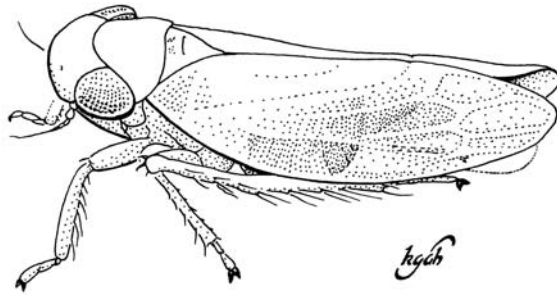


Leafhoppers of the Yukon



FRONTISPIECE. *Chlorita* n. sp., endemic to sun-warmed south-facing slopes in the Yukon, is the only Nearctic species of a large, mainly Old World genus. Length 2.25 mm.

Leafhoppers (Homoptera: Cicadellidae) of the Yukon: Dispersal and Endemism

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Abstract. The Yukon leafhopper fauna includes 145 species, of which 80 are new records; 21 other species from adjacent areas probably occur there. Most are boreal species of the Nearctic region, with a smaller, mainly Holarctic, component that inhabits the tundra. Half are species widespread in the Nearctic, and a quarter are western Nearctic species. Seventeen are Beringian endemic species, and 8 are northwestern plains species restricted to intermontane valleys; these 25 species probably survived the Pleistocene mainly in 2 areas of the Yukon: 6 species centre on the unglaciated arctic plain, and 18 are found along the Yukon River system, where they may have survived the glacial period on sun-warmed south-facing bluffs. The last of these inhabits the Carcross sand dunes, and has a subspecies around the Great Lakes. Fossils and phylogenetic evidence suggest long-standing stability coupled with extinction of species that could not adapt to rapidly changing environments. Such Pleistocene evolution as has occurred resulted in closely similar sister taxa. Postglacial dispersal has usually been slow; most wide-ranging species have not crossed the entire continent in either direction, and a third of the arctic/subarctic fauna has not even crossed the Mackenzie River.

Résumé. *Les cicadelles (Homoptera: Cicadellidae) du Yukon: dispersion et endémisme.* La faune des cicadelles du Yukon compte 145 espèces, dont 80 sont mentionnées ici pour la première fois; 21 espèces additionnelles, présentes dans les régions adjacentes, risquent d'être rencontrées au Yukon. La plupart des espèces appartiennent à la faune boréale de la région néarctique et une composante moins importante, surtout holarctique, habite la toundra. La moitié sont des espèces répandues dans la zone néarctique et un quart sont des espèces néarctiques restreintes à l'ouest. Dix-sept espèces sont endémiques en Béringie et 8 sont des espèces des plaines du nord-ouest confinées aux vallées entre des montagnes; ces 25 espèces ont probablement survécu en deux régions du Yukon au cours du Pléistocène: 6 espèces sont concentrées dans la plaine arctique non englacée et 18 vivent dans le bassin hydrographique du Yukon où elles ont probablement survécu à la période glaciaire sur les adrets. La dernière de ce groupe vit dans les dunes de sable de Carcross et une sous-espèce vit dans la région des Grands Lacs. L'examen des fossiles et l'existence d'indices phylogénétiques permettent de croire à une stabilité qui remonte à une époque ancienne et à l'extinction d'espèces qui n'ont pu s'adapter à des milieux qui ont changé trop rapidement. Cette évolution au Pléistocène a donné lieu à des taxons soeurs très apparentés. La dispersion post-glaciaire a généralement été lente; la plupart des espèces bien répandues n'ont pas traversé tout le continent dans l'une ou l'autre direction et un tiers des espèces arctiques/subarctiques n'ont même pas traversé le Mackenzie.

Introduction

The Yukon is a vast area of diverse topographical and climatic zones, from arctic coastal plains at 69°N to temperate coastal rainforest at 60°N and 400 m ASL in the lower Alsek River valley of Kluane National Park. Winter temperatures in the northern half of the Territory are among the most severe in continental North America. Summer temperature regimes in the Yukon range from very cold on mountain peaks to warm and dry in local spots in sheltered valleys of the interior. Such valleys are generally warmer than the rest of the Territory because local buildup of heat is not dispersed as readily by winds. South-facing slopes where solar heating is most intense may actually mimic summer temperature regimes in parts of southern Canada.

The Yukon insect fauna is, as yet, inadequately sampled. It was virtually unknown until after the building of the Alaska Highway during World War II. The few roads still are concentrated in valley bottoms where the life zones are mostly boreal. This gives a strong

bias towards collection of boreal species. The insect fauna of the Pacific watershed in the Yukon (consisting of 2 small and very wet valleys in the southwest) remains unknown.

This study reports upon the Yukon fauna of leafhoppers (Homoptera: Cicadellidae). These phytophagous insects are abundant and diverse in Canada, with about 1200 known species. In northern areas of the continent the number of species, although not the abundance of individuals, dwindles significantly until they disappear entirely from the tundra at latitude 70°N in Alaska and latitude 63°N on Baffin Island. The Yukon Territory is therefore at the northern edge of the range of leafhoppers. Because leafhoppers were expected to be under-represented in the north there had not been much incentive to collect there until H.H. Ross (then of the Illinois Natural History Survey) in 1968 found unexpected endemism and range extensions. Recent surveys of the insect fauna of the Yukon have intensified the search for Beringian endemic species.

This is the first detailed study of the leafhopper fauna of the Yukon. Only a single species was recorded from the Yukon before 1950 (Sanders and DeLong 1920). Beirne (1950, 1952, 1954) and Beirne and Young (1953) added 7 species to the Yukon fauna. Later, Beirne (1956) in a synopsis of the Canadian and Alaskan fauna recorded 46 species, including 24 incorrect trivial names. Since then, 19 more species have been listed in the Yukon fauna, with 13 Yukon species differentiated from more southerly ones (Ross 1963; Ross and Hamilton 1970a; Hamilton and Ross 1975; Hamilton 1970, 1980, 1983a, b, 1985, 1995a, b; Blocker and Wesley 1985). An additional 80 species are recorded in the species list, and one has been removed as an incorrect identification, for a total of 145 known species. Of these, 11 are new to science; these will be described in a forthcoming synopsis of the Alaskan fauna and in revisions currently in preparation. Another 21 species are listed as probably occurring in the Yukon for an estimated fauna of 166 species.

Biological information is conspicuously lacking from most Yukon collections. Fortunately, it is abundantly available from adjacent parts of Canada and Alaska. Host information is available for 90% of the species in the known Yukon fauna; the species for which host information is lacking probably feed on herbaceous plants. None is known to feed on coniferous tree species, the dominant flora of the Yukon. Only 21% feed on broadleaf trees and shrubs (mostly on willows; also poplar, alder and birch). Almost half feed on grasses and sedges. Of these, the largest fraction feed only on grasses (46 species or 32% of the estimated fauna), although sedges also have a rich fauna (36 species or 25%). Within the herbaceous plants, ericaceous hosts appear to be the most important to Yukon leafhoppers.

No clear instances of species introduced by man are known among the Yukon leafhoppers. Some species are common to Europe or Asia, but these are probably widely dispersing, Holarctic species. One, *Deltocephalus pulicaris* (Fallén), appears to be naturally occurring in the Yukon and Alaska, while specimens from eastern North America, associated with lawn grasses, are clearly introduced from Europe.

The known diversity in Yukon leafhoppers is sufficient to permit biogeographic analysis. Cicadellidae are particularly good indicators of prehistorical events due to their rather low rate of dispersal (Hamilton 1983a) and their intimate association with plants. They also include the only insects that have evolved a rich prairie-endemic fauna (Ross 1970) and have more than 100 such species in Canadian grasslands. These factors together make them particularly excellent indicators of grassland sites that have persisted for a long time.

Leafhoppers range from coastal islands on the northern edge of the Yukon to all parts of the mainland, except the highest mountains. They are concentrated in the warmest valley bottoms, but range up into the lowest part of the alpine zone where winter cold is intense. They have been sampled at elevations up to 1600 m ASL in the south Yukon, which is low

alpine at latitude 61°N. Farther northward the alpine zone blends with the arctic zone; there is little or no differentiation between their leafhopper faunas. Elsewhere in North America they are absent from the middle and high arctic zones, but these zones are not found in the Yukon.

Cool and short summers ensure that most if not all of the species in the Yukon are univoltine. Adult emergence is usually delayed some weeks beyond normal eclosion times in southern Canada. Most adults are present in the Yukon during July or August; *Coulinus*, *Euscelis*, *Hardya* and *Oncopsis* may emerge in June. There, only 6 species in the genera *Aceratagallia*, *Balclutha* and *Cuerna*, plus a few in *Idiocerus* and *Empoasca*, are known to overwinter as adults, becoming active as soon as local temperatures reach spring-like conditions.

No special adaptations to the rigorous Yukon climate are apparent in leafhoppers. Flightless (brachypterous) forms are common, but these are not associated with latitude. Instead, as in other Homoptera, flightlessness is associated with feeding on low-growing plants (principally grasses) that are usually dominants or subdominants and therefore do not present much difficulty for dispersing populations seeking additional stands of hostplants.

Materials and Methods

Material examined in this study includes the collections of the Canadian National Collection (CNCI) in Ottawa, and recent surveys by entomologists in British Columbia under the leadership of G.G.E. Scudder. The 1968 survey material collected by H.H. Ross is preserved in the CNCI along with significant additions from recent collections. Results of these surveys were compared with a faunal list of Alaskan leafhoppers prepared with S.F. Maclean of Fairbanks, Alaska. Leafhoppers have been sampled at 187 Yukon sites (Fig. 1).

To verify conspecificity of transarctic and transBeringian species, specimens from the Yukon were compared to the eastern Siberian fauna (Vilbaste 1980; Anufriev and Emel'janov 1988) and specimens collected at Chaun Bay, northeastern Siberia by S.F. MacLean in 1977.

Names used in this study are mainly compatible with those of previous faunal studies in Newfoundland (Hamilton and Langor 1987) and Alaska (MacLean and Hamilton unpublished). *Limotettix* and its subgenera *Scleroracrus* and *Ophiolix* have been revised recently (Hamilton 1995a, b). The nomenclature in the genus *Cicadula* is currently under revision by L. Huldén (in litt.). An updated nomenclature of the many northern species of *Macrosteles* is presented, based on an unpublished world revision of the genus (Kwon 1988).

Ranges and host records, unless otherwise noted, are based on material in the CNCI. Species that are restricted to North America west of the Mackenzie River and north of the Peace River are considered "East Beringian" endemic species; those that also range into eastern Siberia are noted as "East-West Beringian". Species are "circumpolar" if they are characteristic of the low arctic on both continents, "Holarctic" if they are widespread on both continents, and "transcontinental" if they are distributed from Atlantic Canada to Alaska; this does not necessarily imply that they are found on the Pacific coast (see comments under Distribution, below).

The species are also correlated with climatic zones, based on their total known distribution in North America. Weather data from the Yukon are less precise than from southern regions of Canada due to the paucity of weather stations and great topographical variations

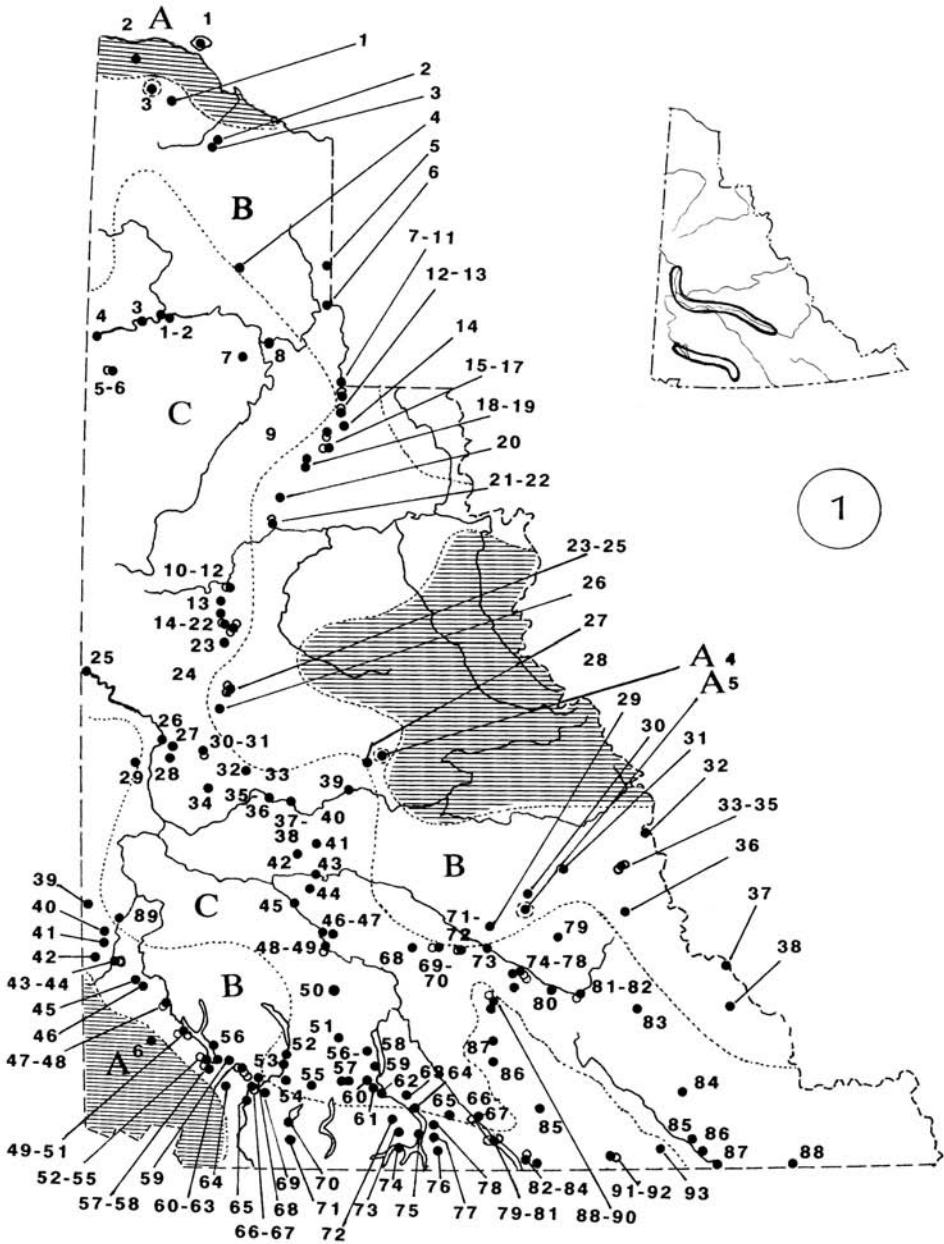


FIG. 1. Collection sites in the Yukon. Circled: areas of endemism along the Yukon River system.

A (JULY MAXIMUM, 15°C)

1, Herschel Is. (69°35'N 139°05'W);

2, Fish Cr. (69°27'N 140°19'W);

3, "Sunday Mtn." 950 m ASL in British Mts.
(69°17'N 140°03'W);

4, Keno Hill 4000 ft (63°57'N 135°11'W);

5, La Force L. 5500 ft (62°32'N 132°22'W);

6, Nines Cr. (61°11'N 139°42'W).

(continued)

FIG. 1 (continued)

B (JULY MAXIMUM 15–20°C)

- 1, Firth R. in British Mts. (69°16'N 139°45'W);
- 2, Philip Cr. (68°53'N 138°35'W);
- 3, Trout L. (68°50'N 138°45'W);
- 4, Driftwood R. (67°56'N 138°15'W);
- 5, White Mts. at "Erebia Creek" (67°58'N 136°29'W);
- 6, McDougall Pass (67°42'N 136°29'W);
- 7–11, Dempster Hwy. km 470 (NWT/YT border 67°03'N 136°13'W), km 458 (66°58'N 136°14'W), km 456 (66°59'N 136°14'W), at "George's Gap" in Richardson Mts. (66°53'N 136°18'W), and km 439 at Cornwall Cr. (66°55'N 136°18'W);
- 12, Dempster Hwy. at Rock R. (66°48'N 136°16'W);
- 13, Richardson Mts. 13 km N Arctic Circle (66°40'N 136°18'W);
- 14, Dempster Hwy. at Arctic Circle (66°33'N 136°19'W);
- 15–17, Dempster Hwy. km 409 (66°37'N 136°20'W), km 404 (66°33'N 136°20'W), and km 400 (66°33'N 136°25'W);
- 18–19, Dempster Hwy. at Eagle R. (66°27'N 136°42'W), and km 371 (66°23'N 136°43'W);
- 20, Dempster Hwy. km 321 (Eagle Plains 66°07'N 137°15'W);
- 21–22, Dempster Hwy. km 297 (65°57'N 137°22'W), and km 293 (65°55'N 137°22'W);
- 23–25, North Fork Pass (64°33'N 138°14'W), North Fork Crossing 3500 ft (64°31'N 138°13'W), and Tombstone (64°30'N 138°15'W);
- 26, Wolf Cr. (64°21'N 138°25'W);
- 27, Halfway Lks. (Elsa) (63°54'N 135°28'W);
- 28, Dickson L. (62°21'N 133°08'W);
- 29, La Force L. (62°41'N 132°20'W);
- 30, Sheldon L. (62°54'N 131°37'W);
- 31, "Sheldon Pass" (62°44'N 131°01'W);
- 32, Macmillan Pass (63°15'N 130°02'W);
- 33–35, Macmillan R. (62°57'N 130°28'W), Wagon Cr. (62°56'N 130°30'W), and North Canol Rd. km 406 (62°55'N 130°33'W);
- 36, Otter L. (62°30'N 130°25'W);
- 37, Nahanni Range Rd. summit (62°01'N 128°25'W);
- 38, Nahanni Range Rd. km 128 (61°38'N 128°20'W);
- 39, Alaska Hwy. mi 1221 (62°34'N 140°58'W);
- 40, Enger Lks. (62°16'N 140°42'W);
- 41, Dry Cr. (62°10'N 140°41'W);
- 42, Alaska Hwy. mi 1202 at Beaver Cr. (62°02'N 140°52'W);
- 43–44, Alaska Hwy. mi 1141 (61°45'N 140°56'W), and Koidern (61°59'N 140°29'W);
- 45, Lake Cr. (61°48'N 140°02'W);
- 46, 19 km NW Donjek R. (61°44'N 139°54'W);
- 47–48, Alaska Hwy. km 1863 (61°34'N 139°27'W), and mi 1156 (61°34'N 139°25'W);
- 49–51, Alaska Hwy. mi 1098 at Duke R. (61°22'N 139°06'W), km 1768 at Duke R. meadows (61°21'N 139°09'W), and Burwash Landing (61°21'N 139°00'W);
- 52–55, Mt. Wallace (Kluane National Park, 61°03'N 138°34'W), Alaska Hwy. mi 1064 at Bayshore Lodge (61°02'N 138°30'W), Silver City (61°02'N 138°23'W), and Alaska Hwy. mi 1054 (61°02'N 138°24'W);
- 56, Cultus Bay on Kluane L. (61°09'N 138°25'W);
- 57–58, Slims R. Delta (60°59'N 138°34'W), and Sheep Cr. (Kluane National Park, 60°59'N 138°34'W),
- 59, Alaska Hwy. mi 1041 (61°01'N 138°06'W);
- 60–63, Alaska Hwy. mi 1038 (60°58'N 137°59'W), mi 1036 (60°58'N 137°55'W), mi 1034 (60°57'N 137°54'W), and mi 1031 (60°55'N 137°50'W);
- 64, Jarvis R. Meadows (60°46'N 138°09'W);
- 65, Dezadeash R. (60°39'N 137°47'W);
- 66–67, Alaska Hwy. mi 1020 (60°47'N 137°40'W), and Haines Jct. (60°45'N 137°35'W);
- 68, Canyon Cr. (60°51'N 137°31'W);
- 69, Haines Rd. mi 136 (60°42'N 137°23'W);
- 70, Dezadeash L. (60°26'N 137°02'W);
- 71, Haines Rd. mi 103 (60°17'N 136°59'W);
- 72, 10 mi N Carcross (60°27'N 134°51'W);
- 73, Lewes Cr. (60°21'N 134°46'W);
- 74, Carcross 3000 ft (60°11'N 134°41'W);
- 75, Tagish (60°18'N 134°16'W);
- 76, Atlin Rd. at Tarfu Cr. (60°06'N 133°53'W);
- 77, Little Atlin L. (60°15'N 133°57'W);
- 78, Jake's Corner (60°20'N 133°58'W);
- 79–81, Alaska Hwy. mi 818 (60°18'N 133°02'W), mi 813 (60°15'N 132°57'W) and Lone Tree Cr. (60°17'N 132°58'W);
- 82–84, Strawberry Cr. (60°05'N 132°20'W), Alaska Hwy. mi 786 (60°04'N 132°20'W) and mi 777.7 at Morley R. Lodge (60°01'N 132°09'W);
- 85, Morley R. (60°35'N 132°09'W);
- 86, Quiet L. (61°04'N 133°03'W);
- 87, South Canol Rd. km 122 at Rose R. (61°16'N 133°02'W);
- 88–90, Rose L. (61°35'N 133°05'W), Lapie Lks. (61°40'N 133°04'W), and Lapie Pass (61°42'N 133°07'W);
- 91–92, Rancheria (60°05'N 130°36'W) and 7 km E (60°04'N 130°29'W);
- 93, Big Cr. (60°09'N 129°42'W).

(continued)

FIG. 1 (continued)

C (JULY MAXIMUM >20°C)

- 1–2, Old Crow (67°34'N 139°50'W) and 6 km E (67°34'N 139°41'W);
- 3, Frog L. (67°30'N 140°15'W);
- 4, Rampart House (67°25'N 140°59'W);
- 5–6, Bluefish R. (67°08'N 140°49'W), Bluefish Ridge (67°08'N 140°46'W);
- 7, Dempster Hwy. km 505 at Peel Plateau (67°15'N 138°10'W);
- 8, Mason Hill (67°19'N 137°40'W);
- 9, Dempster Hwy. km 311;
- 10–12, Dempster Hwy. km 194 (65°21'N 138°15'W), km 200 (65°21'N 138°20'W), and at Ogilvie R. (65°21'N 138°17'W);
- 13, Dempster Hwy. km 174 (65°15'N 138°22'W);
- 14–22, Dempster Hwy. km 170 (65°09'N 138°22'W), km 165, km 159 (65°05'N 138°20'W), km 154 (65°04'N 138°15'W), km 152 at “Windy Pass” (65°04'N 138°05'W), km 151, km 148, km 140 (65°02'N 138°08'W), and km 138 (65°00'N 138°11'W);
- 23, Dempster Hwy. km 128 (64°55'N 138°17'W);
- 24, Dempster Hwy. km 118;
- 25, Boundary (64°41'N 140°59'W);
- 26, Dawson (64°04'N 139°26'W);
- 27, 10 km E Dawson at Klondike Campground (64°01'N 139°16'W);
- 28, Grand Forks on Bonanza Cr. (63°55'N 139°20'W);
- 29, 141-Meridian R. (63°54'N 139°59'W);
- 30–31, Dempster Corner (63°59'N 138°43'W), and Dempster Hwy. at Klondike Hwy. (63°58'N 138°43'W);
- 32, Gravel L. 2050 ft (63°48'N 137°53'W);
- 33, 6 km E Gravel L.;
- 34, Granville (63°40'N 138°37'W);
- 35–36, McQuesten (63°33'N 137°24'W), McQuesten R. (63°33'N 137°26'W);
- 37–38, 10 km E McQuesten, Moose Cr. (63°31'N 137°01'W);
- 39, Mayo, and Mayo Campground (63°36'N 135°53'W);
- 40, Stewart Crossing;
- 41, 24 km S Stewart Crossing (63°10'N 136°29'W);
- 42, Carmacks Rd. mi 76 (63°02'N 136°49'W);
- 43, Pelly Crossing (62°49'N 136°34'W);
- 44, von Wilczek Lks. (62°44'N 136°42'W);
- 45, Minto (62°35'N 136°50'W);
- 46–47, Tatchun Cr. (62°17'N 136°17'W), and Tatchun L. (62°17'N 136°08'W);
- 48–49, Carmacks Rd. mi 2 (62°09'N 136°18'W), and Carmacks (62°06'N 139°18'W);
- 50, Klusha Cr. (61°44'N 136°02'W);
- 51, Dawson Rd. mi 44 (64°04'N 139°26'W);
- 52, Aishihik Rd. mi 2 (61°04'N 136°59'W);
- 53, 14 km N Aishihik R. canyon (60°59'N 137°02'W);
- 54, Alaska Hwy. mi 991 (60°50'N 136°58'W);
- 55, Champagne (60°47'N 136°28'W);
- 56–57, 6 km (60°50'N 135°52'W) and 9 mi W Takhini (60°50'N 135°43'W);
- 58, Richthofen Cr. (61°08'N 135°21'W);
- 59, L. Laberge (60°59'N 135°11'W);
- 60, Takhini Hot Springs (60°52'N 135°21'W);
- 61, Alaska Hwy. mi 915 (61°48'N 135°15'W);
- 62, Whitehorse (60°43'N 135°04'W);
- 63, McClintock River Rd. mi 4 (60°36'N 134°27'W);
- 64, Alaska Hwy. mi 882 at Marsh L. (60°31'N 134°20'W);
- 65, Squanga L. (60°29'N 133°38'W);
- 66–67, Alaska Hwy. mi 837 at Johnson Crossing (60°29'N 133°20'W), Canol Rd. km 4 at Johnson Crossing (60°30'N 133°15'W);
- 68, Little Salmon L. and Campground (62°11'N 134°40'W);
- 69–70, Campbell Hwy. km 490 (62°11'N 134°10'W) and km 460 at Drury Cr. (62°12'N 134°18'W);
- 71–72, Campbell Hwy. km 450 (62°11'N 133°47'W), and km 448 (Magundy R. 62°11'N 133°46'W);
- 73, Faro (62°14'N 133°20'W);
- 74–78, Lapie R. at Glacier Cr. (61°48'N 132°36'W), Lapie Canyon (61°55'N 132°37'W), Ross R. (61°56'N 132°30'W), 8 km S Ross R. on Campbell Hwy. (61°55'N 132°28'W) and 9 km S (61°54'N 132°25'W);
- 79, Canol Rd. km 291 (62°16'N 131°45'W);
- 80, Starr Cr. (61°46'N 131°51'W);
- 81–82, 4 km W Mink Cr. (61°43'N 131°23'W), and Campbell Hwy. km 286 at Mink Cr. (61°44'N 131°20'W);
- 83, Finlayson R. (61°35'N 130°09'W);
- 84, Simpson L. (60°44'N 129°15'W);
- 85, Tom Cr. (60°15'N 129°00'W);
- 86, Watson L. (60°07'N 128°49'W);
- 87, Alaska Hwy. mi 632 (60°02'N 128°38'W);
- 88, “Loon Lake” (60°02'N 127°35'W);
- 89, Snag (62°24'N 140°22'W).

within the areas these cover. The Yukon appears to have 5 clearly recognizable climatic zones:

1. North of (or above) treeline is *arctic/alpine*.
2. Open forest, maintained open by permafrost regardless of elevation, is *subarctic*.

3. Closed forest where growing-season temperatures (above 5.5°C) total less than 1100 degree-days per year is *high boreal*.

4. Closed forest where growing-season temperatures total more than 1100 but less than 1400 degree-days per year is *low boreal* equivalent to mixed hardwood-coniferous forest situations in other parts of Canada.

5. Local situations where growing-season temperatures can exceed 1400 degree-days per year have “hemiboreal” or *Transition zone* conditions, equivalent to those of prairies or northern hardwood forest situations in other parts of Canada.

Some leafhopper species from Transition zone parts of the Yukon may range southward into the austral zone. The austral zone, characterized by summer temperatures in excess of 2200 degree-days per year, is not found in the Yukon; it is represented in Canada only by the hardwood forests of the southern tips of Ontario and of Vancouver Island.

This is a finer classification than often used. For other life-zone classifications, see Scudder (1979). “Hudsonian” or “High Boreal” is often used to denote subarctic areas, and “Canadian” or “Low Boreal” may refer to both high and low boreal regions together.

The author has not personally visited any collection site in the Yukon. Hence, these sites (Fig. 1) cannot be definitely placed in the 5 life-zone categories above. They are listed according to summer maximum temperatures, which serve as a rough estimate of low boreal (C), high boreal to subarctic (B), and arctic (A) zones respectively.

Classification

The Yukon leafhopper faunal list is presented alphabetically for ease of use. A “natural” (phylogenetic) classification is given in Table 1, based on the most recent family-wide treatment (Hamilton 1975, 1983c). The 145 species are placed in 4 subfamilies, 8 tribes, 13 subtribes and 45 genera. Numbers following each genus refer to species in the alphabetical faunal list.

Subfamilies are currently based mainly on morphological evidence of evolutionary lineages, but some are correlated with feeding strategies and dispersal abilities. The subfamily Cicadellinae (the “sharp-shooters”) are xylem-feeders, and are some of the most heavy-bodied members of the Canadian fauna and considered to be among the most plesiomorphic in the family. Subfamily Typhlocybinae, the “micro-leafhoppers”, are tiny mesophyll feeders and usually wind-dispersed. Only 2 other subfamilies are represented in the Yukon: the short-headed Eurymelinae and the flattened Aphrodinae, both average-sized phloem-feeders. Of the 2, Eurymelinae are by far the more aggressive dispersers. Four other subfamilies represented in the Nearctic fauna are restricted to areas below 55°N latitude in Alberta and much more southerly areas farther east. Scarinae are found in the Peace River district of Alberta and eastward to Cape Breton Island, but not Newfoundland (Hamilton and Langor 1987), while Coelidiinae, Ledrinae and Eupelecinae (= Koebeliinae) are restricted to austral areas of Canada (Beirne 1956).

Within the subfamily Aphrodinae (and in other taxa not represented in the Yukon) certain tribes and subtribes are noted for frequency of flightlessness due to shortened wings (brachyptery). Aphrodini of the subtribe Doraturina are almost entirely brachypterous in the New World, though with a low level of macroptery in every such species; while in Deltoccephalini the subtribes Athysanina and Deltoccephalina, and the related Hecalini, have isolated genera in which brachyptery may be common. In the same taxa all the females of some species may be brachypterous.

TABLE 1. Phylogenetic classification of Yukon leafhoppers, based on recent synopses (Hamilton 1975, 1983c).

Subfamily	Tribe	Subtribe	Genus
Cicadellinae	Cicadellini	Proconiina	<i>Cuerna</i> (30)
		Cicadellina	<i>Draeculacephala</i> (40–41)
Typhlocybinae	Typhlocybini	Forcipatini	<i>Forcipata</i> (62–63) <i>Notus</i> (111)
		Dikraneurina	<i>Dikraneura</i> (34–35)
		Empoascina	<i>Chlorita</i> (12)
			<i>Empoasca</i> (43–57)
			<i>Kyboasca</i> (78–79)
Typhlocybina	<i>Typhlocyba</i> (138–145)		
Eurymelinae	Idiocerini	–	<i>Idiocerus</i> (70–76)
	Macropsini	–	<i>Macropsis</i> (93–96) <i>Oncopsis</i> (112–116)
		Megophthalmini	Agalliina
Aphrodinae	Aphrodini	Aphrodina	<i>Stroggylocephalus</i> (136)
		Doraturina	<i>Athysanella</i> (4–7)
	Hecalini	–	<i>Hecalus</i> (69)
	Deldocephalini	Athysanina	<i>Coulinus</i> (28–29)
			<i>Doliotettix</i> (39)
			<i>Euscelis</i> (58–61)
			<i>Hardya</i> (64)
		<i>Limotettix</i> (83–92)	
		Cicadulina	<i>Cicadula</i> (13–18)
			<i>Elymana</i> (42)
<i>Paluda</i> (118)			
<i>Thamnotettix</i> (137)			
Deldocephalina	<i>Amplicephalus</i> (3)		
	<i>Auridius</i> (8)		
	<i>Commellus</i> (24–25)		
	<i>Cosmotettix</i> (26–27)		
	<i>Deldocephalus</i> (31–33)		
	<i>Diplocolenus</i> (36–38)		
	<i>Hebecephalus</i> (65–68)		
	<i>Latalus</i> (80–82)		
	<i>Mocuellus</i> (110)		
	<i>Orocastus</i> (117)		
	<i>Pasaremus</i> (121)		
	<i>Psamnotettix</i> (122–127)		
	<i>Rosenus</i> (128–129)		
<i>Sorhoanus</i> (131–135)			
Macrostelina	<i>Balclutha</i> (9–11)		
	<i>Macrosteles</i> (97–109)		
Platymetopiina	<i>Colladonus</i> (19–23)		
	<i>Idiodonus</i> (77)		
	<i>Paraphlepsius</i> (119–120)		
	<i>Scaphytopius</i> (130)		

Sexual dimorphism is widespread and common throughout the family, but is chiefly expressed in size and phenology, males being smaller than females, emerging earlier, and living considerably shorter lives. Thus collections taken when adults first appear are biased towards males, while about a month later females alone are found. Brachyptery is frequently associated with females but not with males. The large abdomen of some females, e.g. *Hecalus montanus* (Uhler), may make them appear brachypterous. Striking sexual dimorphism in colour is mostly found in Yukon leafhoppers belonging to the typhlocybinae subtribe Empoascina, and euryeline tribes Idiocerini and Macropsini. A few other examples are found in other subfamilies, e.g. *Draeculacephala angulifera* (Walker) in Cicadellinae and *Macrosteles maculipes* (Zett.) in Aphrodinae.

Annotated List of Species

Yukon records include 80 species new to the Yukon fauna, designated by an asterisk (*); sites are numbered as in Fig. 1 and are grouped according to maximum summer temperature zones roughly corresponding to climate zones (A, arctic and alpine; B, subarctic to high boreal; and C, low boreal).

1. ***Aceratagallia sanguinolenta* Provancher*** Nearctic
Distribution: Transcontinental, low boreal to Transition zone.
Yukon records: B - 60; C - 1, 6, 76.
Biological information: Feeds on herbaceous plants.
2. ***Aceratagallia* n. sp.*** Western Nearctic
Distribution: Alaska to Great Plains, high boreal to austral.
Yukon records: B - 53; C - 1, 62.
Biological information: Feeds on herbaceous plants.
3. ***Amplicephalus (Endria) nebulosus* (Ball)*** Holarctic
Distribution: Alaska to Minnesota, and Germany to Korea (Nast 1972), low boreal to Transition zone.
Yukon records: C - 32.
Biological information: Feeds on grasses.
4. ***Athysanella acuticauda* (Baker)** Nearctic
Distribution: Alaska to Quebec, montane and low boreal to Transition zone.
Yukon records: B - 14, 47, 54, 64, 66–67; also (Blocker and Wesley 1985) B - 49, 51, 75; C - 26, 74.
Biological information: Feeds on bluegrasses (*Poa* spp.). This widely dispersing species seems able to colonize remote grassland sites.
5. ***Athysanella macleani* Blocker and Wesley** East Beringian
Distribution: Known only from 3 sites on the arctic coastal plain inland to the Richardson Mts.
Yukon records: B - 1, 10 and (Blocker and Wesley 1985) B - 14.
Biological information: Feeds on sparse dune grasses.
6. ***Athysanella resusca* Blocker and Wesley** East Beringian
Distribution: Yukon and Mackenzie Delta of Northwest Territories, subarctic to boreal.
Yukon records: (Blocker and Wesley 1985) B - 1, 66.
Biological information: Probably feeds on grasses.
7. ***Athysanella robusta* Baker** Western Nearctic
Distribution: Yukon to Colorado, Transition zone to austral, in native grasslands.
Yukon records: C - 43 and (Blocker and Wesley 1985) B - 58.
Biological information: Feeds on grasses.
8. ***Auridius ordinatus* (Ball)*** Western Nearctic
Distribution: Yukon to Colorado, Transition zone to austral, in prairies.
Yukon records: B - 57, 66–67.

Biological information: Feeds on grasses.

9. ***Balclutha confluens* (Rey)*** Holarctic

Distribution: Circumpolar, low boreal to Transition zone.

Yukon records: C - 26, 32.

Biological information: Feeds on grasses.

10. ***Balclutha manitou* (Gillette and Baker)** Western Nearctic

Distribution: Pacific coast, and inland Alaska to northern Manitoba, low boreal.

Yukon records: B - 24, 42, 80; C - 26, 60, 62, 87.

Biological information: Probably feeds on grasses.

Taxonomic notes: Recorded by Beirne (1950) as *B. arctica* (for synonymy, see Hamilton 1983a).

11. ***Balclutha punctata* (Thunberg)** Holarctic

Distribution: Circumpolar, low boreal to Transition zone.

Yukon records: B - 42, 48, 84; C - 26, 60, 62.

Biological information: Feeds on grasses.

12. ***Chlorita n. sp.**** (Frontispiece) East Beringian

Distribution: Endemic to valleys of Yukon river system, Transition zone.

Yukon records: C - 43, 74.

Biological information: Host unknown; taken in association with sp. 44, hence, probably on sage.

13. ***Cicadula* (s.s.) *subcupraea* (Provancher)*** Nearctic

Distribution: Transcontinental, low boreal.

Yukon records: B - 46, 57, 92; C - 26, 32, 56, 57, 60, 62, 72; Aishihik R.

Biological information: Feeds on *Carex* spp.

14. ***Cicadula* (*Cyperana*) *n. sp.**** Palaearctic-East Beringian

Distribution: Alaska to Yukon, and Finland (Huldén, pers. comm.), subarctic to low boreal.

Yukon records: B - 20, 88; C - 49, 56; Aishihik R.

Biological information: Feeds on *Carex* spp.

15. ***Cicadula* (*Cyperana*) *intermedia* (Boheman)** Holarctic

Distribution: Alaska to northern Quebec, and Ireland to Kamchatka (Nast 1972), tundra to high boreal.

Yukon records: B - 33, 57, 67, 75–76; C - 26, 32, 41, 57, 59–60, 66, 79.

Biological information: Feeds on *Carex* spp.

16. ***Cicadula* (*Cyperana*) *longiseta* (Van Duzee)*** Western Nearctic

Distribution: Yukon to montane Arizona, low boreal to austral.

Yukon records: B - 67, 75; C - 44, 58, 77.

Biological information: Feeds on *Juncus balticus* Willd.

17. ***Cicadula* (*Cyperana*) *melanogaster* (Provancher)** Nearctic

Distribution: Transcontinental, low boreal.

Yukon records: B - 18, 53; C - 26, 32, 53, 58, 60, 64, 71, 76, 79; Blue Cr.

Biological information: Feeds on *Carex* spp.

Taxonomic notes: Recorded by Beirne and Young (1953) as *C. straminea* (nec Sanders and DeLong; see Hamilton 1983a).

18. ***Cicadula* (*Cyperana*) *ornata* (Melichar)*** Nearctic

Distribution: Yukon to Newfoundland, low boreal.

Yukon records: B - 40.

Biological information: Feeds on *Carex* spp.

19. ***Colladonus* (s.s.) *flavocapitatus* (Van Duzee)** Western Nearctic

Distribution: Pacific coast, and inland Alaska to Colorado, low boreal to Transition zone.

Yukon records: B - 54, 57, 67; C - 1, 4, 26, 32, 41, 49, 55, 60, 62, 67.

Biological information: Feeds on herbaceous plants.

20. ***Colladonus* (s.s.) *waldanus* (Ball)*** Nearctic

Distribution: Alaska to Ontario, low boreal.

Yukon records: C - 10, 26, 32, 38, 62, 72, 89.

Biological information: Host unknown.

21. *Colladonus (Hypospadianus) belli (Uhler)** Western Nearctic
Distribution: Yukon to montane Mexico, low boreal to austral. This is the first record of this species north of central British Columbia (53°N).
Yukon records: B - 26, 60, 81; C - 26, 35, 39, 62.
Biological information: Feeds on herbaceous plants.
22. *Colladonus (H.) torneelus (Zetterstedt)** Palaearctic-Western Nearctic
Distribution: Alaska to British Columbia, and England to Kamchatka (Nast 1972), arctic and alpine tundra to low boreal.
Yukon records: B - 6, 18, 21, 23, 70, 77; C - 13, 15, 18, 20, 39, 67.
Biological information: Hostplant unknown.
Taxonomic notes: Beirne's (1956) record of *C. torneelus* from the Yukon refers to the next species (23).
23. *Colladonus (H.) youngi Nielson* Nearctic
Distribution: Transcontinental, high to low boreal.
Yukon records: A - 6; B - 23, 26, 47, 72, 93; C - 8, 11, 16, 18, 22, 26, 44, 46, 60, 78, 83.
Biological information: Feeds on *Betula* spp., and possibly on other broadleaved plants.
24. *Commellus cedilla Hamilton* Nearctic
Distribution: Alaska to Quebec, Transition zone.
Yukon records: B - 18, 38.
Biological information: Feeds on wheatgrasses (*Agropyron* spp.).
25. *Commellus sexvittatus (Van Duzee)* Western Nearctic
Distribution: Yukon to the Great Plains, Transition zone to austral, in native grasslands.
Yukon records: B - 57, 67.
Biological information: Feeds on wheatgrasses (*Agropyron* spp.).
26. *Cosmotettix bilineatus (Gillette and Baker)** Nearctic
Distribution: Transcontinental, south in mountains to California, low boreal to Transition zone.
Yukon records: B - 75; C - 39, 60, 76.
Biological information: Feeds on *Carex* spp.
27. *Cosmotettix luteocephalus (Sanders and DeLong)** Nearctic
Distribution: Yukon to Newfoundland, low boreal.
Yukon records: C - 4, 62.
Biological information: Feeds on *Carex* spp.
28. *Coulinus uladus Beirne** Nearctic
Distribution: Alaska to Labrador, arctic to subarctic.
Yukon records: A - 1; B - 23, 57, 75, 90.
Biological information: Probably feeds on sedges.
29. *Coulinus usnus Beirne* Holarctic
Distribution: Alaska to Hudson Bay, and Ural Mountains to Siberia (Nast 1972), on arctic and alpine tundra.
Yukon records: B - 1, 3, 5, 6, 9, 23. Beirne (1954) recorded this species from "Aklavik, Northwest Territories, Yukon" based on an erroneous data label, "Aklavik, YT".
Biological information: Probably feeds on sedges.
30. *Cuerna septentrionalis (Walker)* Nearctic
Distribution: Transcontinental, high boreal to Transition zone.
Yukon records: B - 60, 62, 67, 69, 78; C - 26, 52, 55, 62.
Biological information: Feeds on herbaceous plants.
Taxonomic notes: Recorded by Beirne (1956) as *C. striata* (nec Walker; see Hamilton 1970).
31. *Deltocephalus castoreus Ball** Western Nearctic
Distribution: Yukon to montane Colorado, low boreal.
Yukon records: C - 32, 37, 44.

Biological information: Probably feeds on grasses.

32. ***Deltocephalus nigriventer* Sanders and DeLong*** Nearctic

Distribution: Transcontinental, low boreal.

Yukon records: B - 35, 51; C - 32, 62, 86.

Biological information: Probably feeds on grasses.

33. ***Deltocephalus pulicaris* (Fallén)*** Palaearctic-East Beringian

Distribution: Alaska to Yukon, and Algeria to Kurile Is. (Nast 1972), low boreal to Transition zone; also introduced by man into eastern North America.

Yukon records: C - 57–58.

Biological information: Feeds on grasses.

34. ***Dikraneura ossia* Beirne** Western Nearctic

Distribution: Alaska to Manitoba, low boreal.

Yukon records: C - 26.

Biological information: Probably feeds on sedges.

35. ***Dikraneura variata* Hardy** Holarctic

Distribution: Yukon to Manitoba, and England to Siberia, Transition zone.

Yukon records: C - 49; also recorded by Knight (1968) from C - 20 based on an unassociated female of doubtful identity.

Biological information: Probably feeds on grasses.

36. ***Diplocolenus (s.s.) aquilonius* Ross and Hamilton*** East Beringian

Distribution: Alaska (Ross and Hamilton 1970b) to western Yukon, usually on arctic and alpine tundra.

Yukon records: A - 2; C - 3, 16.

Biological information: Feeds on grasses.

37. ***Diplocolenus (s.s.) brevior* Ross and Hamilton** Western Nearctic

Distribution: Yukon to Colorado, low boreal to Transition zone, in native grasslands.

Yukon records: B - 54, 57, 60, 66–67, 74–75; C - 55, 61.

Biological information: Feeds on many grasses.

38. ***Diplocolenus (Verdanus) evansi* (Ashmead)** Nearctic-West Beringian

Distribution: Alaska to Newfoundland, Kamchatka and Kurile Is. (Nast 1972), high to low boreal.

Yukon records: B - 4, 6, 15, 23, 29–33, 35–37, 45–46, 54, 67, 74, 86–87, 92; C - 1–2, 4, 9–10, 12, 17, 19, 22–23, 24, 26–27, 29–32, 36, 44, 62, 68, 89; Chilkat Pass.

Biological information: Feeds on many grasses, and follows roadside verges.

39. ***Doliotettix lunulatus* (Zetterstedt)*** Palaearctic-East Beringian

Distribution: Alaska to Yukon, and England to Siberia (Nast 1972), in North America associated with alpine tundra and coastal habitats, possibly in sedge meadows.

Yukon records: B - 23, 25, 30, 32, 36–37.

Biological information: Feeds on various grasses.

Taxonomic notes: This species was previously recorded from North America (Beirne 1954) in Alaska as *D. pallens* (Zetterstedt).

40. ***Draeculacephala (Carneocephala) angulifera* (Walker)** Nearctic

Distribution: Transcontinental, low boreal.

Yukon records: B - 18, 57, 67; C - 1, 13, 26, 32, 38, 49, 60, 70, 76, 88–89; Aishihik R.

Biological information: Feeds on sedges, *Juncus*, *Carex*, and *Eriophorum*.

Taxonomic notes: Beirne's (1956) *D. noveboracensis* (Fitch) is probably based on a misidentified female of *D. angulifera*.

41. ***Draeculacephala (Carneocephala) borealis* Hamilton** Nearctic
subspecies ***arctoperata* Hamilton** East Beringian

Distribution: Alaska to Mackenzie River of Northwest Territories, low boreal.

Yukon records: B - 41, 81, and (Hamilton 1985) B - 51, 67–68, 75; C - 4, 12, 44, 50, 55, 76, 80, 86, 89.

Biological information: Feeds on grasses.

Taxonomic notes: Recorded by Beirne (1956) as *D. crassicornis* (nec Van Duzee; see Hamilton 1985).

42. *Elymana inornata* (Van Duzee)* Nearctic
Distribution: Transcontinental, low boreal.
Yukon records: C - 32, 62.
Biological information: Feeds on grasses and sedges, *Carex* and *Juncus* spp.
43. *Empoasca* (s.s.) *filamenta* DeLong Nearctic
Distribution: Yukon and British Columbia to Ontario, Transition zone.
Yukon records: C - 26, 60.
Biological information: Feeds on herbaceous plants.
44. *Empoasca* (s.s.) *nigroscuta* Gillette and Baker Nearctic
n. subsp.* East Beringian
Distribution: Alaska to the Yukon, Transition zone in arid areas.
Yukon records: C - 1, 43, 74.
Biological information: Feeds on “arctic sagebrush” *Artemisia frigida* Willd.
Taxonomic notes: The Beringian subspecies is sexually dimorphic, the males being dark-marked as in typical *E. nigroscuta* while the females are unmarked as in *E. typhlocyboides* Gillette and Baker. Its hostplant also differs from those of typical *nigroscuta* and *E. typhlocyboides*, which feed on true sagebrushes, *Artemisia cana* Pursh and *A. tridentata* Nutt.
45. *Empoasca* (s.s.) *ratio* DeLong and Davidson Western Nearctic
Distribution: Yukon to Mexico, Transition zone and montane.
Yukon records: C - 26.
Biological information: Host unknown.
Taxonomic notes: Recorded by Beirne (1956) as *E. convergens* (nec DeLong and Davidson).
46. *Empoasca* (s.s.) *spira* Caldwell and DeLong* Nearctic
Distribution: Yukon, low boreal, and Ohio to Nova Scotia, Transition zone. This is the first record from west of Ohio.
Yukon records: C - 26; Mayo Rd. mi 125.
Biological information: Host unknown.
47. *Empoasca* (*Kybos*) *andresia* Ross* Nearctic
Distribution: Transcontinental, low boreal to Transition zone.
Yukon records: B - 79.
Biological information: Feeds on willows, *Salix* spp.
48. *Empoasca* (*Kybos*) *clinata* Ross* Nearctic
Distribution: Transcontinental, low boreal.
Yukon records: C - 26.
Biological information: Feeds on willows, *Salix* spp.
49. *Empoasca* (*Kybos*) *copula* DeLong* Nearctic
Distribution: Yukon to Newfoundland, south to Arizona in the mountains, low boreal to Transition zone.
Yukon records: B - 81; C - 26, 32, 60.
Biological information: Feeds on aspen, *Populus tremuloides*.
50. *Empoasca* (*Kybos*) *coronata* Hamilton* Nearctic
Distribution: Yukon to Quebec, low boreal to Transition zone.
Yukon records: C - 32.
Biological information: Feeds on aspen, *Populus tremuloides*.
51. *Empoasca* (*Kybos*) *crystola* Ross* Nearctic
Distribution: Alaska to Ontario, low boreal.
Yukon records: B - 33–34, 57, 66–67; C - 7, 19, 26, 60, 88.
Biological information: Feeds on willows, *Salix* spp.
52. *Empoasca* (*Kybos*) *livingstonii* Gillette* Nearctic
Distribution: Yukon to alpine Colorado, low boreal.
Yukon records: B - 33.
Biological information: Feeds on willows, *Salix* spp.

53. ***Empoasca (Kybos) lucidae* Ross*** Nearctic
Distribution: Yukon to California, Transition zone.
Yukon records: C - 26.
Biological information: Feeds on *Salix lasiandra* Benth.
54. ***Empoasca (Kybos) portola* Ross*** Western Nearctic
Distribution: Alaska to California, widely distributed from low boreal to austral.
Yukon records: C - 26.
Biological information: Feeds on balsam poplar, *Populus balsamifera*.
55. ***Empoasca (Kybos) pura* (Stål)*** Nearctic
Distribution: Transcontinental, high to low boreal.
Yukon records: B - 30–31; C - 4, 26, 32, 60, 62.
Biological information: Feeds on willows, *Salix* spp.
56. ***Empoasca (Kybos) sordidula* Ossiannilsson*** Holarctic
Distribution: Alaska to Quebec, and Norway to Russia, high to low boreal.
Yukon records: B - 11, 38, 70, 89; C - 26, 32.
Biological information: Feeds on willows, *Salix* spp.
57. ***Empoasca (Kybos) yukonensis* Ross** Western Nearctic
Distribution: Alaska to British Columbia, low boreal.
Yukon records: C - 26, 62 and (Ross 1963) C - 4.
Biological information: Feeds on willows, *Salix* spp.
Taxonomic notes: Recorded by Beirne (1956) as *E. clypeata* Gillette and Baker (see Ross 1963).
58. ***Euscelis (Morinda) n. sp.**** East Beringian
Distribution: Yukon River system of Alaska and Yukon (MacLean and Hamilton unpublished), low boreal.
Yukon records: B - 14; C - 11, 25.
Biological information: Host unknown.
Taxonomic notes: This is a sister species of the Siberian *Morinda sibirica* Emeljanov (1962).
59. ***Euscelis (Streptanus) hyperborea* Van Duzee** Western Nearctic-West Beringian
Distribution: Alaska to Hudson Bay, and eastern Siberia (Hamilton 1983a), abundant on arctic and alpine tundra, also high boreal.
Yukon records: A - 1, 3; B - 1, 7, 23, 28–29, 36, 37; C - 1, 32–33, 60.
Biological information: Feeds on grasses.
Taxonomic notes: Recorded by Beirne (1956) as *Streptanus marginatus* (Kirschbaum).
60. ***Euscelis (Streptanus) n. sp.*** East Beringian
Distribution: Pacific coast (Skagway, Alaska and Terrace, British Columbia) to Mackenzie Delta, low boreal.
Yukon records: C - 4, 29–30, 32, 89.
Biological information: Feeds on grasses.
Taxonomic notes: Recorded by Beirne (1956) as *Streptanus aemulans* (Kirschbaum) and by Hamilton (1983a) as *E. okaensis* (Zachvatkin).
61. ***Euscelis (Streptanus) relativa* (Gillette and Baker)** Western Nearctic
Distribution: Alaska to mountains of Colorado, low boreal.
Yukon records: C - 56.
Biological information: Feeds on grasses.
Taxonomic notes: Recorded by Sanders and DeLong (1920) as *E. deceptus* Sanders and DeLong (for synonymy, see Hamilton 1983a).
62. ***Forcipata n. sp.**** East Beringian
Distribution: Alaska to Yukon, low boreal.
Yukon records: C - 32.
Biological information: Host unknown.

63. ***Forcipata triquetra* DeLong and Caldwell*** Nearctic
Distribution: Transcontinental, low boreal to Transition zone.
Yukon records: C - 21.
Biological information: Probably feeds on grasses.
64. ***Hardya youngi* Beirne*** East-West Beringian
Distribution: Alaska to Yukon, and Siberia (Nast 1972), on arctic tundra.
Yukon records: B - 13.
Biological information: Feeds on grasses.
65. ***Hebecephalus algidus* (DeLong and Davidson)*** Nearctic
Distribution: Transcontinental, subarctic to high boreal.
Yukon records: B - 12, 19, 23, 33, 38, 80.
Biological information: Feeds on grasses.
66. ***Hebecephalus crassus* Beamer and Tuthill*** Western Nearctic
Distribution: Yukon to Wyoming, Transition zone.
Yukon records: Aishihik River.
Biological information: Feeds on grasses.
67. ***Hebecephalus occidentalis* Beamer and Tuthill*** Western Nearctic
Distribution: Alaska to Manitoba, low boreal to austral, characteristic of native prairie grasslands. Alaskan sites are steep south-facing slopes where steppe conditions persist, and undisturbed natural meadows.
Yukon records: B - 44, 48, 51, 67, 70, 75, 84, 87; C - 1, 32, 44–45, 55.
Biological information: Feeds on many grasses.
68. ***Hebecephalus rostratus* Beamer and Tuthill*** Western Nearctic
Distribution: Alaska to Manitoba, Transition zone; like *H. occidentalis*, it is characteristic of native prairie grasslands.
Yukon records: B - 66.
Biological information: Feeds on grasses.
69. ***Hecalus montanus* (Ball)** Nearctic
Distribution: Alaska to Quebec, south to montane Utah, low boreal to Transition zone.
Yukon records: B - 61; C - 1, 26, 62, 76.
Biological information: Feeds on wheatgrasses, *Agropyron* spp.
Taxonomic notes: Recorded by Beirne (1956) as *Parabolocratius continuus* DeLong.
70. ***Idiocerus* (s.s.) *productus* Gillette and Baker** Nearctic
Distribution: Transcontinental, including Pacific coast, low boreal.
Yukon records: B - 41, 51, 67, 74; C - 4, 26, 32, 49, 54, 60, 62–63.
Biological information: Feeds on willows, *Salix* spp.
71. ***Idiocerus* (s.s.) *striolus* (Fieber)*** Nearctic
Distribution: Pacific coast, inland Alaska to Ontario, and Newfoundland, low boreal.
Yukon records: B - 74; C - 4, 26.
Biological information: Feeds on willows, *Salix* spp.
72. ***Idiocerus* (s.s.) *xanthiops* Hamilton** Nearctic
Distribution: Transcontinental, subarctic to high boreal.
Yukon records: B -56, and (Hamilton 1980) B - 43, 59, 63; C - 4, 32, 34, 60.
Biological information: Feeds on willows, *Salix* spp.
Taxonomic notes: Recorded by Beirne (1956) as *I. alternatus* (nec Fitch; see Hamilton 1980).
73. ***Idiocerus* (*Populicerus*) *lachrymalis* Fitch*** Nearctic
Distribution: Transcontinental, low boreal to Transition zone.
Yukon records: B - 74; C - 26, 49, 63.
Biological information: Feeds on aspen, *Populus tremuloides*.
74. ***Idiocerus* (*Populicerus*) *maximus* Freytag*** Nearctic
Distribution: Alaska to Colorado, and Quebec, low boreal to Transition zone.

Yukon records: B - 71, 75; C - 26, 32, 49.

Biological information: Feeds on aspen, *Populus tremuloides*.

75. ***Idiocerus (Populicerus) midas* Hamilton** Nearctic

Distribution: Yukon to Nova Scotia, low boreal.

Yukon records: Carmacks-Mayo Rd. mi 213 and (Hamilton 1980) C - 26, 49.

Biological information: Feeds on balsam poplar, *Populus balsamifera*.

76. ***Idiocerus (Populicerus) venosus* Hamilton*** Nearctic

Distribution: Yukon to Newfoundland, south to montane Arizona, high to low boreal.

Yukon records: B - 52.

Biological information: Feeds on balsam poplar, *Populus balsamifera*.

77. ***Idiodonus aurantiacus* (Provancher)** Nearctic

Distribution: Alaska to New Hampshire, low boreal.

Yukon records: B - 17, 74; C - 4, 32, 35.

Biological information: Reported to feed on various broadleaved plants, including *Alnus* and *Arctostaphylos*.

78. ***Kyboasca atrolabes* (Gillette)*** Nearctic

Distribution: Alaska to Nova Scotia, low boreal to Transition zone.

Yukon records: C - 26, 39.

Biological information: Feeds on alders, *Alnus* spp.

79. ***Kyboasca simplex* (DeLong and Davidson)*** Western Nearctic

Distribution: Alaska to Saskatchewan, widely distributed from low boreal to austral.

Yukon records: C - 49, 60.

Biological information: Probably feeds on willow, *Salix* sp.

80. ***Latalus (Adarrus) sobrinus* DeLong and Slesman*** Nearctic

Distribution: Yukon to Newfoundland, low boreal.

Yukon records: B - 35, 67, 75, 82; C - 30, 35.

Biological information: Feeds on grasses.

81. ***Latalus (Adarrus) tatraensis* Heller** Palaearctic-East Beringian

Distribution: Pacific coast of Alaska to the Mackenzie Delta, and mountains of Czechoslovakia (Heller 1975), high boreal.

Yukon records: B - 31, 35–36; C - 32, 40, 73, 78; Chilkat Pass 3200 ft.

Biological information: Feeds on bluejoint grass, *Calamagrostis* spp.

Taxonomic notes: This is the first record of *L. tatraensis* from North America. Recorded by Beirne (1956) as *Errastunus ocellaris* (Fallén).

82. ***Latalus (Quontus) missellus* (Ball)** Western Nearctic

Distribution: Alaska to Colorado, low boreal to Transition zone.

Yukon records: B - 19, 51, 67, 75, 78; C - 1, 4, 26, 36, 39, 43–44, 49, 62, 68; Aishihik R.

Biological information: Feeds on grasses.

83. ***Limotettix* (s.s.) *ferganensis* Dubovsky*** Holarctic

Distribution: Alaska to Quebec, south to Texas, and Uzbekistan (Hamilton 1983a), low boreal to austral.

Yukon records: B - 74.

Biological information: Feeds on spikerush, *Eleocharis* spp.

84. ***Limotettix* (s.s.) *sphagneticus* Emeljanov*** Holarctic

Distribution: Transcontinental in North America, and Siberia (Nast 1972), low boreal.

Yukon records: B - 27; C - 32, 41.

Biological information: Feeds on sedges, *Carex* and *Juncus* spp.

85. ***Limotettix* (*Ophiolix*) *angustatus* (Osborn)** Nearctic

Distribution: Yukon to Newfoundland, low boreal.

Yukon records: C - 89.

Biological information: Feeds on *Carex* spp.

86. *Limotettix (Ophiolix) paludosus (Boheman)** Nearctic
Distribution: Transcontinental, low boreal.
Yukon records: B - 87; C - 26, 41, 49.
Biological information: Feeds on *Carex* spp.
87. *Limotettix (Scleroracus) arctostaphyli (Ball)** Nearctic
Distribution: Transcontinental, high to low boreal.
Yukon records: B - 6, 15–16, 19, 57, 60, 74, 88, 91; C - 1, 7, 32, 60, 63.
Biological information: Feeds on bearberry, *Arctostaphylos uva-ursi* (L.) Spreng.
88. *Limotettix (Scleroracus) dasidus (Medler)** Nearctic
Distribution: Transcontinental, high to low boreal.
Yukon records: B - 23, 44, 91; C - 10, 32, 36, 44, 55, 60, 62, 72, 78.
Biological information: Probably feeds on *Vaccinium* spp.
89. *Limotettix (Scleroracus) instabilis (Van Duzee)** Nearctic
Distribution: Arctic Alaska, and Yukon to Newfoundland, in low boreal and Transition zone.
Yukon records: C - 21.
Biological information: Host unknown.
90. *Limotettix (Scleroracus) osborni (Ball)** Nearctic
Distribution: Yukon and Nova Scotia, Transition zone.
Yukon records: B - 55.
Biological information: Feeds on Asteraceae.
91. *Limotettix (Scleroracus) plutonius (Uhler)** Nearctic
Distribution: Transcontinental, low boreal.
Yukon records: B - 8, 19, 40.
Biological information: Host unknown.
92. *Limotettix (Scleroracus) scudderi Hamilton* East Beringian
Distribution: Known only from Yukon, low boreal.
Yukon records: C - 75 (Hamilton 1995).
Biological information: Host unknown.
93. *Macropsis (Neomacropsis) basalis (Van Duzee)* Nearctic
Distribution: Transcontinental, low boreal to Transition zone, south to mountains of Arizona.
Yukon records: C - 26, 32, 52, 62.
Biological information: Feeds on aspen, *Populus tremuloides*.
94. *Macropsis (Neomacropsis) borealis Hamilton* Western Nearctic
Distribution: Alaska to western Ontario, low boreal, south in mountains to Colorado.
Yukon records: B - 41; C - 26, 28, 86, 88; Klondike Hwy. km. 690.
Biological information: Feeds on willows, *Salix* spp.
Taxonomic notes: Recorded by Beirne (1956) as *M. sordida* (Van Duzee) (see Hamilton 1983b).
95. *Macropsis (Neomacropsis) robusta Breakey* Nearctic
Distribution: Transcontinental, low boreal to Transition zone.
Yukon records: B - 42; C - 32.
Biological information: Feeds on willows, *Salix* spp.
96. *Macropsis (Neomacropsis) vinea Hamilton* Nearctic
Distribution: New York to Alaska, low boreal to Transition zone.
Yukon records: C - 89.
Biological information: Feeds on willows, *Salix* spp.
97. *Macrosteles (s.s.) alpinus (Zetterstedt)** Holarctic
Distribution: Circumpolar, on subarctic to arctic and alpine tundra.
Yukon records: B - 2.
Biological information: Probably feeds on *Juncus* sp.

98. **Macrosteles (s.s.) borealis (Dorst)** Nearctic
Distribution: Transcontinental, high to low boreal.
Yukon records: B - 32–33, 38, 54, 70, 79; C - 32, 49, 60, 62, 89.
Biological information: Feeds on horsetails, *Equisetum* spp.
99. **Macrosteles (s.s.) fascifrons (Stål)** Nearctic-West Beringian
Distribution: Transcontinental in North America, and eastern Siberia, high to low boreal.
Yukon records: B - 54, 70, 84; C - 1, 10, 26, 32, 60, 66, 89.
Biological information: Feeds on *Juncus* spp.
100. **Macrosteles (s.s.) fieberi (Edwards)** Holarctic
Distribution: Circumpolar, low boreal.
Yukon records: B - 39 (Beirne 1952).
Biological information: Feeds on *Carex* spp.
101. **Macrosteles (s.s.) inundatus Hamilton*** Nearctic
Distribution: Alaska to the Yukon, and Quebec to Newfoundland, low boreal.
Yukon records: C - 89.
Biological information: Feeds on herbaceous plants.
102. **Macrosteles (s.s.) laevis (Ribaut)*** Palaearctic-East Beringian
Distribution: Pacific coast, Yukon and Iceland to Kurile Is. (Nast 1972), low boreal.
Yukon records: B - 51, 70, 77, 84; C - 26, 60.
Biological information: Feeds on grasses.
103. **Macrosteles (s.s.) slossonae (Van Duzee)*** Nearctic
Distribution: Yukon, and Wisconsin to Nova Scotia, low boreal to Transition zone; also reported from British Columbia (Downes 1927).
Yukon records: C - 38.
Biological information: Feeds on *Juncus* spp.
104. **Macrosteles (s.s.) tessellatus Hamilton** Nearctic
Distribution: Transcontinental, subarctic to low boreal.
Yukon records: C - 43. Described from the Yukon (Hamilton 1983a).
Biological information: Feeds on *Juncus* spp.
105. **Macrosteles (s.s.) n. sp. A*** Nearctic
Distribution: Yukon to New Brunswick, low boreal.
Yukon records: B - 53.
Biological information: Feeds on *Juncus* sp.
106. **Macrosteles (s.s.) n. sp. B** Western Nearctic
Distribution: Yukon to Manitoba, low boreal.
Yukon records: C - 89.
Biological information: Host unknown.
Taxonomic notes: Recorded by Beirne (1956) as *M. variata* (Fallén).
107. **Macrosteles (s.s.) n. sp. C*** Nearctic
Distribution: Alaska to Yukon, and northern Quebec, coastal tundra to low boreal.
Yukon records: B - 91; C - 26.
Biological information: Host unknown.
108. **Macrosteles (Sonronius) binotatus (Sahlberg)** Holarctic
Distribution: Circumpolar, subarctic to low boreal.
Yukon records: B - 42, 51, 70, 79; C - 26, 32, 49, 60, 89; Chilkat Pass.
Biological information: Probably feeds on sedges.
Taxonomic notes: Recorded by Beirne (1956) as *M. arcuata* (Gillette and Baker).
109. **Macrosteles (Sonronius) maculipes (Zetterstedt)** Holarctic
 subspecies **laetus (Uhler)** Western Nearctic
Distribution: Yukon to mountains of California, subarctic to low boreal, and coastal tundra of Alaska; probably also in Siberia.

Yukon records: B - 30, 33, 37, 84; C - 26, 32, 60, 62, 88; Chilkat Pass.

Biological information: Probably feeds on *Epilobium* sp.

Taxonomic notes: Differs from typical *M. maculipes* (boreal Europe, Labrador, Quebec) in having narrower tegmina. Recorded by Beirne (1956) as *M. dahlborni* (Zetterstedt).

110. ***Mocuellus strictus* Ross and Hamilton** Cordilleran

Distribution: Yukon to northern Alberta, low boreal, in native grasslands.

Yukon records: C - 55 and (Ross and Hamilton 1970b) B - 53.

Biological information: Probably feeds on western wheatgrass, *Agropyron smithii* Rydb.

111. ***Notus sitka* (DeLong and Caldwell)*** Holarctic

Distribution: Alaska to Hudson Bay, and Altai Mountains to the Pacific (Nast 1972), subarctic to high boreal.

Yukon records: B - 6; C - 26, 32, 66.

Biological information: Probably feeds on grasses and sedges.

112. ***Oncopsis albicollis* Hamilton** East Beringian

Distribution: Alaska to northern British Columbia, high to low boreal.

Yukon records: A - 6, 16; C - 1, 10, 25–26, 32, 34, 49, 62, 69; Haldane, Klondike Hwy. km 690.

Biological information: Feeds on birches, *Betula* spp.

Taxonomic notes: Recorded by Beirne (1956) as *O. coloradensis* (nec Baker; see Hamilton 1983b).

113. ***Oncopsis cinctifrons* (Provancher)** Nearctic

Distribution: Pacific coast of Alaska (Kenai Peninsula) to Quebec, high boreal to Transition zone.

Yukon records: B - 6, 18, 83; C - 1, 4, 26, 61, 68, 86.

Biological information: Feeds on birches, *Betula* spp.

Taxonomic notes: Recorded by Beirne (1956) as *O. minor* Fitch (see Hamilton 1983b).

114. ***Oncopsis crispae* Hamilton** Nearctic

Distribution: Transcontinental, including Pacific coast, low boreal.

Yukon records: C - 86.

Biological information: Feeds on green alder, *Alnus crispa* (Ait.) Pursh.

115. ***Oncopsis interior* Hamilton** Western Nearctic

Distribution: Alaska to montane Colorado, low boreal.

Yukon records: C - 87.

Biological information: Feeds on thinleaf alder, *Alnus tenuifolia* Nutt.

116. ***Oncopsis monticola* Hamilton*** Western Nearctic

Distribution: Alaska to southern British Columbia, high to low boreal.

Yukon records: B - 18.

Biological information: Feeds on Sitka alder, *Alnus sinuata* (Reg.) Rydb.

117. ***Orocastus tener* (Beamer and Tuthill)*** Western Nearctic

Distribution: Yukon to Colorado, Transition zone to austral, on native grasslands.

Yukon records: B - 51, 74; C - 30, 49.

Biological information: Feeds on grasses.

118. ***Paluda gladiola* (Ball)*** Nearctic

Distribution: Transcontinental, low boreal to austral.

Yukon records: B - 66, 70; C - 26, 32.

Biological information: Feeds on grasses and sedges, *Carex* and *Juncus* spp.

119. ***Paraphlepsius (Paraphysius) lascivius* (Ball)*** Western Nearctic

Distribution: Yukon and Northwest Territories to Arizona, in Transition zone to austral grasslands.

Yukon records: C - 30, 39, 45, 68, 72.

Biological information: Host unknown.

120. ***Paraphlepsius (Sabix) apertus* (Van Duzee)** Nearctic

Distribution: Transcontinental, including Pacific coast, low boreal to austral.

Yukon records: B - 44, 48, 51, 54, 57, 66–67, 74–75, 79, 82, 92; C - 26–27, 30, 32, 36, 39, 44, 77, 82, 89.

Biological information: Feeds on *Carex* and other sedges.

121. ***Pasaremus concentricus* (Van Duzee)*** Nearctic

Distribution: Yukon to Nova Scotia, Transition zone.

Yukon records: B - 58, 75; C - 43–44, 58.

Biological information: Feeds on Baltic rush, *Juncus balticus* Willd.

122. ***Psammotettix confinis* (Dahlbom)*** Holarctic

Distribution: Yukon, Northwest Territories, Quebec, and Ireland to Mongolia (Nast 1972), low boreal to Transition zone.

Yukon records: B - 24, 84; C - 26, 32, 39, 60, 89.

Biological information: Feeds on grasses.

123. ***Psammotettix knullae* Greene*** Nearctic

Distribution: Alaska to Ontario, low boreal to austral.

Yukon records: C - 49.

Biological information: Feeds on grasses.

124. ***Psammotettix lapponicus* (Ossiannilsson)*** Holarctic

Distribution: Alaska to Manitoba, and Sweden to Siberia (Nast 1972), arctic and alpine tundra to subarctic.

Yukon records: B - 1, 6.

Biological information: Feeds on grasses.

125. ***Psammotettix latipex* (DeLong and Davidson)** Western Nearctic

Distribution: Alaska to Manitoba, occurring in all climate zones, from arctic and alpine tundra to austral.

Yukon records: A - 1, 4; B - 11–12, 16, 18–19, 22, 23, 44, 51, 54, 86; C - 10, 12, 22, 26, 30, 32, 35–36, 38–40, 43–46, 49, 62, 78, 88–89.

Biological information: Feeds on many grasses in many habitats.

Taxonomic notes: Recorded by Beirne (1956) as *P. alienus* (Dahlbom).

126. ***Psammotettix lividellus* (Zetterstedt)** Nearctic-West Beringian

Distribution: Transcontinental; described from Greenland, and taken recently in arctic West Beringia.

Yukon records: B - 30, 67; C - 32, 38, 56, 76, southern subspecies from B - 51, 79; Marsh Lake.

Biological information: Feeds on grasses.

Taxonomic notes: There appear to be 2 subspecies, apparently hybridizing in the Yukon. Typical *P. lividellus* has shorter tegmina and a wider aedeagal shaft apex than the southern subspecies; it is usually on arctic and alpine tundra to high boreal in Alaska to northern Quebec, Baffin Island, Greenland, in mountains south to the St. Lawrence River, and Siberia. The southern subspecies ranges from the Transition zone to the austral zone. In southern valleys of the Yukon this species is morphologically like typical *lividellus* yet inhabits the low boreal zone.

127. ***Psammotettix n. sp.**** East Beringian

Distribution: Known in Yukon only from sand dunes near the southern border, possibly in a Transition zone site.

Yukon records: B - 74.

Biological information: Feeds on grasses.

Taxonomic notes: A long-winged form, possibly subspecifically distinct, is known only from the shores of the Great Lakes.

128. ***Rosenus transarcticus* Hamilton** East-West Beringian

Distribution: Alaska to Mackenzie Delta, from subarctic to arctic and alpine tundra, and recently confirmed from arctic West Beringia.

Yukon records: C - 4, 23; Chilkat Pass.

Biological information: Feeds on grasses.

Taxonomic notes: Recorded by Beirne (1956) as *R. cruciatus* (see Hamilton and Ross 1975).

129. ***Rosenus pendulus* Hamilton and Ross** East Beringian

Distribution: Alaska to Northwest Territories, low boreal.

Yukon records: C - 26, 40, 47 and (Hamilton and Ross 1975) B - 51, 53; Chilkat Pass.

141. ***Typhlocyba (Edwardsiana) expanda* DeLong and Johnson*** Western Nearctic
Distribution: Alaska to Colorado, low boreal.
Yukon records: B - 74; C - 49, 60.
Biological information: Host unknown.
142. ***Typhlocyba (Edwardsiana) tersa* Ribaut** Holarctic
 subspecies ***frigida* Hamilton** Nearctic
Distribution: Alaska to Alberta, and Newfoundland, mainly low boreal but also in Transition zone foothills of Alberta.
Yukon records: B - 67; C - 32, 89.
Biological information: Feeds on hoary willow, *Salix candida* Fluegge.
Taxonomic notes: Reported (Beirne 1956) as *T. kemneri* (nec Ossianilsson).
143. ***Typhlocyba (Empoa) latifasciata* (Christian)*** Nearctic
Distribution: Transcontinental, subarctic to Transition zone.
Yukon records: B - 65; C - 32, 62.
Biological information: Feeds on alders, *Alnus* spp.
144. ***Typhlocyba (Empoa) spinosa* Beamer*** Western Nearctic
Distribution: Alaska to Colorado, low boreal.
Yukon records: C - 26, 32, 42, 48, 60, 62.
Biological information: Feeds on dwarf birches, *Betula glandulifera* (Regel) Butler and *B. glandulosa* Michx.
145. ***Typhlocyba (Zonocyba) pomaria* McAtee*** Nearctic
Distribution: Transcontinental, low boreal to austral.
Yukon records: C - 26.
Biological information: Feeds on a wide range of broadleaved trees (including *Alnus*, *Populus*).

Boreal Leafhoppers Presumed to Occur in the Yukon Territory

146. *Aceratagallia siccifolia* (Uhler). Pacific coast of Alaska to the Yukon and Tanana River valleys near the Yukon border.
147. *Cicadula junea* Hamilton. Alaska and Saskatchewan to Manitoba.
148. *Cosmotettix paludosus* (Ball). Alaska and British Columbia to Ontario.
149. *Cosmotettix* n. sp. Circle Hot Springs, Alaska.
150. *Dikraneura mali* (Provancher). Alaska and Saskatchewan to Nova Scotia.
151. *Empoasca* (s.s.) *deluda* DeLong. Alaska and the Northwest Territories to New Brunswick.
152. *Empoasca* (*Kybos*) *zaisanensis* Dubovsky. Alaska and the Northwest Territories to New Brunswick.
153. *Euscelis* (*Macustus*) *alpina* Ball. Alaska and British Columbia to Newfoundland.
154. *Euscelis* (*Streptanus*) *confinis* (Reuter). Alaska and British Columbia to Newfoundland.
155. *Forcipata acclina* DeLong and Caldwell. Alaska and British Columbia to Newfoundland.
156. *Forcipata citrinella* (Zetterstedt). Ranges within 70 km of the Alaska-Yukon border (longitude 142°W) in the Yukon and Tanana River valleys in central Alaska.
157. *Hebecephalus beameri* Hamilton and Ross. Known only from a single small sample taken near longitude 147°W on a steep hillside along the Tanana River (Hamilton and Ross 1972); it is to be expected elsewhere in the valley.
158. *Idiocerus couleanus* Ball and Parker. Alaska and British Columbia.
159. *Limotettix* (*Scleroracus*) *myralis* (Medler). Alaska and Alberta to Michigan.
160. *Macrosteles* (s.s.) *potorius* (Ball). Alaska and Alberta to Quebec.
161. *Macrosteles* (s.s.) *sordidipennis* (Stål). Alaska and British Columbia to Saskatchewan.
162. *Macrosteles* (s.s.) *vilbastei* Hamilton. Alaska and British Columbia to Nova Scotia.
163. *Macrosteles* (s.s.) n. sp. D. Alaska and the Northwest Territories to Quebec.
164. *Rosenus decurvus* Hamilton and Ross. Northeastern British Columbia only.
165. *Typhlocyba* (*Empoa*) *gillettei* (Van Duzee). Alaska and the Northwest Territories to Newfoundland.
166. *Typhlocyba* (*Zonocyba*) *hockingensis* Knull. Alaska and British Columbia to Newfoundland.

Distribution

The known leafhopper fauna of the Yukon is larger and more diverse than expected, has distinct zones, and contains many interesting elements, including both endemic species and extreme range extensions.

Diversity. Estimates for the Yukon leafhopper fauna may seem to be rather premature due to the large areas of the Yukon that are still not well collected. However, inadequately sampled areas are mostly at high elevation where the fauna is rather limited and uniform. No additional alpine and subalpine species are known from areas adjacent to the Yukon, so none is expected from this part of the Territory.

At low elevations there are 130 species known to inhabit Transition zone and low boreal regions. Twenty-one others from adjacent areas, and therefore of probable occurrence in the Yukon, are noted. Sampling has deliberately focussed on these areas, particularly where summer conditions are warm. Therefore, only a few endemic species and range disjunctions are expected to be discovered in future work.

The high boreal region is inhabited almost exclusively by overlapping elements of the southerly and northerly faunas. Only a single species is known to be peculiar to this region. No additional species are expected from this region.

The arctic coast and Pacific coast forest are the only areas of the Yukon that especially need more detailed work. Several endemic species have been found in the arctic, and postglacial fossils show that others have lived there in the Holocene, and may continue to do so. The Pacific coast forest is confined to 2 small, isolated valleys in the southwest of the Territory. The Tatshenshini River valley is above 1000 m ASL by the time it reaches the Yukon, which suggests a boreal flora. The Alsek River begins in the Yukon at low elevation (400 m ASL), rising rapidly to more than 1000 m ASL. Neither valley in the Yukon has been sampled for leafhoppers, but the elevation of the lower Alsek River assures a coastal rainforest flora, with potential additions to the Yukon leafhopper fauna. A single series taken from near the mouth of the Alsek River (in British Columbia) represents an unknown taxon of *Limotettix*, subgenus *Scleroracus*.

These considerations taken together suggest that at least 80% of the actual leafhopper fauna is known. To date, 145 leafhopper species are known to occur in the Yukon. An estimation of the total leafhopper fauna can be based on known species together with species that occur in adjacent areas. This comes to 166 species, suggesting that 87% of the total fauna is now known.

The faunal diversity in the Yukon is very similar to that of Alaska (151 known leafhopper species and an estimated total of 163 species). This northwestern fauna is distinctly richer in species than that of northeastern North America, represented by the faunas of Newfoundland and Labrador (114 species). In part this is due to temperature differences. Thus, Cape Breton Island in Nova Scotia lies at a latitude of only 3° to the south of Labrador, yet due to its milder climate has at least 162 native species (Hamilton and Langor 1987) in an area one sixth that of Newfoundland and one hundredth that of Alaska. Nowhere in the Yukon are there mild winters, but maximum summer temperatures in the valleys of the Yukon are more than 2°C higher than those of central Newfoundland and probably foster greater species diversity.

Temperature alone cannot account for this diversity. The Yukon fauna also is enriched by leafhopper species from different glacial-age refugia. The presence of a diverse intermontane fauna in British Columbia that has invaded the Yukon after the Pleistocene accounts

for a large part of this richness. Likewise, there is an Old World fauna that has invaded North America across the Bering Strait. The faunas of Alaska and the Yukon also have many endemic species that appear to have survived the Pleistocene in North America north of the ice-sheets.

Zonation. The composition of the Yukon leafhopper fauna shows both latitudinal and longitudinal distribution patterns (Table 2). These patterns apparently differ for leafhopper faunas of diverse origins, suggesting different responses to climate change.

Latitudinal Zonation. All 5 life zones of the Yukon (Transition zone to low arctic) are inhabited by leafhoppers, with many species having distributions that overlap a number of zones. By far the greatest proportion of the Yukon leafhopper fauna (88%) is found in the 2 most southerly zones (Transition zone and low boreal). Only 23% inhabit the high boreal zone, while 13% are found in the subarctic and 10% in the arctic/alpine zones (Table 2). This does not reflect a smooth diminishing northward of a southern fauna; rather, the species each inhabit adjacent life zones in an overlapping, banded pattern. Most species inhabit 1–3 such zones; 4 species (2, 22, 107, 143) overlap across 4 zones. Only 2 are found throughout the north: *Psammotettix latipex* (125) ranges from Colorado to the Yukon and is found in all life zones from austral to arctic, which suggests that adults are transported by summer winds from the south; *Psammotettix lividellus* (126) has 2 hybridizing subspecies, one being found in boreal to austral situations, while the other is characteristic of high boreal to arctic zones.

The austral fauna therefore attenuates through the Transition zone and low boreal zones (21 Nearctic species diminishing to 16, represented in the high boreal to arctic by 2 species and in the subarctic to arctic by a single wind-blown species), while the Transition zone fauna similarly attenuates through the boreal zone (44 Nearctic species decreasing through 33 species in the low boreal to 5 in the high boreal and one in the subarctic).

Almost half of the total Yukon leafhopper fauna (66 species or 48%) occurs in the Transition zone. Eleven of these species are found only in this zone, and apparently are restricted to the valleys with the mildest climate; a number of them are characteristic of sun-warmed south-facing slopes. The remainder are largely species that also live in boreal Yukon.

More than three-quarters of the Yukon leafhopper fauna (119 species or 82% of the known fauna) inhabit the low and high boreal zones, which occupy most of the Yukon. This is a larger proportion even than on insular Newfoundland, which is mostly boreal territory (Hamilton and Langor 1987); there, 48% of the native leafhopper fauna is boreal. Fully 61 species (42% of the Yukon fauna) is exclusively boreal and 44 species are endemic to a single boreal zone. Most of these species are low boreal; only one, *Latalus tatraensis* (81), is restricted to the high boreal zone.

A small proportion (20 species or 13% of the fauna) occurs in the subarctic. Only one species, *Coulinus uladus* (28), occurs mainly in this zone although it has been found also on arctic tundra at Tuktoyaktuk and Herschel Island. Most subarctic leafhoppers are found also in the low arctic, while 3 range from the arctic to the high boreal zone. The subarctic leafhopper fauna shares much of its fauna with the arctic, and has a similarly high proportion of Holarctic species; it is therefore more closely akin to the tundra fauna than to the boreal fauna. Treeline apparently has little effect on leafhoppers which at that latitude feed mainly on sedges and grasses.

Even fewer leafhoppers (15 species or 10% of the fauna) inhabit the arctic and alpine tundras. Four species (5, 36, 39, 64) are exclusively tundra-inhabiting. Only 2 circumpolar

TABLE 2. Yukon leafhopper distributions (species listed by number). "Holarctic" indicates species widespread in Eurasia, and does not include North American species that also occur in easternmost Siberia; these are marked with a plus sign [+]. "Widespread" refers to their North American distributions. Species that occur in only one life zone are boldfaced; those that appear in more than 2 are italicized.

East-West distribution:	Holarctic		Nearctic		Beringian
	Widespread	Western North American	Widespread	Western North American	
North-South distribution	11 (8%)	9 (6%)	71 (49%)	38 (26%)	16 (11%)
Arctic (10%)	<i>15, 97</i>	22, 39 , 124	28, <i>107?</i> , <i>126+</i> ,	29+, <i>125</i>	5, 36 , 59+, 64+ , 128+
Subarctic (13%)	<i>15, 97, 108</i>	<i>14, 22, 124</i>	28, 65, 72, <i>104, 107, 126+, 143</i>	29+, <i>109+?</i> , 111+, <i>125</i>	6, 59+, 128+
High boreal (23%)	<i>15, 56, 108, 131, 137</i>	<i>14, 22, 81</i>	23, 30, 38+, 55, 65, 72, 76, 87, 88, 98, 99+, <i>104, 107, 113, 126+, 134, 136, 143</i>	2, <i>109+?</i> , 111+, 116, <i>125</i>	6, 59+, 112
Low boreal (77%)	9, 11, 56, 83, 100 , <i>108, 122, 131, 137</i>	3, <i>14, 22, 33, 102</i>	1, 4, 13, 17, 18, 20 , 23, 26, 27 , 30, 32 , 38+, 40, 42 , 46, 47, 48 , 49, 50, 51 , 55, 63, 69, 70 , 71 , 73, 74, 75 , 76, 77, 78, 80, 84+ , 85, 86 , 87, 88, 89, 91 , 93, 95, 96, 98, 99+, 101 , 103, <i>104, 105, 107, 113, 114, 118, 120, 123, 126+, 132, 133, 134-136, 139, 143, 145</i>	2, 10 , 16, 19, 21, 31, 34, 37, 52, 54, 57, 61, 67, 79, 82, 94, 106, 109+?, 110, 115, 116, <i>125, 130, 138, 140, 141, 142, 144</i>	41, 58, 60, 62, 92 , 112, 129
Transition (45%)	9, 11, 83, 122, <i>137</i>	3, 33, 35	1, 4, 24 , 26, <i>30, 43, 46, 47, 49, 50, 63, 69, 73, 74, 78, 89, 90, 93, 95, 96, 103, 113, 118, 120, 121, 123, 126+, 134-136, 139, 142, 143, 145</i>	2, 7, 8, 16, 19, 21, 25, 37, 45, 53, 54, 66, 67, 68, 79, 82, 117, 119, 125, 130, 138, 140	12, 44 , 127
Austral (outside Yukon)	83	—	<i>118, 120, 123, 126+, 135, 136, 145</i>	2, 7, 8, 16, 21, 25, 54, 67, 79, 117, 119, 125, 130, 138	—

species (124 and 126) inhabit the tundra far beyond treeline in other parts of Canada, including southern Baffin Island.

Most Beringian leafhoppers are endemic to a single life zone (13 species or 76% of the endemic fauna). Two range from the arctic to subarctic (128) and from the high to low boreal (112) while only one, *Euscelis hyperborea* (59), ranges across 3 life zones, from the arctic to the high boreal.

Longitudinal Zonation. More than half of the Yukon leafhopper fauna (82 species) is composed of species that are widespread across North America. This widespread Nearctic component of the Yukon fauna is largely a low boreal fauna which overlaps into adjacent life zones: 23 of the 62 widespread low boreal species are endemic to that zone. By contrast, only 5 widespread species are endemic to the Transition zone and 7 range from the austral zone into the Transition zone.

The western fauna, which represents 37% of the Yukon leafhoppers (54 species) is also dominated by low boreal species, with considerable overlap across adjacent zones. Presumably the western boreal fauna came north more rapidly than the eastern fauna, as it had a shorter distance to travel. One significant exception must be noted in passing: leafhoppers on birch (*Oncopsis* spp. on *Betula* spp.; see Hamilton 1983b) in the Yukon are all derived from the widespread fauna, and not from the western fauna. Apparently boreal birches repopulated the Yukon from an eastern North American refugium long before the austral and Transition zone species of the west began spreading northward. The low boreal zone has greater floristic uniformity than the Transition zone, which may have permitted comparatively easier southeast-to-northwest migration and settlement of formerly glaciated areas. There is also reason to believe that wind-blown seeds (such as those of birch) were rapidly transported northwestward by strong winds along the melting ice front ca. 10 500 years ago, as spruce forests also migrated very rapidly at that time (Ritchie 1976).

The western leafhopper fauna differs significantly from the widespread fauna in having a greater proportion of species that range from austral areas of the continent into the Transition zone. Presumably this influx of western austral species reflects the floristic similarity of the Transition zone in the Yukon to regions immediately southward, compared to the floristic disparity between these zones on the prairies (cool-season grasses dominate northern prairies, while warm-season grasses dominate southern prairies).

Origins. The Nearctic fauna is thought to have come largely from a southern refugium. If so, its leafhopper component has not been very effective in invading northern areas. In the Yukon the low boreal zone has the largest number of Nearctic species (98), of which 41 are restricted to that life zone (Table 2). The number of Nearctic species dwindles rapidly through high boreal (27 species) and subarctic zones (14 species), and a mere remnant is found in arctic/alpine areas (7 species other than endemic arctic species). This may reflect an inability to adapt to more rigorous climate conditions.

Conversely, the Yukon fauna of endemic species (from a Beringian refugium) and Holarctic species that probably came from (or through) the same area to invade glaciated parts of North America attenuates southward. This attenuation is much less dramatic than the northward attenuation of the Nearctic fauna, and is not evenly expressed down through the various life zones. The total number of species does not diminish until the Transition zone (which area is very limited in the Yukon), and actually increases in the boreal zone. Instead, the attenuation is expressed only as a decreasing proportion of Holarctic or endemic species, reflecting only the large number of Nearctic species that did not travel northward.

Dispersal

Many northern leafhoppers are not found over the entire area to which they are adapted. Examples of ranges that terminate in the Yukon are considered first in the analysis. These are ranges that do not correspond to climatic zones or host ranges and probably reflect the insect's inability to disperse rapidly over long distances.

When the glaciers had retreated from the Yukon lowlands by 10 000 years ago vast tracts of unvegetated country were exposed across Canada. Spruce forests are thought to have recolonized these areas rapidly; other plants and their associated insects followed after, sometimes thousands of years later (Matthews 1979). Boreal leafhoppers, following after such a spruce forest invasion from the south, present the simplest distributional patterns and are considered next in the analysis. Leafhoppers from the far north present a different picture which yields information on dispersal rates. Once these faunas are understood, the perplexing distributions of Transition zone leafhoppers in the Yukon may be addressed, and the significance of endemism analysed.

Range Limits. The Yukon has few natural boundaries. The St. Elias Mountains are restricted to the extreme southwest and the Beaufort Sea forms the narrow northern coast. The Selwyn and Mackenzie mountain ranges to the east do not form a continuous barrier, nor do deep intermontane valleys seem to prevent dispersal of leafhoppers. The Territory thus has no internal division, and serves as a broad zone of overlap for northern, eastern, southern and western species.

It is hard to determine which species widespread in North America have their farthest northerly distribution in the Yukon, given the very few collecting sites scattered through northern regions. Ten species, however, have such striking northerly extensions as to make them worthy of special note: 6 prairie species (7, 8, 25, 37, 66, 117) reach their northern limits in the Yukon, and 4 other species represent extreme northern extensions of montane faunas (16, 21, 31, 52).

The only species to reach their eastern limits in the Yukon, other than endemic species, are 3 that are widespread in the Old World and also traverse Alaska (33, 39, 64).

Species that reach their southernmost range in the Yukon are either endemic (5, 6, 12, 44, 92, 129) or East-West Beringian (59, 128). More widely distributed species become more southerly the farther east they go, following the general southeastward trend of life zones in western Canada.

Seventeen widespread Nearctic species, mostly in the boreal zone, reach their western or northwestern limits in the Yukon (18, 27, 43, 49, 50, 53, 75, 76, 80, 85, 89, 90, 103, 105, 106, 121, 135), usually close to the Alaska border. Some of these will probably be found in eastern Alaska once more intensive collecting has been done there. Two others, *Empoasca spira* (46) and *Macrosteles slossonae* (103) are apparently disjunct, their Yukon populations far to the northwest of Ohio and Wisconsin respectively.

Boreal Zone Dispersals. Boreal leafhoppers are widely distributed through a nearly continuous and ecologically homogeneous lowland forest belt. Even these insects do not range completely over the boreal zone. Only 56% of the Nearctic leafhoppers of the Yukon are found as far east as Newfoundland or Cape Breton Island in Nova Scotia (Hamilton and Langor 1987). Many of these mainly western species presumably are adapted to arid or montane conditions. But even omitting species restricted to the western mountains, there are still 5 species that reach only as far as Minnesota (3), Ontario (20, 51, 123) or New York (96), while another 13 range no farther than Quebec (4, 50, 56, 69, 83, 101, 113, 122, 126,

135), New Hampshire (77) or New Brunswick (30, 105). These 13 widespread species not known from the east coast are comparable in number to the 17 widespread Nearctic species that are not yet known from Alaska.

Why there is no significant difference in western and eastern dispersal patterns is something of a puzzle. Modern climate patterns show strong northwesterly winds prevalent throughout the boreal zone, which should favour west-to-east dispersal. Possibly during the early Holocene strong southeasterly winds induced by the melting ice cap may have aided westward dispersal of leafhoppers (along with dispersal of tree seeds), counterbalancing modern prevailing winds which favour eastward dispersal of leafhoppers.

Arctic and Subarctic Zone Dispersals. Subarctic leafhoppers of the Yukon, if fully winged, apparently invade freely into nearby subalpine mountain ranges. More collecting is needed to establish whether short-winged species (5, 64) of the north slope have been able to colonize the alpine zone of the Richardson Mountains.

Restricted faunal ranges are surprisingly much more common in open (subarctic) woodlands and on the bare tundra than in the boreal zone. All of the 24 leafhopper species inhabiting these northern areas (5, 6, 14, 15, 22, 28, 29, 36, 39, 59, 64, 65, 72, 97, 104, 107–109, 111, 124–126, 128, 143) are represented in western North America, where they presumably found their glacial-age refugium. Six species (25% of this fauna) are restricted to areas west of the Mackenzie River (5, 14, 22, 36, 39, 64) and 2 have invaded the Mackenzie delta itself (6, 128). Thus, only 67% of the northern fauna has succeeded in crossing the Mackenzie River. Five species (29, 59, 111, 124, 125) range across the Northwest Territories only as far as Hudson Bay, reducing the eastern arctic/subarctic fauna to 11 species (46%). Six more (15, 28, 65, 97, 107, 109) range no farther east than Labrador, leaving only 5 species (20%) that are transcontinental: 3 range to Newfoundland (72, 104, 126) and 2 more southerly species to Nova Scotia (108, 144). *Psammotettix lividellus* (126) alone has invaded southwestern Greenland, representing a mere 4% of the arctic/subarctic leafhopper fauna. The considerable drop-off in numbers of leafhopper species eastward across the width of the continent speaks of limited dispersal powers in the 10 000 years since deglaciation.

One would think that the presence of the Bering land bridge during much of the Pleistocene would have permitted free interchange of northern Nearctic and Palaeartic faunas. But instead it must have had a mosaic of environments that served as a biological “filter.” Many Palaeartic tundra species successfully invaded Nearctic Beringia, and 2 East-West Beringian species (59, 128) probably found their way from North America into easternmost Siberia, but 4 species (25% of the leafhopper fauna on the Yukon tundra) remain exclusively Nearctic.

What caused this partial disjunction? Mikkola et al. (1991) suggest that the Bering land bridge was a wet (shrub) tundra that prevented dry-steppe fauna from crossing between the continents. Young (1982) argues rather for a vegetational assembly without modern counterparts: in the south, shrubby lowlands and dry, sun-warmed uplands dominated mainly by a mixture of subarctic and boreal plants; centrally, fell-field with pockets of boreal plants in sheltered locations; and, in the north, dry, high-arctic steppe. Perhaps leafhoppers endemic to Beringia were found on warm uplands in valleys and coastal bays, but could not survive on the bleak conditions of extensive fell-field.

Transition Zone Dispersals. Sixteen species of leafhoppers apparently are restricted to Transition zone areas in the Yukon (Table 2). Most of these species live on native grasslands and sage-dominated south-facing hillsides. Considering the evidence of relatively slow leafhopper dispersals even in homogeneous zones, such as arctic tundra, one would not

expect to find a sizeable fauna of grassland leafhoppers in the Yukon. Their presence in valleys surrounded by extensive boreal forests that they are now unable to cross poses a real challenge to our present understanding of biogeography.

Eight of these species (7, 8, 25, 37, 66–68, 117) are represented by very isolated and mostly thriving colonies of grass-feeding leafhoppers otherwise associated with intermontane grasslands of British Columbia and the northwestern Great Plains east of the Rockies. Four of these leafhoppers (7, 8, 25, 117) are usually flightless. All 8 are concentrated in 2 oblique valley systems: along the Alaska Highway from Carcross to Burwash Landing on Kluane Lake, and along the Yukon and Pelly rivers from Ross River to Dawson (Fig. 1). Data from Alaska suggest that these and additional “relict prairie” species are centred around the Yukon drainage system, and may once have occupied much of the valley west to present-day Tanana in central Alaska (152°W). Before the submergence of the Bering land bridge and the resulting cooling of western Alaska their Transition zone grassland may have extended along the Yukon River to the Pacific Ocean (Fig. 2) to mingle with the coastal shrub flora.

The presence of such a prairie-like faunal suite suggests an influx from some much warmer period than today. Such a period could not have been postglacial. Even during the postglacial period of maximum temperatures, the Hypsithermal, extensive grasslands apparently extended only a few degrees farther north (Fig. 3)¹ than present prairie limits. To permit leafhoppers to disperse northward, such a grassland must have extended more or less continuously from the northern Great Plains into central Alaska via the Yukon (Fig. 4).

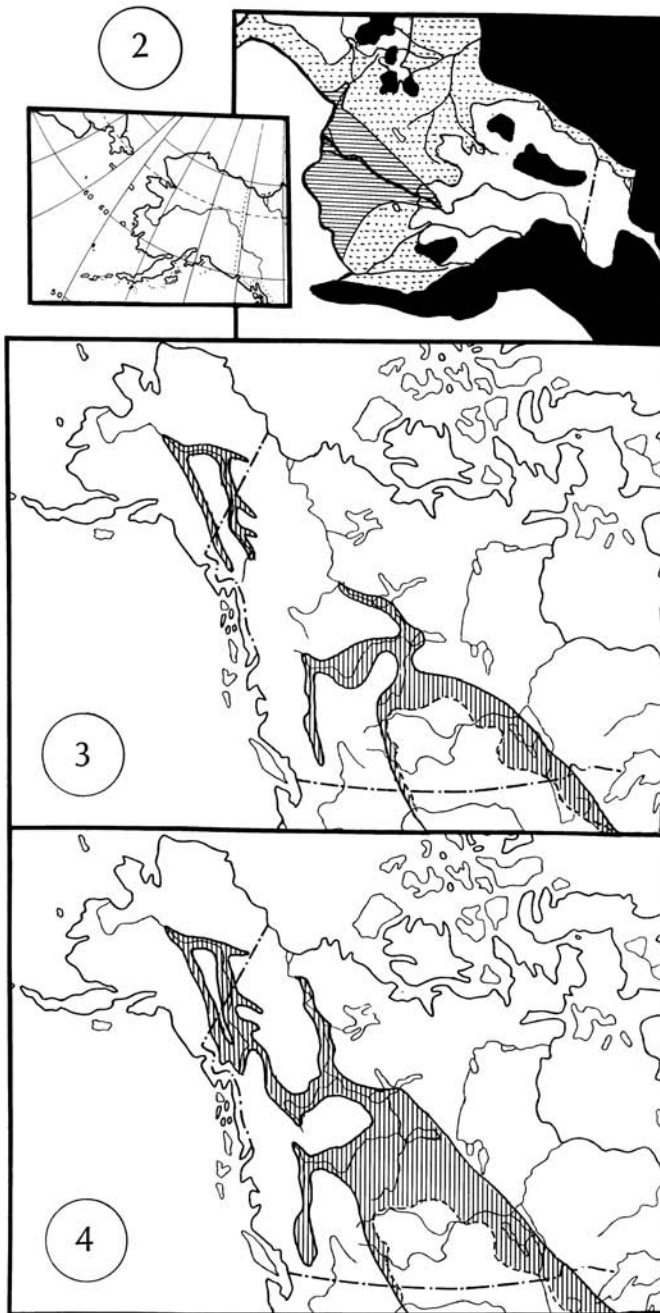
High-temperature regimes lasting longer than the 8000–15 000 years of known interstadial periods (Matthews 1979) would have been needed to permit such a large-scale invasion of grassland species, many of which are short-winged and slow to disperse. Such temperature regimes could only have been interglacial or preglacial. If so, these northern grasslands must have existed continuously throughout the Wisconsinan glaciation. Let us now turn our attention to evidence of endemism, which supports such an hypothesis.

Endemism. During the Wisconsinan glaciation most parts of Canada and Alaska were ice-covered; the few unglaciated areas were mostly northern (Matthews 1979, fig. 2.7) or close to the ice front, and are presumed to have been very cold. As such, they would be inhospitable to insects like leafhoppers which today are scarce or absent from the arctic. It is, therefore, surprising that there is a sizeable fauna found only in the Yukon and Alaska. A total of 21 taxa are endemic to this area; 14 of these are present in the Yukon (Table 3) representing 10% of the known fauna. Other species that once may have been endemic to this area have now become East-West Beringian, or have spread eastward across the Northwest Territories.

Only 5 Beringian endemic species of leafhoppers are known to be tundra-adapted (Table 2), 2 of which are restricted to Alaska and the Yukon: *Athysanella macleani* (5) is known only from the arctic slope, while *Diplocolenus aquilonius* (36) occurs on both arctic coastal tundra and alpine tundra in the Alaska Range. The arctic fauna in general being most speciose in the west suggests that these 2 species may have found a glacial-age refugium in Alaska. Three East-West Beringian species (59, 64, 128) may have become established subsequently on the Siberian side of the Bering Strait, while 4 others (28, 29, 107, 126) have also ranged far to the east.

Two leafhopper fossils from Blow River, on the arctic coast of the Yukon, suggest a radically transformed arctic environment. These specimens are submacropterous tegmina

¹ Near Lac La Ronge, Saskatchewan (55°N) a mixture of *Artemisia*-chenopod-grass-spruce pollen indicates a spruce savannah existed there from 10 000–7000 yr B.P., but adjacent sites to the north and west maintained spruce dominance (Ritchie 1976).



FIGS. 2–4. Inferred prehistorical environments in northern North America: 2, Reconstruction of glacial maximum extent of Transition-zone grasslands (hatched) and areas of permanent ice (black) in Beringia, ca. 18 000 yr B.P., with Bering land bridge shaded, and (inset) map area; 3, Reconstruction of Hypsithermal extent of the northern Great Plains, ca. 7000 yr B.P., based on palynology (Ritchie 1976) and distribution of the leafhopper *Elymana circius* Hamilton (Chiykowski and Hamilton 1985) and the cicada *Okanagana occidentalis* (Walker), with historical extent of Great Plains indicated by dashed line, and extent of prairie advance indicated by hatched area; 4, Reconstruction of northern extent of preglacial grassland, based on prairie species in the Yukon, with prairie advance similarly indicated.

TABLE 3. Leafhoppers endemic to the Yukon and adjacent areas (14 species or 10% of the known fauna). Five occur exclusively within the Yukon River drainage system (■); 3 others (@) are restricted to the northern Yukon.

Pattern of endemism	Species
Endemic to Yukon only	<i>Chlorita</i> n. sp. (12) ■ <i>Limotettix scudderi</i> Hamilton (92) ■ <i>Psammotettix</i> n. sp. (127)
Endemic to Yukon and Alaska	<i>Athysanella macleani</i> Blocker and Wesley (5) @ <i>Diplocolenus aquilonius</i> Ross and Hamilton (36) @ <i>Empoasca nigroscuta</i> Gillete and Baker? (44) ■ <i>Euscelis</i> n. sp. (58) ■ <i>Forcipata</i> n. sp. (62) <i>Rosenus pendulus</i> Hamilton and Ross (129) ■
Endemic to Yukon and Alberta	<i>Mocuellus strictus</i> Ross and Hamilton (110)
Endemic to Yukon and 2–3 adjacent areas	<i>Athysanella resusca</i> Blocker and Wesley (6) @ <i>Draeculacephala borealis arctoperata</i> Hamilton (41) <i>Euscelis</i> n. sp. (60) <i>Oncopsis albicollis</i> Hamilton (112)

9600 years old, coinciding with the coming of *Populus* to the arctic (J.V. Matthews, pers. comm.). Possibly this was the period that saw the breakup of summer ice on the arctic coast (Tomirdiario 1982) producing wetter summers that ended the grass domination of the arctic as sedge meadow communities developed. One specimen appears to be a brownish specimen of *Driotura gammaroides* (Van Duzee), a black or rufous species now confined to grasslands at latitudes below 56°N. The other cannot be identified with any extant species; it may be a member of the prairie-inhabiting genus *Memnonia*, or it may represent a Palaearctic genus not known to me. Whether these represent components of a fairly rich Beringian arctic fauna, of which the known endemic species of dry arctic grasslands (5, 6, 36, 59, 64, 128) represent the last vestige, or whether they represent a brief-lived invasion of Transition zone species, cannot be determined at the present.

The closest known Transition zone or boreal refugium, and therefore the most likely source for most of the endemic leafhoppers of the Yukon, is the Pacific coast of Alaska. Seven endemic taxa are known from this coast, but only one has invaded central Alaska and this species has not been found in the Yukon. The great ecological differences between the Pacific coast and the intermontane valleys of the Yukon may discourage such faunal influxes; endemic leafhoppers in the Yukon therefore are probably not derived from this source.

Fossil and subfossil evidence summarized by Matthews (1979) suggests that Alaska had an extensive glacial-age grassland community that supported herds of bison and mammoth. This grassland was probably a cold steppe, most probably akin to that still extant on Wrangel Island (north of eastern Siberia) where dwarf mammoth lived until ca. 3000 years ago. Being induced by permanently frozen arctic waters (Tomirdiario 1982), this steppe would be arctic in climate and unsuitable for boreal and Transition zone leafhoppers. Possibly a more temperate central Yukon refugium could have been a mosaic of plant

communities including *Artemisia*-rich grasslands above extensive meltwater lakes (Matthews 1982).

The Yukon River and its main tributary valleys are unglaciated and may have served as a refugium for leafhoppers. This would account for the high degree of endemism in these valleys. They hold exclusively 36% of all the Yukon endemic leafhopper taxa (Table 3), and include some of the ranges of all endemic species except the 3 arctic ones and one (127) from its watershed divide.

The Pelly and Lapie rivers, tributaries of the Yukon River, form a single valley system with steep, sun-warmed south-facing bluffs which support a sagebrush-grass community similar to those of the Yukon and Tanana rivers in central Alaska (Howenstein et al. 1985). Plant communities on such bluffs include species common to Siberian steppe, vicariant populations of such species, and Beringian endemic species (Murray et al. 1983). Both these sites support a Yukon-Alaska endemic leafhopper (44) feeding on *Artemisia*. Two other Transition zone leafhopper species (12 and 92) may be restricted entirely to such bluffs in the Yukon, in the Pelly and Lapie valleys.

Thus, the leafhopper fauna suggests that a Transition zone refugium existed during the Pleistocene as a few isolated, south-facing slopes along the Yukon River which were dominated by *Artemisia* and grasses. Palaeoecology tells us that such sites were probably far down the Yukon River (Fig. 2) from their present location, the latter being close to the ice front at the glacial maximum.

Refugia. In summary, northwestern endemic species and East-West Beringian species seem to have originated in 3 main areas:

1. Dry, grassy tundra and open forest on elevated areas of the central part of Alaska and the Bering land bridge, later migrating to the shores of the Beaufort Sea and to the alpine tundra of the Alaska Range (in the Yukon: 5, 6, 36, 59, 64, 128; possibly extinct species as well);

2. Low boreal areas and steep, south-facing Transition zone slopes along the Yukon River valley of western Alaska and adjacent Bering land bridge, later migrating up the valley to the Tanana and Pelly River valleys (in the Yukon: 12, 41, 44, 58, 60, 62, 92, 110, 112, 129, possibly 146, 157); and

3. Temperate rainforest Pacific Ocean shores of Alaska east of the Alaska Peninsula (8 coastal species, none known yet from the Yukon).

One additional species (127) seems to have evolved in association with ice-front conditions.

Evolution

As we have seen so far, at least 10 leafhopper species that are endemic to Beringia, plus 8 grassland species that are also found in the Yukon (p. 366), must have survived Wisconsinan glaciation despite major, and rapid, changes in their environment. The picture of a fairly stable non-boreal Yukon biota that somehow weathered the vicissitudes of glaciation is mirrored in its evolutionary perspective. Leafhoppers give little evidence of adaptability in meeting changing environmental conditions. Furthermore, no major evolutionary change is traceable to Pleistocene events. If changes have occurred due to glaciation over the last 1.5 million years, these have resulted in sister taxa which are morphologically quite similar; possibly only subspecific taxa have evolved during Wisconsinan glaciation and the subsequent postglacial period (together, the last 100 000 years). Finally, older evolutionary

events involving Beringian fauna may be detected in phylogenetic analyses but likewise involve closely related species.

Adaptability. First we must consider the adaptability of leafhoppers. Could modern distribution patterns be the result, not of leafhoppers shifting to find sites suited for them, but rather of leafhoppers “staying put” and adapting to changing environmental conditions?

One possible line of evidence for adaptability comes from the genus *Psammotettix*. Although arctic leafhoppers seem well adapted to alpine conditions in the Yukon, they are seldom encountered in milder alpine sites farther south, which one would think would be more hospitable to leafhoppers. Only *Macrosteles alpinus* (97) is found far south of its Alaskan-northern Canadian range (Hamilton 1983a, map 2). The northern subspecies of *Psammotettix lividellus* (126) is found only on low-lying arctic to high boreal sites from Alaska to Newfoundland, and on Mt. Jacques Cartier in the Gaspé peninsula of Quebec, but not on alpine sites in the Appalachian and Rocky Mountains (Fig. 5). Instead, certain of these high mountains have endemic relatives of the Transition zone European *Psammotettix cephalotes* (Herrich-Schäffer): *P. alexanderi* Greene in the White Mountains of New Hampshire (including the summit of Mt. Washington), and *P. beirnei* Greene on Mt. Revelstoke and adjacent Mt. Harry, British Columbia², at 2000–2500 m ASL.

The absence of arctic-adapted leafhoppers on isolated southern sites that contain other arctic-adapted plants and insects suggests that leafhoppers are less adaptable to changing conditions. Microclimatic conditions near Pleistocene glacial fronts (primarily solar radiation) were unlike subarctic and northern alpine conditions. It seems that, as a result, only a few temperate-zone leafhopper species could adapt to such anomalous conditions during Pleistocene glaciation, and these have found similar conditions today only on mountain-tops far south of the arctic.

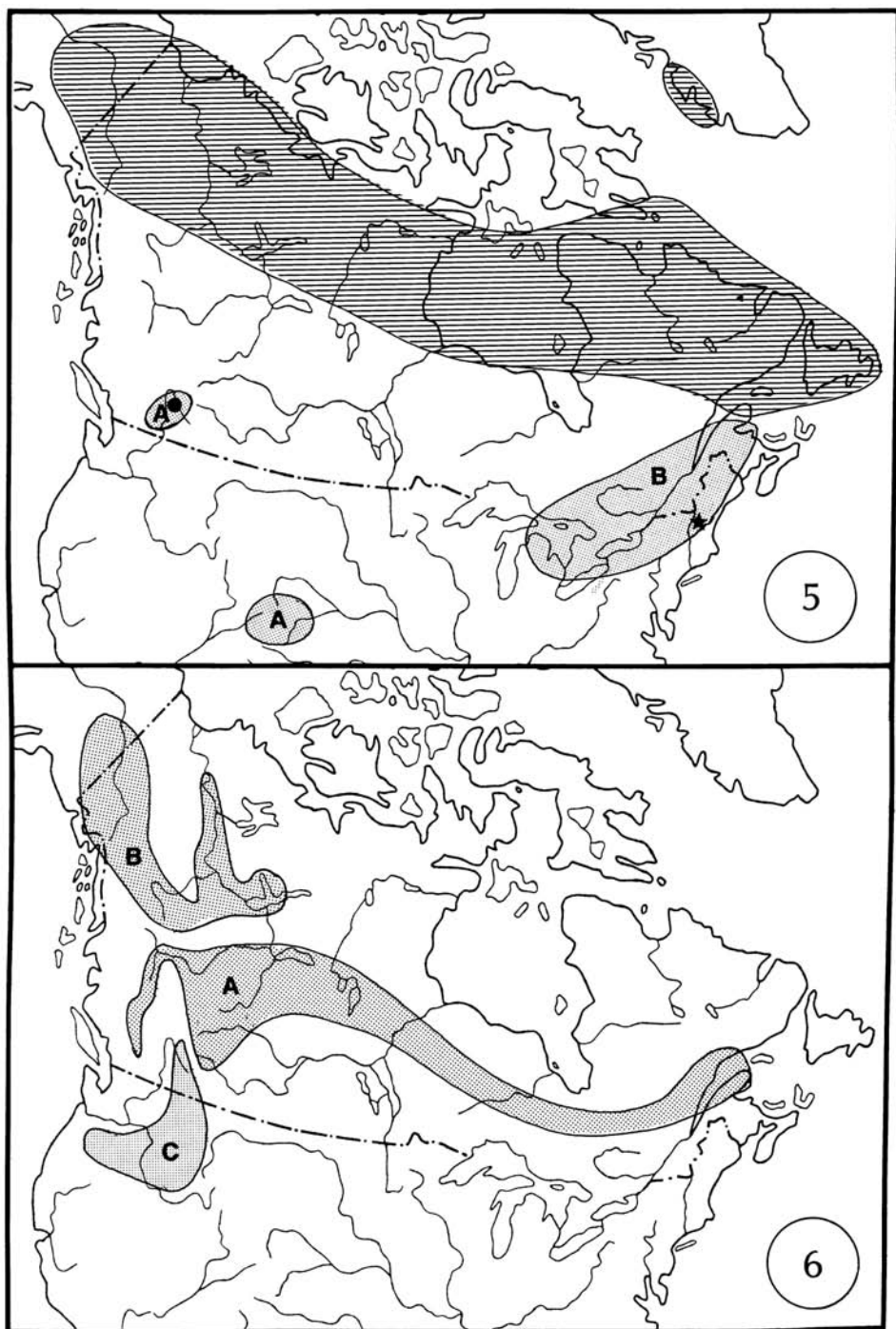
Psammotettix n. sp. (127), a relative of the European *P. maritimus* (Perris), may be such a temperate-zone species adapted to cooler conditions associated with ice fronts. It is known only from dunes near the shores of lakes at Carcross, Yukon, while another subspecies is found on dunes and alvars in northern Michigan state. This suggests a periglacial grassland environment during the retreat of the ice sheet that has been largely eliminated by subsequent growth of forests. Since then, it must have become readapted to milder weather.

Probably only leafhoppers belonging to the genus *Psammotettix* were able to make the transition from Transition zone to quasi-subarctic ice-front environments. They have left highly isolated populations on mountains, sand dunes and alvars throughout the Transition and boreal zones.

Vicariance. Two species endemic to Beringia, *Chlorita* n. sp. (12) and *Rosenus pendulus* (129) have no extant close relatives. Presumably their sister species are now extinct. As there is no way to determine how recently the extinction occurred (it could have been as recently as 9000 years ago, when arctic steppe was replaced by sedge-meadow) and phylogeny does not indicate them to belong to ancient lineages, information to determine when they evolved is lacking.

Other endemic taxa in the Yukon have one or more sister taxa in the Old World or in more southerly parts of North America. Eight such taxa (Table 4) each have a single closely related sister taxon, 2 with sister taxa in the Old World and the rest with sister taxa in more southerly regions. The latter appear to be Wisconsinan-age vicariant populations separated

² Incorrectly recorded by Greene (1971) from the Northwest Territories.



FIGS. 5–6. Vicariant distributions in leafhoppers: 5, Short winged taxa of *Psammotettix*: *P. lividellus* (Zetterstedt) (126), typical subspecies (hatched), its 2 siblings, *P. affinis* Gillette and Baker (A) and *P. ferratus* DeLong and Davidson (B), and others on mountaintops: *P. beirnei* Greene (dot) and *P. alexanderi* Greene (star); 6, Subspecies of *Draeculacephala borealis* Hamilton (41): typical subspecies (A), subspecies *arctoperata* (B) and *orea* Hamilton (C).

TABLE 4. Sister species: leafhoppers endemic to the Yukon and adjacent areas and their most closely related species.

Endemic species (species no.)		Sister species (area)
<i>Euscelis</i> n. sp. (58)	+	<i>E. sibirica</i> Emeljanov (Siberia)
<i>Forcipata</i> n. sp. (62)	+	<i>F. loca</i> DeLong and Caldwell (coastal Alaska and Transition zone to austral North America)
<i>Limotettix scudderi</i> Hamilton (92)	+	<i>L. medleri</i> Hamilton (Transition zone Saskatchewan)
<i>Mocuellus strictus</i> Ross and Hamilton (110)	+	<i>M. n. sp.</i> (austral Idaho, Montana, Utah)
<i>Oncopsis albicollis</i> Hamilton (112)	+	<i>O. flavicollis</i> (L.) (Eurasia)
<i>Psanmotettix</i> n. sp. (127)	+	<i>P. n. ssp.</i> (Michigan)
<i>Aceratagallia</i> n. sp. (146)	+	<i>A. siccifolia</i> (Uhler) (austral North America)
<i>Hebecephalus beameri</i> Hamilton and Ross (157)	+	<i>H. occidentalis</i> Beamer and Tuthill (austral North America)

from Beringian ones by intervening glaciers. Even the sister taxa now separated by the Bering Strait show little differentiation as yet.

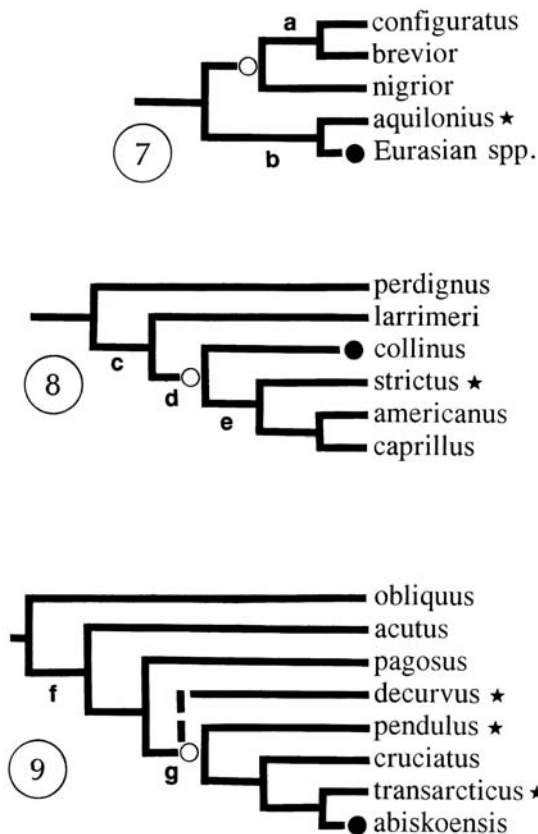
Pinumius sexmaculatus (Gillette and Baker), a leafhopper of northern prairies, is not found north of Peace River, Alta. (56°N). It is almost indistinguishable except for slight differences in body size and crown proportions³ from its Mongolian relative *Pinumius areatus* (Stål). For a dispersal route between Asian and North American steppes we must look to preglacial times. Thus, *Pinumius* spp. must have been geographically isolated at least since the Pliocene. Other presumptive vicariant species showing a similar degree of morphological differentiation are probably of similar age.

Two taxa in the Yukon appear to belong to species that each fragmented into 3 races. As the southern ones would probably have fused into a single entity over an extended period of contact, such multiple subspecies are probably of Wisconsinan age. *Draeculacephala borealis arctoperata* (41) is restricted to the northwest and was probably isolated from 2 other subspecifically distinct populations to the south and east of its present-day range (Hamilton 1985) by glaciation (Fig. 6). Similarly, the *Artemisia*-feeding leafhopper of the Yukon (44) appears to be one of 3 isolates from a widespread Nearctic species that also gave rise to the sagebrush-feeding sister species *Empoasca nigroscuta* and *E. typhlocyboides*, almost certainly during the Pleistocene. Whether the Yukon population is a distinct species, or a subspecies of one of the other 2 taxa, is a question that must remain unanswered until breeding experiments can be performed.

Beringian Lineages. Some Holarctic and Palaearctic leafhopper lineages may have originated in Beringia (Ross 1970). For example, *Oncopsis flavicollis* (L.), a Palaearctic species, is closely allied to *O. albicollis* (112) from western mountainous regions including the Yukon (Hamilton 1983b). The latter probably became isolated from its Transition zone Nearctic lineage during the Pleistocene, and the Palaearctic species may be a postglacial segregate adapted to milder conditions in Eurasia. Similarly, *Rosenus abiskoensis* (Lindberg) from the European subarctic is closely related to *Rosenus transarcticus* (128)⁴, an East-West

³ *Pinumius sexmaculatus* (here reaffirmed as a valid species) is smaller than *Pinumius areatus*, and has a narrower crown. Length of *sexmaculatus*: male 2.5–2.9 mm, female 2.6–3.3 mm; width of crown between eyes: male 3.5–3.8 mm, female 4.0–4.5 mm. Length of *areatus*: male 3.7–4.1 mm, female 3.1–3.8 mm; width of crown between eyes: male 3.9–4.2 mm, female 4.5–5.0 mm.

⁴ These species were previously incorrectly synonymized (Vilbaste 1980) but examination of specimens from Europe shows them to be differentiated both by wing length and details of the genitalia (Hamilton and MacLean unpublished).



FIGS. 7–9. Phylogeny of Beringian endemic leafhopper species (star) and their Nearctic relatives (dot = Eurasian lineages; circle = prairie lineages): 7, *Diplocolenus aquilonius* Ross and Hamilton (36) and relatives; 8, *Mocuellus strictus* Ross and Hamilton (110) and relatives; 9, *Rosenus decurvedus* Hamilton and Ross (164), *R. pendulus* Hamilton and Ross (129), *R. transarcticus* Hamilton (128) and relatives. Basal synapomorphies (characters of male genitalia): a, aedeagal processes short; b, subgenital plates lobe-tipped; c, anal tube with long basal processes; d, aedeagus decurved; e, aedeagal shaft sagittate; f, aedeagal tip serrate; g, aedeagal apex shallowly notched.

Beringian species and, more distantly, to *R. cruciatus* (Osborn and Ball) from the northern Great Plains (Hamilton and Ross 1975).

Endemic grassland leafhoppers such as *Diplocolenus aquilonius* (36), *Mocuellus strictus* (110) and *Rosenus pendulus* (129) are mostly early offshoots of essentially Transition zone lineages of western intermontane valleys. From each of these lineages descended 2 or more additional species, at least one of which now occupies the northern Great Plains (Figs. 7–9). This suggests that their origins were in the Pliocene or earlier.

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