



Orthoptera of Northeast Asia and Northwest America

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Abstract

An annotated list of 42 species in 26 genera and four families of Orthoptera recorded from Beringia (Northeast Yakutia, Chukotka, Magadan region, and Kamchatka in Russia, Alaska in USA, Yukon and the Northwestern Territories in Canada) is given. The distribution of species is clarified. The exchange of orthopteran faunas between Asia and America by the Bering Land Bridge in Pleistocene was strongly limited. The only three species, *Tetrix subulata* (Linnaeus, 1761), *Melanoplus frigidus* (Boheman, 1846), and *Stethophyma grossum* (Linnaeus, 1758), are recorded from both Asian and American parts. The orthopteran fauna of Beringia is not original. Majority of Beringian species are widespread throughout either Asia or North America. There are only four endemic grasshoppers, namely two Asian subspecies, *Melanoplus frigidus kamtchatkae* (Sjosted, 1935) and *Aeropedellus variegatus gelidus* Mistshenko, 1951, and two American species, *A. arcticus* Hebard, 1935 and *Bruneria yukonensis* Vickery, 1969. Composition of the regional faunas is briefly discussed. The monotypic genus *Bohemanella* Ramme, 1951 is again considered as a synonym of *Melanoplus* Stål, 1873, where a type species of the former genus, *Melanoplus frigidus* (Boheman, 1846) **comb. resurr.**, forming its own species group.

Key words: Tettigoniidae, Rhaphidophoridae, Tetrigidae, Acrididae, fauna, diversity, Northeast Asia, Northwest America, Beringia

Introduction

There are more than 29 000 species of the order Orthoptera in World, majority of them distributed in tropics and subtropics (Cigliano *et al.*, 2022). The fauna of grasshoppers and their kin in Boreal zone is less diverse (Sergeev, 2011) and only a few species inhabit the Arctic and Subarctic zones of Northeast Asia. Taxonomic diversity of Orthoptera in East Asia considerably decreases in the northern regions. Previously, 141 species in 79 genera and 10 families are recorded from the Russian Far East; of them 108 species are known from Primorsk region, 80—from the south part of Khabarovsk region, 71—from Amur region, 42—from Central and South Yakutia, 32—from Sakhalin Island, 28—from South Kuril Islands, 15—from Magadan region, 9—from Kamchatka Peninsula, and only three species—from Chukotka region (Storozhenko, 2011).

An aim of present paper is to clarify the composition of orthopteran fauna of the main administrative regions of Northeast Asia and Northwest America, i.e. so called “Beringia”. Beringia is defined today as area bounded on the west by the Lena River in Russia; on the east by the Mackenzie River in Canada; on the north by the Arctic Ocean; and on the south by the tip of the Kamchatka Peninsula (Fig. 1). The series of Beringian land bridges prior to and during periods of glaciation and Beringian refugia appear to have been important factors that determined the presence of most of the orthopteran species now found in this region.

First data on Orthoptera of the Asian part of Beringia were published by Miram (1922; 1928, 1931, 1933), Ramme (1928), and Sjöstedt (1935). Later a few species were added for this region (Bey-Bienko & Mistshenko, 1951). The review of fauna of Orthoptera from Northeast Siberia was given by Mistshenko (1971). After 1971 the studies of grasshoppers and their kin were continued mainly by staffs of the Institute of Biological Problems of the North, Magadan (Matis & Glushkova, 1973, 1976; Matis *et al.*, 1977; Berman *et al.*, 1983, 1989; Ryabukhin & Zasyapkina, 2005) and the Institute for Biological Problems of Cryolithozone, Yakutsk (Ermakova, 2011; Ermakova *et al.*, 2016).

The data on the fauna of the American part of Beringia were summarized in the first edition of the monograph of Canadian orthopteroid insects provided by distribution-maps for each species (Vickery & Kevan, 1983), while intensive investigation of the grasshoppers and their kin of Alaska, Yukon and the Northwest Territories starts after 1967 by Vickery (1967, 1969). The review of the fauna of Alaska with illustrated key to species has been published recently (Haberskii *et al.*, 2021).

All available data on Orthoptera of the Asian and American parts of Beringia are summarized here and compositions of the regional faunas are also discussed.

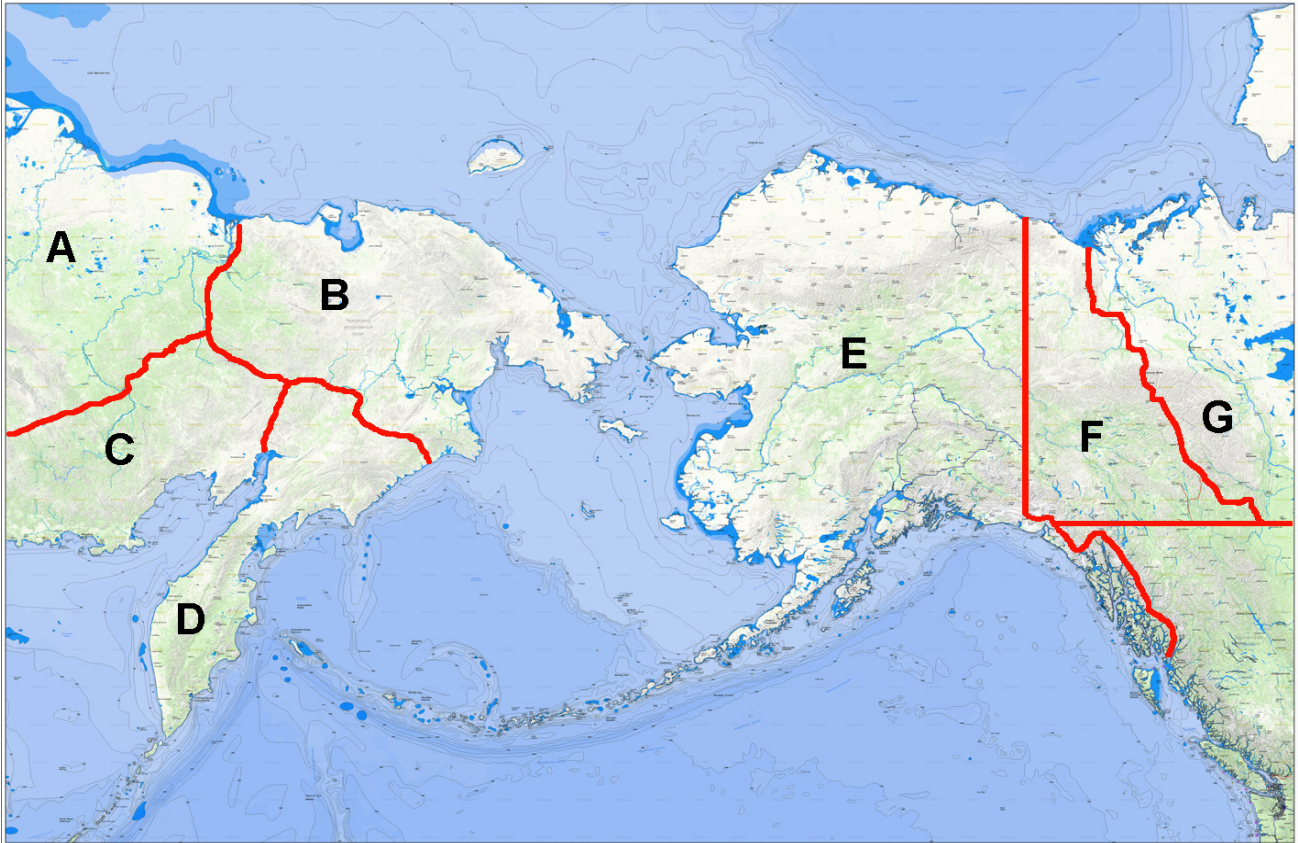


FIGURE 1. Map of Beringia. Administrative regions: A. Northeast Yakutia (eastward of Lena River); B. Chukotka; C. Magadan region; D. Kamchatka; E. Alaska; F. Yukon; G. Northwestern Territories (westward of Mackenzie River).

Material and methods

Present paper is based on critical analysis of the published data, the collections of the Zoological Institute (St. Petersburg) and Federal Scientific Center of the East Asia Terrestrial Biodiversity (Vladivostok), as well as the specimens collected by D.I. Berman and author in the Northeast Asia and North America. Taxonomy and classification of Orthoptera mainly follows to the database Orthoptera Species File (Cigliano *et al.*, 2022). Statistical data processing and plotting were carried out using PAST software packages—Paleontological Statistics (version 1.57) (Hammer *et al.*, 2006). The Jaccard index was used as a measure of similarity. The statistical significance of the formation of clusters was assessed using bootstrap analysis in 1000 repetitions.

List of the species and subspecies recorded from Beringia

An annotated list of Orthoptera known from Northeast Russia (Northeast Yakutia, Chukotka, Magadan region, and Kamchatka), USA (Alaska), and Canada (Yukon and the Northwest Territories) is given below.

Family Tettigoniidae

Subfamily Tettigoniinae

Decticus verrucivorus verrucivorus (Linnaeus, 1758)

Decticus verrucivorus: Miram, 1922: 286; Mistshenko, 1971: 575; Berman *et al.*, 1983: 345; Ryabukhin & Zasykina, 2005: 305.

Tettigonia verrucivora: Sjöstedt, 1935: 17.

Remarks. This widely distributed Palaearctic species is divided into 11 subspecies (Cigliano *et al.*, 2022) of which the nominotypical one has been recorded from Magadan region and Kamchatka where it occupies grassy areas of the mountain slopes. It is univoltine and overwinters in the egg stage.

Gampsocleis sedakovii sedakovii (Fischer von Waldheim, 1846)

Gampsocleis sedakovii sedakovii: Ermakova, 2011: 19; Ermakova *et al.*, 2016: 126.

Remarks. This subspecies is widely distributed throughout Siberia and adjacent regions (Storozhenko, 2004). A single specimen has been recorded from the mountain steppe in the Yana Plateau (middle basin of the Yana River, Northeast Yakutia).

Metrioptera brachyptera (Linnaeus, 1761)

Platypleis brachyptera: Miram, 1922: 287.

Chelidoptera brachyptera: Sjöstedt, 1935: 17.

Metrioptera brachyptera: Mistshenko, 1971: 574; Berman *et al.*, 1983: 345; Ryabukhin & Zasykina, 2005: 305; Ermakova, 2011: 19.

Remarks. This species is widely distributed in Palaearctic and has also been recorded from Northeast Yakutia, Magadan region and Kamchatka where it occurs through steppes and dry tundra.

Sphagniana sphagnorum (Walker, 1869)

Metrioptera (Sphagniana) sphagnorum: Vickery, 1967: 275.

Sphagniana sphagnorum: Vickery & Kevan, 1983: 489.

Remarks. This species is distributed across Canada. In the Northwest Territories, it has only been recorded from Fort Smith which is situated near the boundary with Alberta. It inhabits open grassy places along paths and roads in swampy areas.

Family Rhaphidophoridae

Subfamily Ceuthophilinae

Pristoceuthophilus cercalis Caudell, 1916

Pristoceuthophilus cercalis: Vickery & Kevan, 1983: 337; Haberski *et al.*, 2021: 48.

Remarks. In Alaska, this species has only been collected on Prince of Wales Island and is probably restricted to southeastern Alaska. It can be found under logs in dense forests. This species has also been reported from British Columbia, Alberta, Montana, Oregon, and Washington.

Subfamily Tropicischiinae

Tropicischia xanthostoma (Scudder, 1861)

Tropicischia xanthostoma: Vickery & Kevan, 1983: 327; Haberski *et al.*, 2021: 49.

Remarks. In Alaska, this species was only found in a few southeastern islands situated along the coast of British Columbia. This species has also been reported from British Columbia, Washington, Oregon, and California.

Family Tetrigidae

Subfamily Tetriginae

Tetrix bipunctata (Linnaeus, 1758)

Tetrix bipunctata: Matis & Glushkova, 1976: 419; Matis *et al.*, 1977: 135; Ryabukhin & Zasyrkina, 2005: 306; Storozhenko & Akulova, 2011: 12.

Acridium kraussi: Miram, 1931: 46.

Acridium bipunctatum: Miram, 1933: 44.

Remarks. This Palearctic species is widely distributed in Europe and Asia and has also been recorded from Northeast Yakutia, Chukotka and Magadan region.

Tetrix brunnerii (Bolivar, 1887)

Tetrix brunnerii: Vickery, 1967: 252; Vickery & Kevan, 1983: 1209; Vickery, 1984: 34; Vickery, 1997: 233; Haberski *et al.*, 2021: 45.

Remarks. This species has been reported throughout Canada and United States, except the prairie region. It occurs in Alaska, Yukon and the Northwest Territories and prefers moist habitats, such as bogs, in forested regions.

Tetrix fuliginosa (Zetterstedt, 1828)

Tetrix fuliginosa: Bey-Bienko & Mistshenko, 1951: 94; Mistshenko, 1971: 575; Matis & Glushkova, 1973: 121; Matis *et al.*, 1977: 135; Berman *et al.*, 1989: 86; Ryabukhin & Zasyrkina, 2005: 306; Ermakova, 2011: 19; Storozhenko & Akulova, 2011: 12.

Acridium fuliginosum: Miram, 1931: 46; Miram, 1933: 44.

Remarks. This species occupies humid moss habitats in the forest-tundra and north taiga zones of Europe and Asia. Nymphs and all instars immature stay in winter in the soil and the upper layer of the moss (Berman *et al.*, 1989). In Beringia, it occurs in Northeast Yakutia, Chukotka, Magadan region, and Kamchatka.

Tetrix ornata ornata (Say, 1824)

Tetrix ornata ornata: Vickery & Kevan, 1983: 1218; Vickery, 1984: 34; Vickery, 1997: 233.

Tetrix ornata: Haberski *et al.*, 2021: 46.

Remarks. This species is widely distributed across Canada and the United States and can be found as far east as New Brunswick and as far south as Arizona and South Carolina. It is divided into four subspecies (Cigliano *et al.*, 2022) of which the nominotypical one has been recorded from Alaska, Yukon and the Northwest Territories.

***Tetrix subulata* (Linnaeus, 1761)**

Tetrix subulata: Bey-Bienko & Mistshenko, 1951: 94; Vickery, 1967: 250; Mistshenko, 1971: 575; Matis *et al.*, 1977: 135; Vickery & Kevan, 1983: 1204; Vickery, 1984: 32; Vickery, 1997: 233; Ryabukhin & Zasyrkina, 2005: 306; Ermakova, 2011: 19; Haberski *et al.*, 2021: 47.
Acridium subulatum: Miram, 1933: 44.

Remarks. This species widely distributed in Palaearctic and Nearctic regions. In Beringia, it is known from Northeast Yakutia, Magadan region, Alaska, Yukon, and the Northwest Territories. There is a single generation per year in most of Eurasia and North America. Winter is passed in the adult stage; nymphal growth is accelerated, probably because of long day-length (Vickery, 1984).

***Tetrix tenuicornis* (Sahlberg, 1893)**

Tetrix nutans tenuicornis: Bey-Bienko & Mistshenko, 1951: 99.
Tetrix tenuicornis: Matis *et al.*, 1977: 135; Ermakova, 2011: 19; Storozhenko & Akulova, 2011: 12.
Tetrix tenuicornis tenuicornis: Ryabukhin & Zasyrkina, 2005: 306.

Remarks. This Transpalaearctic species has also been recorded from Northeast Yakutia, Magadan region and Kamchatka. It occupies sunny areas in grasslands and forest edges.

Family Acrididae

Subfamily Melanoplinae

***Melanoplus borealis* Fieber, 1853**

Melanoplus borealis borealis: Vickery & Kevan, 1983: 828; Vickery, 1984: 11; Berman *et al.*, 1995: 2; Vickery, 1997: 226.
Melanoplus borealis: Haberski *et al.*, 2021: 5, 37.
Melanoplus gordonae: Vickery, 1969: 258.

Remarks. This species ranges east to Newfoundland and as far south as Colorado and Massachusetts and recorded from Alaska, Yukon, and the Northwest Territories. It is highly variable in color and wing morphology. Both long and short-winged morphotypes are present. Described from Alaska *Melanoplus gordonae* Vickery, 1969 now is considered as a synonym of *Melanoplus b. borealis* (Haberski *et al.*, 2021).

***Melanoplus bruneri* Scudder, 1897**

Melanoplus bruneri: Vickery, 1967: 260; Vickery & Kevan, 1983: 846; Vickery, 1984: 14; Berman *et al.*, 1995: 3; Vickery, 1997: 226; Haberski *et al.*, 2021: 38.

Remarks. In Canada, the distribution is quite broad, from Quebec to British Columbia and northward to Yukon and the Northwest Territories. It also occurs in the western United States from Alaska to Arizona. This species may have a two-year life cycle in the northern regions (Vickery & Kevan, 1983).

***Melanoplus fasciatus* (Walker, 1870)**

Melanoplus fasciatus: Vickery & Kevan, 1983: 858; Vickery, 1984: 16; Berman *et al.*, 1995: 3; Vickery, 1997: 229; Haberski *et al.*, 2021: 39.

Remarks. This species ranges east to Newfoundland and south to Washington, Colorado, and Massachusetts and west to Northwest Territories, Yukon, and Alaska. It is associated with blueberries and other heath plants (Vickery, 1997). In the vicinity of Kluane Lake it has been found in open grassy sagebrush steppe, tundra and dry tundra at altitude 800–1600 m (Berman *et al.*, 1995).

***Melanoplus femurrubrum* (De Geer, 1773)**

Melanoplus femurrubrum femurrubrum: Vickery, 1967: 253; Vickery & Kevan, 1983: 823.

Remarks. This subspecies has a very wide distribution in Canada, from the Atlantic (but not Newfoundland and Labrador) to the Pacific and northward into the southern part of the Northwest Territories (Vickery & Kevan, 1983). It also occurs over most of the continental United States (but not in Alaska).

***Melanoplus frigidus frigidus* (Boheman, 1846), comb. resurr.**

Melanoplus frigidus frigidus: Bey-Bienko & Mistshenko, 1951: 233; Mistshenko, 1952: 425; Mistshenko, 1971: 576; Vickery & Kevan, 1983: 863; Ryabukhin & Zasykina, 2005: 307; Ermakova, 2011: 20; Ermakova *et al.*, 2016: 126.

Melanoplus frigidus: Miram, 1933: 41; Berman *et al.*, 1983: 345.

Podisma frigida: Miram, 1928: 19; Miram, 1931: 44.

Bohemanella frigida: Ramme, 1951: 18; Vickery, 1984: 18; Haberski *et al.*, 2021: 34.

Bohemanella frigida frigida: Vickery, 1997: 229.

Remarks. The genus *Melanoplus* Stål, 1873 consists of about 200 species in 27 species groups (Cigliano *et al.*, 2022). The monotypic genus *Bohemanella* Ramme, 1951 was proposed for *Melanoplus frigidus* distributed in Eurasia and North America (Ramme, 1951), while Mistshenko (1952: 422; 1971: 577) based on the critical analysis of taxonomic characters synonymized *Bohemanella* under *Melanoplus*. Here I agree with such synonymy and again placed *frigidus* in the genus *Melanoplus*, where this species forming its own species group *frigidus*. The nominotypical subspecies has a very wide distribution in Europe, Asia, and North America. In Beringia, it is recorded from Northeast Yakutia, Magadan region, Chukotka, Alaska, Yukon, and the Northwest Territories.

***Melanoplus frigidus kamtchatkae* (Sjosted, 1935)**

Podisma frigida var. *kamtchatkae*: Sjöstedt, 1935: 16.

Melanoplus frigidus kamtchatkae: Bey-Bienko & Mistshenko, 1951: 233; Mistshenko, 1952: 425; Mistshenko, 1971: 577.

Remarks. This subspecies is endemic to Kamchatka. It occupies mountain grass habitats in the north taiga zone.

***Melanoplus kennicottii* Scudder, 1878**

Melanoplus kennicottii kennicottii: Vickery & Kevan, 1983: 853; Vickery, 1984: 16; Berman *et al.*, 1995: 3; Vickery, 1997: 228.

Melanoplus kennicottii: Haberski *et al.*, 2021: 40.

Remarks. This species occurs throughout the grasslands of western Canada and United States (southwards to Colorado and New Mexico) with disjunct populations in the dry grasslands of the Alaska, Yukon, and the Northwest Territories.

***Melanoplus packardii brooksi* Vickery, 1979**

Melanoplus packardii brooksi: Vickery, 1979: 699; Vickery & Kevan, 1983: 877; Berman *et al.*, 1995: 3.

Remarks. This subspecies was known from northern parts of Saskatchewan and Alberta and firstly recorded from Yukon by Berman *et al.* (1995). In Yukon it occupies the tall-grass sagebrush steppe and forest clearings. The nominotypical subspecies, *M. p. packardii* Scudder, 1878, occurs in the southern part of Canada and in United States (Texas and Oregon).

***Melanoplus sanguinipes sanguinipes* (Fabricius, 1798)**

Melanoplus sanguinipes sanguinipes: Vickery & Kevan, 1983: 835; Vickery, 1984: 12; Vickery, 1997: 226.
Melanoplus sanguinipes: Haberski *et al.*, 2021: 41.

Remarks. This species ranges throughout Canada and United States and divided into three subspecies (Cigliano *et al.*, 2022). The nominotypical subspecies has been recorded from Alaska, Yukon, and the Northwest Territories. Habitats are variable; it inhabits grassy fields, pastures, roadsides, arid lands, open areas in forests, and northern tundra (Vickery & Kevan, 1983).

***Podisma pedestris pedestris* (Linnaeus, 1758)**

Podisma pedestris: Miram, 1933: 40.

Remarks. In Beringia, this Transpalaeartic subspecies has been recorded only from vicinity of the Verkhoyansk City in Yakutia (Miram, 1933) while widely distributed in Siberia. It is univoltine and overwinters in the egg stage.

***Prumna polaris* Miram, 1928**

Prumna polaris: Miram, 1928: 20; Miram, 1931: 45; Miram, 1933: 42; Ermakova, 2011: 20.
Primnoa polaris: Bey-Bienko & Mistshenko, 1951: 219; Mistshenko, 1952: 374; Mistshenko, 1971: 576; Berman *et al.*, 1983: 345; Ryabukhin & Zasyrkina, 2005: 307.

Remarks. This species ranges throughout East Siberia and Russian Far East (except Kuril Islands and Primorsk territory) and has also been recorded from Northeast Yakutia, Magadan region and Kamchatka.

***Zubovskya koeppeni koeppeni* (Zubovsky, 1900)**

Podisma koeppeni: Miram, 1931: 44.
Zubovskia koeppeni: Bey-Bienko & Mistshenko, 1951: 215; Mistshenko, 1952: 354.
Zubovskya koeppeni: Miram, 1933: 42; Ryabukhin & Zasyrkina, 2005: 307.

Remarks. This subspecies is widely distributed throughout Siberia and North Mongolia but replaced in the south part of the Russian Far East, Northeast China and North Korea by *Z. k. parvula* (Ikonnikov, 1911). In Beringia, the nominotypical subspecies has been recorded from Chukotka and Magadan region.

Subfamily Gomphocerinae

***Aeropedellus arcticus* Hebard, 1935**

Aeropedellus arcticus: Vickery, 1967: 270; Vickery & Kevan, 1983: 1143; Vickery, 1984: 30; Vickery, 1997: 232; Haberski *et al.*, 2021: 31.

Remarks. It is endemic to the northern parts of Alaska, Yukon and the Northwest Territories. This is the only grasshopper species known to occur north of the Canadian mainland and it is the only species restricted to the Arctic. All other Nearctic species of Orthoptera, even those that occur in the Arctic localities, occur also in subarctic localities.

***Aeropedellus clavatus* (Thomas, 1873)**

Aeropedellus clavatus: Vickery, 1967: 279; Vickery & Kevan, 1983: 1140; Vickery, 1984: 32.

Remarks. This species widely distributed in prairie of Canada and United States. In Beringia, it has been recorded only from the Northwest Territories around the Great Slave Lake. This species is an inhabitant of dry, somewhat sandy areas (Vickery & Kevan, 1983).

***Aeropedellus variegatus borealis* Mistshenko, 1951**

Aeropedellus variegatus borealis: Bey-Bienko & Mistshenko, 1951: 494; Mistshenko, 1971: 579; Berman *et al.*, 1983: 345; Ryabukhin & Zasyrkina, 2005: 306; Ermakova, 2011: 20; Ermakova *et al.*, 2016: 126.

Aeropedellus variegatus: Matis *et al.*, 1977: 136.

Gomphocerus variegatus: Miram, 1922: 285; Miram, 1931: 43; Miram, 1933: 32.

Remarks. This subspecies was described from Central Yakutia, Khabarovsk region, Kamchatka, and Magadan region. Nowadays it is also known from Northeast Yakutia and Chukotka. It inhabits mountain steppes, open areas in taiga and bush areas in tundra.

***Aeropedellus variegatus gelidus* Mistshenko, 1951**

Aeropedellus variegatus gelidus: Bey-Bienko & Mistshenko, 1951: 494; Mistshenko, 1971: 580.

Gomphocerus variegatus: Miram, 1928: 14.

Remarks. This subspecies is endemic to Chukotka (Chaunskaya Bay, vicinity of Pevek).

***Bruneria yukonensis* Vickery, 1969**

Bruneria yukonensis: Vickery, 1969: 265; Vickery & Kevan, 1983: 1137; Vickery, 1984: 29; Berman *et al.*, 1995: 4; Vickery, 1997: 232.

Remarks. This species is endemic to Yukon. So far, it was known only from the type locality (Kluane National Park). In the vicinity of Kluane Lake it is one of the most abundant species and inhabits tall-grass and open grass sagebrush steppe at altitude 800–1400 m (Berman *et al.*, 1995).

***Chloealtis abdominalis* (Thomas, 1873)**

Chloealtis abdominalis: Vickery & Kevan, 1983: 1122; Vickery, 1984: 27; Berman *et al.*, 1995: 4; Vickery, 1997: 231; Haberski *et al.*, 2021: 36.

Remarks. It primarily inhabits parklands and dry forests with grassy clearings, where it feeds on grasses and sedges (Vickery & Kevan, 1983). In the vicinity of Kluane Lake, it occurs through all steppe slopes, but most abundant in dry tundra where it is related with dump grassy locations (Berman *et al.*, 1995). It is widely distributed throughout Canada and the United States and has also been recorded from Alaska, Yukon and the Northwest Territories.

***Chorthippus fallax fallax* (Zubowsky, 1900)**

Chorthippus fallax: Miram, 1931: 43; Mistshenko, 1971: 581; Matis & Glushkova, 1973: 121; Matis *et al.*, 1977: 135; Berman *et al.*, 1983: 345.

Chorthippus fallax fallax: Ryabukhin & Zasyrkina, 2005: 306.

Chorthippus (Chorthippus) fallax fallax: Ermakova, 2011: 21; Ermakova *et al.*, 2016: 126.

Remarks. *Chorthippus fallax* is divided into seven subspecies distributed in Russia (Siberia and the Russian Far East), Mongolia, North China, Korea and Japan (Cigliano *et al.*, 2022). In Beringia, the nominotypical subspecies has been recorded from Northeast Yakutia and Magadan region where it occurs through steppe slopes of mountains and dry tundra.

***Glyptobothrus maritimus maritimus* Mistshenko, 1951**

Chortippus biguttulus maritimus: Bey-Bienko & Mistshenko, 1951: 514; Mistshenko, 1971: 580; Ryabukhin & Zasyrkina, 2005: 306.

Chorthippus biguttulus: Matis & Glushkova, 1973: 121; Matis *et al.*, 1977: 135; Berman *et al.*, 1983: 345.

Glyptobothrus maritimus maritimus: Storozhenko, 2002: 7.

Remarks. *Glyptobothrus maritimus* is divided into seven subspecies (Cigliano *et al.*, 2022). The nominotypical subspecies is widely distributed from Europe to Korea and Japan. It has been recorded from Magadan region and Kamchatka where it inhabits open grass steppes and pebblestone areas along rivers.

***Glyptobothrus maritimus jacutus* Storozhenko, 2002**

Glyptobothrus maritimus jacutus: Storozhenko, 2002: 8; Ermakova, 2011: 20.

Remarks. This subspecies is endemic to Central and Northeast Yakutia where it occupies dry grasslands and steppes.

***Gomphocerus sibiricus sibiricus* (Linnaeus, 1767)**

Gomphocerus sibiricus: Miram, 1931: 43; Miram, 1933: 32; Mistshenko, 1971: 578; Matis & Glushkova, 1973: 121; Matis *et al.*, 1977: 135; Berman *et al.*, 1983: 345; Ermakova *et al.*, 2016: 126.

Gomphocerus sibiricus sibiricus: Bey-Bienko & Mistshenko, 1951: 487.

Aeropus sibiricus sibiricus: Ermakova, 2011: 20.

Aeropus sibiricus: Ryabukhin & Zasyrkina, 2005: 306.

Remarks. The nominotypical subspecies is Transpalearctic. In Beringia, it has been recorded from Northeast Yakutia, Magadan region and Kamchatka where it is common in the steppes, open larch and birch forests or grassy clearings.

***Gomphocerus kudia* (Caudell, 1927)**

Gomphocerus kudia: Bey-Bienko & Mistshenko, 1951: 486; Mistshenko, 1971: 578; Matis & Glushkova, 1976: 419; Matis *et al.*, 1977: 135; Ryabukhin & Zasyrkina, 2005: 306.

Remarks. This species is distributed in North Korea and the Russian Far East. In Magadan region, it has only been recorded from the middle basin of the Kolyma River where it occupies larch and burned-out forests (Mistshenko, 1971).

***Podismopsis gelida* Miram, 1931**

Podismopsis gelida: Miram, 1931: 40; Miram, 1933: 22; Matis *et al.*, 1977: 135; Berman *et al.*, 1983: 345; Ryabukhin & Zasyrkina, 2005: 307; Ermakova, 2011: 20.

Podismopsis (Podismacris) gelida: Bey-Bienko & Mistshenko, 1951: 425; Mistshenko, 1971: 578.

Remarks. Described from Northeast Yakutia this species nowadays is known from Central Yakutia, Magadan region, Kamchatka, Khabarovsk region, and North Sakhalin. Here it is recorded for the first time from Chukotka based on 26 specimens, collected by D. Berman in follow localities: the Amguema River basin, Ekityki Lake, the basin of the Velikaya River in the Koryak Mountains, and vicinity of Anadyr. It inhabits open grass steppes, larch forests and dry tundra.

***Pseudochorthippus curtipennis curtipennis* (Harris, 1835)**

Chorthippus curtipennis curtipennis: Vickery, 1967: 274; Vickery & Kevan, 1983: 1127; Vickery, 1984: 28; Vickery, 1997: 231.
Pseudochorthippus curtipennis: Haberski *et al.*, 2021: 42.

Remarks. One of the most widely distributed Nearctic grasshoppers, occurring throughout Canada and the United States including Alaska, the Northwest Territories and Yukon, and found in a variety of habitats, including bogs, fens, and tundra. Another subspecies, *P. c. californicus* (Vickery, 1967) was described from California.

***Pseudochorthippus montanus* (Charpentier, 1825)**

Chorthippus montanus: Miram, 1931: 43; Miram, 1933: 29; Mistshenko, 1971: 581; Matis & Glushkova, 1973: 121; Matis *et al.*, 1977: 135; Ryabukhin & Zasykina, 2005: 307.
Chorthippus (Chorthippus) montanus: Ermakova, 2011: 21.

Remarks. It is one of the most widespread Palaearctic species occurring from Atlantic to Pacific and also recorded from Beringia (North-Eastern Yakutia, Magadan region and Kamchatka). It inhabits open areas in larch forests and burned-out forests.

Subfamily Oedipodinae

***Arphia conspersa* Scudder, 1875**

Arphia conspersa: Vickery & Kevan, 1983: 929; Vickery, 1984: 22; Berman *et al.*, 1995: 4; Vickery, 1997: 229; Haberski *et al.*, 2021: 33.

Remarks. This species ranges north to Alaska, Yukon and the Northwest Territories, east to the Great Lakes and south to Mexico. In the northern regions, *A. conspersa* appears in spring as it passes the winter as late instar nymphs therefore the two-year life-cycle occurs in north while in the southern parts of its range, the species may have one generation per year. It occupies forest clearings and grassland, generally on sandy or gravelly soils (Vickery & Kevan, 1983).

***Bryodemella tuberculata* (Fabricius, 1775)**

Bryodemella tuberculata: Ermakova *et al.*, 2016: 126.
Bryodemella (Bryodemella) tuberculata: Ermakova, 2011: 21.
Bryodema tuberculatum: Berman *et al.*, 1983: 345.
Bryodema tuberculatum dilutum: Mistshenko, 1971: 581; Ryabukhin & Zasykina, 2005: 306.

Remarks. This species is widely distributed in Palaearctic and has also been recorded from Northeast Yakutia and Magadan region where it inhabits exposed rocky or gravelly places along rivers.

***Camnula pellucida* (Scudder, 1862)**

Camnula pellucida: Vickery & Kevan, 1983: 947; Vickery, 1984: 24; Berman *et al.*, 1995: 5; Vickery, 1997: 230; Haberski *et al.*, 2021: 35.

Remarks. This species is one of the most widespread of all North American grasshoppers, distributed throughout the western United States and Canada including Alaska, Yukon and the Northwest Territories. It is univoltine and overwinters in the egg stage.

***Stethophyma grossum* (Linnaeus, 1758)**

Mecostethus grossus: Miram, 1931: 44; Miram, 1933: 34; Mistshenko, 1971: 581; Matis & Glushkova, 1973: 121; Matis *et al.*, 1977: 134; Matis *et al.*, 1977: 136.

Stethophyma grossum: Ryabukhin & Zasyrkina, 2005: 307; Ermakova, 2011: 21; Haberski *et al.*, 2021: 43.

Stethophyma lineatum (partim): Vickery, 1967: 269; Vickery & Kevan, 1983: 1080; Vickery, 1984: 20; Vickery, 1997: 229.

Remarks. A few specimens of this species have been recorded from Yukon, the Northwest Territories and Alaska as *S. lineatum* Scudder, 1863 (Vickery & Kevan, 1983). Recently the specimens from Alaska were correctly identified as *S. grossum* (Haberski *et al.*, 2021). The records of isolated populations of *S. lineatum* from the extremely North Canada seem to be result of misidentification and belong to *S. grossum*. In Beringia, this Holarctic species has been recorded from Northeast Yakutia, Magadan region, Alaska, Yukon, and the Northwest Territories. This large and conspicuous grasshopper inhabits wetlands.

***Xanthippus brooksi* Vickery, 1967**

Xanthippus corallipes brooksi: Vickery, 1967: 263; Vickery & Kevan, 1983: 968; Vickery, 1984: 23; Berman *et al.*, 1995: 4.

Xanthippus brooksi: Vickery, 1997: 230; Haberski *et al.*, 2021: 44.

Remarks. This species is endemic to eastern Alaska, southwestern Yukon, and the delta of Mackenzie River in the Northwest Territories. In the vicinity of Kluane Lake it was found on the edges of aspen forest and sagebrush steppe at altitude 800–1250 m (Berman *et al.*, 1995). The life cycle of this species lasts for two years. The eggs deposited by females do not hatch until the following spring. The progeny spends the next winter as nymphs and reach maturity in the following summer (Vickery & Kevan, 1983).

***Pardalophora apiculata* (Harris, 1835)**

Pardalophora apiculata: Vickery & Kevan, 1983: 952; Vickery, 1984: 21.

Remarks. This species is widespread grasshoppers, occurring from Canada to the United States southwest to Oklahoma and Colorado. All known records from the Northwest Territories are either east of the Mackenzie River or near the Alberta border.

***Trimerotropis verruculata verruculata* (Kirby, 1837)**

Trimerotropis verruculata verruculata: Vickery & Kevan, 1983: 1056.

Trimerotropis verruculata: Vickery, 1984: 25.

Remarks. This species is not found in Alaska and Yukon, in the Northwest Territories it only found along the Mackenzie River and Great Bear Lake. The nominotypical subspecies is replaced in southern Canada and the northwestern United States by *T. v. suffosa* Scudder, 1876. This species prefers exposed rocky or gravelly places.

Discussion

Totally 42 species (or 45 species and subspecies) in 26 genera and four families of Orthoptera are known from Beringia. The most diverse group in this region is grasshoppers. The fauna of Acrididae consists of 30 species in three subfamilies. Subfamily Gomphocerinae presents by 12 species of the genera *Aeropedellus* Hebard, 1935, *Bruneria* McNeill, 1897, *Chloealtis* Harris, 1841, *Chorthippus* Fieber, 1852, *Glyptobothrus* Chopard, 1951, *Gomphocerus* Thunberg, 1815, *Podismopsis* Zubowsky, 1900, and *Pseudochorthippus* Defaut, 2012. Eleven species from four genera (*Melanoplus* Stål, 1873, *Podisma* Berthold, 1827, *Prumna* Motschulsky, 1859 and *Zubovskya* Dovnar-Zapolsky, 1932) of the subfamily Melanoplineae and seven species of the genera *Arphia* Stål, 1873, *Bryodemella* Yin, 1982, *Camnula* Stål, 1873, *Stethophyma* Fischer, 1853, *Xanthippus* Saussure, 1884, *Pardalophora* Saussure, 1884, and *Trimerotropis* Stål, 1873 of the subfamily Oedipodinae are recorded from Beringia. The nominotypical

subfamily of the family Tetrigidae presents by six species of the genus *Tetrix* Latrielle, 1802. Four species belonging the genera *Decticus* Serville, 1831, *Gampsocleis* Fieber, 1852, *Metrioptera* Wesmaël, 1838, and *Sphagniana* Zeuner, 1941 of the family Tettigoniidae (all from nominotypical subfamily) are recorded from Beringia. The family Rhaphidophoridae is less diverse. There are only two species of the genera *Pristoceuthophilus* Rehn, 1903 and *Tropidischia* Scudder, 1862 belonging to the subfamilies Ceuthophilinae and Tropidischinae, respectively.

The fauna of Chukotka consists of six species in five genera and two families, Tetrigidae (*Tetrix fuliginosa*, *T. bipuncata*) and Acrididae (*Melanoplus figidus*, *Zubovskya koeppeni*, *Podismopsis gelida*, *Aeropedellus variegatus borealis*, and an endemic to this region subspecies *A. v. gelidus*).

Seventeen species belonging 14 genera and three families (Tettigoniidae, Tetrigidae and Acrididae) have been recorded from Northeast Yakutia; of them the only *Gampsocleis sedakovii* absent in all other regions of Beringia. There are no endemic taxa in this part of Yakutia.

The fauna of Magadan region is the richest in the Asian part of Beringia. Eighteen species belonging 14 genera have been recorded from this region. Endemic taxa are absent but *Gomphocerus kudia* is found only in this part of Beringia.

The fauna of Kamchatka is less diverse. There are 11 species belonging 10 genera of Orthoptera recorded from here, of them the only one subspecies, *Melanoplus figidus kamtchatkae*, is endemic to this region.

In Alaska, 18 species belonging 11 genera of the families Acrididae, Tetrigidae and Rhaphidophoridae have been recorded but two species of latter family (*Pristoceuthophilus cercalis* and *Tropidischia xanthostoma*) were found on the islands situated considerably southwards relative to the continental part of the state. The most diverse genera are *Melanoplus* (6 species) and *Tetrix* (3 species). There are no endemic taxa in this part of North America.

The number of the species in Yukon is the same as in Alaska but members of Acrididae and Tetrigidae only have been recorded from this region. The most diverse genera are also *Melanoplus* (7 species) and *Tetrix* (3 species). One species, *Bruneria yukonensis*, is endemic to Yukon and *Melanoplus packardii* is known in Beringia only from this region.

The fauna of the Northwest Territories situated westward of Mackenzie River is the richest within Beringia; 21 species belonging 12 genera of the families Tettigoniidae, Tetrigidae and Acrididae are known from here but four species (*Sphagniana sphagnorum*, *Melanoplus femurrubrum*, *Aeropedellus clavatus*, and *Pardalophora apiculata*) have been recorded only from the southernmost part of this region near the boundary with Alberta.

The results of the analysis of the species lists of the administrative regions of Beringia using the Jaccard faunistic similarity index showed that at a low similarity level (0.06) but a high bootstrap value (100%), two clusters are distinguished, the first of which is formed by the faunas of Northeast Asia, and the second combines the faunas of the Alaska, Yukon and the Northwest Territories (Fig. 2). It is obvious because only three Holarctic species (*Tetrix subulata*, *Melanoplus frigidus*, and *Stethophyma grossum*) are recorded from both Asian and American parts of Beringia. In Asian part, the fauna of Chukotka forming its own branch at a low similarity level (0.32) and with high support (99%) because consists of the only six species only that well adapted to the harsh Arctic conditions. The most similar are the faunas of Northwest Yakutia and Magadan region (similarity level 0.74 and bootstrap value 83%). The faunas of American part of Beringia forming a compact cluster distinctly divided at a high similarity level (0.67) and bootstrap value (100%) into the branch of the Northwest Territories and the cluster of the most similar faunas of Alaska and Yukon.

The dissimilarity of Orthoptera faunas of Beringia is mainly determined by historical factors. In the Pleistocene, this region was characterized by the steppes without modern analogues (Berman *et al.*, 2001). During the last glacial maximum, the Bering Land Bridge allowed species exchange between ice-free Alaska and Eastern Siberia, but ice sheets blocked dispersal to the rest of North America. As result, the only three species of grasshoppers were penetrated from Asia to North America. Therefore, the fauna of Northeast Siberia was formed by species widely distributed in Asia, while the fauna of the northernmost America mainly consists of species distributed throughout Canada and the United States.

Majority of Beringian grasshoppers and their kin in studied region prefers the open places, such as different types of the steppes, forest clearings, grasslands, and dry tundra. The species of the family Rhaphidophoridae were found under logs in dense forests. A few species, such as *Tetrix brunnerii*, *T. fuliginosa* or *Stethophyma grossum*, occupy wetlands and humid moss habitats. Most grasshoppers of the subfamily Oedipodinae prefer the exposed rocky or gravelly places.

Almost all Beringian Orthoptera produce only one generation per year and overwinters in the egg stage. The

species of the genus *Tetrix* are also univoltine but pass winter in nymph stage or imago. The life cycle of *Xanthippus brooksi* and *Arphia conspersa* lasts for two years.

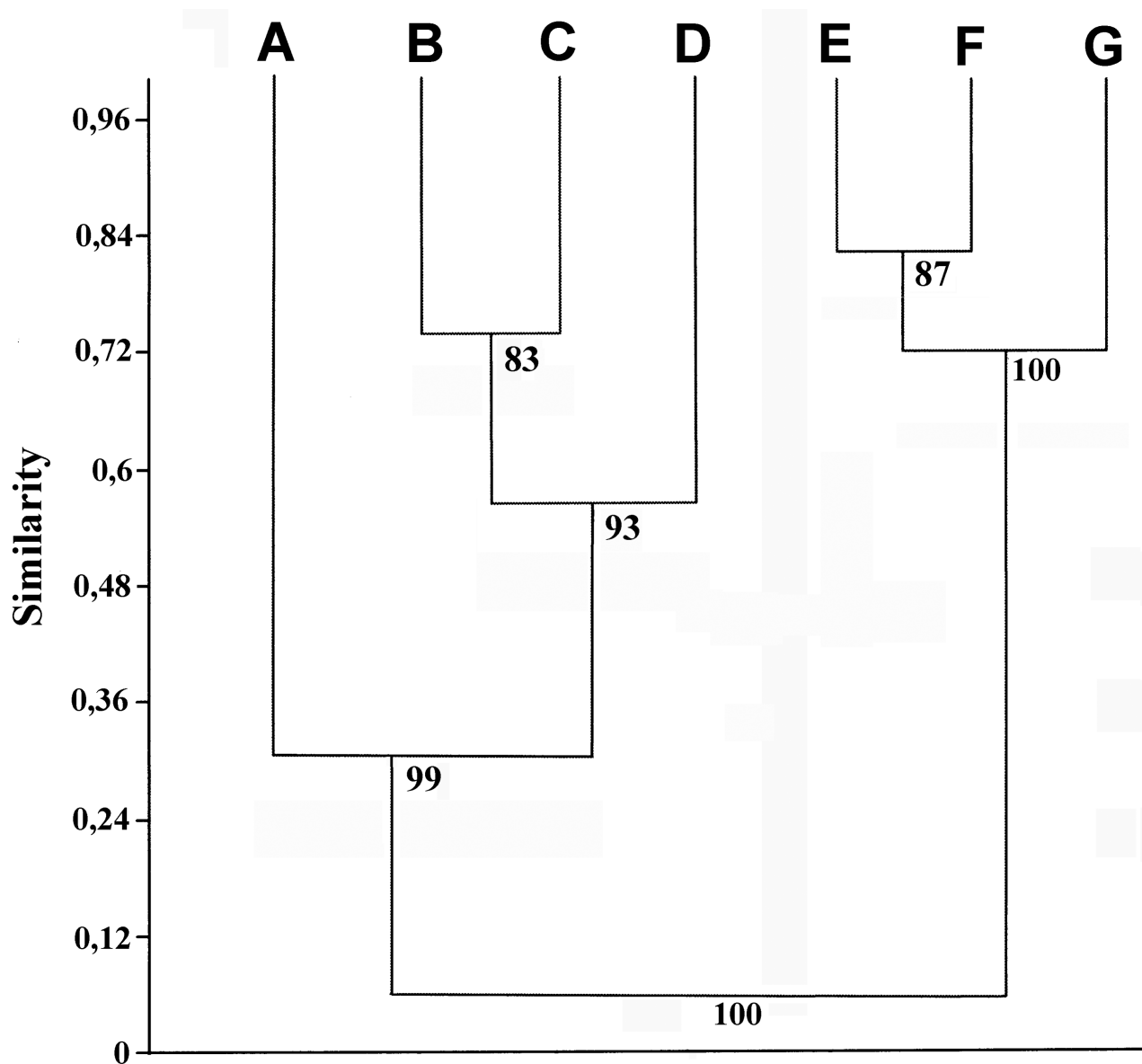


FIGURE 2. The similarity of the species composition of orthopteran faunas of Beringia calculated by the method of paired group (UPGMA) (Jaccard index, bootstrap 1000). Bootstrap values (%) are given at the base of the branches. Administrative regions: A. Northeast Yakutia; B. Chukotka; C. Magadan region; D. Kamchatka; E. Alaska; F. Yukon; G. Northwestern Territories.

Conclusion

The faunas of Orthoptera of the Asian and American parts of Beringia consist of 20 and 25 species, respectively. The three species only, *Tetrix subulata*, *Melanoplus frigidus*, and *Stethophyma grossum*, are recorded from both parts of this territory. It means that the exchange of orthopteran faunas between Asia and America by the Bering Land Bridge in Pleistocene was strongly limited. The orthopteran fauna of Beringia is not original. There are only four taxa endemic to Beringia, namely two Asian subspecies, *Melanoplus frigidus kamtchatkae* and *Aeropedellus variegatus gelidus*, and two American species, *A. arcticus* and *Bruneria yukonensis*. Other species are more or less widespread throughout Asia or North America.

The diversity of Orthoptera in the Pacific continental regions of East Asia strongly depends on latitude. In the subarctic and the northern part of the boreal zones further north than 51° N, the 20 species only from three families are recorded (present paper). In boreal zone of the south part of the Russian Far East (42–52° N), 127 species

belonging 9 families have been recorded (Storozhenko, 2011), while the fauna of Orthoptera in Vietnam (South-East Asia, 8.3–23.5° N) consists of 656 species from 12 families (Kim & Pham, 2014). Compared to the Asian part of Beringia, the number of orthopteran species in the boreal zone of continental regions of East Asia increases in 6.4 times, and in the tropical zone in 36.5 times, while the number of families only in 3 and 4 times, respectively. The same trend is also observed in North America north of Mexico.

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