)* sp. 4

89. *Leucopis (Leucopis)* sp. 5

Comments: Species of *Leucopis* (*Leucopis*) feed on a variety of Homoptera including aphids, mealybugs and coccid scale insects (S. D. Gaimari pers. comm.). There are many undescribed North American species in the subgenus *Leucopis* (*Leucopis*) and identification of species is very difficult.

90. *Leucopis* (*Anchioleucopis*) n.sp.1

Comments: *Leucopis* (*Anchioleucopis*) species are known only as predators of adelgids (S. D. Gaimari pers. comm.), which usually feed on trees. Only one female was identified and may have been an accidental visitor to my site. In McAlpine (1987) species of *Anchioleucopis* key to the *Leucopis geniculata*-group, which has a single described species. This specimen does not correspond to that species and is undescribed (S. D. Gaimari pers. comm.).

91. *Leucopis ocellaris* group sp. 1

92. *Leucopis ocellaris* group sp. 2

93. *Leucopis ocellaris* group sp. 3

94. *Leucopis ocellaris* group sp. 4

Comments: Members of the *Leucopis ocellaris* group are predators of the egg sacs of coccids (Homoptera) and they are also known from mealybugs (Homoptera) (S. D. Gaimari pers. comm.).

95. *Pseudodinia occidentalis* Barber Western Nearctic disjunct

Distribution: Southern BC and WA, south to NM (Barber 1985); BC (Penticton) (CNC); YT.

Specimens collected 1997: Site 2 (1), site 4 (1), site 5 (1), (16.vi-25.vi).

Specimens collected 1998: None.

Comments: The larvae are predacious on Homoptera. Barber (1985) suggested that this species is often associated with rocky hills. This is the first record in the Yukon.

Family Sepsidae

The larvae of the family Sepsidae (black scavenger flies) live mostly in dung but some species are found in other types of decaying organic material and some are apparently associated with ants. The adults are usually found near materials in which the larvae breed (Steyskal 1987b). There are about 30 described species in North America (Steyskal 1987b). One species was collected at my sites.

96. *Sepsis* sp. 1

Distribution: Unknown.

Specimens collected 1997: site 1 (2), (08.vi).

Specimens collected 1998: None.

Comments: Species of *Sepsis* are common in meadows or fields, especially where dung of large mammals is present. Larvae feed on dung, carrion or garbage (Melander and Spuler 1917). The specimens are both females, and the only existing key to species (Melander and Spuler 1917) is based on males only.

Family Agromyzidae

Larvae of all Agromyzidae (leaf-miner flies) feed on living plant tissue. As the common name suggests, they are mostly leaf-miners, but they also attack all parts of the plant, including stems, seeds, and roots. There are about 500 described species in North America but many more remain undescribed (Spencer 1987). This was the most diverse family in my study with 32 species found at my sites.

97. *Agromyza spiraeae* Kaltenbach Palearctic widespread Nearctic

Distribution: Northern BC, ON, QC; Europe; Japan (Spencer 1969); AK, YT; SK (CNC).

Specimens collected 1997: Site 6 (1), (16.vi).

Specimens collected 1998: None.

Comments: Larvae mine leaves of various members of the subfamily Rosoideae, family Rosaceae (Sehgal 1971).

98. *Calycomyza n.sp.*1

Distribution: Unknown.

Specimens collected 1997: Site 3 (1), site 4 (9), site 5 (4), site 6 (5), site 8 (2), (08.vi-08.vii).

Specimens collected 1998: Site 3 (1), site 4 (3), (03-15.vii).

Comments: The specimens key to *C. humeralis* in Spencer (1969) but the male genitalia do not correspond to that species.

99. *Cerodontha angulata* (Loew) Palearctic widespread Nearctic

Distribution: Central AB, ON, DC; Europe (Spencer 1969); YT.

Specimens collected 1997: Site 1 (1), (14.vi).

Specimens collected 1998: None.

Comments: This species has been recorded from *Carex* species (Spencer 1969). This is the first record in the Yukon.

100. *Cerodontha dorsalis* (Loew) Palearctic widespread Nearctic

Distribution: BC, AB, ON, QC, widespread in USA; Mongolia; Neotropical region (Spencer 1969); northern AB, northern BC (LEMQ); YT.

Specimens collected 1997: Site 3 (9), (13.vi-10.vii).

Specimens collected 1998: Site 1 (1), (11.vii).

Comments: Larvae are associated with several genera of grasses, where they mine in the leaf-sheath (Spencer 1969). This is the first record in the Yukon.

101. *Cerodontha gibbardi* Spencer Western Nearctic disjunct

Distribution: Northern BC (Atlin), southern AB, SK, MB (Spencer 1969); YT.

Specimens collected 1997: Site 6 (1), (16.vi).

Specimens collected 1998: None.

Comments: The host-plant of this species is unknown, but most species of *Cerodontha* are associated with grasses. This is the first record in the Yukon.

102. *Cerodontha lateralis* (Macquart) Palearctic-Widespread Nearctic

Distribution: AK to NB, widespread in USA; Europe; Japan (Spencer 1969).

Specimens collected 1997: Site 5 (1), site 6 (3), (11-15.vi).

Specimens collected 1998: Site 1 (1), (05.vii).

Comments: Larvae feed as leaf-miners on many genera of Poaceae in North America (Spencer 1969).

103. *Cerodontha ?muscina* (Meigen) Palearctic-Widespread Nearctic

Distribution: AK, YT, NT, BC, MB, ON, QC, widespread in USA; Europe (Spencer 1969).

Specimens collected 1997: Site 3 (1), (10.vii).

Specimens collected 1998: None.

Comments: Larvae of *C. muscina* feed on several genera of Poaceae. This specimen is a female that keys to either *C. muscina* or *C. calamagrostidis* Nowakoski. The description of *C. muscina* in Spencer (1969) matches the specimen more closely, but male genitalia would be required to distinguish the two species definitely. *Cerodontha muscina* is a much more abundant and widespread species, and has a broad range of known hosts. *Cerodontha calamagrostidis* is not abundant and the only North American record is from southern Alberta. Based on the description of the species, and the range of the species, I tentatively identified this species as *C. muscina*.

104. *Cerodontha* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (8), site 4 (7), site 5 (24), site 6 (23), site 7 (1), site 8 (1), (08.vi-08.vii).

Specimens collected 1998: Site 1 (3), site 5 (2), (02-25.vii).

Comments: This species keys to *C. butomomyzina* Spencer, known only from New Brunswick, but the male genitalia do not correspond to that species or any other described *Cerodontha*.

105. *Cerodontha* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (14.vi).

Specimens collected 1998: None.

Comments: This specimen is a female that cannot be identified without associated males.

106. *Chromatomyia* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (5), (08.vi).

Specimens collected 1998: None.

Comments: These specimens all represent a single species that does not key out in Griffiths (1974). It may be an undescribed species but confirmation is required.

107. *Liriomyza lima* (Melander) Widespread Nearctic disjunct

Distribution: Southern AB (Edmonton), ID, SD (Spencer 1969); ON (CNC); YT.

Specimens collected 1997: Site 4 (1), site 5 (2), site 6 (5), (11.vi-08.vii).

Specimens collected 1998: Site 5 (2), site 6 (4), (03-25.vii).

Comments: The host plant of this species is unknown. This is the first record in the Yukon.

108. *Liriomyza socialis* (Spencer) Western Nearctic disjunct

Distribution: Southern AB (Blairmore) (Spencer 1969). YT.

Specimens collected 1997: Site 5 (1), site 8 (1), (11-16.vi).

Specimens collected 1998: Site 1 (1), site 3 (1), (02-20.vii).

Comments: The host plant of this species is unknown. This is the first record in the Yukon.

109. *Liriomyza taraxaci* Hering Palearctic-Widespread Nearctic disjunct

Distribution: Southern AB (Edmonton), ON, QC; Europe (Spencer 1969); YT.

Specimens collected 1997: Site 5 (1), (15.vi).

Specimens collected 1998: None.

Comments: This species has been reared from *Taraxacum officinale* Weber ex Wiggers (Asteraceae) (Sehgal 1971) and it may also feed in some other species of *Taraxacum* and *Cichorium* (Spencer 1969). There were no specimens of *Taraxacum* identified at this site, but they may have been present near the highway at the base of the site. *Liriomyza taraxaci* may be an accidental visitor at the site. This is the first record in the Yukon.

110. *Melanagromyza* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), site 5 (1), (16.vi-06.vii).

Specimens collected 1998: None.

Comments: The specimens are females and could not be identified without associated males.

111. *Metopomyza bellissima* Spencer Western Nearctic disjunct

Distribution: BC (Atlin, Telegraph Creek, Osoyoos) (Spencer 1969); YT (CNC).

Specimens collected 1997: Site 2 (7), site 3 (1), (02-25.vi).

Specimens collected 1998: None.

Comments: The host plant is unknown.

112. *Napomyza nugax* Spencer Widespread Nearctic disjunct

Distribution: Northern BC (Terrace), southern AB, ON, QC (Spencer 1969); YT.

Specimens collected 1997: Site 1 (1), site 4 (3), site 5 (1), (13-19.vi).

Specimens collected 1998: None.

Comments: The host plant is unknown. This is the first record in the Yukon.

113. *Ophiomyia monticola* Sehgal Western Nearctic

Distribution: AK, YT, BC, AB, MB (Spencer 1969).

Specimens collected 1997: Site 2 (1), site 7 (6), (12-28.vi).

Specimens collected 1998: None.

Comments: The host plant is unknown.

114. *Ophiomyia nasuta* (Melander) Palearctic-Widespread Nearctic

Distribution: YT to QC, northern USA; Europe; Japan (Spencer 1969).

Specimens collected 1997: Site 2 (3), site 8 (1), (11.vi-04.vii).

Specimens collected 1998: None.

Comments: Specimens have been reared from *Taraxacum officinale* (Asteraceae) (Spencer 1969; Sehgal 1971). Because *Taraxacum* species were not recorded at my sites, this species may be an accidental visitor from *Taraxacum* plants growing along the highway at the bottom of the site.

115. *Ophiomyia* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (2), (19-27.vi).

Specimens collected 1998: None.

Comments: The specimens key to *Ophiomyia quinta* Spencer in Spencer (1969) but the genitalia do not correspond to that species.

116. *Ophiomyia* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 2 (1), (12-18.vi).

Specimens collected 1998: None

Comments: The specimen is a female that cannot be identified without associated males.

117. *Paraphytomyza luteoscutellata* (de Meijere) Palearctic-Widespread Nearctic disjunct

Distribution: AB (?), ON, QC; Europe (Spencer 1969); YT.

Specimens collected 1997: Site 6 (1), (16.vi).

Specimens collected 1998: None.

Comments: The known host plants for this species are *Lonicera* spp. and *Symphoricarpos* spp. (Caprifoliaceae) (Spencer 1969), which are either unknown (*Symphoricarpos*) or are rare and localized (*Lonicera*) in the Yukon (Cody 1996). This species may have other host-plants in this area. Spencer (1969) concluded that the Alberta record of *P. luteoscutellata* was questionable but he did not justify his decision. This is the first record in the Yukon.

118. *Phytoliriomyza* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 4 (1), site 5 (51), (15.vi-08.vii).

Specimens collected 1998: Site 5 (1), (15-19.vii).

Comments: Very little is known on the biology of *Phytoliriomyza* species, but it has been suggested that some species feed on Asteraceae. Almost all the specimens (44) were collected at site 5 on a single date (03.vii.97); this site had a higher diversity of plant species, including Asteraceae, than most other sites. This species is close to *P. beckerella* Spencer, which is found only in California, but the male genitalia are distinctly different.

119. *Phytoliriomyza* n.sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 5 (3), (15.vi-03.vii).

Specimens collected 1998: None

Comments: See comments on biology under species #118.

120. *Phytomyza* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (23), site 2 (4), site 4 (6), site 5 (12), site 6 (7), site 7 (1), (08.vi-09.vii).

Specimens collected 1998: Site 1 (23), site 3 (6), site 4 (2), site 5 (3), site 6 (4), (02-08.vii).

Comments: Phytomyza is a diverse genus in the Holarctic, with many undescribed species. This and the other species of *Phytomyza* at my sites may represent undescribed species, or Palearctic species not known from North America.

121. *Phytomyza* sp. 2

Distribution: Unknown

Specimens collected 1997: Site 1 (2), (14.vi).

Specimens collected 1998: None.

Comments: See comments under species #120.

122. *Phytomyza* sp. 3

Distribution: Unknown.

Specimens collected 1997: Site 1 (3), site 5 (7), site 6 (6), (11.vi-09.vii).

Specimens collected 1998: Site 1(17), site 5 (3), site 6 (1), (02-25.vii).

Comments: See comments under species #120.

123. *Phytomyza* sp. 4

Distribution: Unknown.

Specimens collected 1997: Site 4 (4), site 6 (1), (29.vi-08.vii).

Specimens collected 1998: Site 4 (2), (15.vii).

Comments: See comments under species #120.

124. *Phytomyza* sp. 5

Distribution: Unknown.

Specimens collected 1997: Site 1 (13), site 2 (3), site 4 (2), site 5 (11), site 6 (1), site 7 (1), (08.vi-09.vii).

Specimens collected 1998: Site 1 (1), site 3 (1), (09-26.vii).

Comments: See comments under species #120.

125. *Phytomyza* sp. 6

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 3 (16), (04-24.vii).

Comments: See comments under species #120.

126. *Phytomyza* sp. 7

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 3 (2), (09-20.vii).

Comments: See comments under species #120.

127. *Phytomyza* spp.

Distribution: Unknown.

Specimens collected 1997: Site 1 (3), site 5 (1), site 6 (2), site 7 (1), (06.vi-08.vii).

Specimens collected 1998: Site 1 (2), site 3 (1), site 5 (1), (02-15.vii).

Comments: These specimens are all females which cannot be associated with males.

128. *Pseudonapomyza lacteipennis* (Malloch) Widespread Nearctic disjunct

Distribution: Southern BC to southern ON, Widespread in USA (Spencer 1969); YT.

Specimens collected 1997: Site 5 (2), site 6 (12), (11.vi-03.vii).

Specimens collected 1998: Site 1 (4), site 5 (4), site 6 (1), (05-19.vii).

Comments: The host plant is unknown but probably some species of Poaceae (Spencer 1969). Spencer (1969) suggested that this species was parthenogenetic because he had seen no male specimens. I collected two males at site 6 (29.vi and 03.vii), which refutes Spencer's suggestion. This is the first record in the Yukon.

Family Anthomyzidae

Larvae of the family Anthomyzidae (anthomyzid flies) are probably phytophagous in grass stems, although it has been suggested that they may be saprophagous in damaged and dead tissues (Ferrar 1987). The adults are generally found in damp, grassy areas and marshes. There are ten described species in North America, but many more are undescribed (Vockeroth 1987). A single species was collected at my sites.

129. *Anthomyza* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (14.vi).

Specimens collected 1998: None

Comments: The genus *Anthomyza* is very abundant and diverse in grasslands further south, but in the Yukon specimens are mostly restricted to moister areas. Most species of North American *Anthomyza* are undescribed.

Family Carnidae

Larvae of the family Carnidae (carnid flies) are saprophagous in a variety of substrates including dung, carrion, vertebrate nests, and decaying vegetation. Adults of most species are usually found near the larval habitat. Adults of the genus *Carnus* Nitzsch are ectoparasites of birds. There are 16 described species of Carnidae in North America (Sabrosky 1987a). At least two species were collected at my sites.

130. *Meoneura* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (5), (08.vi-09.vii).

Specimens collected 1998: None.

Comments: The larvae of *Meoneura* are saprophagous. The specimens are all males and belong to an undescribed species not included in Sabrosky (1959).

131. *Meoneura* n.sp. 2

Distribution: Unknown

Specimens collected 1997: Site 1 (1), (13-19.vi).

Specimens collected 1998: None

Comments: The larvae of *Meoneura* are saprophagous. The specimen is a male and belongs to an undescribed species not included in Sabrosky (1959).

132. *Meoneura* spp.

Distribution: Unknown.

Specimens collected 1997: Site 1 (66), site 2 (17), site 3 (11), site 4 (1), site 5 (7), site 6 (10), site 8 (2), (08.vi-10.vii).

Specimens collected 1998: Site 1 (2), site 4 (1), site 5 (1), site 6 (1), (05-22.vii).

Comments: The larvae of *Meoneura* are saprophagous. These specimens are all females and cannot be identified to species because the key by Sabrosky (1959) is based on males only . Some of these females may be associated with males of the two species identified above, but it is impossible to say which without additional taxonomic work.

133. *Hemeromyia* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (05.vii).

Comments: The larvae of *Hemeromyia* are apparently saprophagous. The puparium of a species of *Hemeromyia* was collected in a rodent's nest (Ferrar 1987). This is the first Yukon record of the genus, and the northernmost record of *Hemeromyia*. The northernmost published record is from Washington, USA (Sabrosky 1965a) and there are some specimens of an undescribed species from near Osoyoos in southern BC in the CNC.

Family Tethinidae

Most species of Tethinidae (tethinid flies) occur on or near marine shores. A few species also occur along fresh water lakes and ponds and some species occur inland in dry saline habitats (Melander 1951). Larvae are unknown for Nearctic Tethinidae, but are apparently saprophagous. Adults are usually swept from vegetation along beaches and sand dunes. There are 24 North American species (Mathis and Munari 1996). One species was collected at my sites.

134. *Pelomyiella mallochi* Sturtevant Palearctic-Widespread Nearctic

Distribution: Inland in BC to CA, MB, CO, WY. Coastal in northern MB, Baffin Island, ME to NY; widespread in the Palearctic (Mathis and Munari 1996); YT.

Specimens collected 1997: Site 1 (1) (19.vi).

Specimens collected 1998: Site 4 (2), (15.vii).

Comments: Pelomyiella mallochi is one of the few species of Tethinidae that is common in inland habitats (Melander 1951). This is the first record in the Yukon.

Family Chloropidae

The larvae of Chloropidae (grass flies) have a diverse range of habits. Many species are phytophagous, especially on grasses and sedges, others are secondary invaders of damaged plant tissues. Chloropid larvae are also saprophagous in a range of decaying organic materials, predacious on the larvae or eggs of other insects and spiders, kleptoparasites of the prey of spiders and large predacious insects and even parasites of amphibians (Sabrosky 1987b). There are about 270 described species of Chloropidae in North America (Sabrosky 1987b) but many more species are undescribed. This was one of the most diverse families at my sites with 31 species.

135. *Chlorops* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (8), (01-09.vii).

Specimens collected 1998: Site 1 (3), (02-26.vii).

Comments: Known species of *Chlorops* are phytophagous in grasses.

136. *Chlorops* sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 5 (9), site 6 (17), (11.vi-08.vii).

Specimens collected 1998: None.

Comments: Known species of *Chlorops* are phytophagous in grasses.

137. *Chlorops* sp. 3

Distribution: Unknown.

Specimens collected 1997: Site 1 (4), site 2 (37), site 3 (119), site 4 (31), (08.vi-08.vii).

Specimens collected 1998: Site 3 (9), site 4 (3), site 5 (2), (04-19.vii).

Comments: Known species of *Chlorops* are phytophagous in grasses.

138. *Conioscinella* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (122), site 2 (10), site 4 (9), site 5 (9), site 6 (13), site 8 (3), (08.vi-09.vii).

Specimens collected 1998: Site 1 (50), site 4 (3), site 5 (1), site 6 (1), (02-22.vii).

Comments: Known species of *Conioscinella* are saprophagous in a variety of decaying organic materials including rotting vegetation and carrion. The six described North American species of *Conioscinella* are mostly found in southern Canada and the United States, especially in the east, but there are several undescribed species. None of the specimens from my sites corresponds to any of the described species (T.A. Wheeler pers. comm.).

139. *Conioscinella* n.sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 4 (9), site 5 (5), site 6 (14), site 7 (1), (11.vi-08.vii).

Specimens collected 1998: Site 6 (1), (03-08.vii).

Comments: See comments under species #136.

140. *Conioscinella* n.sp. 3

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 5 (1), (19-25.vii).

Comments: See comments under species #136.

141. *Dasyopa* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (4), site 2 (5), (25.vi-06.vii).

Specimens collected 1998: Site 1 (1), site 3 (2), site 5 (1), site 6 (1), (04-15.vii).

Comments: *Dasyopa* includes two rarely collected species found in the western and eastern United States, respectively. The biology of the species is unknown, but based on the mouthparts of the adults and the habitat distribution of specimens in museum collections, they are probably saprophagous (T. A. Wheeler pers. comm.). The two species collected at my sites do not correspond to either of the described species. This is the first record of the genus in the Yukon and the first record in Canada.

142. *Dasyopa* n.sp. *2*

Distribution: Unknown.

Specimens collected 1997: Site 1 (9), site 2 (35), site 4 (12), site 6 (2), (12.vi-08.vii).

Specimens collected 1998: None.

Comments: See comments under species #139.

143. *Epichlorops puncticollis* (Zetterstedt) Palearctic-Widespread Nearctic

Distribution: AK to NF, south to CA, NE, IA and NY; Europe, Asia (Wheeler 1994).

Specimens collected 1997: Site (1), (14.vi).

Specimens collected 1998: None.

Comments: The larvae of *Epichlorops* species are phytophagous in sedges (Wheeler 1994). This specimen was probably an accidental visitor to my site, given that this species is associated with wetter areas (T. A. Wheeler pers. comm.).

144. *Fiebrigella oophaga* (Sabrosky) Western Nearctic disjunct

Distribution: Southern BC, ID (Sabrosky 1967); YT.

Specimens collected 1997: Site 4 (1), (08.vi).

Specimens collected 1998: None.

Comments: The larvae are predators of grasshopper eggs (Sabrosky 1967). This is the first record in the Yukon.

145. *Incertella incerta* (Becker) Widespread Nearctic

Distribution: NT to NF (Labrador), south to AZ, KS, TN and MA (Sabrosky 1965b); YT.

Specimens collected 1997: Site 1 (6), site 2 (1), site 3 (2), site 4 (11), site 5 (41), site 6 (113), (08-29.vi).

Specimens collected 1998: None.

Comments: The larvae of this species are saprophagous (T. A. Wheeler pers. comm.). This is the first record in the Yukon.

146. *Incertella* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (3), site 6 (2), (16.vi-08.vii).

Specimens collected 1998: None.

Comments: The biology is unknown, but most species of *Incertella* are saprophagous.

147. *Meromyza canadensis* Fedoseeva Western Nearctic disjunct

Distribution: Southern SK (Fedoseeva 1971); YT.

Specimens collected 1997: Site 1 (1), (08.vi).

Specimens collected 1998: None.

Comments: Larvae of *Meromyza* are phytophagous on Poaceae (Ferrar 1987). This is the first record in the Yukon; the species was previously known only from the types, from Saskatchewan.

148. *Meromyza columbi* Fedoseeva Western Nearctic disjunct

Distribution: AK, ID, UT (Fedoseeva 1971); central AB (Dunvegan) (LEMQ); YT.

Specimens collected 1997: Site 1 (100), site 2 (2), site 4 (2), site 5 (45), site 6 (10), (11.vi-09.vii).

Specimens collected 1998: Site 1 (178), site 5 (8), site 6 (8), (02-26.vii).

Comments: Larvae of *Meromyza* are phytophagous on Poaceae (Ferrar 1987). This is the first record in the Yukon and the first record in Canada.

149. *Meromyza pratorum* Meigen Palearctic-Western Nearctic

Distribution: AK, BC, ID, MT; Europe, Central Asia, Siberia (Fedoseeva 1971, 1978); central AB (Dunvegan) (LEMQ); YT.

Specimens collected 1997: Site 1 (310), site 2 (8), site 3 (16), site 4 (539), site 5 (222), site 6 (184), site 7 (1), (08.vi-10.vii).

Specimens collected 1998: Site 1 (235), site 3 (7), site 4 (136), site 5 (140), site 6 (93), (02-25.vii).

Comments: This species is phytophagous and has been recorded from various grasses (Ferrar 1987). This is the first record in the Yukon and this was one of the most abundant species at my sites.

150. *Neoscinella* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), site 2 (5), site 3 (1), site 5 (4), site 6 (10), (11.vi-10.vii).

Specimens collected 1998: Site 2 (1), site 6 (2), (15-26.vii).

Comments: The genus *Neoscinella* is known from three rarely collected species found in the eastern United States. The specimens from my sites do not correspond to any of the described species. This is the first record of the genus in the Yukon, and the first record in Canada.

151. *Olcella parva* (Adams) Widespread Nearctic

Distribution: BC to ON and MA, south to Mexico and FL (Sabrosky 1965b); southern AB (CNC); YT.

Specimens collected 1997: Site 1 (4), site 2 (2), site 3 (1), site 6 (1), (13.vi-06.vii).

Specimens collected 1998: Site 3 (2), (04-09.vii).

Comments: This is the first record in the Yukon.

152. *Olcella provocans* (Becker) Widespread Nearctic

Distribution: AK, SK to QC, south to CA, UT and NJ (Sabrosky 1965b); southern BC, central AB (CNC); YT.

Specimens collected 1997: Site 1 (1), (27.vi).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon.

153. *Olcella pygmaea* (Becker) Western Nearctic disjunct

Distribution: WY (Sabrosky 1965b); YT.

Specimens collected 1997: Site 2 (2), site 4 (1), site 5 (1), site 6 (102), (11.vi-08.vii).

Specimens collected 1998: Site 6 (16), (03-25.vii).

Comments: This is the first record in the Yukon, and first record in Canada. This species was previously known only from the types, from Wyoming.

154. *Olcella* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (2), site 4 (1), (13-24.vi).

Specimens collected 1998: None.

Comments: *Olcella* is a New World genus that is most diverse in the western and southwestern United States. This species does not correspond to any of the described North American species of

Olcella.

155. *Olcella* n.sp. 2 East Beringian

Distribution: Unknown, but apparently restricted to south facing slopes in the Yukon.

Specimens collected 1997: Site 1 (599), site 2 (68), site 3 (33), site 4 (235), site 5 (6), site 6 (284), site 8 (3), (08.vi-09.vii).

Specimens collected 1998: Site 1 (56), site 3 (62), site 4 (49), site 5 (9), site 6 (94), (02-25.vii).

Comments: See comments under species #154. I collected this species at all my sites and it was very abundant. I did not collect this species at any other sites in the Yukon, northern BC or northern AB during 1997 and 1998, and there are no specimens of this species in the collections of the CNC or LEMQ. Because of this, it appears that this species might be restricted to south-facing slopes in the Yukon.

156. *Olcella* n.sp. 3

Distribution: Unknown.

Specimens collected 1997: Site 1 (30), site 2 (5), site 3 (1), site 5 (10), site 6 (1), (08.vi-06.vii).

Specimens collected 1998: Site 1 (1), (18-22.vii).

Comments: See comments under species #154.

157. *Oscinella frit* (Linnaeus) Palearctic-Widespread Nearctic

Distribution: AK to NF, south to CA, TX and GA; widespread in Palearctic (Sabrosky 1965b).

Specimens collected 1997: Site 1 (3), (13.vi-01.vii).

Specimens collected 1998: Site 1 (1), (18-22.vii).

Comments: This species is a primary phytophagous invader of grasses, and is sometimes a serious pest of cereal crops (Ferrar 1987).

158. *Oscinella* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (26.vi-01.vii).

Specimens collected 1998: None.

Comments: There are only three described species of *Oscinella* in North America; the genus is more diverse in the Palearctic. This species may be an undescribed North American species, or a previously unrecorded species from the Palearctic.

159. *Oscinella* n.sp. 2

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (18.vii).

Comments: See comments under species #158.

160. *Rhopalopterum* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (19.vi).

Specimens collected 1998: None.

Comments: There are several undescribed North American species in this genus and there is no reliable key to the described species.

161. *Thaumatomyia glabra* (Meigen) Palearctic-Widespread Nearctic

Distribution: AK to NF, south to CA, TX, FL, Mexico; Europe (Sabrosky 1965b).

Specimens collected 1997: Site 5 (1), site 6 (1), (29.vi-03.vii).

Specimens collected 1998: Site 1 (1), (11.vii).

Comments: The larvae of *Thaumatomyia* are predacious on small arthropods in the soil (Ferrar 1987). This is one of the abundant and widespread species of Chloropidae in North America. It can be collected in large numbers in almost any habitat, anywhere on the continent (T. A. Wheeler pers. comm.).

162. *Thaumatomyia pulla* (Adams) Widespread Nearctic

Distribution: BC to QC, south to CA, TX, FL, Mexico (Sabrosky 1965b); AK, NT, southern AB (CNC); YT.

Specimens collected 1997: Site 1 (1), (27.vi).

Specimens collected 1998: Site 1 (1), (26.vii).

Comments: The larvae are predacious on soil arthropods. This is the first record in the Yukon.

163. *Tricimba brunnicollis* (Becker) Widespread Nearctic

Distribution: WA, OR, CA (Sabrosky 1965b); BC, AB, QC (CNC); YT.

Specimens collected 1997: Site 1 (30), site 2 (4), site 3 (12), site 4 (4), site 5 (3), site 6 (9), (11.vi-10.vii).

Specimens collected 1998: Site 6 (4), (15-25.vii).

Comments: Larvae of *Tricimba* species are saprophagous (Ferrar 1987). This is the first record in the Yukon.

164. *Tricimba cincta* (Meigen) Palearctic-Widespread Nearctic

Distribution: BC, CA; Europe (Sabrosky 1965b); MB, ON (CNC); YT.

Specimens collected 1997: Site 1 (39), site 3 (4), site 5 (4), site 6 (14), (16.vi-09.vii).

Specimens collected 1998: Site 1 (1), site 4 (3), site 5 (5), site 6 (8), (03-25.vii).

Comments: The larvae are saprophagous. This is the first record in the Yukon.

165. *Tricimba melancholica* Widespread Nearctic

Distribution: AK to NF (Labrador), south to CA, TX and FL (Sabrosky 1965b).

Specimens collected 1997: Site 1 (16), site 2 (2), site 4 (2), site 5 (11), site 6 (2), (24.vi-08.vii).

Specimens collected 1998: Site 1 (7), site 4 (8), site 5 (5), site 6 (8), (02-25.vii).

Comments: The larvae are saprophagous. This species is often very abundant in habitats with a lot of decaying organic material (T. A. Wheeler pers. comm.).

Family Heleomyzidae

The larvae of Heleomyzidae (heleomyzid flies) are saprophagous in decaying vegetation, dung, mammal burrows, bird nests, etc. The adults are usually found in moist shaded woods and near the larval habitat. There are about 112 species recorded in North America (Gill and Peterson 1987). At least five species were collected at my sites.

166. *Anorostoma jersei* Garrett Widespread Nearctic

Distribution: AK to QC, south to CA, NM, NE, MI, NJ (Gill 1965).

Specimens collected 1997: Site 1 (2), site 2 (1), site 4 (34), site 5 (2), site 6 (4), (08.vi-08.vii).

Specimens collected 1998: Site 4 (1), (15-19.vii).

Comments: This species is saprophagous in a variety of habitats (Gill 1962).

167. *Pseudoleria parvitarsus* Garrett Widespread Nearctic

Distribution: BC to MB, south to CA and NM, IN (Gill 1965); YT.

Specimens collected 1997: Site 1 (19), site 2 (1), site 4 (1), (19.vi-08.vii).

Specimens collected 1998: Site 1 (54), site 3 (1), site 4 (9), site 5 (3), site 6 (2), (02-26.vii).

Comments: This is a saprophagous species. Specimens have been collected in caves, burrowing owl nests and mammal burrows (Gill 1962). This is the first record in the Yukon.

168. *Pseudoleria robosta* Garrett Western Nearctic

Distribution: BC, WA, CA, UT, MT (Gill 1965); YT.

Specimens collected 1997: Site 2 (1), (12-18.vi).

Specimens collected 1998: None.

Comments: This species is saprophagous and has been previously collected from a swallow nest (Gill 1962). This is the first record in the Yukon.

169. *Pseudoleria* spp.

Distribution: Unknown.

Specimens collected 1997: Site 1 (35), site 2 (1), site 3 (2), site 4 (5), site 6 (1), (13.vi-08.vii).

Specimens collected 1998: None.

Comments: Species of *Pseudoleria* have been bred from nests of small mammals and swallows, dung, and a variety of other decaying materials (Ferrar 1987). All these specimens are females and cannot be identified without associated males.

170. *Suillia nemorum* (Meigen) Palearctic-Widespread Nearctic

Distribution: AK to QC, south to AZ, NM, VT; Europe (Gill 1965).

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (2), site 3 (2), (08-26.vii).

Comments: Almost all the breeding record of the subfamily Suilliinae are from fungi (Ferrar 1987).

Family Trixoscelididae

The immature stages of Trixoscelididae (trixoscelid flies) are unknown and nothing is known of the biology of this family. Adults are often collected on flowers and other vegetation in grasslands, open forest and desert habitats. The family is most abundant and diverse in the arid areas of the western United States (Melander 1952, Teskey 1987). There are 30 described species in North America (Teskey 1987). One species was collected at my sites.

171. *Trixoscelis fumipennis* Melander Widespread Nearctic disjunct

Distribution: WA, southern AB, southern MB, NE (Vockeroth 1965); southern BC, CO, ON (CNC); YT (Fig. 9).

Specimens collected 1997: Site 1 (75), site 2 (6), site 3 (3), site 4 (26), site 5 (24), site 6 (40), (08.vi-09.vii).

Specimens collected 1998: Site 1 (22), site 4 (2), site 5 (2), site 6 (8), (03-26.vii).

Comments: The biology and immature stages are unknown, but given the distribution this species seems to be associated with grasslands. This is the first record in the Yukon and a major range extension; the known distribution is now disjunct in grasslands. The only records from habitats other than grasslands are the Ontario specimens in the CNC that were collected in a peatland near Ottawa. Because of the habitat difference from western populations, the Ontario specimens may represent a different species (T. A. Wheeler pers. comm.).

Family Sphaeroceridae

The Sphaeroceridae (small dung flies) is one of the most diverse and abundant families of acalyptrate Diptera. These flies are associated with all types of decaying organic material and are abundant in all moist terrestrial environments (Marshall 1997). There are 241 described species in North America, and several undescribed species in some genera (Marshall and Richards 1987, Marshall 1997). Two species were collected at my sites.

172. *Rachispoda limosa* Fallen Palearctic-Widespread Nearctic

Distribution: BC to NS, south to CA, CO, TN and FL; Europe and Western Asia (Wheeler 1995); YT.

Specimens collected 1997: Site 1 (1), (19.vi).

Specimens collected 1998: None.

Comments: This species is saprophagous, and occurs in muddy stream margins, marshes, and peatlands (Wheeler 1995). This is the first record in the Yukon.

173. *Spelobia* n.sp. 1 near *semioculata* (Richards)

Distribution: Unknown.

Specimens collected 1997: Site 1 (42), site 2 (2), site 4 (1), site 5 (1), (08.vi-09.vii).

Specimens collected 1998: Site 1 (4), site 4 (1), site 5 (1), (11-19.vii).

Comments: This species appears to be associated with ground squirrel burrows (Marshall 1997). This species is part of a complex of closely related species in western Canada (Marshall 1997).

Family Drosophilidae

Larvae of the family Drosophilidae (pomace flies) are almost all saprophagous and feed on microorganisms in fermenting substances. Some species are leaf miners, predators of scale insects (Homoptera), or ectoparasites of immature Cercopidae (Homoptera) (Ferrar 1987). Adults of some species feed at flowers or in the flowing sap of tree wounds. There are about 175 described species in North America, approximately 40% of them in the genus *Drosophila* (Wheeler 1987).

174. *Drosophila* spp.

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), site 5 (1), site 6 (1), (24.vi-08.vii).

Specimens collected 1998: None.

Comments: Larvae of *Drosophila* are saprophagous in a wide variety of decaying materials (Ferrar 1987). Two species of *Drosophila* were collected at my sites, but there is no reliable key to identify the North American species.

Family Ephydridae

Larvae of the family Ephydridae (shore flies) are found mostly in aquatic or damp situations. Most larvae are saprophagous in a variety of decaying organic materials including rotting vegetation, carrion, dung. A few genera contain species that are leaf-miners in aquatic plants or terrestrial grasses. Some ephydrid larvae are predators and attack a wide assortment of prey. Most adults feed on micro-organisms but some are predacious on other insects; they are usually found in moist habitats (Ferrar 1987; Foote 1995). There are 425 species of Ephydridae in North America (Wirth et al. 1987). Five species were collected at my sites.

175. *Hydrellia caliginosa* Cresson Widespread Nearctic disjunct

Distribution: AK, ID, MT, WY, MN, MI, ME, QC (Deonier 1971); YT.

Specimens collected 1997: Site 3 (1), (26-30.vi).

Specimens collected 1998: None

Comments: Larvae of this species are phytophagous leaf miners of aquatic plants. Adults are often found on the leaves of aquatic plants such as *Nuphar advena* (Deonier 1971). The specimen was probably an accidental visitor to my site. This is the first record in the Yukon.

176. *Philotelma alaskense* Cresson Widespread Nearctic

Distribution: AK to ON, south to NV (Wirth 1965).

Specimens collected 1997: Site 5 (2), (15.vi).

Specimens collected 1998: None.

Comments: Larvae of this species are saprophagous.

177. *Philygria nigrescens* Cresson Widespread Nearctic

Distribution: AK to QC, south to CA and CO (Wirth 1965).

Specimens collected 1997: Site 1 (32), site 2 (1), site 3 (3), site 4 (5), site 5 (3), site 6 (4), (08.vi-10.vii).

Specimens collected 1998: Site 1 (338), site 3 (31), site 4 (70), site 5 (59), site 6 (85), (07-25.vii).

Comments: *Philygria* is the only genus of Ephydridae that is commonly found in arid grasslands (Foote 1995).

178. *Trimerinoides adfinis* Cresson Western Nearctic

Distribution: BC, ID (Wirth 1965); WY (CNC): YT.

Specimens collected 1997: Site 1 (3), site 4 (1), (08-29.vi).

Specimens collected 1998: None.

Comments: This is the first record in the Yukon.

179. *Trimerina madizans* (Fallen) Palearctic-Widespread Nearctic disjunct

Distribution: QC, IA, MA, ME, NH, OH; Widespread Palearctic (Mathis and Zatwarnicki 1997); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 5 (1), (03.vii).

Comments: This is the first record in the Yukon and the first record in the western Nearctic.

Family Tachinidae

Larvae of this Tachinidae (tachinid flies) are all parasitoids on other insects (rarely other arthropods). Lepidoptera is the most common host group, but at least seven other orders of insects have been recorded as hosts. The adults feed on flowers and on honeydew (Wood 1987). Over 1200 species have been recorded in the Nearctic (Wood 1987). Twenty-three species were collected at my sites, making this one of the most diverse families.

180. *Acemya tibialis* Coquillett Widespread Nearctic

Distribution: YT, BC to QC, NF (Labrador), south to CA and MI (D. M. Wood pers. comm.)

Specimens collected 1997: Site 3 (1), site 6 (2), (11-26.vi)

Specimens collected 1998: None.

Comments: Larvae are parasitoids of Acrididae (Orthoptera) (Arnaud 1978).

181. *Allophorocera delecta* (Curran) Widespread Nearctic

Distribution: YT, BC, MB, ON and VT (D. M. Wood pers. comm.).

Specimens collected 1997: Site 1 (1), (27.vi).

Specimens collected 1998: None.

Comments: Larvae are parasitoids of Noctuidae (Lepidoptera) (Arnaud 1978).

182. *Aphria ocypterata* Townsend Widespread Nearctic

Distribution: YT, BC to ON, south to CA, UT, OH and MA (D. M. Wood pers. comm.).

Specimens collected 1997: Site 3 (2), (13-30.vi).

Specimens collected 1998: None.

Comments: Larvae are parasitoids of Noctuidae and Pyralidae (Lepidoptera) (Arnaud 1978).

183. *Aplomya theclarum* (Scudder) Widespread Nearctic

Distribution: YT, BC to NS (D. M. Wood pers. comm.).

Specimens collected 1997: None.

Specimens collected 1998: Site 3 (2), (09-20.vii).

Comments: Larvae are parasitoids of several genera of Lasiocampidae and Lycaenidae (Lepidoptera) (Arnaud 1978).

184. *Belida chaetoneura* (Coquillett) Widespread Nearctic

Distribution: AK to NS, widespread in USA (D. M. Wood pers. comm.).

Specimens collected 1997: Site 1 (1), (01.vii).

Specimens collected 1998: None.

Comments: Larvae are parasitoids of Argidae and Tenthredinidae (Hymenoptera) (Arnaud 1978).

185. *Besseria anthophila* (Loew) Widespread Nearctic

Distribution: BC to SK, south to CA and IA (D. M. Wood pers. comm.); YT.

Specimens collected 1997: Site 2 (3), site 3 (1), site 4 (1), site 5 (3), site 7 (1), (12.vi-10.vii).

Specimens collected 1998: Site 1 (8), site 4 (4), (02-19.vii).

Comments: Larvae are parasitoids of Hemiptera and Coleoptera (Ferrar 1987). This is the first record in the Yukon.

186. *Catherosia calva* (Coquillett) Widespread Nearctic

Distribution: BC to SK, south to CA, NM, TX (D. M. Wood pers. comm.); YT.

Specimens collected 1997: Site 1 (1), (19-27.vi).

Specimens collected 1998: Site 1 (3), site 5 (1), (08-26.vii).

Comments: Larvae are parasitoids of Orthoptera and Lepidoptera (Ferrar 1987). This is the first record in the Yukon.

187. *Cylindromyia californica* (Bigot) Widespread Nearctic

Distribution: BC, NT to MB, south to CA, TX, PA (D. M. Wood pers. comm.); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), (19-25.vii).

Comments: Larvae are parasitoids of Hemiptera and Coleoptera (Ferrar 1987). This is the first record in the Yukon.

188. *Drino bakeri* (Coquillett) Widespread Nearctic

Distribution: AK to QC, OH, NY; northern Mexico (D. M. Wood pers. comm.).

Specimens collected 1997: Site 4 (1), (16.vi).

Specimens collected 1998: None.

Comments: Larval hosts are unknown.

189. *Erynnia tortricis* (Coquillett) Widespread Nearctic

Distribution: AK to NF, south to CA and NC (D. M. Wood pers. comm.).

Specimens collected 1997: Site 3 (1), (07.vi).

Specimens collected 1998: Site 5 (1), (19-25.vii).

Comments: Larvae are parasitoids of many families of Lepidoptera (Arnaud 1978).

190. *Graphogaster alberta* (Curran) Widespread Nearctic

Distribution: YT, NT, AB, ID, CA and UT (D. M. Wood pers. comm.).

Specimens collected 1997: None.

Specimens collected 1998: Site 3 (1), (13-20.vii).

Comments: Larvae are parasitoids of Lepidoptera (Arnaud 1978).

191. *Graphogaster* sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 1 (2), site 4 (1), (08-29.vi).

Specimens collected 1998: None.

Comments: Larvae are probably parasitoids of Lepidoptera.

192. *Gymnosoma* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 3 (1), (13-20.vii).

Comments: Larvae of *Gymnosoma* are parasitoids of Hemiptera (Arnaud, 1978).

193. *Medina* n.sp. 1 Widespread Nearctic

Distribution: Widespread in North America (D. M. Wood pers. comm.).

Specimens collected 1997: Site 1 (17), site 2 (2), site 6 (1), (08-27.vi).

Specimens collected 1998: Site 4 (2), (03-25.vii).

Comments: This is an undescribed species that is widely distributed in North America (D. M. Wood pers. comm.). The larval hosts are unknown.

194. *Periscepsia helymus* (Walker) Widespread Nearctic

Distribution: AK to Baffin Island and NS, south to CA and MD (D. M. Wood pers. comm.).

Specimens collected 1997: Site 4 (1), (03-08.vii).

Specimens collected 1998: Site 1 (3), site 4 (3), site 6 (2), (08-25.vii).

Comments: Larvae are parasitoids of many genera of Noctuidae (Lepidoptera) (Arnaud 1978).

195. *Periscepsia rohweri* (Townsend) Western Nearctic

Distribution: YT, NT, AB, ID, WY and CO (D. M. Wood pers. comm.).

Specimens collected 1997: Site 1 (3), (08.vi-09.vii).

Specimens collected 1998: Site 1 (1), (07.vii).

Comments: Larvae are parasitoids of Noctuidae (Lepidoptera) (Arnaud 1978).

196. *Phasia aldrichi* (Townsend) Widespread Nearctic

Distribution: BC to ON, south to CA, IN, PA (D. M. Wood pers. comm.); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (18.vii).

Comments: Larvae are parasitoids of Lygaeidae (Hemiptera) (Arnaud 1978). This is the first record in the Yukon.

197. *Phytomyptera flavipes* (Reinhard) Widespread Nearctic disjunct

Distribution: ON, QC, WI, MI, MT (D. M. Wood pers. comm.); YT.

Specimens collected 1997: Site 1 (3), site 4 (2), (01-09.vii).

Specimens collected 1998: Site 3 (1), site 5 (1), (08-24.vii).

Comments: Larvae are parasitoids of Dioptidae and Geometridae (Lepidoptera) (Arnaud 1978). This is the first record in the Yukon and represents a major range extension.

198. *Phytomyptera* n.sp. 1

Distribution: Unknown.

Specimens collected 1997: Site 3 (1), (30.vi).

Specimens collected 1998: None.

Comments: Larvae of known species of *Phytomyptera* are parasitoids of Lepidoptera (Arnaud 1978). The CNC has the largest collection of Canadian Tachinidae and one of the best tachinid collections in the world; there are no other specimens of this species in the CNC (D. M. Wood pers. comm.).

199. *Phytomyptera* n.sp. 2

Distribution: Unknown.

Specimens collected 1997: Site 3 (2), (07.vi).

Specimens collected 1998: None.

Comments: Larvae of known species of *Phytomyptera* are parasitoids of Lepidoptera (Arnaud 1978).

200. *Platymya confusionis* (Sellers) Widespread Nearctic disjunct

Distribution: IA, NY and PA (D. M. Wood pers. comm.); YT.

Specimens collected 1997: Site 6 (1), (16-24.vi).

Specimens collected 1998: Site 5 (1), (08-15.vii).

Comments: Larvae are parasitoids of Pyralidae (Lepidoptera) (Arnaud 1978). This is the first record in the Yukon record and the first record in the western Nearctic, and represents a major range extension.

201. *Pseudochaeta argentifrons* Coquillett Widespread Nearctic

Distribution: BC to QC, south to CA and TX (D. M. Wood pers. comm.); YT.

Specimens collected 1997: None.

Specimens collected 1998: Site 4 (1), site 6 (1), (15-25.vii).

Comments: Larvae are parasitoids of Arctiidae, Bombycidae and Pyralidae (Lepidoptera) (Arnaud 1978). This is the first record in the Yukon.

202. *Tachina rostrata* (Tothill) Widespread Nearctic

Distribution: YT, BC, AB, MT, south to AZ and ND (D. M. Wood pers. comm.).

Specimens collected 1997: Site 1 (1), site 4 (2), (01-08.vii).

Specimens collected 1998: None.

Comments: Larvae are parasitoids of various Lepidoptera (Arnaud 1978).

Family Sarcophagidae

Larvae of the family Sarcophagidae (flesh flies) show a broad range of feeding habits. Some develop in carrion of vertebrates and invertebrates and in some species (the screwworms) this has evolved into feeding on living tissues. Many species are parasitoids of other insects including Orthoptera, Coleoptera and Lepidoptera. Others are kleptoparasites associated with the nests of Hymenoptera and Isoptera, where they eat the prey items stored for the developing host larvae, and often destroy the egg or larva of the host (Ferrar 1987; Shewell 1987b). Adults feed on nectar, honeydew, tree sap and juices from damaged fruits (Downes 1965). There are about 350 described species in North America (Shewell 1987b). Eleven species were collected at my sites.

203. *Acridiophaga* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (3), site 3 (3), site 6 (1), (04-26.vii).

Comments: Larvae are parasitoids of adult and nymphal grasshoppers (Ferrar 1987).

204. *Agria housei* Shewell Widespread Nearctic

Distribution: NT, BC to NS, south to AZ, ID and MI (Shewell 1971); YT.

Specimens collected 1997: Site 6 (1), (24-29.vi).

Specimens collected 1998: Site 4 (6), site 6 (2), (03-25.vii).

Comments: Larvae are parasitoids of several families of Lepidoptera (Shewell 1971). This is the first record from the Yukon.

205. *Arachnidomyia* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), site 4 (1), site 6 (2), (03-25.vii).

Comments: Larvae of *Arachnidomyia* are parasitoids of Lepidoptera (Ferrar 1987).

206. *Blaesoxipha atlanis* (Aldrich) Widespread Nearctic

Distribution: BC to QC, south to CA and VA (Downes 1965); YT.

Specimens collected 1997: Site 1 (1), (13-19.vi).

Specimens collected 1998: None.

Comments: Larvae are parasitoids of grasshoppers (Ferrar 1987). This is the first record in the Yukon.

207. *Boettcheria sp.*

Distribution: Unknown.

Specimens collected 1997: Site 1 (1), (13-19.vi).

Specimens collected 1998: Site 4 (1), (19-25.vii).

Comments: Larvae are parasitoids of Lepidoptera (Ferrar 1987).

208. *Brachicoma* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (05.vii).

Comments: Larvae of one species (*Brachicoma devia* (Fallén)) live in nests of bumble bees (Apidae: *Bombus* spp.) and wasps (Vespidae). The *Brachicoma* larvae attack and eat the immature Hymenoptera after the larva spins a cocoon to pupate (Ferrar 1987).

209. *Metopia argyrocephala* (Meigen) Palearctic-Widespread Nearctic

Distribution: YT to NF, south to Mexico and FL; Europe (Downes 1965).

Specimens collected 1997: Site 1 (2), site 2 (2), site 4 (3), site 6 (1), (12.vi-09.vii).

Specimens collected 1998: Site 3 (1), (13-20.vii).

Comments: Larvae of this genus are kleptoparasites in the nest of wasps (Ferrar 1987).

210. *Phrosinella* sp. 1

Distribution: Unknown.

Specimens collected 1997: None.

Specimens collected 1998: Site 1 (1), (22-26.vii).

Comments: Larvae of *Phrosinella* are kleptoparasites in the nests of Hymenoptera (Ferrar 1987).

211. *Protodexia hunteri* (Hough) Widespread Nearctic

Distribution: BC to QC, south to CA, FL and Mexico (Downes 1965); NT (CNC); YT.

Specimens collected 1997: Site 5 (2), site 6 (8), (24.vi-08.vii).

Specimens collected 1998: Site 4 (12), site 5 (5), site 6 (4), (03-25.vii).

Comments: Larvae are parasitoids of grasshoppers (Ferrar 1987). This is the first record in the Yukon.

212. *Sphixapata trilineata* Wulp Widespread Nearctic

Distribution: BC to NS, south to CA and FL (Downes 1965); NT, YT (CNC).

Specimens collected 1997: Site 1 (18), site 4 (81, site 6 (72), (13.vi-09.vii).

Specimens collected 1998: Site 1 (7), site 3 (1), site 4 (46), site 5 (21), site 6 (31), (03-25.vii).

Comments: Larvae are kleptoparasites in the nests of Hymenoptera (Ferrar 1987).

213. *Taxigramma heteroneura* Palearctic-Widespread Nearctic

Distribution: BC to ON, south to CA, TX and CT; Europe (Downes 1965); YT, NT, QC, PEI (CNC).

Specimens collected 1997: Site 1 (1), site 4 (6), site 6 (12), (24.vi-08.vii).

Specimens collected 1998: Site 4 (6), site 5 (2), site 6 (7), (03-25.vii).

Comments: Larvae are parasitoids of grasshoppers (Ferrar 1987).

Family Anthomyiidae

Larvae of Anthomyiidae (anthomyiid flies or root-maggot flies) are mostly phytophagous; others are saprophagous, and a few are parasitoids of Orthoptera or kleptoparasites in nests of bees and wasps (Ferrar 1987). Adults feed on nectar and are important pollinators (Griffiths 1997). There are about 600 species of anthomyiids in North America; 131 of these species have been collected in the Yukon and a further 20 are expected (Griffiths 1997).

Specimens collected 1997: 345.

Specimens collected 1998: 347.

Family Muscidae

Most larvae of the family Muscidae (muscid flies) are saprophagous in a variety of decaying organic materials. Others are phytophagous or predacious (Huckett and Vockeroth 1987). Adults are either predacious on other insects or blood feeder on vertebrates, saprophagous or feed at flowers. There are about 600 species in North America (Huckett and Vockeroth 1987).

Specimens collected 1997: 52.

Specimens collected 1998: 46.

Family Fanniidae

This family was originally included as a subfamily of Muscidae (McAlpine 1989), and shows similar biological habits. The larvae are saprophagous and are found in nests and burrows of birds, mammals and Hymenoptera, decaying organic material and dung (Ferrar 1987). There are about 105 described species in North America (Chillcott 1960).

Specimens collected 1997: 83.

Specimens collected 1998: 31.

3.2. Abundance of Grassland Brachycera

In 1997, 15,004 specimens of Brachycera were collected and 5283 specimens were collected in 1998, for a total of 20,287 specimens from both years of the study (Table 3).

3.2.1. Dominant families

Dominant taxa were defined as those representing over 5% of the total specimens collected. In terms of abundance, the dominant families in 1997 were Chamaemyiidae (45% of the total specimens), Chloropidae (25%) and Dolichopodidae (10%) (Fig. 10a). The dominant families in 1998 were Chamaemyiidae (28%), Chloropidae (23%), Ephydridae (11%) and Phoridae (9%) (Fig. 10b).

Combining the data from both years, the dominant families were Chamaemyiidae (41%), Chloropidae (24%), Dolichopodidae (8%) and Phoridae (5%) (Fig. 10c).

3.2.2. Dominant Species

The most abundant species in 1997 were *Chamaemyia herbarum* (species #84, 43%), *Medetera veles* (#33, 9%), *Meromyza pratorum* (#149, 9%) and *Olcella n.sp.* 2 (#155, 8%) (Fig. 11a). The most abundant species in 1998 were *Chamaemyia herbarum* (27%), *Meromyza pratorum* (12%), *Philygria nigrescens* (#177, 11%) and *Olcella* n.sp. 2 (5%) (Fig. 11b).

Overall, the most abundant species were *Chamaemyia herbarum* (41%), *Meromyza pratorum* (12%), *Medetera veles* (8%) and *Olcella* n.sp. 2 (7%) (Fig. 11c).

3.2.3. Dominant Guilds

The ecological guild was known for 204 species representing 19,058 specimens (96% of the total species and 94% of the total specimens). The predacious flies dominated the Diptera fauna in 1997 with 59% of the total specimens with known biology. The saprophagous flies represented 20%, the phytophagous flies 17%, the parasitoid flies 3% and the kleptoparasitic flies 1% (Fig. 12a). In 1998 the predacious flies represented 41% of the total specimens with known biology. Saprophagous flies represented 32%, phytophagous flies 21%, parasitoid flies 4% and kleptoparasitic flies 2% (Fig. 12b).

Overall, predacious flies represented 54% of the specimens, saprophagous flies 23%, phytophagous flies 18%, parasitoid flies 3% and kleptoparasitic flies 2% (Fig. 12c).

3.3. Diversity of Grassland Brachycera

Thirty families of Brachycera were identified in 1997, representing a total of 180 species. In 1998, 27 families and 119 species of Brachycera were identified. Overall, 32 families and 213 species of Brachycera have been identified to date from my sites (Table 3). Five families were collected only in 1997 (Asilidae, Piophilidae, Sepsidae, Anthomyzidae, Drosophilidae) and two families were collected only in 1998 (Platypezidae, Conopidae).

In addition to the families, there were also several species that were collected only in one of the two years (Table 3). Some of the more notable examples were *Metopomyza bellissima* (Agromyzidae) (#111, 8 specimens in 1997 only), *Phytomyza* sp. 6 (Agromyzidae) (#125, 16 specimens in 1998 only), *Chlorops* sp. 2 (Chloropidae) (#136, 58 specimens in 1997 only) and *Incertella incerta* (Chloropidae) (#145, 174 specimens in 1997 only).

Although many of the species collected could not be identified for various reasons, there were 34 species that are definitely undescribed. Over half of these new species were in the two families Chloropidae (12 new species) and Pipunculidae (7 new species).

3.3.1. Taxonomic Diversity

The most diverse families in 1997 were the Agromyzidae with 30 species (17% of total species), Chloropidae (29 species, 16%), Tachinidae (17 species, 9%), Pipunculidae (14 species, 8%), Empididae (13 species, 7%), Chamaemyiidae (12 species, 7%) and Syrphidae (9 species, 5%) (Fig. 13a). The most diverse families in 1998 were the Chloropidae (20 species, 17%), Agromyzidae (15 species, 13%), Tachinidae and Pipunculidae (14 species each, 12%), Sarcophagidae (10 species, 8%) and Syrphidae (6 species, 5%) (Fig. 13b).

Combining the data from both years, the most diverse families overall were the Agromyzidae (32 species, 15%), Chloropidae (31 species, 15%), Tachinidae (23 species, 11%), Pipunculidae (20 species, 9%), Empididae (14 species, 7%), Syrphidae and Chamaemyiidae (12 species each, 6%) (Fig. 13c).

3.3.2. Diversity of Guilds

In 1997, the Diptera fauna was dominated by phytophagous species representing 28% of the 173 species with known biology, followed by the predacious species (27%), saprophagous species (22%), parasitoid species (21%) and kleptoparasitic species (2%) (Fig. 14a). In 1998, the fauna was dominated by parasitoid species representing 32% of the 113 species with known biology, followed by the phytophagous (24%), saprophagous (24%), predacious (16%) and kleptoparasitic species (4%) (Fig. 14b).

Overall the fauna was dominated by phytophagous and parasitoid species, each representing 25.5% of the total species with known biology (204 species), followed by predacious species (25%), saprophagous species (22%) and kleptoparasitic species (2%) (Fig. 14c).

3.4. Zoogeographic Patterns

The Diptera fauna was dominated by widespread Nearctic species, representing 40% of the 114 species with known distribution, followed by Palearctic-Widespread Nearctic species (20%), western Nearctic disjunct species (14%), widespread Nearctic disjunct species (9%), western Nearctic species (9%), Palearctic-Widespread Nearctic disjunct species (4%), Palearctic-western Nearctic species (2%) and East-Beringian species (2%) (Table 3).

Over half (51%) of the species with known distribution represented new records for the Yukon fauna (not including species that have been collected in the Yukon but not previously published, such as specimens deposited in the CNC). This included the two most abundant species at my sites, *Chamaemyia herbarum* (#84), and *Meromyza pratorum* (#149). New Yukon records are identified with an asterisk in Table 3.

3.4.1. Widespread Species

This category includes species that are widespread in North America only (40%) or widespread in North America and also present in the Palearctic (20%). They represented together 60% of the total species with known distribution. Almost half of these species (40%) were parasitoids, followed by saprophagous species (28%). The predacious flies represented only 15% of the species in the widespread category, but accounted for 81% of the specimens.

Although these species are widespread and often abundant, 37% of the widespread species represented new records for the Yukon.

3.4.2. Western Species

This category includes the species found only in the western part of North America (9%) or in western North America and the Palearctic (2%). The western species were dominated by predacious flies representing 42% of the species, followed by saprophagous and phytophagous species at 25% each. Although the phytophagous flies represented only 25% of the western species, they accounted for 98% of the specimens in this category.

3.4.3. Disjunct Species

Species with disjunct distributions between the southern populations and the populations found further north represented 27% of the species with known distribution. These were dominated by the western Nearctic disjunct species (14%), followed by widespread Nearctic disjunct species (9%) and the Palearctic-Widespread Nearctic disjunct species (4%).

Most of the species with a disjunct distribution were phytophagous, representing 57% of the 30 species with known biology. The parasitoids represented 20% of the species and the predacious flies represented 17%. The phytophagous flies were also dominant in terms of abundance, representing 81% of the specimens with disjunct distributions.

Most of the disjunct species (91%) represented new records for the Yukon and 19% of the disjunct species were new Canadian records.

3.4.4. Beringian Species

Only two of the species identified to date have an East Beringian distribution: *Lasiopogon canus* (#15), and *Olcella* n.sp. 2 (#155).

4. DISCUSSION

4.1. Abundance of Grassland Brachycera

With over 20,000 specimens collected in the course of my sampling, the Brachycera of these xeric grasslands were more abundant than in many other habitats (e.g. Blades and Marshall 1994; Blades and Maier 1996). However, there was a major difference in abundance of Diptera between the two sampling seasons. Almost three times as many specimens were collected in 1997 than in 1998.

The summer of 1998 was very dry in the southern Yukon; the vegetation on my sites was stunted and even drier than usual, and many of the plants did not flower or produce new leaves. The lack of healthy vegetation available to phytophagous insects would reduce their abundance and this could reduce the abundance of parasitoids and predators that feed on the phytophagous species. Saprophagous species might also have been affected because of the lower production of organic material. The reduced availability of vegetation is probably the major reason for the lower number of Diptera specimens in 1998. However, other than the difference in overall number of specimens, the pattern of abundance in the Brachycera was very similar in both years.

4.1.1. Dominant Taxa

Very few families were dominant in terms of overall abundance, and in each of these families, the dominance was due to one or two very abundant species.

In both years the predacious Chamaemyiidae was the most abundant family, due mostly to the high numbers of *Chamaemyia herbarum* (#84), which represented 96% of all Chamaemyiidae and was the most abundant species of Brachycera in both years. This abundance is surprising because chamaemyiids are usually not such a dominant component of grasslands and similar habitats. Chamaemyiidae were much less abundant in a survey of terrestrial arthropods of Canadian peatlands (Blades and Marshall 1994) and no Chamaemyiidae at all were identified in a survey of grassland and montane arthropods in the southern Okanagan region of British Columbia (Blades and Maier 1996). One reason for the abundance of *Chamaemyia herbarum* at my sites might be a very high density of mealybugs (Homoptera) as a food source for the larvae. The grasses found at my sites may have had very high populations of mealybugs, and other insects that feed on Homoptera, such as syrphid flies, were not abundant. Thus, the larvae of *C. herbarum* might have had access to a large food source in a fairly uniform habitat, without competitors.

The Chloropidae was the second most abundant family in both years, and the phytophagous species *Meromyza pratorum* (#149) was the second most abundant species. Like the chamaemyiids, lack of abundant competitors for breeding space in the stems of grasses might be the reason for the dominance of this species. Another chloropid species that was dominant in both years was *Olcella* n.sp. 2. (#155). Although the ecology of most *Olcella* species is poorly known, there is increasing unpublished evidence that they are all saprophagous, specializing on dead or dying insects (T. A. Wheeler pers. comm.).

The Dolichopodidae was the third most abundant family overall, mainly due to the predacious species *Medetera veles* (#33), which ranked third in overall abundance. This species was much less abundant in 1998, possibly because dry conditions at my sites reduced the numbers of its preferred prey.

A species that showed the opposite trend to *Medetera veles* was the ephydrid *Philygria nigrescens* (#177). This species was not very abundant in 1997 but it was present in much greater numbers in 1998 and ranked third in abundance in that year. It is one of the few species that was more abundant in 1998, and the one with the largest increase. *Philygria nigrescens* is associated with much drier habitats than many Ephydridae (Foote 1995) and it may be adapted to surviving drier situations better than some other saprophagous species. It may have replaced many of the species whose numbers decreased at my sites in 1998.

The other family that was dominant in both years was the Phoridae, mainly because of the high abundance of *Megaselia* spp. (#38). There are probably several species of *Megaselia* in my samples so it is impossible to say if one species is dominant as in other families. Even though *Megaselia* was abundant at my sites, it was still less common than in many moister habitats.

4.1.2. Dominant Guilds

As discussed above, *Chamaemyia herbarum* (#84) was by far the most abundant species in both years of the study. The high numbers of *C. herbarum* combined with the abundance of *Medetera veles* (#33) made the predacious flies the most abundant guild in both years. These two species comprised 91% of the total number of predacious flies.

Flies belonging to the saprophagous guild were second in abundance, mostly because of the high numbers of *Olcella* n.sp. 2 (#155), *Megaselia* spp. (#38) and *Philygria nigrescens* (#177). These three together represent 69% of the saprophagous flies.

Despite the abundance of *Meromyza pratorum* (#149), the phytophagous flies ranked third, although as will be discussed later, they were a much more diverse group. Parasitoids and kleptoparasites made up a much lower proportion of the total fauna, and this is the case in most habitats.

One of the unexpected results of my study was the relatively low abundance of saprophagous flies. In many other habitats the saprophagous flies are usually more abundant and more diverse, often representing half or more of the specimens or species collected (Blades and Marshall 1994). The reason for the lower percentage of saprophagous flies at my sites might be due to the fact that these south-facing slopes are very dry and windy, and dead organic material does not seem to accumulate; such material either blows away or dries out quickly and this may remove potential substrates for developing saprophagous larvae. The saprophagous flies that are abundant on my sites may feed on dead insects, as has been suggested for *Olcella* species, rather than decaying vegetation or dung.

It is difficult to compare the relative abundance of the guilds in my study because very few similar studies on Diptera have been conducted and published. There are some large studies of Diptera diversity currently underway in the Osoyoos region of British Columbia (Blades and Maier 1996), at Canadian Forces Base Suffield in Alberta (Finnamore 1998), at Grasslands National Park in Saskatchewan, and at the Scott Lake Long Term Ecological Research site in Algonquin Park, Ontario (T. A. Wheeler pers. comm.) and it will be interesting to compare the results of those studies to mine.

4.2. Diversity of Grassland Brachycera

4.2.1. Taxonomic Diversity

Thirty-two families of Brachycera were collected. This is relatively high considering that there are 84 families of Brachycera in North America and approximately 20 of these families are restricted to the southern or eastern Nearctic (McAlpine 1989). Blades and Maier (1996) identified 36 families of Brachycera, although their study area in southern British Columbia included many grassland types and covered a large range in elevation up the side of a mountain. Because of this variation in habitats, I would have expected the insect diversity to be much higher in Blades and Maier's study.

In my study, seven families (Agromyzidae, Chloropidae, Tachinidae, Pipunculidae, Empididae, Syrphidae, Chamaemyiidae) were much more diverse than the others. Together they represent 68% of the 213 species identified. These numbers reflect the diversity of these families in Canada as a whole (Danks 1979); for example, there are about 500 known species of Tachinidae, 300 known species of Empididae and 500 known species of Syrphidae in Canada. If we compare the number of species collected at my sites in each of these families with the total number of reported species in Canada, they all represent 5% or less of the known Canadian fauna; so these families were really not that diverse at my sites compared to other habitats. But this is not the case with other families. The Agromyzidae (305 Canadian species, 11% at my sites), Chloropidae (100 Canadian species, 31% at my sites), Pipunculidae (45 Canadian species, 44% at my sites) and Chamaemyiidae (30 Canadian species, 40% at my sites) were not only among the most diverse families on my sites but they also include over 10% of the known Canadian fauna in each family. Although this shows that these families are all quite diverse in Yukon grasslands compared to many other habitats, it also reflects the lack of knowledge of these families in Canada. Each of these families has a large estimated number of undescribed or unreported species in Canada, representing more than 50% of the fauna in each family. According to Danks (1979), there may be 350 additional species of Agromyzidae, 100 species of Pipunculidae, 150 species of Chloropidae and 75 species of Chamaemyiidae that are undescribed or unreported in Canada, and the real numbers may be much higher in some families.

Despite our poor knowledge of the above families everywhere in Canada, there are still some interesting trends in some of the families at my sites.

Thirty two species of Agromyzidae were collected on my sites, including 10 new Yukon records and five undescribed species. Prior to my study, there were 38 species of Agromyzidae recorded from the Yukon, 18 of these, almost half the known Yukon agromyzids, were in the genus *Phytomyza*. The high diversity of *Phytomyza* is partly due to the fact that it is the largest genus in Canada with over 100 species (Spencer 1969; Sehgal 1971; Griffiths 1976) but also because G. C. D. Griffiths worked specifically on this genus in the Yukon (see Griffiths 1976). If special effort were made to collect agromyzids in the Yukon the known diversity would probably be much higher.

The Chloropidae have been poorly studied in Canada in the past and the current fauna of 100 recorded species is probably only a small proportion of the real diversity. Thirty one species were identified in my study, including 10 new Yukon records and 12 undescribed species. Prior to this only 12 species were recorded in the Yukon (Sabrosky 1965b), so my study has increased the known diversity of Yukon Chloropidae by several species. Chloropidae are abundant and diverse in habitats that are dominated by grasses and sedges (Sabrosky 1987b), and they are most diverse in the drier areas of North America (Sabrosky 1965b). Because of this, I expected Chloropidae to be one of the dominant families at my sites, and they may be more diverse in these grasslands than in many other habitats in the Yukon.

Another example is the Tachinidae, which is a fairly well known group in Canada, with about 500 described and recorded species, and about 200 undescribed or unreported (Danks 1979). Twenty species were previously known from steppe or prairie habitats in Alaska and the Yukon (Wood 1994). These are all Nearctic species and none are restricted to Beringia. Twenty-three species were identified in my study, including eight new Yukon records, and three undescribed species. Some of my species, such as *Phytomyptera* n.sp. 1 (#198), may also represent the first known Beringian species of Tachinidae in this habitat.

Many of the species collected in my study are undescribed, probably because of a combination of factors. Several families of North American Diptera have not been studied by systematists since the 1950's or even earlier, and a lot of these older revisions were based on smaller collections of specimens. In most families there are many specimens in museum collections that have not been described, probably because there were no specialists working on those families. Most groups of North American Diptera have been poorly collected, especially in the northwestern part of the continent. Some of these species might be restricted to south-facing slopes or other dry grassland habitats that have not been sampled very much in the past. Collecting techniques have also changed. Before the late 1970's most flies were collected only by sweeping. Now that more studies use methods like pan traps, many species are being collected that would not be taken by sweeping. In my study, many of the species were much more abundant in pan traps than in sweep samples: 92% of all *Meoneura* specimens (#130-132); 97% of *Olcella* n.sp. 2 (#155); 98% of *Spelobia* n.sp. near *semioculata* (#173); and 95% of *Medina* n.sp. 1 (#193) were taken in pan traps.

Evidence for the lack of collecting is very obvious in some families. The Pipunculidae is not considered one of the more diverse families in Canada, but seven of the 20 species at my sites (35%) are definitely new species, and all the described Pipunculidae with known distributions collected at my sites represent new Yukon records.

4.2.2. Diversity of Guilds

The phytophagous and parasitoid guilds were the most diverse even though they ranked only third and fourth in abundance. The high diversity of the phytophagous guild was due to the Agromyzidae which was the most diverse family with 32 species, all leaf miners, and the Chloropidae which was the second most diverse family with 31 species including 11 phytophagous species. These two families together represented 83% of the phytophagous species. The high diversity for the parasitoid guild was due to the Pipunculidae (20 species) and Tachinidae (23 species) which are entirely parasitoid; together they represented 83% of the parasitoid species. The predacious guild was both abundant and diverse. The diversity was mainly due to three families: Empididae (14 species); Syrphidae (9 predacious species); and Chamaemyiidae (12 species), representing together 69% of the predacious species. In 1998 the predacious guild was less diverse (16%), but this was mainly due to the fact that the *Leucopis* specimens were not identified to species and were treated as a single taxon in the analysis. The saprophagous guild, which was quite abundant, was not that diverse. The Chloropidae (14 saprophagous species), Stratiomyidae (5 species) and Heleomyzidae (5 species) were the only families with five or more saprophagous species, and these three families together represented 53% of the saprophagous species.

4.3. Zoogeographic Patterns

The distribution is known for 114 of my species; the others are the undescribed or unidentified species. Over half of these species (58 of 114) are recorded for the first time in the Yukon, including the two most abundant species at my sites, *Chamaemyia herbarum* (#84) and *Meromyza pratorum* (#149). This shows that the Yukon fauna in particular, and the northwestern North American fauna in general, has been very poorly collected. Many of my widespread Nearctic species are known only to occur in, for example, British Columbia to Nova Scotia but they are probably also present in Alaska, the Yukon and the Northwest Territories.

Even with efforts to collect specimens, there are so many unpublished data about the distribution of some species that many of the species classified as widespread Nearctic disjunct based only on published distributions may be found to be widespread after additional collecting and examination of material in museum collections. Some species such as *Parapiophila atrifrons* (#81), which was previously known from Washington, Idaho and Maine (Steyskal, 1965), would have been classified as widespread Nearctic disjunct based on published data only; but there are specimens of this species in the CNC from British Columbia, southern Alberta, Saskatchewan, Northwest Territories, and the Yukon, which changes the distribution pattern to Widespread Nearctic. A similar case is *Tricimba brunnicollis* (#163), which was previously known only from Washington, Oregon and California (Sabrosky, 1965b); there are specimens of *T. brunnicollis* in the CNC from Alberta, British Columbia, and Quebec. This shows the importance of examining specimens in museum collections to get a more accurate knowledge of the distribution. Although the CNC is the most important collection of Canadian Brachycera, and the LEMQ has a good collection of higher Diptera, it will be necessary to consult additional institutions with large collections of North American Diptera such as the Smithsonian Institution, the University of Guelph Insect Collection, and the California Academy of Sciences before more realistic distributions can be determined with more confidence.

Despite these problems, some patterns are obvious from the known distributions. Four main distribution patterns are discussed separately.

4.3.1. Widespread Species

The Diptera fauna of the Yukon xeric grasslands is dominated by species that are widespread in the Nearctic. Sixty percent of my species are widespread Nearctic species (including Palearctic-Widespread Nearctic species), but the true percentage will probably be higher when more accurate distributional data are available for some of the supposedly disjunct species.

Most of the species (68%) that are widespread in the Nearctic are parasitoids or saprophagous. Most of the parasitoid species with a widespread Nearctic distribution are in the families Pipunculidae and Tachinidae. Although some parasitoids in these families are specific to a single species of host, most of them attack several species in a genus, or sometimes more than one genus (Ferrar 1987) and the widespread distribution of so many parasitoid species in North America is probably due to the widespread distribution of their potential hosts. The saprophagous species are also dominant in this category probably because many of the saprophagous flies usually feed on a range of food sources so they are not restricted to a particular habitat.

Although the parasitoid and saprophagous guilds are more diverse, the predacious flies are the most abundant guild overall in the widespread category. This is due mainly to the two widespread species, *Chamaemyia herbarum* (#84) and *Medetera veles* (#33), which represent 65% and 16%, respectively, of the widespread predacious flies.

The phytophagous flies represent a small portion of the widespread Nearctic species (13% of the species and 2% of the specimens), probably because phytophagous flies are more directly associated with a particular habitat such as grasslands and their distribution is associated with the distribution of their host plants. The phytophagous species that do have a widespread distribution are mostly agromyzid species that are not specialists on one genus or species of host. *Agromyza spiraeae* (#97), for example, feeds on many genera of Rosaceae, *Cerodontha lateralis* (#102), *Cerodontha dorsalis* (#100) and *Cerodontha muscina* (#103) feed on many genera of Poaceae. *Ophiomyia nasuta* (#114) is a specialist on *Taraxacum* spp., but this genus of hosts is widespread and abundant in North America, especially *Taraxacum officinale*, which is a cosmopolitan weed (Cody 1996). The other phytophagous species with a widespread distribution are two species of Chloropidae and two species of Tephritidae. One of the Chloropidae, *Epichlorops puncticollis* (#143), was probably an accidental visitor at my sites, because this species feeds on sedges in wet areas (Wheeler 1994), and only one specimen was collected. The other chloropid species, *Oscinella frit* (#157), feeds on several species of Poaceae. In the family Tephritidae, the host is unknown for one of the widespread species, *Campiglossa farinata* (#75) and the other species, *Tephritis araneosa s.l.* (#80), has been recorded from many genera of Asteraceae. Furthermore, *Tephritis araneosa* is probably a complex of closely related species (Foote et al. 1993) and the distribution of the Yukon species may not be widespread after species limits in this group have been studied.

4.3.2. Western Species

This category represents a small proportion (9%) of the total species collected. Most of the western species are restricted to mountain habitats and this explains their restriction to the western part of North America. Some of the others that are found in lowlands are restricted to western North America probably because they are specialists in grassland habitats; for example, the agromyzid *Ophiomyia monticola* (#113) might be a leaf miner on species of Poaceae that are restricted to the west. Species in the Western category are mostly predacious, although the sample size is small, so the dominance is not that pronounced. The western Nearctic distribution of the abundant chloropid *Meromyza pratorum* (#149) contributes to the phytophagous species being the most abundant guild with this distribution pattern.

4.3.3. Disjunct Species

Overall, 27% of the species collected are disjunct northern populations of species found further south. These results are similar to those found by Finnamore (1997) who found that 32% of the Yukon aculeate wasp fauna has a disjunct distribution. Most of the disjunctions in my species and in the aculeate Hymenoptera were found in western species occurring from the southwestern United States to southwestern Canada and on south-facing slopes in the Yukon. It is not surprising that the phytophagous species dominate both the diversity and the abundance for this category because they are the species that are more often restricted in their distributions depending on their host plant.

Some of the disjunctions are very pronounced; for example, *Tachypeza binotata* (#29) was previously known only from Washington and California; *Tomosvaryella agnesea* (#63) is widespread in the western United States but has never been recorded in Canada; *Olcella pygmaea* (#153) and *Platymya confusionis* (#200) are also newly recorded in Canada. But as Finnamore (1997) pointed out, it is often not possible to separate real disjunctions from collecting artifacts. Like the aculeate wasps, the Canadian Diptera fauna is inadequately collected. The above species that are newly recorded in Canada are either parasitoids, predacious or saprophagous, and are not restricted to a particular habitat, so it is difficult to find a reason for this disjunction. Also, it was mentioned earlier that the family Pipunculidae is poorly collected in the Yukon, and probably also in the rest of Canada, so the absence of species like *Tomosvaryella agnesea* elsewhere in Canada is probably due to a lack of collecting rather than the rarity of this species.

Not all the disjunctions are due to a lack of collecting; some almost definitely reflect real disjunctions. For example, one of the species that is newly recorded in Canada is the phytophagous tephritid *Tephritis leavittensis* (#79, Fig. 8) which was previously known only from Oregon, California, Nevada, Utah, Montana and South Dakota. I collected this species at four sites and it was relatively abundant. The host is unknown, but specimens of *T. leavittensis* have been swept from *Arnica diversifolia* Greene. This fly probably has other hosts in the family Asteraceae because *A. diversifolia* is rare in the Yukon and was not present on my sites (Cody 1996). It is probable that *Tephritis leavittensis* really is disjunct in North America, as it occurs in areas that have widespread dry habitats, and the boreal forest would probably be a major barrier for this species.

Another species of Tephritidae which shows a large and apparently real disjunction is *Rhagoletis juniperina* (#78, Fig. 7); this species was previously known from the western USA (OR, CA, ID, UT, AZ), Texas, New York, Massachusetts, and southern Manitoba. This species was collected at three of my sites. This species has been reared from two species of *Juniperus* in the Section *Sabina* (*Juniperus virginiana* L. and *Juniperus monosperma* (Engelm.) Sarg.); both of these host plants are restricted to the southern and eastern United States (Flora of North America Editorial Committee 1993). Because *R. juniperina* also occurs outside the range of these two recorded host species, it probably also feeds on other species of *Juniperus* in the Section *Sabina* (Bush 1966). The only species of *Juniperus* common on my sites was *Juniperus horizontalis*, which is in the Section *Sabina*, which makes it the likely host of *R. juniperina* in the Yukon. *Rhagoletis juniperina* was not collected at any of the sites that did not have *Juniperus horizontalis*. Although *Juniperus horizontalis* is widespread in Canada with scattered records in northern United States, *R. juniperina* might have a restricted distribution in warmer habitats; this would explain the presence of this species only in the United States, southern Canada, and on warm south-facing slopes of the Yukon.

Finally, *Trixoscelis fumipennis* (#171, Fig. 9) also has an unusual disjunction; it was previously known from the southern prairies, the Okanagan valley, and scattered sites in Colorado, Nebraska and Ontario. This species is rare in collections, and was also rare or absent in other habitats in the southern Yukon, but it was abundant at my sites and was collected at all the primary sites. The biology of this species is unknown but it seems to be associated with grassland habitats.

There are also some species in which the disjunctions are not as pronounced. *Oxyna aterrima* (#77, Fig. 6), which was previously known from southern Alberta, southern Saskatchewan, and some localities in the western United States, was abundant at my sites, but I also collected specimens in grasslands of the Peace River valley in Central Alberta. This species was collected at all the primary sites except the Nares site. The host plant is unknown, but most of the specimens collected on my sites were swept from *Artemisia frigida*, which suggests that this might be the host plant. There are only three rarely collected species of *Oxyna* in North America (Foote et al. 1993), and two of these species are associated with species of *Artemisia* (*Artemisia tridentata* and *Artemisia tridentata* var. *vaseyana*) which makes it even more likely that *O. aterrima* is associated with *A. frigida*. The Nares site, where this species was not collected, has fewer plants of *Artemisia frigida* than my other sites.

Meromyza columbi (#148) was previously known only from Alaska, Idaho and Utah, which is a major disjunction. Additional records from my sites in the southern Yukon, and the grasslands of the Peace River valley in central Alberta suggest that this species is probably disjunct in dry grassland habitats.

Many of the species with a disjunct distribution were not abundant on my sites; I collected less than five specimens of 63% of the species. One of the reasons that they haven't been collected in much of central Canada in the past is that they are not really common anywhere in their range.

4.3.4. Beringian Species

Only two species identified so far have a Beringian distribution; neither has been recorded in the Palearctic, so they are both East Beringian.

Lasiopogon canus (#15 Fig. 5) is known from western Alaska east through the Yukon, to the Tuktoyaktuk Peninsula of the Northwest Territories. This species occurs in many different habitats, which makes it surprising that it is still restricted to Beringia, and never expanded its distribution outside this range. The other species with an East Beringian distribution is *Olcella* n.sp. 2 (#155), which is so far known only from the southern Yukon. A total of 1498 specimens of this species were collected at all my primary sites. There are no specimens of this species in the CNC or LEMQ collections and no specimens were collected at any other sites in the southern Yukon, northern British Columbia and northern Alberta. This species seems to be restricted to dry *Artemisia*-grassland slopes of the Yukon. It will be interesting in the future to see if it also occurs on grassland slopes in the unglaciated parts of the northern Yukon.

As more of my new species are identified and described, and compared against existing museum collections, there may be more Beringian species in my material.

4.4. Geographic Affinities and Origins of the Brachycera Fauna

The present distribution of the Canadian insect fauna is the result of many factors combined, and hence extremely complex. Each species responds differently to environmental changes; habitat requirements, dispersal ability and the presence of barriers or corridors are partly responsible for determining where a species will live. Having information about the ecology and present distribution of a species and the history and nature of potential barriers or corridors can help us to determine where a species could have survived glaciation and how it could have dispersed from refugia. Other evidence such as fossil records, which confirm the former presence of a species in a particular area (Coope 1970), and good phylogenetic and distributional data are helpful in understanding the present distribution of the fauna (Danks et al. 1997).

Some orders, such as Coleoptera, have strong fossil evidence to support hypotheses on their origins and history (Morgan and Morgan 1980; Ball and Currie 1997), but Diptera have a poor fossil record, especially in the northern Nearctic. Because of this, the origins of the Diptera of southern Yukon grasslands must be determined based on present distribution patterns and phylogenetic information when available. It is sometimes difficult to make conclusions about the affinities of the fauna because the complete distribution is not known for all species. For some of the species collected in my study, the southern Yukon is the northern and western limit of their range, but this may be due to a lack of collecting in Alaska and in the northern Yukon. Knowing the complete distribution might make the difference between assuming that a species colonized the Yukon from the south, and assuming that a species survived in Beringia. Nevertheless, I can make some assumptions on the possible origins of the Diptera fauna of the southern Yukon based on the known distributions so far.

4.4.1. Widespread Species

Species that are widespread in North America are mostly those that have good dispersal abilities and that were able to colonize previously glaciated areas. Many authors (e.g., Ball and Currie 1997; Griffiths 1997; Scudder 1997a) have divided this category into "Nearctic excluding East Beringia" and "Nearctic including East Beringia" probably because these two categories have species with different origins. If a species is not present in Beringia today, it probably means that it is not adapted to northern conditions and could not have survived glaciation in a northern refugium. For example, given that *Olcella parva* (#151) is known to occur in the southern Yukon and British Columbia to Ontario, south to Mexico and Florida, it is most likely that this species (and the others in this category) colonized the Yukon from the south postglacially (Danks et al. 1997). Griffiths (1997) made the same conclusion for the anthomyiid flies with similar distributions, based only on the fact that they were absent from unglaciated areas. Although this might be true for many species, evidence other than the distribution patterns should be considered. Even if a species is absent from Beringia today, it does not mean that this species was never there before. Twenty-seven of 74 species of ground beetles (Coleoptera: Carabidae) that are known to have occurred in the Beringian refugium based on fossil evidence would not be included in the Beringian component based on present distribution patterns only (Ball and Currie 1997). Foottit and Maw (1997) suggested that the aphids that are widely distributed in North America and reach their northernmost limit in the southern Yukon and Alaska, might have colonized the Yukon from the south, but they also pointed out that the apparent abundance of these species in southern Yukon might be due to a lack of collecting data from more northern regions.

The second category contains species that are widespread Nearctic including East Beringia. Some of these species may have colonized the northern regions entirely from the south (Lafontaine and Wood 1988) or may have survived in Beringia as well as south of the ice sheet (Scudder 1993; Danks et al. 1997; Griffiths 1997). Anderson (1997) suggested that the weevils (Coleoptera: Curculionidae) that are widespread in the Nearctic seem to have a southern origin only, because the Beringian specimens cannot be differentiated from the southern populations. Holarctic species of caddisflies (Trichoptera) apparently survived in both northern and southern refugia, based on variation in the morphology between the populations (Wiggins and Parker 1997). Some ground beetle fossils also support this hypothesis (Ball and Currie 1997).

It is difficult to conclude anything on the origins of the widespread Diptera collected in my project without any other evidence than their present distribution. The fact that a species is not present in Beringia today does not mean that this species was not there during the Pleistocene. The opposite is also true. A species that is in Beringia today does not imply that this species survived there during glaciation, especially if it occurs in a habitat that was absent there during the Pleistocene. For example, the boreal forest was supposedly absent or rare in Beringia during the Pleistocene (Schweger 1982) and a boreal forest adapted species that is found in Beringia today would have had to follow the boreal forest as it moved northward postglacially. *Cyrtopogon bimacula* (#13) is a widespread species in Canada and Alaska and occurs mostly in forests but also in other habitats; it probably survived south of the ice sheets, and dispersed northward following the boreal forest, but it could have survived in Beringia as well, because it is also known from other habitats such as sand dunes and dry south-facing slopes (Cannings 1997).

4.4.2. Western Species

Like the widespread species, there are different opinions concerning the origins of the western fauna. Scudder (1997b) stated that Palearctic-western Nearctic species that do not occur south of 49°N probably survived glaciation only in Beringia and later spread southward. Stewart and Ricker (1997) moved the limit southward and suggested that western Nearctic species that are not found further south than northern California and Montana probably survived glaciation in Beringia.

This interpretation could be applied to *Ophiomyia monticola* (#113) which is known from Alaska, British Columbia, Alberta and Manitoba and *Psila washingtona* (#74) which is known from Alaska south to Washington. *Meromyza pratorum* (#149) which is widespread in the Palearctic and is also found in Alaska, Yukon, British Columbia, Alberta, Idaho and Montana could also be of Beringian origin in the Nearctic.

However, this general statement is not always true. *Asaphidion yukonense* Wickhan, a carabid beetle which is presently known from Alaska and northwestern Canada (with a southernmost limit at about 50°N in Alberta), is now known from late Pleistocene fossils (18,700-8300 B.P.) from Wisconsin to Vermont and obviously survived the last glaciation south of the ice sheet. The present distribution suggests that the species also survived in Beringia, but there are no Beringian fossils of the species (Ashworth and Schwert 1991).

Danks et al. (1997) and Griffiths (1997) treated the origins of the western species in the same way as the widespread species. Whether the species is present in Beringia or not, it will have a northern or southern origin, respectively. But without fossil evidence or phylogenetic information on the relationships of the species, it is risky to speculate on the origins of the fauna. The origins of the present western Nearctic species are difficult to explain partly because of the difficulty in interpreting the effects of the Pleistocene on these insects due to the complex topography of this region (Howden 1969).

4.4.3. Disjunct Species

There are two possible origins for the Yukon grassland species that are disjunct northern populations of species found in the southern prairie grassland. These species might be postglacial colonists of the Yukon from the south (Lafontaine and Wood 1988; Anderson 1997; Ball and Currie 1997; Finnamore 1997) or the Yukon population could have survived glaciation in Beringia, and the southern grassland population would have spread from south of the ice sheet (Scudder 1993, 1997b).

The first hypothesis is based on close phylogenetic relationships to southern species and low endemism in Beringia (Lafontaine and Wood 1988), and to morphological similarities between the two populations (Anderson 1997). Although populations of *Euxoa aequalis* (Harvey) (Lepidoptera: Noctuidae) are morphologically differentiated from those of southern British Columbia and areas further south, Lafontaine and Wood (1988, 1997) did not discuss the possibility that the populations could be of two different origins.

Scudder (1993) supported the second hypothesis, and suggested that some species survived in two refugia based on the fact that these species have a bicentric distribution, with the distribution divided into two clearly disjunct parts. Scudder also stated that many species considered widespread also have a bicentric distribution (but not as obvious) and probably have their origins from both a southern and a northern refugia. The only difference between the disjunct and widespread species is that the widespread species dispersed further postglacially to a point where the two populations eventually joined. Survival of species in two refugia has been supported by a molecular analysis of the lygaeid bug *Geocoris bullatus* (Say) which is widespread in the Nearctic and appeared to have dispersed northward from a southern refugium. DNA analysis found that Yukon specimens differ enough from specimens in central and southern British Columbia, Alberta and Saskatchewan, that the two populations have been separated since before the end of the Wisconsinan (Scudder 1997b).

Thirty-two species of flies collected in my study have disjunct distributions and some of them, such as *Tephritis leavittensis* (#79, Fig. 8) and *Trixoscelis fumipennis* (#171, Fig. 9), show considerable disjunctions. It seems more likely that these species survived in both refugia as proposed by Scudder (1993, 1997b) for species that have an obvious bicentric distribution. The southern population apparently did not spread very far northward during the Hypsithermal, perhaps because suitable habitats or host plants did not expand their range, or possibly because these flies do not disperse well. If these species did survive in Beringia, I would predict that they are also present on south-facing slopes in more northern areas that were unglaciated.

Other fly species do not have such major disjunctions, with populations also found in grasslands of the Peace River region of central Alberta (e.g. *Meromyza columbi* (#148) and *Oxyna aterrima* (#77, Fig. 6)). These species apparently have better dispersal ability since they were able to extend their range as far north as the Peace River region, and it might be assumed that these species colonized the Yukon from the south postglacially. In order for this to happen though, the prairie grasslands would have to have been continuous at one point postglacially. The grasslands were much more extensive than at present during the Hypsithermal (Anderson et al. 1989) and the grasslands of the Peace River region are a remnant of this expansion (Moss 1952), but continuous prairie vegetation apparently did not reach as far north as the Yukon (Hamilton 1997). It would have been easy for these fly species to colonize the Peace River grasslands during the Hypsithermal, but how they would have reached the southern Yukon without continuous natural grasslands is not clear. Even if the grasslands were not continuous further north than the Peace River region during the

Hypsithermal, suitable grassland patches might have been more extensive than today on warm south-facing slopes along river valleys as far north as the Yukon. Of course, there is also the possibility that the Yukon populations of these flies survived in Beringia, and spread southward to colonize the southern Yukon. If these species are also present in grasslands of unglaciated parts of the Yukon, it would give further support to Beringian survival. Molecular analysis of Yukon and southern populations would also be helpful in estimating the time of divergence of the populations and might, therefore, determine whether or not the Yukon population came from the south postglacially or survived in Beringia.

4.4.4. Beringian Species

Many Beringian species are found in both east and west Beringia but some were also separated by the formation of the Bering Strait, resulting in two closely related species. This is apparently the case with *Lasiopogon canus*, which is restricted to East Beringia but whose closest relative is in the East Palearctic (Cannings 1997). A dry land Beringian connection between North America and Eurasia existed for about 60 million years, from the early Tertiary until the Pliocene. After that date the connection was broken and reestablished several times when sea level was lower during glaciation (Matthews 1979). Danks et al. (1997) stated that species normally evolve slowly and the timing of the initial breakup of the Beringian land bridge was too recent for species to evolve on both sides of Beringia. They concluded that most of the East Beringian endemic species are relicts of more widespread Beringian species rather than species that recently evolved due to isolation. The problem with this statement is that there are many examples of North American insect species that apparently evolved during the Pleistocene or even more recently (Howden 1963; Bush 1966).

The origin of *Olcella* n.sp. 2 may be evidence of Pleistocene speciation in Beringia. *Olcella* is restricted to the New World, with 11 known species in North America (mostly in the arid regions of the southern USA) and 14 in South America. *Olcella* n.sp. 2 probably evolved in Beringia after being isolated from southern relatives. If this species is really a Beringian endemic, I would expect it to be present on other warm south-facing slopes further north in unglaciated parts of the Yukon and Alaska.

4.5. Insects and the Origin of Southern Yukon Grasslands

Many authors believe that the xeric grasslands of the Yukon have not been connected with the southern prairie grasslands since the Pleistocene (e.g. Scudder 1993). This creates a problem when trying to explain the apparent southern origins of insects present in these northern grasslands. Other authors have suggested that this habitat was not even a significant part of the Beringian ecosystem. Ball and Currie (1997) suggested that this habitat has spread only recently in the Yukon because many of the ground beetles in xeric to mesic open habitats have colonized postglacially. Lafontaine and Wood (1988) also concluded that the southern steppe habitat was absent from Beringia or insignificant based on the strong affinities of southern steppe species in Beringia to southern grassland species.

My results, and those of other recent studies, indicate that the Yukon grasslands have played a long and important role in determining the distribution of the present insect fauna. There are endemic flies, and endemic insects from many other orders, apparently restricted to these grasslands. This provides strong evidence that these grasslands have been in existence in Beringia for a long time and have been isolated long enough for speciation to occur.

A species like *Lasiopogon canus* does not tell us very much about past habitats of Beringia because it is found in many different habitats from tundra to forest to riverbanks to grasslands and it may have survived in any of these habitats in Beringia. However, the situation is different for species like *Olcella* n.sp. 2, *Connatichela artemisiae* (see Anderson 1984) and *Chlorita nearctica* (see Hamilton 1998); these species are only found on warm south-facing slopes dominated by dry *Artemisia* grasslands. Because these endemic species are not found in any other habitat, suitable grasslands had to be present in Beringia during the Pleistocene. This would support Guthrie's (1982) and Matthews' (1982) hypothesis that Beringia was dominated by a productive grassland. However, it is impossible to say exactly how extensive these grasslands were in Beringia. Based on the distribution of grassland associated leafhoppers, Hamilton (1997) suggested that a few isolated south-facing slopes dominated by grasses and *Artemisia* existed along the Yukon River during the Pleistocene. These habitats would have been present far down the Yukon River in Alaska and the grasslands would have dispersed up the Yukon River valley to the Tanana and Pelly River valleys in the Yukon as the ice sheets receded, and later spread to other south facing slopes.

There are also disjunct populations of several southern species in these grasslands. The most likely explanation is that the flies had a continuous distribution at some point in the past but disappeared from the regions in the middle. There are two possible explanations for this: first, the grasslands and the flies were separated and survived in two refugia, in which case the disjunctions are due to glaciation. This does not tell us much about the origin of the grasslands except that they have been in the Yukon since before the Wisconsinan and probably survived there. The second possibility is that the flies did not survive in Beringia and have moved northward postglacially through suitable grassland habitats. The most likely time period for this was during the Hypsithermai. Although there is good paleoecological evidence for grasslands as far north as 56°N, and evidence from endemic insects that suitable grasslands persisted in Beringia, there is little evidence of what occurred in the areas between the Peace River valley and the southern Yukon. If we assume that the flies with disjunct populations survived in both refugia, the lack of grasslands between central Alberta and the Yukon is not a major problem. If we assume survival in a southern refugium only, followed by dispersal of several species northward to the Yukon postglacially, then we need a grassland connection from Alberta to the Yukon that is not supported by botanical evidence.

Therefore, it appears that the grasslands of the southern Yukon have been in existence since before the Wisconsinan. The grasslands and their endemic insect fauna survived in unglaciated Beringia during the Wisconsinan and expanded their range southward to the southern Yukon postglacially, probably during the Hypsithermal. Along with the endemic species, many disjunct populations probably survived in these grasslands. As this community moved south in the Hypsithermal, it probably was colonized by widespread and southern species moving up from the southern refugium while the climate was suitable. The picture is still not clear, however, and much more research will be required before the origins of the grasslands and the associated insects fauna can be determined more precisely.

4.6. Recommendations for Future Research

My inventory of the Brachycera fauna in relict grasslands of the southern Yukon is only the first step in understanding the fauna of this unique habitat. My inventory has shown that the Diptera fauna is abundant and diverse in these xeric sites. The zoogeographic analysis demonstrated that the Diptera fauna is dominated by widespread Nearctic and Holarctic species, but also contains Beringian species, and southern species that either survived glaciation in Beringia or dispersed northward into these grasslands postglacially.

Many questions were raised during this project, and much more research will be required to understand the origins and zoogeography of the Diptera fauna of southern Yukon grasslands.

Additional collecting is required, especially in British Columbia and Alberta, to determine if the disjunctions shown by many of my species are real. Particular efforts should be made to collect in relict grasslands in central and northern parts of those provinces.

The Diptera inventory of Yukon xeric grasslands is also incomplete. My results are based on sites in the southern Yukon that were all glaciated. Other grassland sites in unglaciated areas of the northern Yukon and Alaska should be sampled. If the disjunct species are found in more northern grasslands, that would give more support to the possibility that they survived glaciation in Beringia, and make it less likely that they dispersed into these sites postglacially. Also, if there are more Beringian endemic species in grassland habitats, it would be likely that they are found in the unglaciated areas.

One of the weaknesses in my study was the lack of reliable taxonomic information on many of the families and genera of flies collected. Systematic revisions of diverse groups like the Chloropidae, Agromyzidae and Pipunculidae would provide names for undescribed species, determine their overall distribution in the Holarctic, and provide phylogenetic information on their relationships to species in other habitats and other regions.

If disjunct distributions are found to be real, and not due to a lack of collecting, other methods of analysis should be applied to determine the origins of the populations. Molecular analysis of Yukon and southern populations of disjunct species might provide a relative time of divergence for the populations and allow us to predict whether the disjunctions are older or younger than the Wisconsinan glaciation.

5. REFERENCES

Anderson, R. S. 1984. *Connatichela artemisiae*, a new genus and species of weevil from the Yukon Territory (Coleoptera: Curculionidae: Leptopiinae): Taxonomy, paleontology, and biogeography. *The Canadian Entomologist* **116**: 1571-1580.

Anderson, R. S. 1997. Weevils (Coleoptera: Curculionoidae, excluding Scolytinae and Platypodinae) of the Yukon. Pp. 523-562. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1024 pp.

Anderson, T. W., R. W. Mathewes and C. E. Schweger. 1989. Holocene climatic trends in Canada with special reference to the Hypsithermal interval. Pp. 520-528. *In* R. J. Fulton (Ed.). Quaternary Geology of Canada and Greenland. Geology of Canada No. 1. Geological Survey of Canada, Ottawa. 839 pp.

Arnaud, P. H. 1978. A host-parasite catalog of North American Tachinidae (Diptera). United States Department of Agriculture Miscellaneous Publication No. 1319. 860 pp.

Ashworth A. C. and D. P. Schwert 1991. On the occurrences of *Opisthius richardsoni* Kirby and *Asaphidion yukonense* Wickham (Coleoptera, Carabidae) as late Pleistocene fossils. *Proceeding of the Entomological Society of Washington* **93**: 511-514.

Ball, G. E. and D. C. Currie. 1997. Ground beetles (Coleoptera: Trachypachidae and Carabidae) of the Yukon: geographical distribution, ecological aspects, and origin of the extant fauna. Pp. 446-489. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1024 pp.

Barber, K. N. 1985. A revision of the genus *Pseudodinia* Coquillett (Diptera: Chamaemyiidae). *Proceedings of the Entomological Society of Ontario* **116**: 105-167.

Bickel, D. J. 1985. A revision of the Nearctic *Medetera* (Diptera: Dolichopodidae). United States Department of Agriculture, Agricultural Research Service. Technical Bulletin No. 1692. 109 pp.

Blades, D. C. A. and C. W. Maier. 1996. A survey of grassland and montane arthropods collected in the southern Okanagan region of British Columbia. *Journal of the Entomological Society of British Columbia* **93**: 49-73.

Blades, D. C. A. and S. A. Marshall. 1994. Terrestrial arthropods of Canadian peatlands: Synopsis of pan trap collections at four southern Ontario peatlands. Pp. 221-284. *In* Finnamore, A. T. and S. A. Marshall (Eds.). Terrestrial arthropods of peatlands, with particular reference to Canada. *Memoirs of the Entomological Society of Canada* **169**: 1- 289.

Borror, D. J., C. A. Triplehorn and N. F. Johnson. 1989. An Introduction to the Study of Insects, Sixth Edition. Saunders College Publishing. 875 pp.

Brown, B. V. 1993. A further chemical alternative to critical-point-drying for preparing small (or large) flies. *Fly Times* **11**: 10.

Bush, G. L. 1966. The taxonomy, cytology, and evolution of the genus *Rhagoletis* in North America (Diptera, Tephritidae). *Bulletin of the Museum of Comparative Zoology* **134**: 431-562.

Cannings, R. A. 1997. Robber flies (Diptera: Asilidae) of the Yukon. Pp. 637-662. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Chillcott J. G. 1960. A revision of the Nearctic species of Fanniinae (Diptera: Muscidae). *The Canadian Entomologist, Supplement* **14**: 1-295.

Clague, J. J. 1989a. Cordilleran ice sheet; Pp. 40-42. *In* R. J. Fulton (Ed.). Quaternary geology of Canada and Greenland. Geology of Canada No. 1. Geological Survey of Canada, Ottawa. 839 pp.

Clague, J. J. 1989b. Relationship of the Cordilleran and Laurentide glaciers. Pp. 42-43. *In* R. J. Fulton (Ed.). Quaternary Geology of Canada and Greenland. Geology of Canada No. 1. Geological Survey of Canada, Ottawa. 839 pp.

Cody, W. J. 1996. Flora of the Yukon Territory. NRC Research Press, Ottawa. 643 pp.

Coope. 1970. Interpretations of quaternary insect fossils. *Annual Review of Entomology* **15**: 97-120.

Corpus, L. D. 1989. A revision and proposed phylogeny of the Nearctic *Hercostomus* (Diptera: Dolichopodidae). *Entomography* **6**: 213-260.

Cwynar L. C. and J. C. Ritchie. 1980. Arctic steppe-tundra: a Yukon perspective. *Science* **208**: 1375-1377.

Danks, H. V. (Ed.). 1979. Canada and its insect fauna. *Memoirs of the Entomological Society of Canada* **108**: 1-573.

Danks, H. V. 1994. Regional diversity of insects in North America. *American Entomologist* **40**: 50-55.

Danks, H. V. and J. A. Downes (Eds.). 1997. Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Danks, H. V., J. A. Downes, D. J. Larson and G. G. E. Scudder. 1997. Insects of the Yukon:

characteristics and history. Pp. 963-1010. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

De Meyer, M. 1989. Systematics of the Nearctic species of the genus *Cephalops* Fallén (Diptera, Pipunculidae). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique (Entomologie)* **59**: 99-130.

Deonier, D. L. 1971. A systematic and ecological study of Nearctic *Hydrellia* (Diptera: Ephydridae). *Smithsonian Contributions to Zoology* **68**: 1-147.

Dillon, L. S. 1956. Wisconsin climate and life zones in North America. *Science* **123**: 167-176.

Downes, W. L. 1965. Family Sarcophagidae. Pp. 933-961. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Fedoseeva, L. I. 1971. A revision of the Nearctic species of grass flies of the genus *Meromyza* Meigen (Diptera, Chloropidae). *Entomological Review* **50**: 520-529.

Fedoseeva, L. I. 1978. New data on the genus *Meromyza* Meigen (Diptera, Chloropidae) in North America. *Entomological Review* **57**: 630-633.

Ferrar, P. 1987. A guide to the breeding habits and immature stages of Diptera Cyclorrhapha Part 1. *Entomonograph* **8**: 1-478. E. J. Brill/Scandinavian Science Press, Leiden and Copenhagen.

Finnamore, A. T. 1997. Aculeate wasps (Hymenoptera: Aculeata) of the Yukon, other than Formicidae. Pp. 867-900. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Finnamore, A. T. 1998. Results from grasslands: aculeate wasps from Canadian Forces Base Suffield (Hymenoptera: Chrysididae, Vespoidea, and Apoidea: Sphecidae). *Newsletter of the Biological Survey of Canada (Terrestrial Arthropods)* **17**: 44-57.

Flint, R. F. 1957. Glacial and Pleistocene Geology. Wiley, New York. 553 pp.

Flora of North America Editorial Committee. 1993. Flora of North America north of Mexico. Vol. 2. Pteridophytes and gymnosperms. Oxford University Press, New York. 475 pp.

Foote, B. A. 1995. Biology of shore flies. *Annual Review of Entomology* **40**: 417-442.

Foote, R. H., F. L. Blanc and A. L. Norrbom. 1993. Handbook of the Fruit Flies (Diptera: Tephritidae) of America North of Mexico. Cornell University Press, Ithaca. 571 pp.

Foote, R. H., Coulson, J. R. and Robinson, H. 1965. Family Dolichopodidae. Pp. 482-530. *In* A.

Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Foottitt and Maw. 1997. Aphids (Homoptera: Aphidoidea) of the Yukon. Pp. 387-404. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Gill, G. D. 1962. The heleomyzid flies of America North of Mexico (Diptera: Heleomyzidae). *Proceedings of the United States National Museum* **113**: 495-603.

Gill, G. D. 1965. Family Heleomyzidae. Pp. 808-816. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Gill, G. D. and Peterson, B. V. 1987. Heleomyzidae. Pp. 973-980. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Giterman, R. E., A. V. Sher and J. V. Matthews Jr. 1982. Comparison of the development of tundra-steppe environments in west and east Beringia: pollen and macrofossil evidence from key sections. Pp. 43-73. *In* D. M. Hopkins, J. V. Matthews Jr., C. E. Schweger and S. B. Young (Eds.). Paleoecology of Beringia. Academic Press, New York. 489 pp.

Griffiths, G. C. D. 1976. Studies on boreal Agromyzidae (Diptera). XII. Phytomyza and Chromatomyia miners on Astereae (Compositae). *Quaestiones Entomologicae* **12**: 239-278.

Griffiths, G. C. D. 1974. Studies on boreal Agromyzidae (Diptera). V. On the genus *Chromatomyia* Hardy, with revision of Caprifoliaceae-mining species. *Quaestiones Entomologicae* **10**: 35-69.

Griffiths, G. C. D. 1997. Anthomyiid flies (Diptera: Anthomyiidae) of the Yukon. Pp. 687-722. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Guthrie, R. D. 1982. Mammals of the mammoth steppe as paleoenvironmental indicators. Pp. 307-326. *In* D. M. Hopkins, J. V. Matthews Jr., C. E. Schweger and S. B. Young (Eds.). Paleoecology of Beringia. Academic Press, New York. 489 pp.

Hall, J. C. 1981. Bombyliidae. Pp. 589-602. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

Hamilton, K. G. A. 1997. Leafhoppers (Homoptera: Cicadellidae) of the Yukon: dispersal and endemism. Pp. 337-375. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Hamilton, K. G. A. 1998. New World species of *Chlorita*, *Notus* and *Forcipata* (Rhynchota: Homoptera: Cicadellidae: Typhlocybinae) with a new tribe Forcipatini. *The Canadian Entomologist* **130**: 491-507.

Hansen, H. P. 1949. Postglacial forests in south central Alberta, Canada. *American Journal of Botany* **36**: 54-65.

Hanson, W. J. 1963. New species of the genus *Nemotelus* from the western United States (Diptera: Stratiomyidae). *Journal of the Kansas Entomological Society* **36**: 133-146.

Hardy, D. E. 1943. A revision of Nearctic Dorilaidae (Pipunculidae). *University of Kansas Science Bulletin* **29**: 1-231.

Hardy, D. E. 1965. Family Pipunculidae. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Hardy, D. E. 1987. Pipunculidae. Pp. 745-748. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Hilchie, G. J. 1985. The tiger beetles of Alberta (Coleoptera: Carabidae: Cicindelini). *Quaestiones Entomologicae* **21**: 319-347.

Hopkins, D. M. 1982. Aspects of the paleogeography of Beringia during the late Pleistocene. Pp. 3-28. *In* D. M. Hopkins, J. V. Matthews Jr., C. E. Schweger and S. B. Young (Eds.). Paleoecology of Beringia. Academic Press, New York. 489 pp.

Howden, H. F. 1963. Speculations on some beetles, barriers, and climates during the Pleistocene and pre-Pleistocene periods in some non-glaciated portions of North America. *Systematic Zoology* **12**: 178-201.

Howden, H. F. 1969. Effects of the Pleistocene on North American insects. *Annual Review of Entomology* **14**: 39-56.

Huckett, H. C. 1987. Anthomyiidae. Pp. 1099-1114. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Huckett, H. C. and J. R. Vockeroth. 1987. Muscidae. Pp. 115-1131. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No.

28. Pp. 675-1332.

Irwin, M. E., and L. Lyneborg. 1981. Therevidae. Pp. 513-523. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

James, M. T. 1936. Notes on *Nemotelus* (Diptera: Stratiomyidae). *Bulletin of the Brooklyn Entomological Society* 31: 86-91.

James, M. T. 1965. Family Stratiomyidae. Pp. 299-319. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

James, M. T. 1981. Stratiomyidae. Pp. 497-511. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol.1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

Kessel, L. 1987. Platypezidae. Pp. 681-688. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Lafontaine, J. D. and D. M. Wood. 1988. A zoogeographic analysis of the Noctuidae of Beringia, and some inferences about past Beringian habitats. Pp. 109-123. *In* J. A. Downes and D. H. Kavanaugh (Eds.). Origins of the North American insect fauna. *Memoirs of the Entomological Society of Canada* **144**: 1-168.

Lafontaine, J. D. and D. M. Wood. 1997. Butterflies and moths of the Yukon. Pp. 723-785. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Marshall, S. A. 1997. Sphaerocerid flies (Diptera: Sphaeroceridae) of the Yukon. Pp. 663-685. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Marshall, S. A. and O. W. Richards. 1987. Sphaeroceridae. Pp. 993-1006. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Marston, N. 1963. A revision of the Nearctic Species of the *albofasciatus* group of the genus *Anthrax* Scopoli (Diptera: Bombyliidae). Kansas State University Agricultural Experiment Station. Technical Bulletin No. 127. 79 pp.

Marston, N. 1970. Revision of New World species of *Anthrax* (Diptera: Bombyliidae), other than the *Anthrax albofasciatus* group. *Smithsonian Contributions to Zoology* **43**: 1-48.

Mathis, W. N. and L. Munari. 1996. World catalog of the family Tethinidae (Diptera). *Smithsonian Contributions to Zoology* **584**: 1-27.

Mathis, W. N. and T. Zatwarnicki. 1995. World Catalog of Shore Flies (Diptera: Ephydridae). Memoirs on Entomology, International, Vol. 4. Associated Publishers, Gainesville. 430 pp.

Matthews, J. V., Jr. 1979. Tertiary and Quaternary environments: historical background for an analysis of the Canadian insect fauna. Pp. 31-86. *In* H. V. Danks (Ed.). Canada and its insect fauna. *Memoirs of the Entomological Society of Canada* **108**: 1-573.

Matthews, J. V., Jr. 1982. East Beringia during late Wisconsin time: A review of the biotic evidence. Pp. 127-156. *In* D. M. Hopkins, J. V. Matthews Jr., C. E. Schweger and S. B. Young (Eds.). Paleoecology of Beringia. Academic Press, New York. 489 pp.

McAlpine, J. F. 1965. Family Chamaemyiidae. Pp. 706-709. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

McAlpine, J. F. 1977. A revised classification of the Piophilidae including 'Neottiophilidae' (Diptera: Schizophora). *Memoirs of the Entomological Society of Canada* **103**: 1-66.

McAlpine, J. F. 1987. Chamaemyiidae. Pp. 965-971. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

McAlpine, J. F. (Ed.). 1989. Manual of Nearctic Diptera. Vol. 3. Research Branch Agriculture Canada. Monograph No. 32. Pp. 1333-1580.

McAlpine, J. F., B. V. Peterson, G. E. Shewell, H. J. Teskey, J. R. Vockeroth and D. M. Wood (Eds.). 1981. Manual of Nearctic Diptera. Vol. 1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

McAlpine, J. F., B. V. Peterson, G. E. Shewell, H. J. Teskey, J. R. Vockeroth and D. M. Wood (Eds.). 1987. Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Melander, A. L. 1920. Synopsis of the dipterous family Psilidae. *Psyche* (*Cambridge*) 27: 91-101.

Melander, A. L. 1951. The North American species of Tethinidae (Diptera). *Journal of the New York Entomological Society* **59**: 187-212.

Melander, A. L. 1952. The American species of Trixoscelidae. *Journal of the New York Entomological Society* **60**: 37-52.

Melander, A. L. 1965. Family Empididae. Pp. 446-481. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Melander, A. L. and A. Spuler. 1917. The Dipterous families Sepsidae and Piophilidae. *Bulletin of the Washington Agricultural Experiment Station* **143**: 1-103.

Miller, R. M. 1977a. Taxonomy and biology of the Nearctic species of *Homoneura* (Diptera: Lauxaniidae) I. Subgenera *Mallochomyza* and *Tarsohomoneura*. *Iowa State Journal of Research* **52**: 147-176.

Miller, R. M. 1977b. Ecology of Lauxaniidae (Diptera: Acalyptratae) I. Old and new rearing records with biological notes and discussion. *Annals of the Natal Museum* **23**: 215-238.

Morgan, A. V. and A. Morgan. 1980. Faunal assemblages and distributional shifts of Coleoptera during the late Pleistocene in Canada and the northern United States. *The Canadian Entomologist* **112**: 1105-1128.

Moss, E. H. 1952. Grassland of the Peace River region, western Canada. *Canadian Journal of Botany* **30**: 99-123.

Painter, R. H. 1962. The taxonomy and biology of *Systoechus* and *Anastoechus* bombyliid (Diptera) predators in grasshopper egg pods. *Journal of the Kansas Entomological Society* **35**: 255-269.

Painter, R. H. and E. M. Painter. 1965. Family Bombyliidae. Pp. 407-419. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Peterson, B. V. 1987. Phoridae. Pp. 689-712. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Priddy, R. B. 1958. The genus *Conophorus* in North America (Diptera, Bombyliidae). *Journal of the Kansas Entomological Society* **31**: 1-33.

Ritchie, J. C. 1975. The late-Quaternary vegetational history of the Western Interior of Canada. *Canadian Journal of Botany* **54**: 1793-1818.

Ritchie, J. C. 1989. History of the boreal forest in Canada. Pp. 508-512. *In* R. J. Fulton (Ed.). Quaternary Geology of Canada and Greenland. Geology of Canada No. 1. Geological Survey of Canada, Ottawa. 839 pp.

Ritchie, J. C. and L.C. Cwynar. 1982. The late Quaternary vegetation of the north Yukon. Pp. 113-

126. *In* D. M. Hopkins, J. V. Matthews Jr., C. E. Schweger and S. B. Young (Eds.). Paleoecology of Beringia. Academic Press, New York. 489 pp.

Robinson, H. and J. R. Vockeroth. 1981. Dolichopodidae. Pp. 625-639. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

Sabrosky, C. W. 1959. The Nearctic species of the filth fly genus *Meoneura* (Diptera, Milichiidae). *Annals of the Entomological Society of America* **52**: 17-26.

Sabrosky, C. W. 1965a. Family Milichiidae Pp. 728-733. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Sabrosky, C. W. 1965b. Family Chloropidae. Pp. 773-793. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Sabrosky, C. W. 1967. Two new and economically significant Chloropidae, with the description of a new genus (Diptera). *Journal of the Kansas Entomological Society* **40**: 151-156.

Sabrosky, C. W. 1987a. Carnidae. Pp. 909-912. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Sabrosky, C. W. 1987b. Chloropidae. Pp. 1049-1067. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Schweger, C.E. 1989. Paleoecology of the western Canadian ice-free corridor. Pp. 491-507. *In* R. J. Fulton (Ed.). Quaternary Geology of Canada and Greenland. Geology of Canada No. 1. Geological Survey of Canada, Ottawa. 839 pp.

Scudder, G. G. E. 1993. Geographic distribution and biogeography of selected species of xeric grassland-adapted Nearctic Lygaeidae in western North America (Insecta: Heteroptera). Pp. 75-113. *In* G. E. Ball and H. V. Danks (Eds.). Systematics and entomology: diversity, distribution, adaptation, and application. *Memoirs of the Entomological Society of Canada* **165**: 1-272.

Scudder, G. G. E. 1997a. Environment of the Yukon. Pp. 13-57. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Scudder, G. G. E. 1997b. True bugs (Heteroptera) of the Yukon. Pp. 241-336. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Sehgal, V. K. 1971. A taxonomic survey of the Agromyzidae (Diptera) of Alberta, Canada, with observations on host-plant relationships. *Quaestiones Entomologicae* 7: 291-405.

Shewell, G. E. 1965a. Family Psilidae. Pp. 638-641. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Shewell, G. E. 1965b. Family Lauxaniidae. Pp. 695-706. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Shewell, G. E. 1971. On the type of *Agria*, with description of a new Nearctic species (Diptera: Sarcophagidae). *The Canadian Entomologist* **103**: 1179-1191.

Shewell, G. E. 1987a. Lauxaniidae. Pp. 951-964. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Shewell, G. E. 1987b. Sarcophagidae. Pp. 1159-1186. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Smith, K. G. V. and B. V. Peterson. 1987. Conopidae. Pp. 749-756. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Spencer, K. A. 1969. The Agromyzidae of Canada and Alaska. *Memoirs of the Entomological Society of Canada* **64**: 1-311.

Spencer, K. A. 1987. Agromyzidae. Pp. 869-879. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Stewart K. W. and W. E. Ricker. 1997. Stoneflies (Plecoptera) of the Yukon. Pp. 201-222. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Steyskal, G. C. 1965. Family Piophilidae. Pp. 710-713. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture

Handbook No. 276. 1696 pp.

Steyskal, G. C. 1987a. Psilidae. Pp. 781-784. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Steyskal, G. C. 1987b. Sepsidae. Pp. 945-950. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Steyskal, G. C. and L. V. Knutson. 1981. Empididae. Pp. 607-624. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

Stone, A., C. W. Sabrosky, W. W. Wirth, R. H. Foote and J. R. Coulson (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Sturtevant, A. H. and M. R. Wheeler. 1954. Synopses of Nearctic Ephydridae (Diptera). *Transactions of the American Entomological Society* **79**: 151-257.

Teskey, H. J. 1987. Trixoscelididae. Pp. 981-984. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Vickery, V. R. 1997. Orthopteroid insects (Orthoptera) of the Yukon. Pp. 223-239. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Vockeroth, J. R. 1965. Family Trixoscelididae. Pp. 817-818. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Vockeroth, J. R. 1987. Anthomyzidae. Pp. 887-890. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Vockeroth, J. R. 1992. The insects and arachnids of Canada. Part 18. The flower flies of the subfamily Syrphinae of Canada, Alaska, and Greenland (Diptera: Syrphidae). Research Branch, Agriculture Canada. 456 pp.

Vockeroth, J. R. and F. C. Thompson. 1987. Syrphidae. Pp. 713-743. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Wheeler, M. R. 1987. Drosophilidae. Pp. 1011-1018. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Wheeler, T. A. 1994. A revision of the genus *Epichlorops* Becker (Diptera: Chloropidae). *Entomologica Scandinavica* **25**: 393-414.

Wheeler, T. A. 1995. Systematics of the New World *Rachispoda* Lioy (Diptera: Sphaeroceridae): morphology, key to species groups, and revisions of the *atra*, *fuscipennis*, *limosa* and *vespertina* species groups. *Journal of Natural History* **29**: 159-230.

Wiggins, G. B. and C. R. Parker. 1997. Caddisflies (Trichoptera) of the Yukon, with analysis of the Beringian and Holarctic species of North America. Pp. 788-866. *In* H. V. Danks and J. A. Downes (Eds.). Insects of the Yukon. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp.

Wirth, W. W. 1965. Family Ephydridae. Pp. 734-759. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Wirth, W. W., W. N. Mathis and J. R. Vockeroth. 1987. Ephydridae. Pp. 1027-1047. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Wirth, W. W., Y. S. Sedman and H. V. Weems. 1965. Family Syrphidae. Pp. 557-625. *In* A. Stone et al. (Eds.). A Catalog of the Diptera of America North of Mexico. United States Department of Agriculture. Agriculture Handbook No. 276. 1696 pp.

Wood, D. M. 1987. Tachinidae. Pp. 1193-1269. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 2. Research Branch Agriculture Canada. Monograph No. 28. Pp. 675-1332.

Wood, D. M. 1994. Relationships among Tachinidae of northern Europe, Siberia, and northwestern North America. Pp. 247-248. *In* Abstract volume. Third International Congress of Dipterology, Guelph, Canada. August 15-19, 1994.

Wood, G. C. 1981. Asilidae. Pp. 549-573. *In* McAlpine, J. F. et al. (Eds.). Manual of Nearctic Diptera. Vol. 1. Research Branch Agriculture Canada. Monograph No. 27. 674 pp.

Yurtsev, B. A. 1982. Relics of the xerophyte vegetation of Beringia in northeastern Asia. Pp. 157-177. *In* D. M. Hopkins, J. V. Matthews Jr., C. E. Schweger and S. B. Young (Eds.). Paleoecology of Beringia. Academic Press, New York. 489 pp.

Table 1. Diversity and abundance of vegetation identified on primary study sites (D - dominant; P- present but not dominant; R - rare; blank - not observed at site)

Plant species	**Study site**					
	1	**2**	**3**	**4**	**5**	**6**
Juniperus horizontalis Moench	P	P	D			
Calamagrostis sp.	P	P	P	D	D	D
Elymus sp.		R	R			
Festuca sp.	D	D	D	D	D	D
Stipa comata Trin. and Rupr.		P				
Populus tremuloides Michx	R	R			R	
Pulsatilla ludoviciana (Nutt.) Heller	P	R	P	R	P	R
Arabis sp.					R	
Sedum lanceolatum Torr.			R			
Saxifraga tricuspidata Rottb.	R		P			
Potentilla ?pensylvanica L.	P	P	P	R	P	R
Rosa acicularis Lindl.	P		P	R		R
Lupinus arcticus Wats.	R					
Arctostaphylos uva-ursi (L.) Sprengel	P	R	P			
Androsace septentrionalis L.					R	
Penstemon gormanii Greene	R				R	
Achillea millifolium L.	R		R		R	
Antennaria rosea Greene					P	
Artemisia frigida L.	D	D	P	D	D	D
Erigeron sp.	R		P	R	R	R

Table 2. List of Brachycera families identified to species level, with collaborating specialists who provided or confirmed species identifications (if applicable), and taxonomic keys used by S. Boucher to identify species in other families.

Family	Det*	Taxonomic Keys Used
Stratiomyidae		James 1936; Hanson 1963
Bombyliidae		Painter 1962; Priddy 1958; Marston 1963, 1970
Asilidae	RAC	
Empididae	JMC	
Dolichopodidae		Bickel 1985; Corpus 1989
Syrphidae	JRV	Vockeroth 1992
Pipunculidae		Hardy 1943; De Meyer 1989
Psilidae		Melander 1920
Tephritidae	ALN	
Piophilidae		McAlpine 1977
Lauxaniidae		Miller 1977a, Miller 1977b
Chamaemyiidae	SDG	
Agromyzidae		Spencer 1969
Tethinidae		Melander 1951
Chloropidae	TAW	Fedoseeva 1971
Heleomyzidae		Gill 1962
Trixoscelididae		Melander 1952
Sphaeroceridae	SAM	Wheeler 1995
Ephydridae		Sturtevant and Wheeler 1954; Deonier 1971
Tachinidae	DMW	
Sarcophagidae	TAW	

* ALN - A. L. Norrbom; DMW - D. M. Wood; JMC - J. M. Cumming; JRV - J. R. Vockeroth; RAC - R. A. Cannings; SAM - S. A. Marshall; SDG - S. D. Gaimari; TAW - T. A. Wheeler.

Table 3. Brachycera species, with overall abundance, ecological guild and distribution pattern. Abbreviations: Sap = Saprophagous; Pre = Predacious; Par = Parasitoid; Phy = Phytophagous; Kle = Kleptoparasitic; Pal = Palearctic; WSNea = Widespread Nearctic; WNea = Western Nearctic; Dis = Disjunct; EBer = East Beringia; N.Y.R. = New Yukon Record.

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Stratiomyidae							
Nemotelus	*beameri*	1	1	2	Sap	WSNea/Dis	*
Nemotelus	sp. 1	1		1	Sap	?	
Nemotelus	sp. 2	1	1	2	Sap	?	
Nemotelus	*montanus*	1		1	Sap	WNea	
Stratiomys	sp. 1		1	1	Sap	?	
Bombyliidae							
Anastoechus	*barbatus*	114	235	349	Pre	WSNea	
Anthrax	*albofasciatus*	2	1	3	Par	WSNea	
Conophorus	*fallax*	2		2	?	WNea/Dis	*
Hemipenthes	sp. 1		1	1	?	?	
Therividae							
Pandivirilia	sp. 1	20	13	33	Pre	?	
Thereva	sp. 1	2		2	Pre	?	
Asilidae							
Cyrtopogon	*banksi*	3		3	Pre	WNea	
Cyrtopogon	*bimacula*	1		1	Pre	WSNea	
Cyrtopogon	*glarealis*	1		1	Pre	WNea	
Lasiopogon	*canus*	2		2	Pre	Eber	
Empididae							
Drapetis	n.sp. 1	1		1	Pre	?	
Hilara	sp. 1	1		1	Pre	?	
Hilara	sp. 2	1		1	Pre	?	
Hilara	sp. 3	1		1	Pre	?	
Iteaphila	*orchestris*	29	3	32	Pre	WNea	*
Oedalea	n.sp. 1	1		1	Pre	?	
Platypalpus	sp. 1	1	1	2	Pre	?	
Platypalpus	sp. 2	1		1	Pre	?	
Platypalpus	sp. 3	1		1	Pre	?	
Platypalpus	sp. 4	4		4	Pre	?	
Rhamphomyia	n.sp. 1	1		1	Pre	?	
Rhamphomyia	sp. 1	9		9	Pre	?	
Rhamphomyia	sp. 2		1	1	Pre	?	

Table 3. Continued

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Tachypeza	*binotata*	1		1	Pre	WNea/Dis	*
Dolichopodidae							
Chrysotus	spp.	22	21	43	Pre	?	
Dolichopus	sp. 1		1	1	Pre	?	
Hercostomus	*unicolor*	5	6	11	Pre	WSNea	
Medetera	*veles*	1413	178	1591	Pre	Pal-WSNea	
Platypezidae							
Microsenia	sp. 1		1	1	Sap	?	
Phoridae							
Aenigmatias	sp. 1	6	1	7	Par	?	
Anevrina	sp. 1	1		1	Sap	?	
Beckerina	sp. 1		8	8	?	?	
Megaselia	spp.	461	443	904	Sap	?	
Phora	sp. 1	5	4	9	?	?	
Syrphidae							
Chrysotoxum	*fasciatum*	1		1	Pre	Pal-WNea	
Dasysyrphus	*venustus*	1		1	Pre	Pal-WSNea	
Eristalis	*brousii*		1	1	Sap	WSNea	
Eristalis	*anthophorinus*		1	1	Sap	Pal-WSNea	
Paragus	*haemorrhous*	13	16	29	Pre	Pal-WSNea	
Paragus	sp. 1		1	1	Pre	?	
Platycheirus	*concinnus*	1		1	Pre	WNea	
Platycheirus	sp. 1	1	2	3	Pre	?	
Sphaerophoria	*contigua*	3	1	4	Pre	WSNea/Dis	
Sphaerophoria	*philanthus*	1		1	Pre	Pal-WSNea	
Sphaerophoria	sp. 1	1		1	Pre	?	
Volucella	*bombylans*	1		1	Sap	Pal-WSNea	
Pipunculidae							
Cephalops	n.sp. 1	2		2	Par	?	
Cephalops	*furnaceous*		1	1	Par	WNea/Dis	*
Cephalops	*mainensis*		2	2	Par	WSNea	*
Dorylomorpha	n.sp. 1	3	3	6	Par	?	
Eudorylas	*affinis*	1		1	Par	WSNea	*
Eudorylas	spp.	2	3	5	Par	?	
Eudorylas	*stigmaticus*	8	1	9	Par	WSNea	*

Table 3. Continued

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Eudorylas	*subopacus*	32	20	52	Par	WSNea	*
Pipunculus	*alpinus*	2		2	Par	WSNea/Dis	*
Pipunculus	*ater*	1		1	Par	Pal-WSNea/Dis	*
Pipunculus	*fuscus*		1	1	Par	WSNea	*
Tomosvaryella	*agnesea*	1		1	Par	WNea/Dis	*
Tomosvaryella	*lepidipes*	171	36	207	Par	WSNea	*
Tomosvaryella	*sylvatica*	49	5	54	Par	Pal-WSNea	*
Tomosvaryella	n.sp. 1	49	8	57	Par	?	
Tomosvaryella	n.sp. 2		1	1	Par	?	
Tomosvaryella	n.sp. 3		6	6	Par	?	
Tomosvaryella	sp. 1		21	21	Par	?	
V. (Jassidophaga)	n.sp. 1	5	1	6	Par	?	
V. (Verrallia)	n.sp. 1	1		1	Par	?	
Conopidae							
Thecophora	sp. 1		1	1	Par	?	
Psilidae							
Psila	*microcera*	2	3	5	Phy	WNea/Dis	
Psila	*washingtona*	1		1	Phy	WNea	
Tephritidae							
Campiglossa	*farinata*	61	29	90	Phy	WSNea	
Neaspilota	*viridescens*	1		1	Phy	WNea/Dis	
Oxyna	*aterrima*	117	15	132	Phy	WNea/Dis	*
Rhagoletis	*juniperina*	11	6	17	Phy	WSNea/Dis	*
Tephritis	*leavittensis*	59	8	67	Phy	WNea/Dis	*
Tephritis	*araneosa s.l.*	127	1	128	Phy	WSNea	
Piophilidae							
Parapiophila	*atrifrons*	3		3	Sap	WSNea	
Lauxaniidae							
Homoneura	*melanderi*	116	13	129	Sap	WSNea	
Lauxania	*cylindricornis*	5	5	10	Sap	Pal-WSNea	
Chamaemyiidae							
Chamaemyia	*herbarum*	6459	1413	7872	Pre	Pal-WSNea	*
Leucopis	All species	294	60	354	Pre	?	
Pseudodinia	*occidentalis*	3		3	Pre	WNea/Dis	*

Table 3. Continued

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Sepsidae							
Sepsis	sp. 1	2		2	Sap	?	
Agromyzidae							
Agromyza	*spiraeae*	1		1	Phy	Pal-WSNea	
Calycomyza	n.sp. 1	21	4	25	Phy	?	
Cerodontha	*angulata*	1		1	Phy	Pal-WSNea/Dis	*
Cerodontha	*dorsalis*	9	1	10	Phy	Pal-WSNea	*
Cerodontha	*gibbardi*	1		1	Phy	WNea/Dis	*
Cerodontha	*lateralis*	4	1	5	Phy	Pal-WSNea	
Cerodontha	*muscina*	1		1	Phy	Pal-WSNea	
Cerodontha	n.sp.1	64	5	69	Phy	?	
Cerodontha	sp. 1	1		1	Phy	?	
Chromatomyia	sp. 1	5		5	Phy	?	
Liriomyza	*lima*	8	6	14	Phy	WSNea/Dis	*
Liriomyza	*socialis*	2	2	4	Phy	WNea/Dis	*
Liriomyza	*taraxaci*	1		1	Phy	Pal-WSNea/Dis	*
Melanagromyza	sp. 1	2		2	Phy	?	
Metopomyza	*bellissima*	8		8	Phy	WNea/Dis	*
Napomyza	*nugax*	5		5	Phy	WSNea/Dis	*
Ophiomyia	*monticola*	7		7	Phy	WNea	
Ophiomyia	*nasuta*	4		4	Phy	Pal-WSNea	
Ophiomyia	n.sp. 1	2		2	Phy	?	
Ophiomyia	sp. 1	1		1	Phy	?	
Paraphytomyza	*luteoscutellata*	1		1	Phy	Pal-WSNea/Dis	*
Phytoliriomyza	n.sp. 1	52	1	53	Phy	?	
Phytoliriomyza	n.sp. 2	3		3	Phy	?	
Phytomyza	sp. 1	53	38	91	Phy	?	
Phytomyza	sp. 2	2		2	Phy	?	
Phytomyza	sp. 3	16	21	37	Phy	?	
Phytomyza	sp. 4	5	2	7	Phy	?	
Phytomyza	sp. 5	31	2	33	Phy	?	
Phytomyza	sp. 6		16	16	Phy	?	
Phytomyza	sp. 7		2	2	Phy	?	
Phytomyza	spp.	7	4	11	Phy	?	
Pseudonapomyza	*lacteipennis*	14	9	23	Phy	WSNea/Dis	*

Table 3. Continued

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Anthomyzidae							
Anthomyza	sp. 1	1		1	?	?	
Carnidae							
Meoneura	n.sp. 1	5		5	Sap	?	
Meoneura	n.sp. 2	1		1	Sap	?	
Meoneura	spp.	114	5	119	Sap	?	
Hemeromyia	sp. 1		1	1	Sap	?	
Tethinidae							
Pelomyiella	*mallochi*	1	2	3	Sap	Pal/WSNea	
Chloropidae							
Chlorops	sp. 1	8	3	11	Phy	?	
Chlorops	sp. 2	26		26	Phy	?	
Chlorops	sp. 3	191	14	205	Phy	?	
Conioscinella	n.sp. 1	166	55	221	Sap	?	
Conioscinella	n.sp. 2	29	1	30	Sap	?	
Conioscinella	n.sp. 3		1	1	Sap	?	
Dasyopa	n.sp. 1	9	5	14	?	?	
Dasyopa	n.sp. 2	58		58	?	?	
Epichlorops	*puncticollis*	1		1	Phy	Pal-WSNea	
Fiebrigella	*oophaga*	1		1	Pre	WNea/Dis	*
Incertella	*incerta*	174		174	Sap	WSNea	*
Incertella	n.sp. 1	5		5	Sap	?	
Meromyza	*canadensis*	1		1	Phy	WNea/Dis	*
Meromyza	*columbi*	159	194	353	Phy	WNea/Dis	*
Meromyza	*pratorum*	1280	611	1891	Phy	Pal-WNea	*
Neoscinella	n.sp. 1	21	3	24	?	?	
Olcella	*parva*	8	2	10	Sap	WSNea	*
Olcella	*provocans*	1		1	Sap	WSNea	*
Olcella	*pygmaea*	106	16	122	Sap	WNea/Disj	*
Olcella	n.sp. 1	3		3	Sap	?	
Olcella	n.sp. 2	1228	270	1498	Sap	Eber	
Olcella	n.sp. 3	47	1	48	Sap	?	
Oscinella	*frit*	3	1	4	Phy	Pal/WSNea	
Oscinella	n.sp. 1	1		1	Phy	?	
Oscinella	n.sp. 2		1	1	Phy	?	

Table 3. Continued

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Rhopalopterum	sp. 1	1		1	Phy	?	
Thaumatomyia	*glabra*	2	1	3	Pre	Pal-WSNea	
Thaumatomyia	*pulla*	1	1	2	Pre	WSNea	*
Tricimba	*brunnicollis*	62	4	66	Sap	WSNea	
Tricimba	*cincta*	61	17	78	Sap	Pal-WSNea	*
Tricimba	*melancholica*	33	28	61	Sap	WSNea	
Heleomyzidae							
Anorostoma	*jersei*	43	1	44	Sap	WSNea	
Pseudoleria	*parvitarsus*	21	69	90	Sap	WSNea	*
Pseudoleria	*robusta*	1		1	Sap	WNea	*
Pseudoleria	spp.	44		44	Sap	?	
Suillia	*nemorum*		4	4	Sap	Pal-WSNea	
Trixoscelididae							
Trixoscelis	*fumipennis*	174	34	208	?	WSNea/Dis	*
Sphaeroceridae							
Rachispoda	*limosa*	1		1	Sap	Pal-WSNea	*
Spelobia	n.sp. 1	46	6	52	Sap	?	
Drosophilidae							
Drosophila	spp.	3		3	Sap	?	
Ephydridae							
Hydrellia	*caliginosa*	1		1	Phy	WSNea/Dis	*
Philotelma	*alaskense*	2		2	Sap	WSNea	
Philygria	*nigrescens*	48	583	631	Sap	WSNea	
Trimerinoides	*adfinis*	4		4	Sap	WNea	*
Trimerina	*madizans*		1	1	Pre	Pal-WSNea/Dis	*
Tachinidae							
Acemya	*tibialis*	3		3	Par	WSNea	
Allophorocera	*delecta*	1		1	Par	WSNea	
Aphria	*ocypterata*	2		2	Par	WSNea	
Aplomya	*theclarum*		2	2	Par	WSNea	
Belida	*chaetoneura*	1		1	Par	WSNea	
Besseria	*anthophila*	9	12	21	Par	WSNea	*
Catherosia	calva	1	4	5	Par	WSNea	*
Cylindromyia	*californica*		1	1	Par	WSNea	*
Drino	*bakeri*	1		1	Par	WSNea	

Table 3. Continued

Family & Genus	Species	1997	1998	Total	Guild	Distribution	N.Y.R.
Erynnia	*tortricis*	1	1	2	Par	WSNea	
Erynnia	*tortricis*	1	1	2	Par	WSNea	
Graphogaster	*alberta*		1	1	Par	WSNea	
Graphogaster	sp. 1	3		3	Par	?	
Gymnosoma	sp. 1		1	1	Par	?	
Medina	n.sp. 1	20	2	22	Par	WSNea	
Periscepsia	*helymus*	1	9	10	Par	WSNea	
Periscepsia	*rohweri*	3	1	4	Par	WNea	
Phasia	*aldrichi*		1	1	Par	WSNea	*
Phytomyptera	*flavipes*	5	2	7	Par	WSNea/Disj	*
Phytomyptera	n.sp. 1	1		1	Par	?	
Phytomyptera	n.sp. 2	2		2	Par	?	
Platymya	*confusionis*	1	1	2	Par	WSNea/Disj	*
Pseudochaeta	*argentifrons*		2	2	Par	WSNea	*
Tachina	*rostrata*	3		3	Par	WSNea	
Sarcophagidae							
Acridiophaga	sp. 1		7	7	Par	?	
Agria	*housei*	1	7	8	Par	WSNea	
Arachnidomyia	sp. 1		4	4	Par	?	
Blaesoxipha	*atlanis*	1		1	Par	WSNea	*
Boettcheria	sp. 1	1	1	2	Par	?	
Brachicoma	sp. 1		1	1	Pre	?	
Metopia	*argyrocephala*	8	1	9	Kle	Pal-WSNea	
Phrosinella	sp. 1		1	1	Kle	?	
Protodexia	*hunteri*	10	21	31	Par	WSNea	*
Sphixapata	*triliniata*	171	106	277	Kle	WSNea	*
Taxigramma	*heteroneura*	19	15	34	Kle	Pal-WSNea	*
Anthomyiidae		345	347	692			
Muscidae		52	46	98			
Fanniidae		83	31	114			
Total		15 004	5283	20 287			

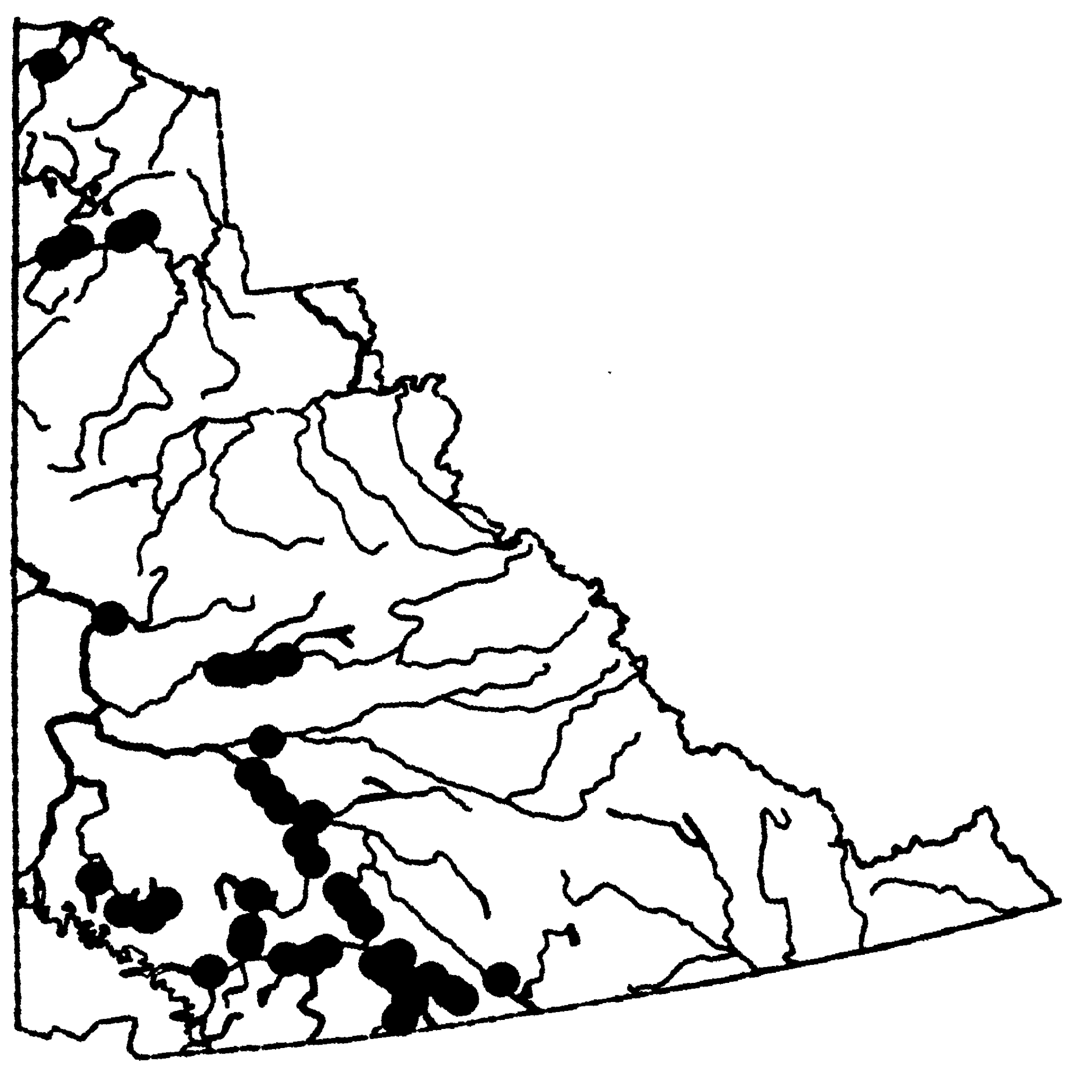

Fig. 1. Map of the Yukon showing known occurrence of xeric grassland communities.

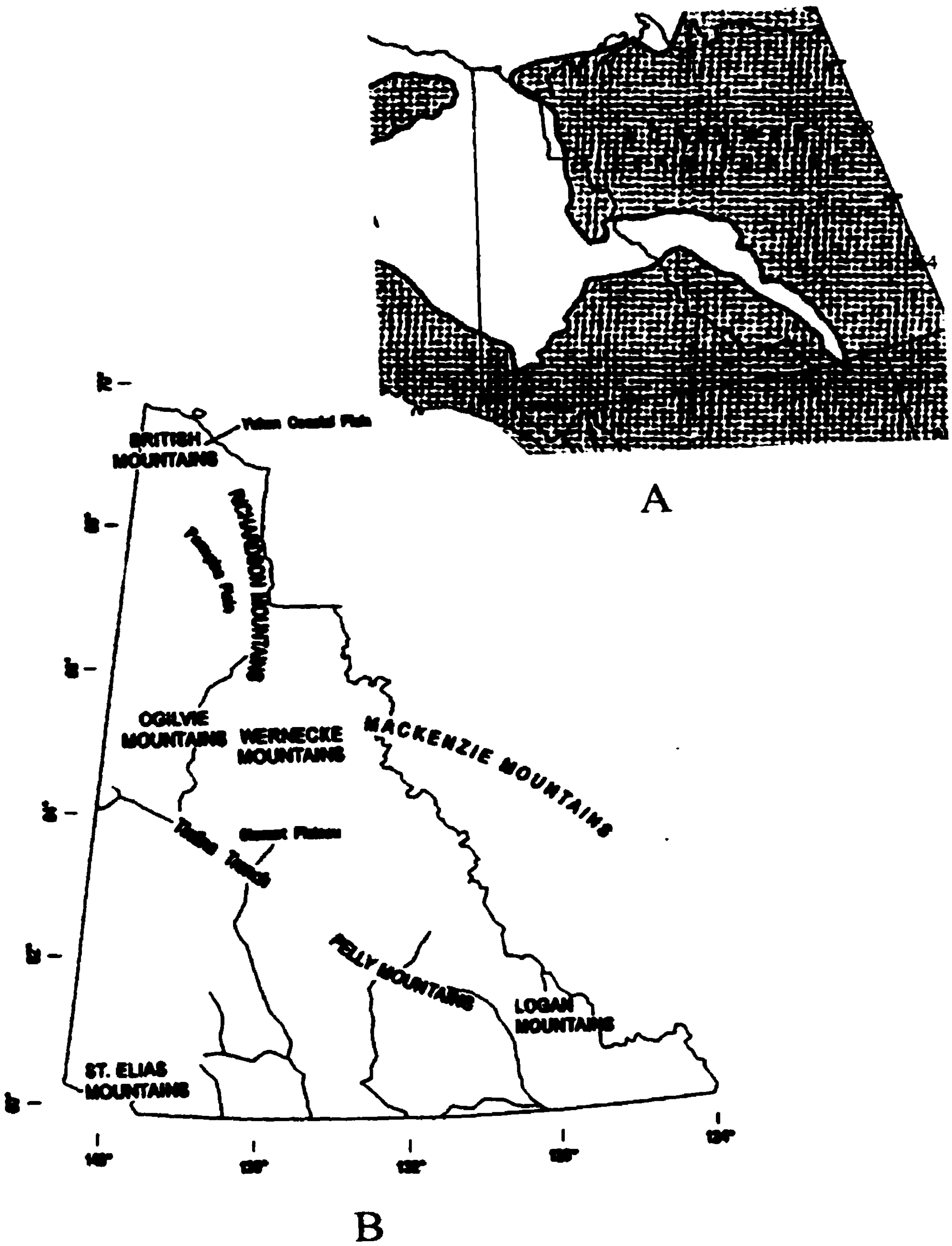

Fig. 2. A. Map of the Yukon showing unglaciated regions (unshaded).
B. Map of the Yukon showing major topographic features.

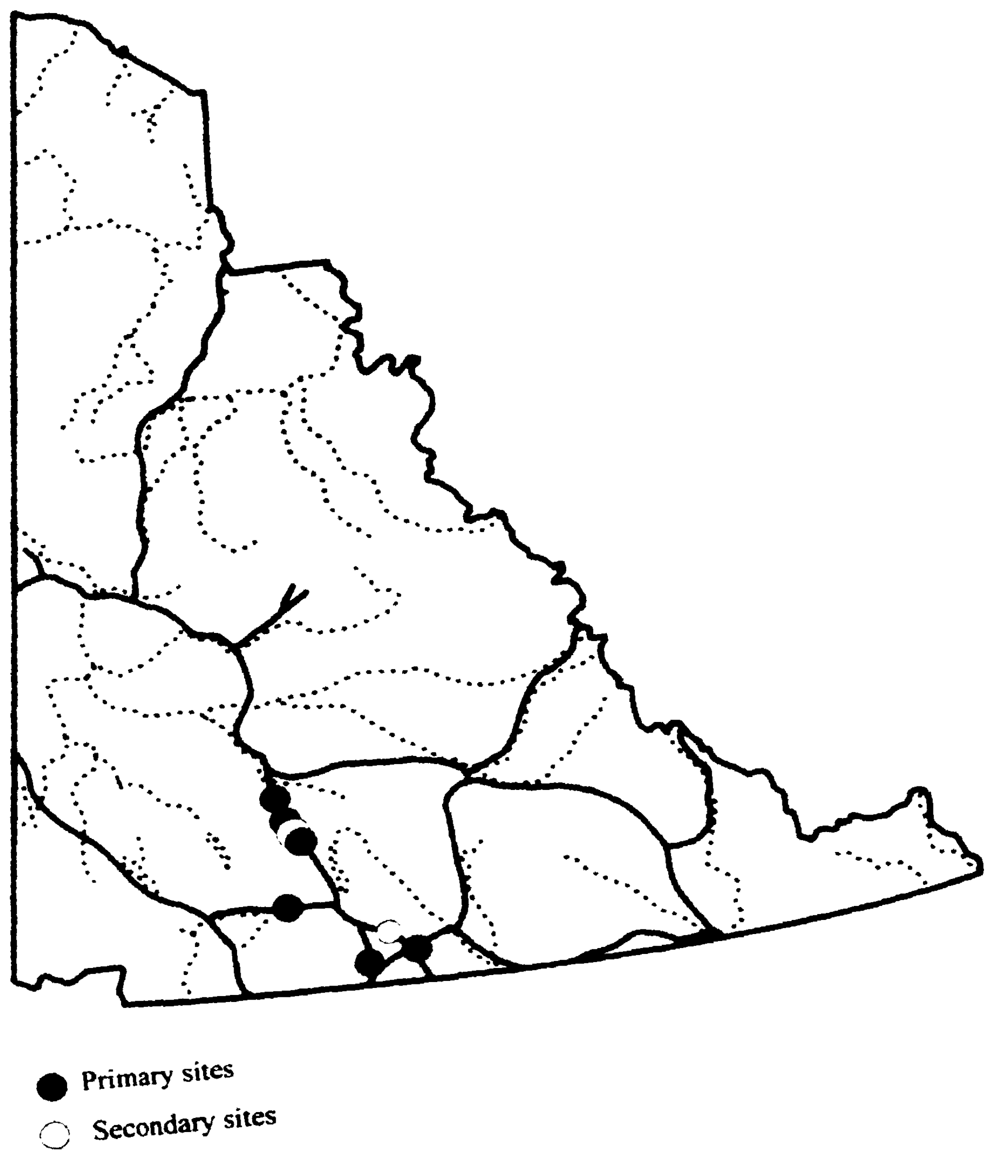

Fig. 3. Map of the Yukon showing location of study sites.

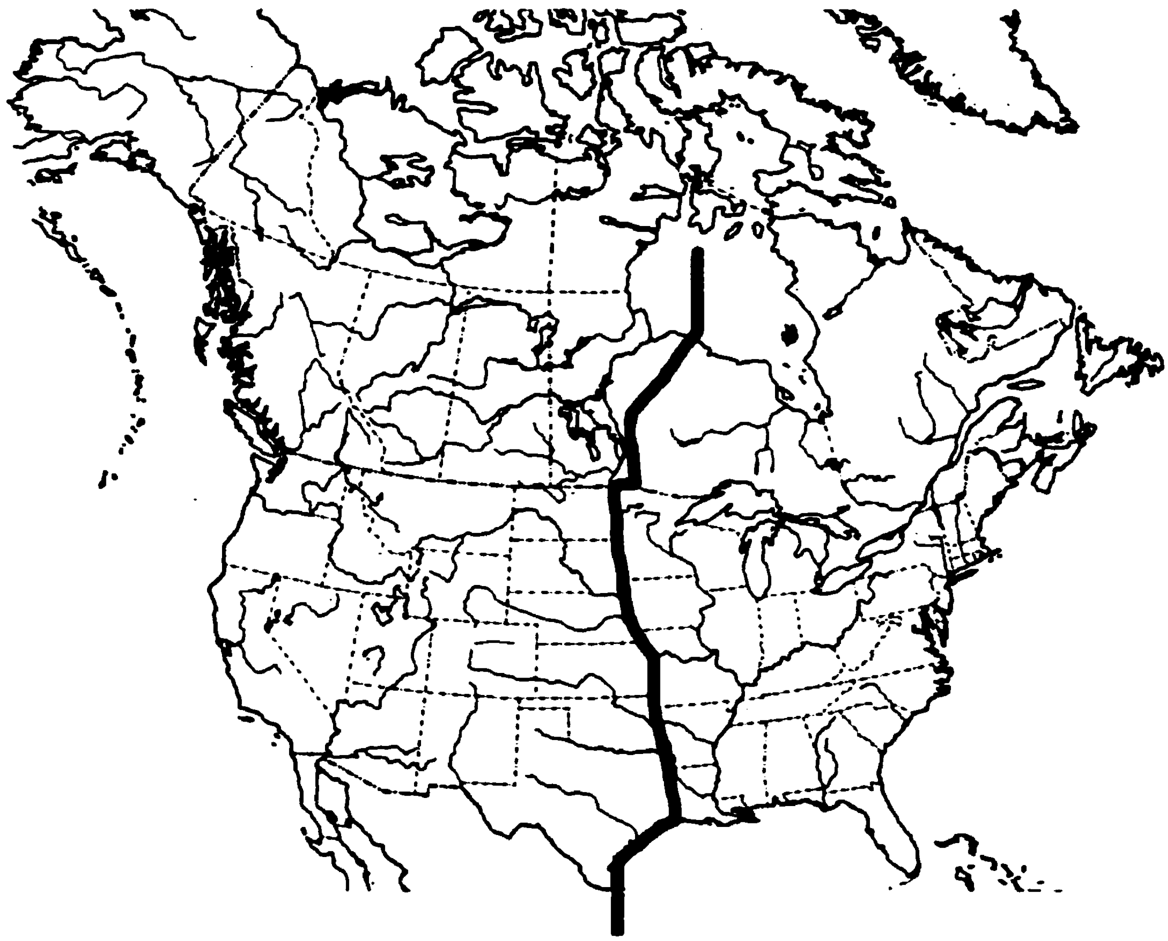

Fig. 4. Map of North America showing division of western and eastern regions.

Fig. 5. Distribution of *Lasiopogon canus*

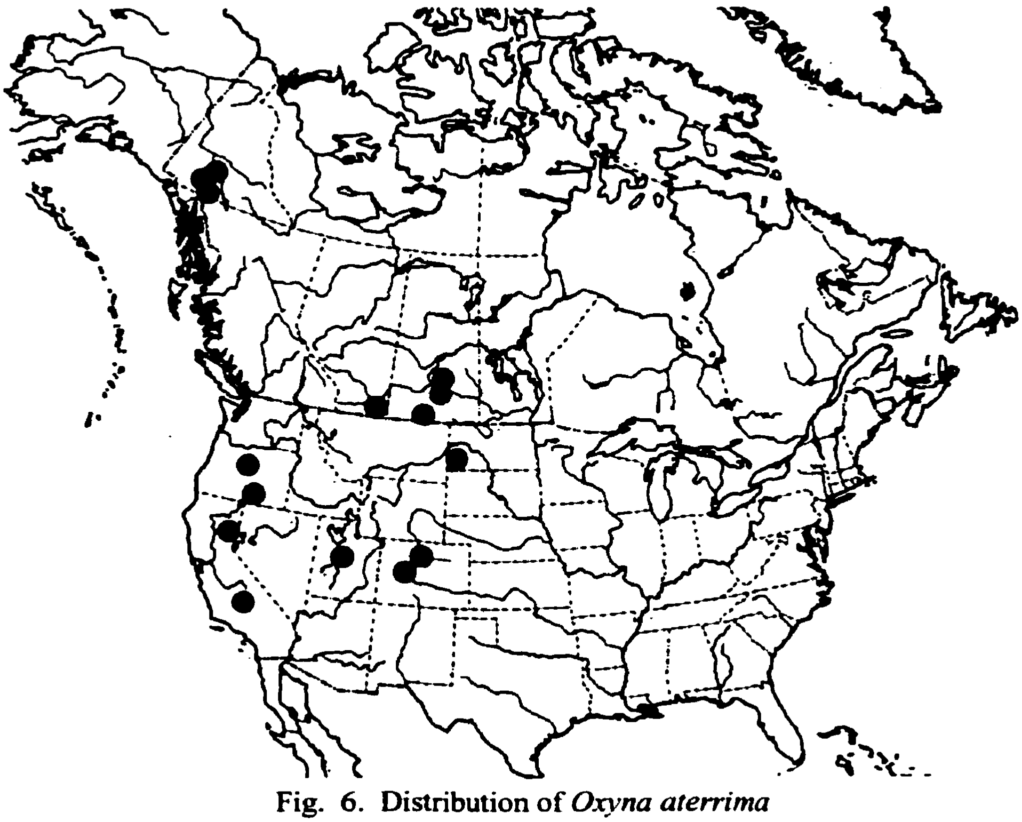

Fig. 6. Distribution of *Oxyna aterrima*

Fig. 7. Distribution of *Rhagoletis juniperina*

Fig. 8. Distribution of *Tephritis leavittensis*

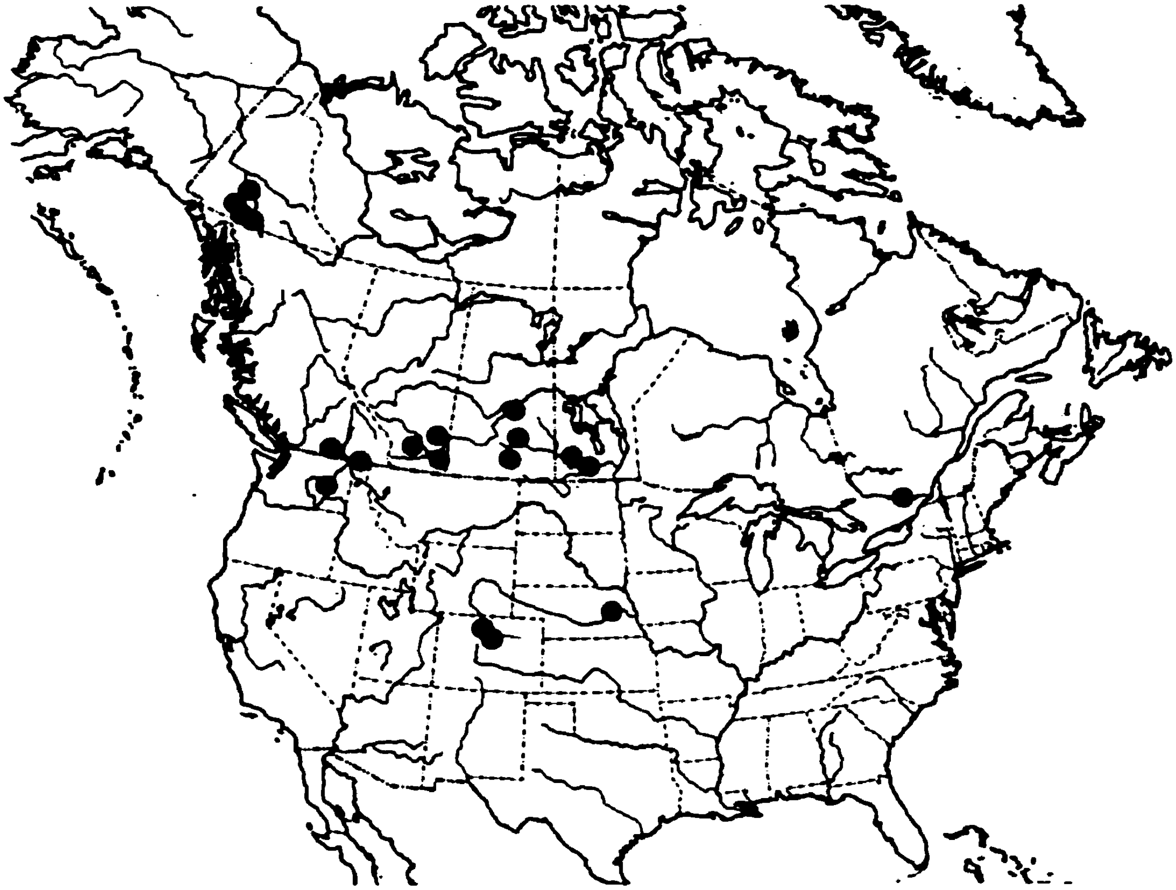

Fig. 9. Distribution of *Trixoscelis fumipennis*

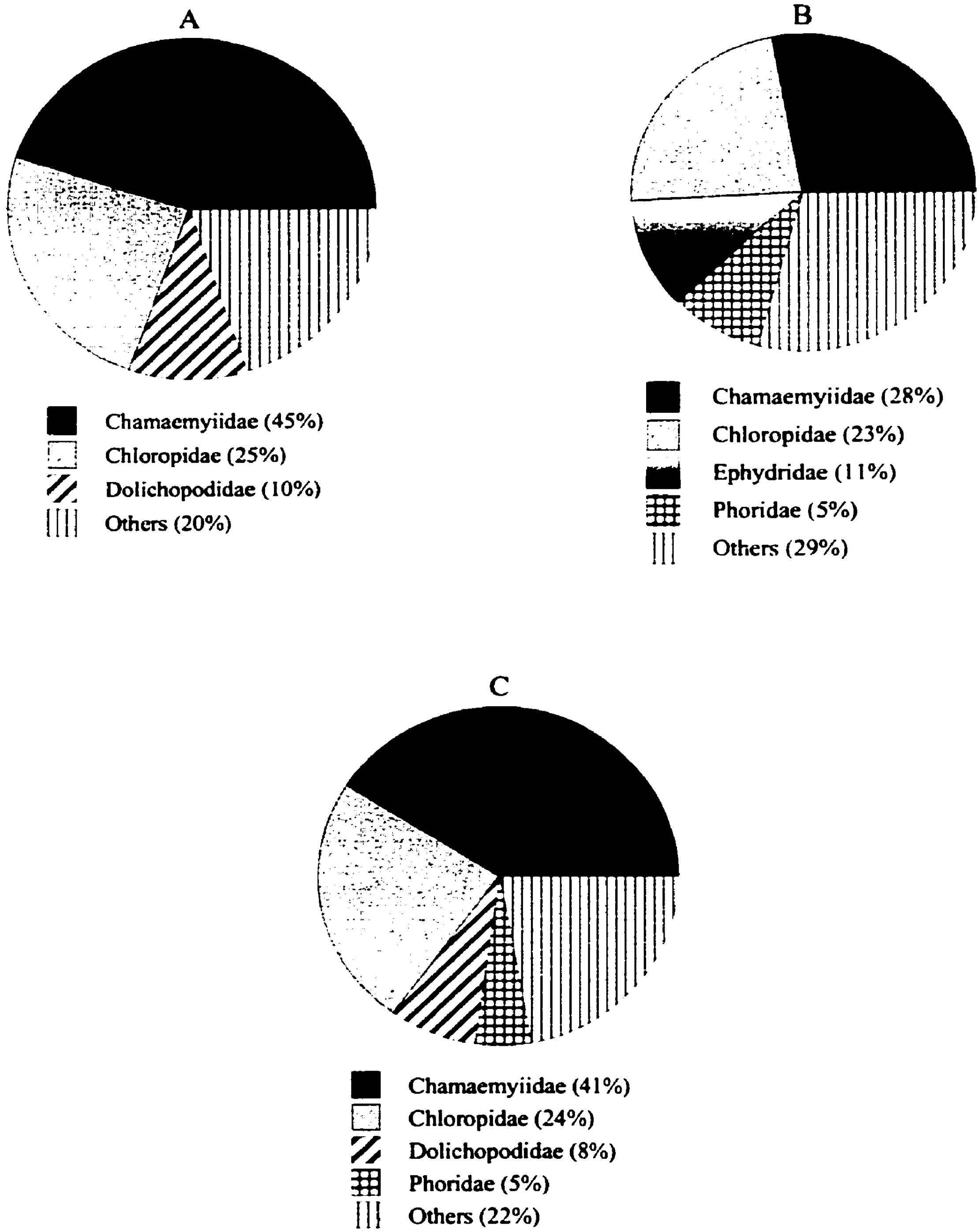

Fig. 10. Brachycera abundance; dominant families. A. 1997; B. 1998; C. Both years combined.

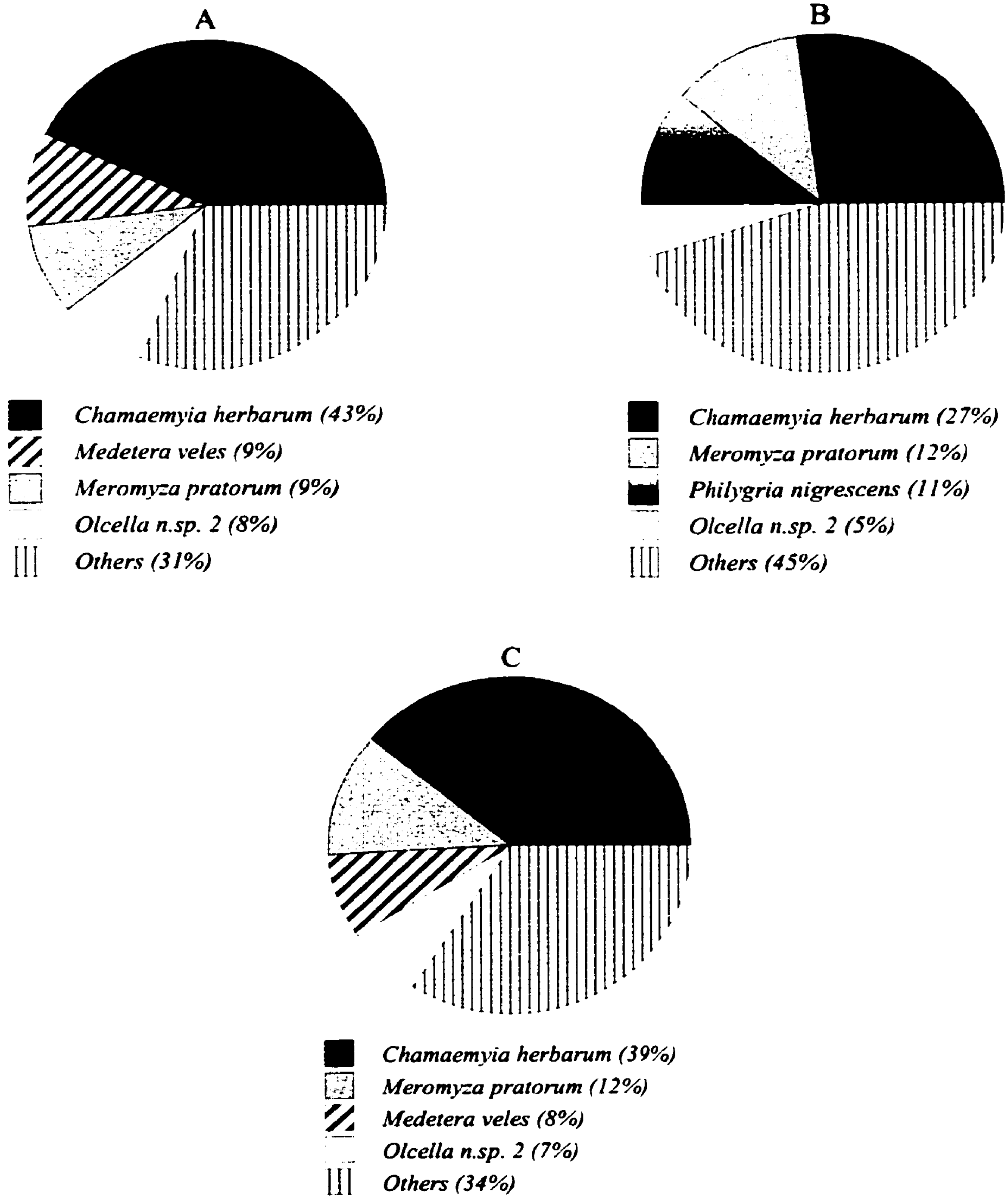

Fig. 11. Brachycera abundance; dominant species. A. 1997; B. 1998; C. Both years combined.

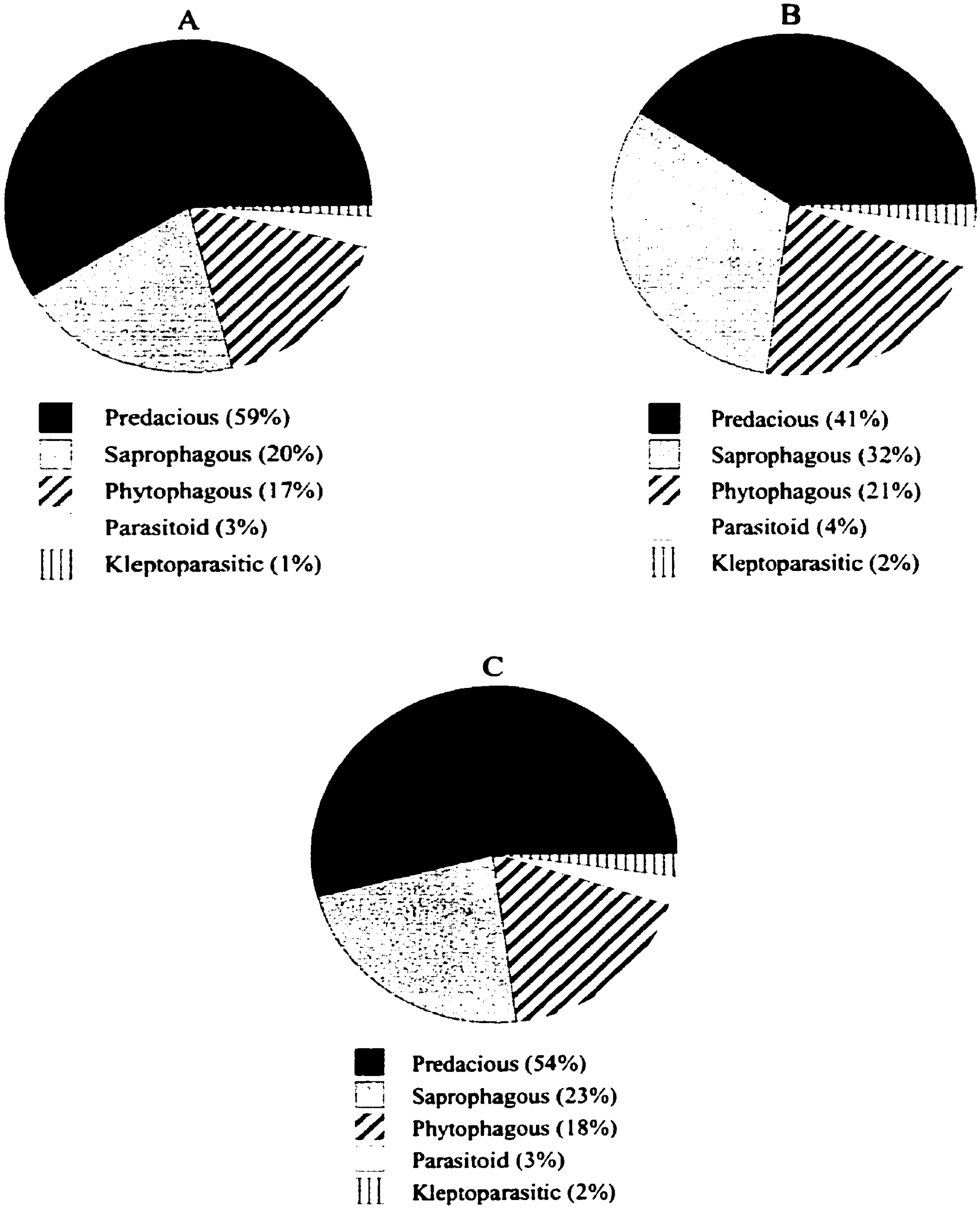

Fig. 12. Brachycera abundance; dominant guilds. A. 1997; B. 1998; C. Both years combined.

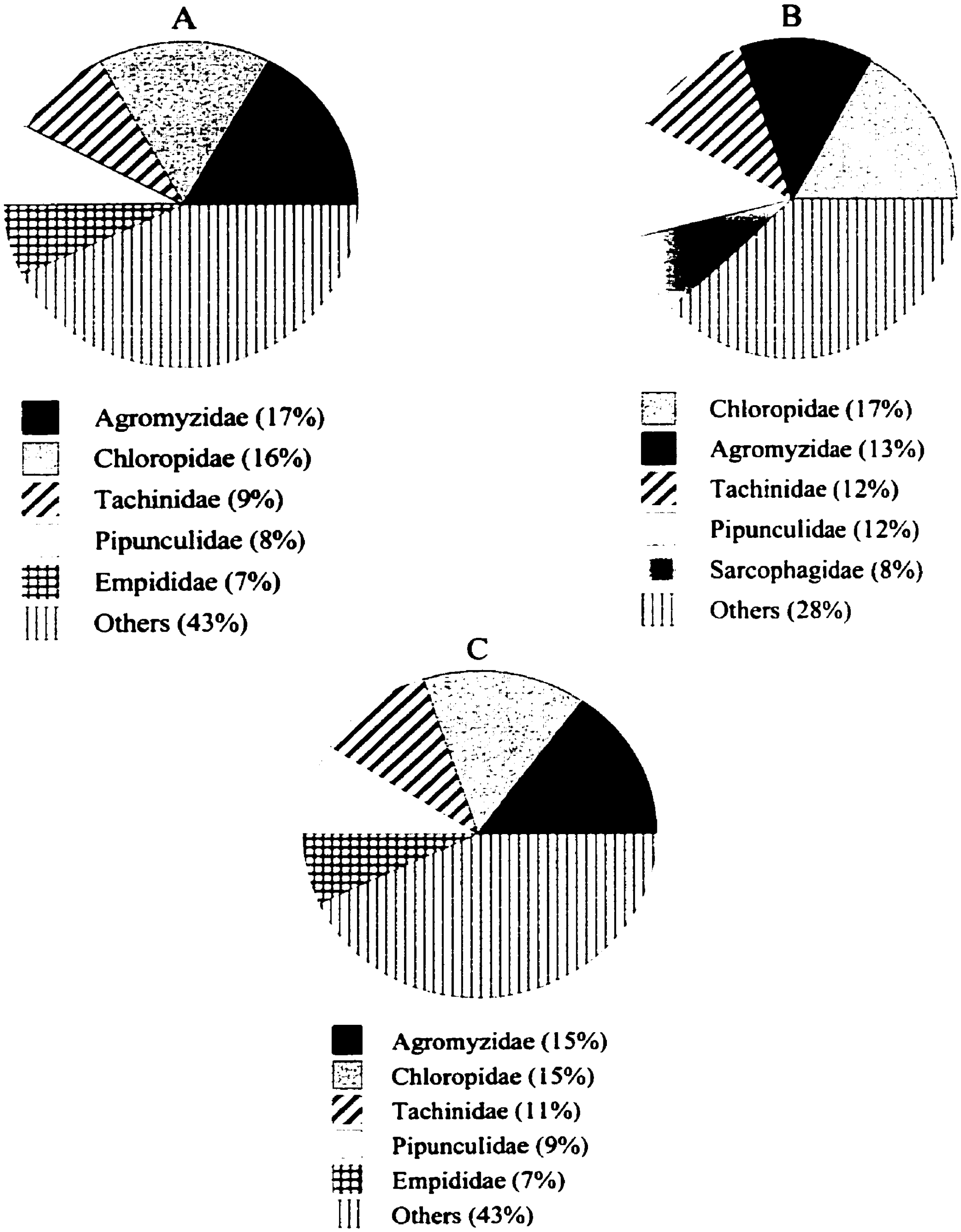

Fig. 13. Brachycera diversity; five most dominant families. A. 1997; B. 1998; C. Both years combined.

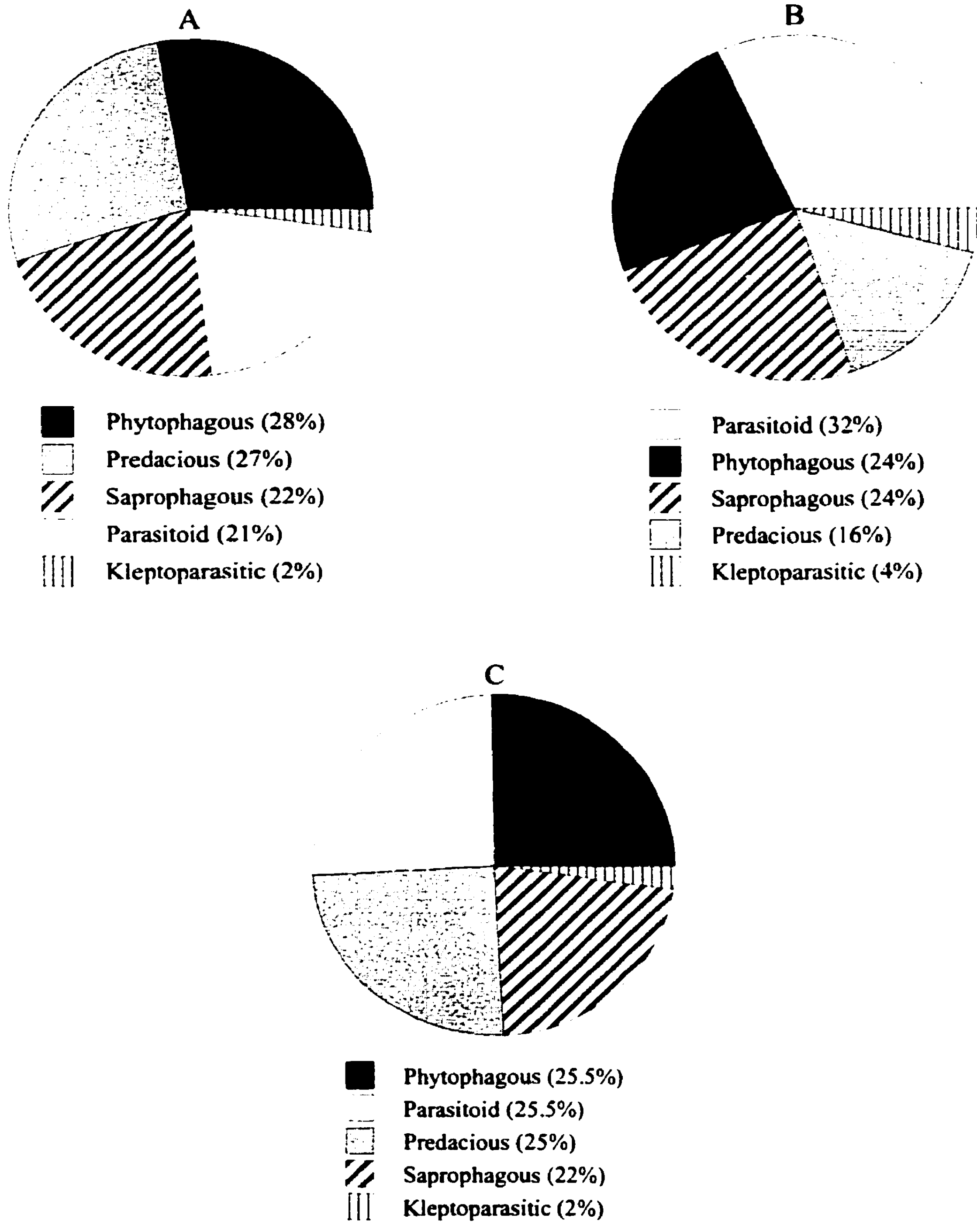

Fig. 14. Brachycera diversity; dominant guilds. A. 1997; B. 1998; C. Both years combined.

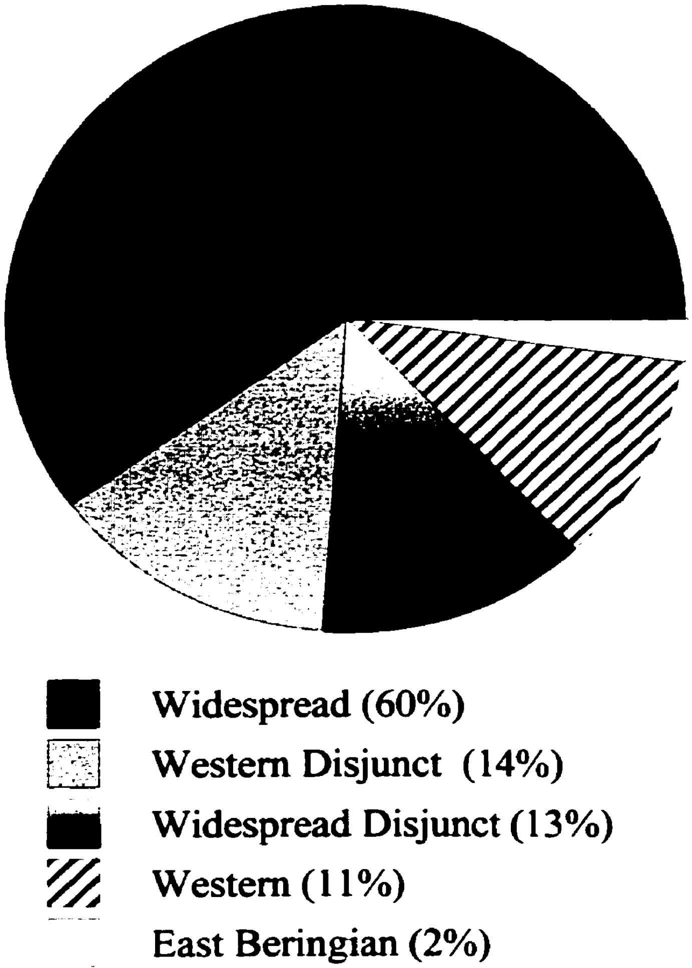

Fig. 15. Geographic patterns of Brachycera. Each category, where applicable, includes both Nearctic and Holarctic distributions.