Orthoptera of Alaska: A photographic key, new records, and synonymy of *Melanoplus gordonae*

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Abstract

Currently, 18 species of Orthoptera are known from Alaska, representing the families Acrididae, Tetrigidae, and Rhaphidophoridae. There is considerable overlap in fauna between Alaska and the adjacent provinces of British Columbia (BC) and the Yukon Territory. Thirteen of the species known from Alaska also occur in both BC and the Yukon, two others are shared with just BC, two with just the Yukon, and one species is known only from Alaska and the Palearctic. We here present a photographic dichotomous key to adults of all 18 species, as well as updated distribution maps and a review of the available DNA barcode data. *Stethophyma grossum* (Linnaeus, 1758) is added as a new state and continent record based on a combination of molecular and morphological evidence. *Stethophyma lineatum* (Scudder, 1862) is subsequently removed from the Alaskan fauna. *Melanoplus gordonae* Vickery, 1969, previously believed to be an Alaskan endemic, is synonymized under *Melanoplus borealis* (Fieber, 1853). DNA barcoding results suggest that there may be undocumented diversity within Alaskan *Pseudochorthippus curtipennis* and *Tetrix subulata* (Linnaeus, 1758).

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Introduction

Orthoptera (grasshoppers, crickets, and katydids) are among the most familiar and easily recognized insects. Orthopteran diversity is greatest in the tropics and decreases towards the poles. Alaska lies mostly above the 60th parallel where low temperatures and a short growing season act as strong filters to northward dispersal (Fielding 2004; Fielding and Defoliart, 2007; Kaufmann 2017). As such, of the 1,200 or so North American species, only 18 are known from Alaska (Table 1). The short-horned grasshoppers (Acrididae), dwarf grasshoppers (Tetrigidae), and camel crickets (Rhaphidophoridae) are represented, but the nocturnal-singing true crickets (Gryllidae) and katydids (Tettigoniidae) are conspicuously absent. Fifteen Alaskan species are shared with the 18 species that occur in the Yukon (Vickery 1997). The three not known from Alaska are *Stethophyma lineatum* (Scudder, 1862), *Melanoplus packardii* Scudder, 1878, and the Yukon-endemic *Bruneria yukonensis* Vickery, 1969. The last species has been collected less than 150 km from the Alaskan border, however, so *Bruneria yukonensis* may be present in eastern Alaska but has yet to be collected (Catling 2008). Rugged geography and limited road access have left much of the state, particularly the western half, under-sampled (Fig. 1).

Three species, *Melanoplus sanguinipes* (Fabricius, 1798), *M. borealis* (Fieber, 1853), and *Camnula pellucida* (Scudder, 1862), are significant agricultural pests (Pfadt 2002). Although normally in low abundance, they can reach outbreak levels when unusually warm summer temperatures enable rapid maturation (Washburn 1953). Alaska is warming faster than any other state, and we can expect outbreak conditions to be met more frequently as mean summer temperatures rise (Serreze et al. 2000; Walsh et al. 2008). For example, warming has already contributed to intensified outbreaks of spruce beetles (*Dendroctonus rufipennis* Kirby, 1837) on the Kenai Peninsula (Berg et al. 2006).

During the last glacial maximum, Interior Alaska formed part of an ice-free refugium known as Beringia. At this time, the Bering Land Bridge allowed for species exchange between ice-free Alaska and eastern Siberia, but ice sheets blocked dispersal to the rest of North America. Beringia was characterized by an open steppe grassland with no modern analogue (Young 1982). Habitat restrictions or low dispersal ability may have therefore prevented some species from spreading into deglaciated Canada at the end of the Pleistocene. This complex biogeographic history has led to intercontinental disjunctions and endemic species (e.g., Sikes et al. 2016). Catling (2008) listed three Alaskan species as having a Beringian distribution: *Aeropedellus arcticus* Hebard, 1935, *Bohemanella frigida* (Boheman, 1846), and

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Table 1. Checklist of Alaskan Orthoptera with count of specimens in UAM and count of DNA barcoded UAM specimens.

	Number of specimens in UAM	Number of specimens with DNA barcodes
Caelifera		
Acrididae		
Gomphocerinae		
Aeropedellus arcticus Hebard, 1935	773	2
Chloealtis abdominalis (Thomas, 1873)	9	3
Pseudochorthippus curtipennis (Harris, 1835)	45	3
Melanoplinae		
Bohemanella frigida (Boheman, 1846)	166	0
Melanoplus borealis (Fieber, 1853)	75	2
= *Melanoplus gordonae* Vickery, 1969, **syn. nov.**		
Melanoplus bruneri Scudder, 1897	18	0
Melanoplus fasciatus (Walker, 1870)	14	2
Melanoplus kennicottii Scudder, 1878	0	0
Melanoplus sanguinipes (Fabricius, 1798)	1213	2
Oedipodinae		
Arphia conspersa Scudder, 1875	19	2
Camnula pellucida (Scudder, 1862)	56	6
Stethophyma grossum (Linnaeus, 1758)	2	1 *
Xanthippus brooksi Vickery, 1967	0	0
Tetrigidae		
Tetrix brunnerii (Bolivar, 1887)	4	4
Tetrix ornata (Say,1824)	6	0
Tetrix subulata (Linnaeus, 1758)	70	12
Ensifera		
Rhaphidophoridae		
Ceuthophilinae		
Pristoceuthophilus cercalis Caudell, 1916	279	2
Tropidischiinae		
Tropidischia xanthostoma (Scudder, 1861)	1	0 **

* Attempted DNA barcoding on 2nd specimen, which failed; ** DNA barcoding failed

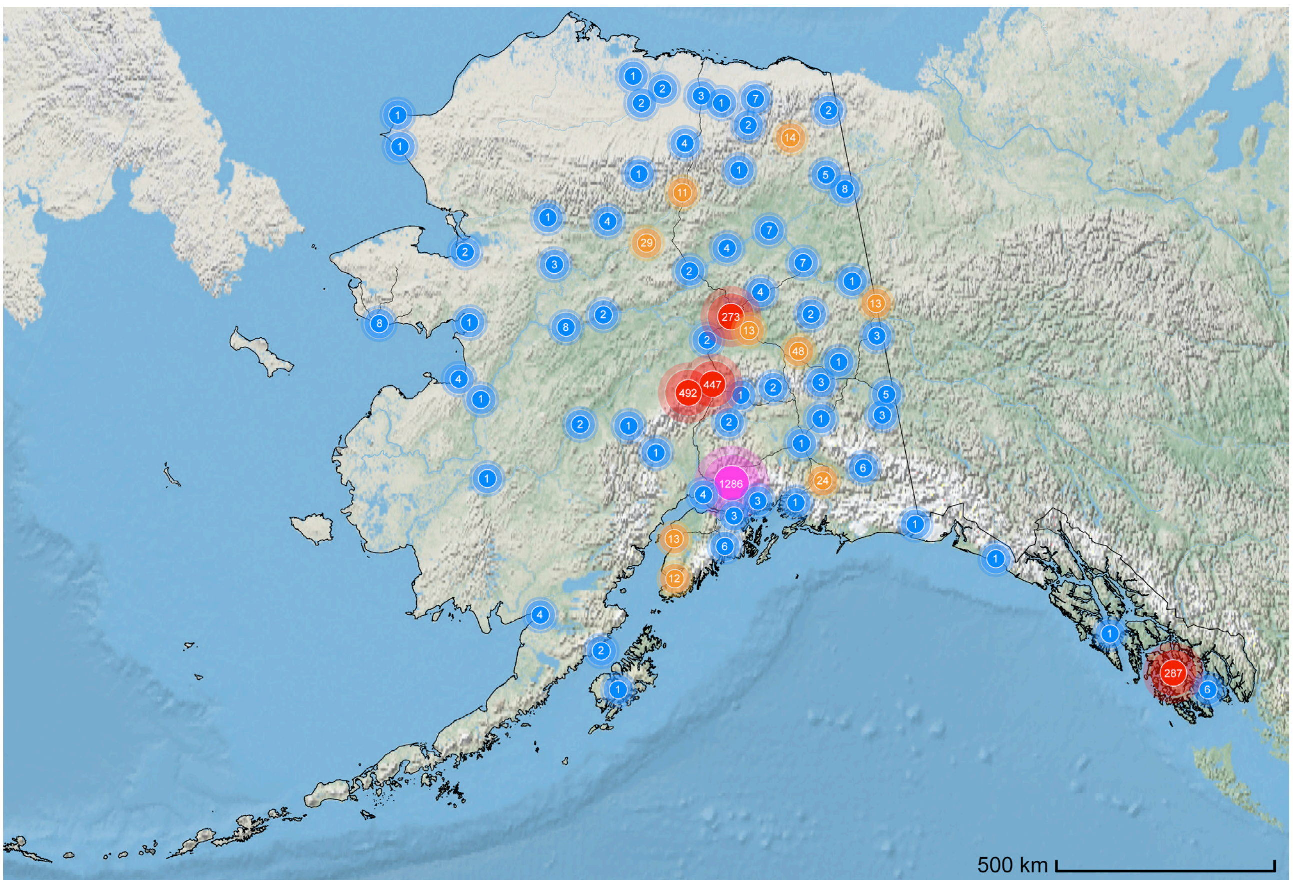


Figure 1. Map of Orthoptera collection records in Alaska. The most thoroughly sampled localities are Palmer (1286 specimens), Denali National Park & Preserve (939), Prince of Wales Island (287), and Fairbanks (273). Numbers in colored circles correspond to specimen record counts and colors indicate orders of magnitude, with blue = 1-9, yellow 10-99, red 100-999, purple >1000.

Xanthippus brooksi Vickery, 1967.

At the start of our investigation, an additional species, *M. gordonae* Vickery, 1969, was recognized from Alaska. *Melanoplus gordonae* was known only from the type specimens collected near Fairbanks, Alaska, in 1969. Subsequent efforts to recollect it had failed, leading us to believe that it was either a rare endemic or, possibly, extinct. However, these assumptions were called into question when we examined unidentified *Melanoplus* specimens in the University of Alaska Museum (UAM) Insect Collection that exhibited some morphological traits characteristic of *M. gordonae*, but not the distinctly trilobate male subgenital plate described by Vickery (1969) as the primary distinguishing character of the species. These specimens did not key out cleanly to any known Alaskan species using existing keys for Alaska and Yukon, Canada (Vickery 1969; Vickery and Kevan 1985 (1986); Catling 2008). These findings prompted an investigation into the taxonomic status of *M. gordonae*, which is described herein.

Our goal was to review all available literature, specimen, and DNA barcode data to produce a complete and concise resource for identifying the known Alaskan Orthoptera. This key includes high-resolution color photographs of each species and all diagnostic characters, as well as updated species distribution maps. Synanthropic species that can only survive indoors in Alaska, such as *Acheta domesticus* (Linnaeus, 1758), are not included. We incorporated recent taxonomic changes as well as many new collection records.

A brief overview of Orthoptera research in Alaska

The earliest known Alaskan Orthoptera specimens were collected by Robert Kennicott, who, in 1860, descended the Yukon River as far west as Fort Yukon, Alaska (Foster 1913). He collected the state's first records of *Arphia conspersa* Scudder, 1875, *M. borealis*, *M. sanguinipes*, and a new species named in his honor: *M. kennicottii* Scudder, 1878 (Scudder 1875, 1878, 1897). He returned to Alaska in 1865 but died unexpectedly in the spring of 1866 before he could collect more specimens (Schlachtmeyer 2010).

Collections were rare for the remainder of the 19th and early 20th centuries. In 1893, T.C. Mendenhall contributed three specimens of *M. bruneri* Scudder, 1897 to the U.S. National Museum while surveying the boundary between Alaska and Canada (Scudder 1897). In 1899, Trevor Kincaid, entomologist of the Harriman expedition, collected 14 individuals of *M. borealis* at Kukak Bay, the only Orthoptera among his 8,000 specimens (Caudell 1900). In 1912, J.M. Jessups of the Canadian Arctic Expedition collected *B. frigida* along the 69th parallel (Caudell 1915; Weber 1950), which was a new record for Alaska as well as the western hemisphere.

Grasshoppers have traditionally been overlooked by the general Alaskan public (perhaps due to limited abundance), so much so that they were "considered a novelty by many and in some areas of the state have been written up as a news story when noticed…" (Washburn 1965). This changed in 1951 when there was an outbreak of *M. sanguinipes* on agricultural lands near Butte, Alaska. Grasshopper densities reached an incredible 300 individuals per square yard (Washburn 1953). A subsequent outbreak in 1953 was only halted after a float plane sprayed crops with Aldrin, a now-banned insecticide. This was the first example of an airplane suppression program for agricultural pests in Alaska (Washburn 1965). Outbreaks of this and other species continued sporadically for several decades. In 1990, a fungal pathogen, "*Entomophaga praxibuli*," was experimentally released as a biological control agent at two sites near Delta Junction, but the project was halted due to poor results and later concerns for non-target grasshopper species (Goodman 1993; Hostetter 1996-2000, Quarberg and Jahns 2002). The outbreaks ceased in 1992 when late spring and early autumn snow greatly reduced populations by interrupting lifecycles (Quarberg and Jahns 2002).

Alaska's most prolific collector of Orthoptera was Richard Washburn. He collected over 1,200 specimens (now part of the UAM insect collection) during his 29 years at the Agricultural Experiment Station in Palmer, Alaska, from 1950-1979 (Murray 1979). Among his contributions were a detailed description of the life history of *M. sanguinipes* in Alaska and collection of the first state record of *Tetrix subulata* (Linnaeus, 1758) (Rehn 1952; Washburn 1965).

In recent decades, The University of Alaska Fairbanks and the U.S. Department of Agriculture have conducted extensive work on the physiology and ecology of sub-arctic Melanoplini (e.g., Fielding 2004; Fielding and Defoliart 2007; Zhang and Fielding 2011). The UAM has expanded its collection of Alaskan Orthoptera to over 3,000 specimens due to extensive sampling in Denali National Park & Preserve and on Prince of Wales Island (Fig. 1). The museum's DNA barcoding efforts have also identified new state records and potential cryptic species (Sikes et al. 2017).

Materials & Methods

The key presented here is for adult Orthoptera and is based largely on the works of Vickery and Kevan (1985 (1986)) and Catling (2008) who covered the Alaskan species in their keys to the Canadian fauna. Adults for all Alaskan species can be distinguished from nymphs by the presence of fully developed wings, except in the case of the two Rhaphidophoridae species whose life stages all resemble one another with the exception of relative size

Table 2. List of institutions that provided specimens, photographs, and GBIF.org distribution data.

Abbreviation	Institution	Specimens	Photos	GBIF data
ANSP	The Academy of Natural Sciences of Drexel University, Philadelphia, PA, USA	-	yes	-
ASUHIC	Arizona State University Hasbrouck Insect Collection, Tempe, AZ, USA	yes	yes	-
BYUC	Brigham Young University Monte L. Bean Life Science Museum, Provo, UT, USA	-	-	yes
CSUC	Colorado State University C. P. Gillette Museum of Arthropod Diversity, Fort Collins, CO, USA	-	-	yes
KNWR	Kenai National Wildlife Refuge, Soldotna, AK, USA	-	-	yes
LEMQ	McGill University Lyman Entomological Museum and Research Laboratory, Ste. Anne de Bellevue, Quebec, Canada	yes	yes	yes
OMNH	University of Oklahoma, Oklahoma Museum of Natural History, Norman, OK, USA	-	-	yes
OSUM	Ohio State University Museum of Biological Diversity, Oberlin, OH, USA	-	-	yes
UAM	University of Alaska Museum of the North, Fairbanks, AK, USA	yes	yes	yes
UBCZ	University of British Columbia Spencer Museum, Vancouver, British Columbia, Canada	-	-	yes
UMMZ	University of Michigan Museum of Zoology, Ann Arbor, MI, USA	-	yes	yes
USDA APHIS PPQ S&T	Phoenix Lab Rangeland Orthoptera Collection, Phoenix, AZ, USA	yes	yes	-
USNM	National Museum of Natural History, Washington, D.C., USA	-	yes	yes
UWBM	University of Washington Burke Museum of Natural History and Culture, Seattle, WA, USA	-	-	yes

(adults being the largest and most robust) and presence of fully developed cerci and genitalia. Taxonomy used here follows that of the most current Orthoptera Species File (Cigliano et al. 2020). Morphological terminology is consistent with that of Catling (2008). An informational overview for each species follows the key and is organized alphabetically by genus and then specific name. A list of institutions that contributed specimens, photographs, and distribution data can be found in Table 2.

This key should correctly identify males and short-winged females of all species. However, difficulty may arise for some long-winged females, specifically for the species *M. bruneri*, *M. sanguinipes*, and *Melanoplus fasciatus* (Walker, 1870). To explain, both Vickery and Kevan (1985 (1986)), and Catling (2008) relied on a combination of ventral coloration of the hind femur and cercus shape to distinguish females of *M. bruneri* and *M. sanguinipes*. Catling (2008) describes *M. bruneri* as having a "hind femur entirely yellowish below; upper side of cercus straight" and *M. sanquinipes* as having a "hind femur with pink or reddish stripe below; upper side of cercus convex." However, we found these characters to be variable in the Alaskan specimens we examined. For example, many specimens of *M. sanguinipes* in the UAM collection have straight cerci, and the undersides of their femora are yellow, red, pink, or pink-striped. Furthermore, preserved specimens are often faded or discolored, limiting the usefulness of this color-based character. Thus, our key is not designed to distinguish between females of *M. bruneri* and *M. sanguinipes* meaning some specimens will key out inconclusively. This issue will only be rectified by collecting and examining a longer series of Alaskan *M. bruneri* in order to develop more reliable characters. Like *M. buneri*, reliable identification of *M. fasciatus* females will only be possible with more specimens because, as of yet, insufficient numbers have been collected from Alaska. Therefore, the current best methods for identifying females of these species are either examining hind femora coloration in newly collected specimens or by association with males.

We identified UAM specimens by use of the prior mentioned keys in combination with identifications made by the following orthopterists: A. B. Gurney, P. Naskrecki, D. Nickle, and J. Rehn. Specimen data were compiled from the literature, UAM records, and by searching GBIF.org (https://doi.org/10.15468/dl.h86qrh) (GBIF.org 2020). UAM specimen data are publicly available via the Arctos database (http://arctos.database.museum/saved/Orthoptera), which serves data to GBIF.org among other data aggregators. GBIF.org records were limited to those based on preserved specimens and those with verifiable photographs. Literature records were georeferenced following the MaNIS georeferencing guidelines (Chapman and Wieczorek 2006), and distribution maps were then created in R (R Core Team 2018). DNA barcode data were archived on the Barcode of Life Database (BOLD) website (http://www.boldsystems.org) (Ratnasingham and Hebert 2007).

Body length measurements for the acridids and tetrigids were taken from Catling (2008). Specimens of the two rhaphidophorids were measured from the front of the head (excluding the antennae) to the tip of the abdomen and the mean length for each sex is reported. For *Pristoceuthophilus cercalis* Caudell, 1916, ten UAM specimens of each sex were measured. For *Tropidischia xanthostoma* (Scudder, 1861) males, only one Alaskan specimen was available, and its length is reported. Female length was based on nine specimens from California as no specimens from Alaska or Canada were available.

Except for living specimens, images for the key were taken with either a Leica Microsystems DFC425 camera attached to a Leica MZ16 microscope or a Macroscopic solutions Macropod Pro 3D imaging system attached to a Canon EOS 6D Mark II DSLR camera with a 65 mm lens. Multiple images were taken at different focal lengths and then stacked into a single composite image. Images from the Leica DFC425 were processed with Leica Application Suite V3.8, and images from the Macropod system were processed using Zerene Stacker (Build T2020-05-22-1330). Adobe Photoshop was used to add scale bars and adjust light levels. All images were taken using UAM specimens unless otherwise noted.

Morphological Terms

Figs. 2–3

Abdomen: the third and posterior body segment.

Antennae: paired, segmented sensory organs on the head.

Carina: an elevated ridge, notably on the head and pronotum

Cercus(i): paired posterior-directed appendages emerging from the tenth abdominal segment.

Fastigium: a flat surface at the extreme front of the head.

Femur: the third segment of the leg, exceptionally large on the hind leg.

Foveolae: a depression with well-marked sides.

Furculae: paired posterior-directed appendages emerging from the ninth abdominal segment.

Ovipositor: paired blade-like structures protruding from the tip of females' abdomens, used to lay eggs

Pronotum: the dorsal plate of the first thoracic segment.

Prosternum: the first ventral thoracic segment, located between the forelegs.

Subgenital plate: the terminal ventral plate of the abdomen, covers the internal male and female genitalia.

Supra-anal plate: the terminal dorsal plate of the abdomen, covers the internal male genitalia.

Tegmen(ina): the sclerotized forewing(s).

Thorax: the second body segment bearing the legs, pronotum, and wings.

Tibia: the fourth leg segment, exceptionally long and thin on the hind leg.

Tubercles: small, rounded buttons or bumps.

Results

Taxonomy

Melanoplus borealis (Fieber, 1853)

Melanoplus gordonae Vickery, 1969, **syn. nov.**

We hereby establish *M. gordonae* Vickery, 1969 as a junior synonym of *M. borealis* based on accumulated morphological evidence. *Melanopus gordonae* was described using only five type specimens: male holotype (Fig. 4A,B,E), female allotype (Fig. 4C,D,F), and three nymphs that were collected by a V. Gordon: "U.S.A.: Alaska, nr. Fairbanks, 2 mi. along Gilmore Trail, 13-VIII-1968" (Vickery, 1969). Despite numerous efforts by Vickery and subsequent collectors, including AH and DSS, no more specimens of this species have been found, leading to the presumption that it was a very rare endemic or, possibly, extinct. However, both of these seemed unlikely since macropterous grasshopper species are seldom found to be restricted to a single small area (unlike many brachypterous and apterous species), nor do species with presumed long-range flight abilities tend to go extinct within such short time frames with the possible extraordinary exception of the Rocky Mountain locust (*Melanoplus spretus* (Walsh, 1866)) (Lockwood, 2004).

Regardless, these hypotheses were challenged when, during the course of this research, 18 *Melanoplus* spp. specimens (12 male, 6 female) found in the UAM (14 collected in the vicinity of Fairbanks, three from Palmer, and one from the Kanuti National Wildlife Refuge, Alaska) did not key out smoothly to any of the more common species found in Alaska using the three aforementioned taxonomic keys for Alaska and Yukon, Canada. To understand this better, it should first be mentioned that the *M. gordonae* holotype possesses one primary unique morphological character: the subgenital plate is distinctly trilobate at its apex (Fig. 5C). Two further characters that helped separate it from other species were the combination of wings that extended beyond the apex of the abdomen in both sexes (although this was not explicitly noted in the original description) (Fig. 4A-D) and a lack of banding on the outer face of the hind femora in males, but with some in females (Vickery 1969) (Fig. 4C). Note that the latter character was seemingly misunderstood by Catling (2008) to not be present at all. His confusion was most likely compounded by the fact that the key in Vickery

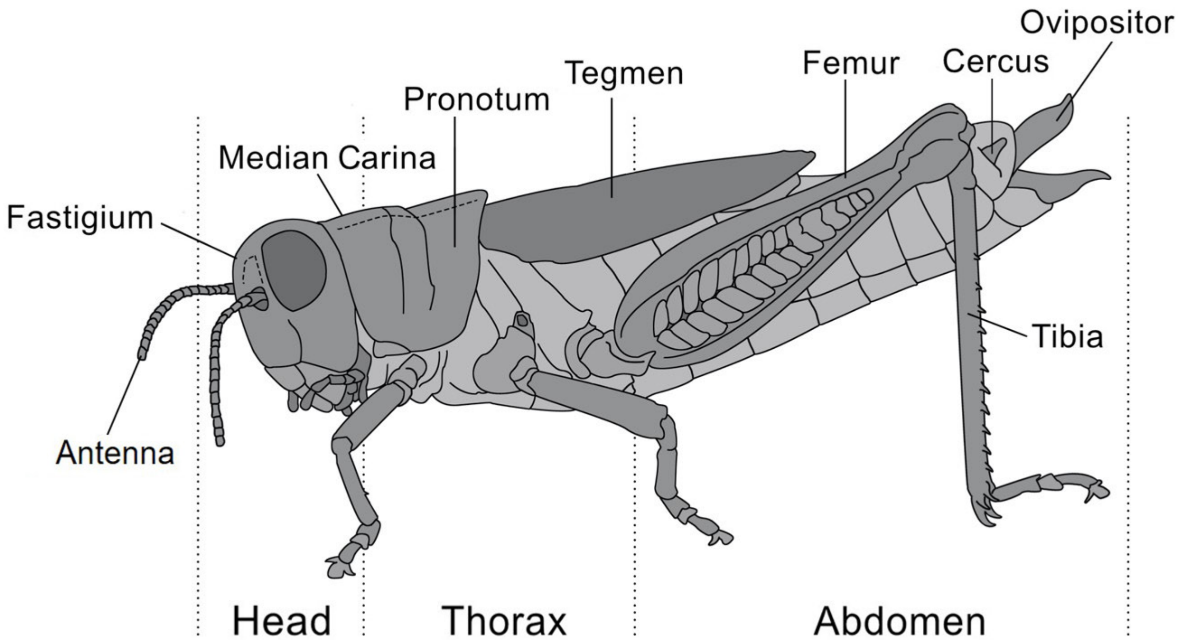


Figure 2. Left lateral view of a female grasshopper (Acrididae) illustrating characters used in the key.

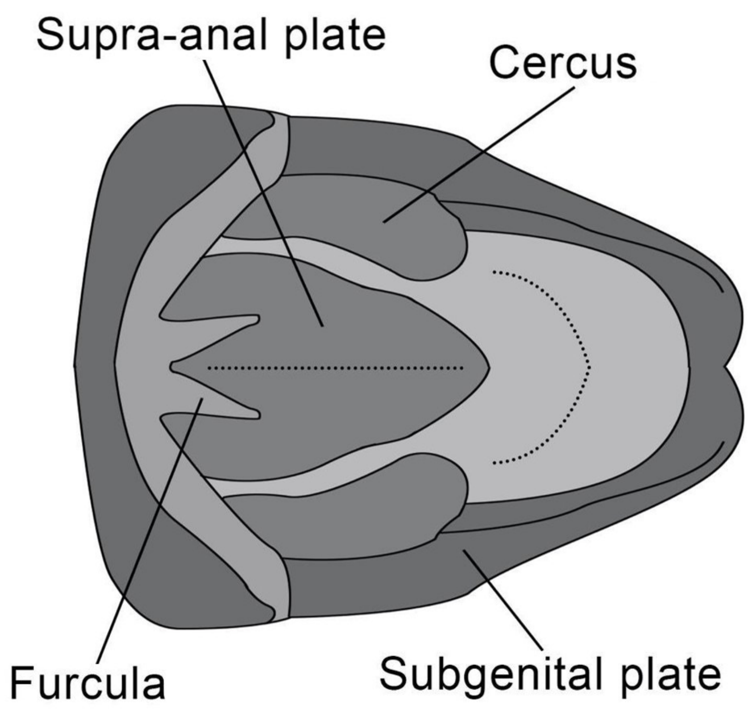


Figure 3. Dorsal view of the male terminalia of a grasshopper (Acrididae) illustrating characters used in the key.

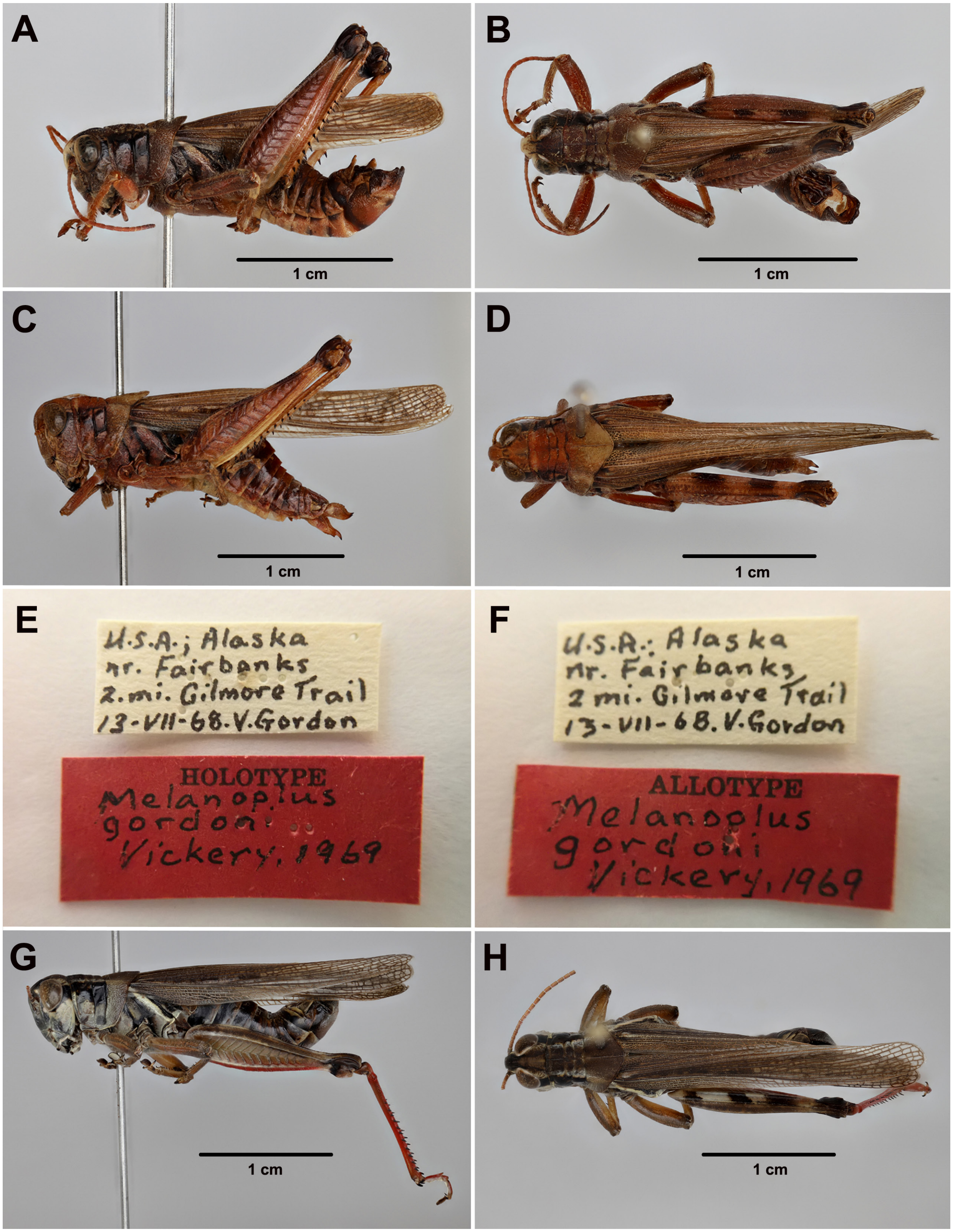


Figure 4. *Melanoplus gordonae* Vickery, 1969 holotype habitus: **A)** left lateral and **B)** dorsal; *M. gordonae* allotype habitus: **C)** left lateral and **D)** dorsal; **E)** holotype and **F)** allotype labels - note that the specific name on the labels is incorrect; *M. borealis* (Fieber, 1853) (UAM100269521) habitus: **G)** left lateral and **H)** dorsal.

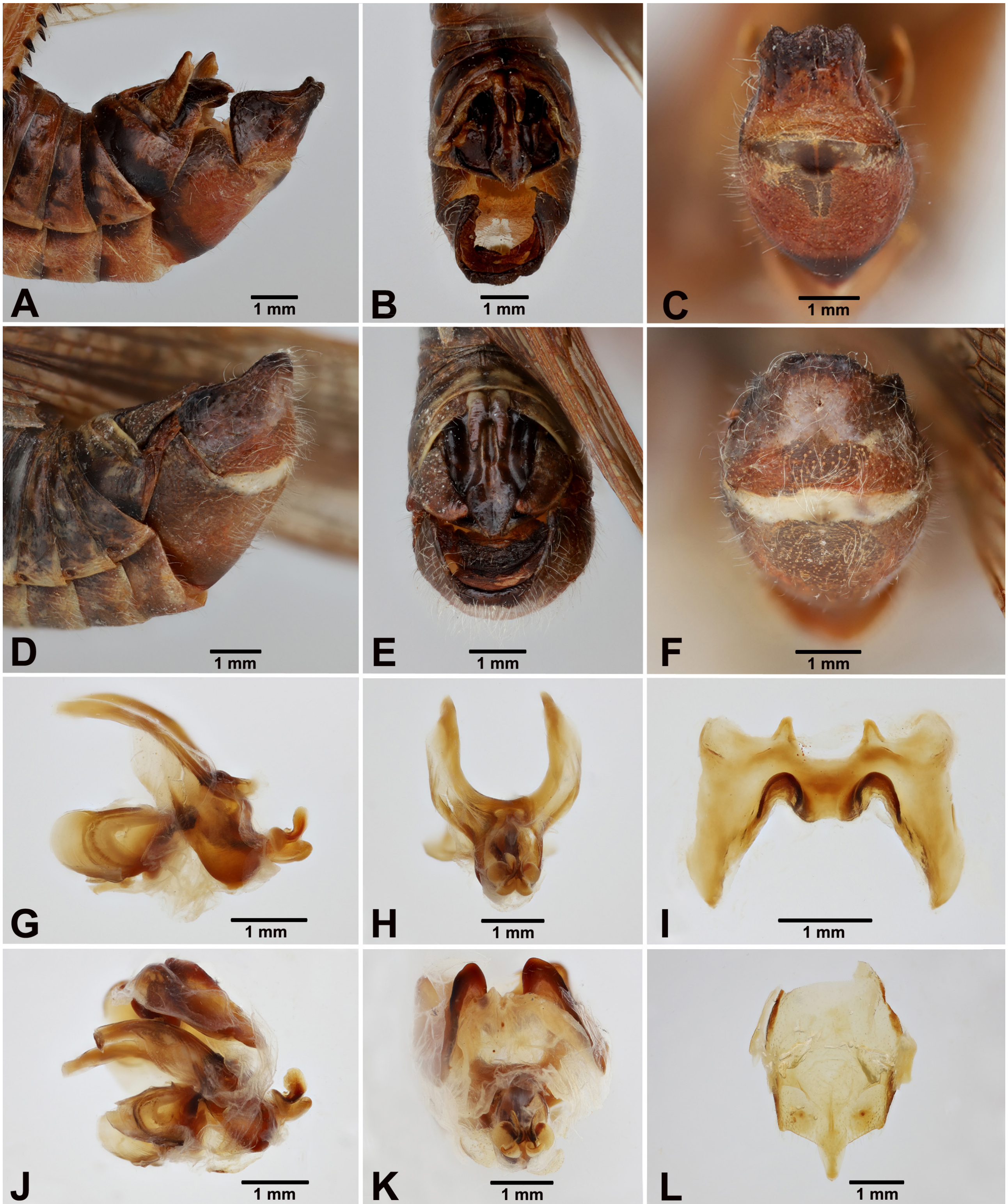


Figure 5. *Melanoplus gordonae* Vickery, 1969 holotype external genitalia: A) left lateral, B) dorsal, C) posterior; *M. borealis* (Fieber, 1853) (UAM100269379) external genitalia: D) left lateral, E) dorsal, F) posterior; *M. gordonae* holotype internal genitalia: G) left lateral, H) posterior, I) epiphallus (dorsal); *M. borealis* (ASUHIC) internal genitalia: J) left lateral and K) posterior; L) *M. gordonae* allotype's subgenital plate (dorsal).

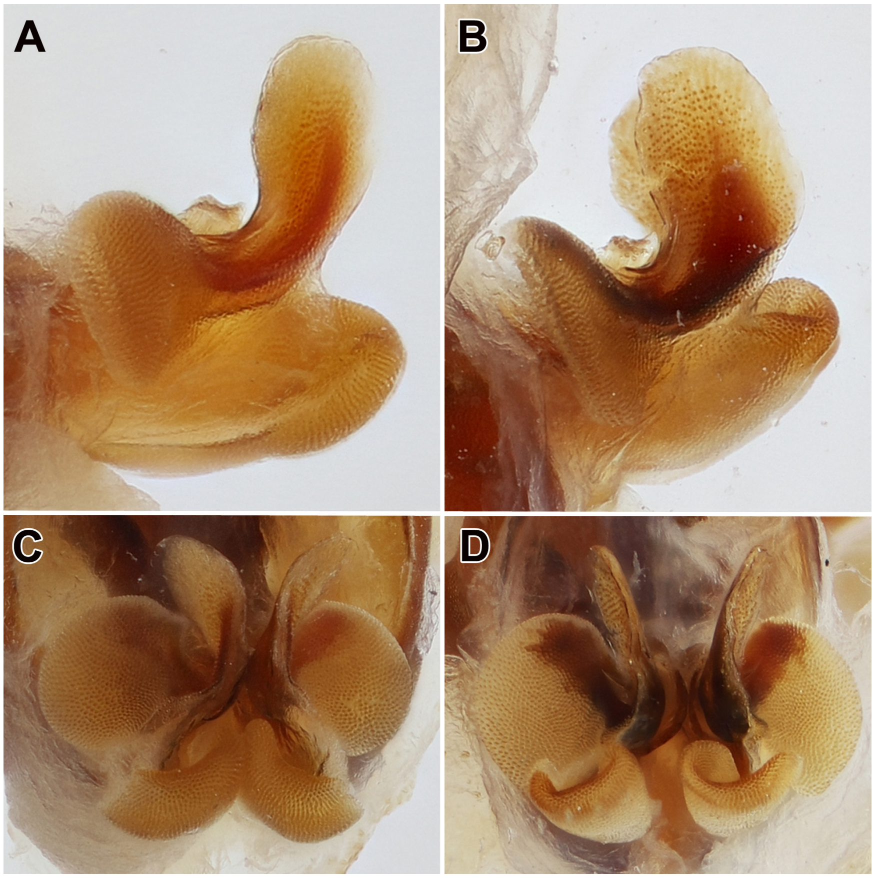


Figure 6. Close-up comparison of the valves of aedeagus of internal genitalia of *Melanoplus gordonae* Vickery, 1969 holotype: A) left lateral and C) posterior vs. *M. borealis* (Fieber, 1853) (ASUHIC): B) left lateral and D) posterior.

and Kevan (1985 (1986)) mistakenly said that the female lacked the banding.

Close examinations of the holotype and allotype specimens from the Lyman Entomological Museum confirmed these unique characters and allowed for careful comparisons to the 18 UAM specimens, which all possess the long wings possessed by the *M. gordonae* type specimens, but the apices of the subgenital plates of all 12 males would be difficult to describe as distinctly "trilobate." In fact, running all 18 specimens through the three keys repeatedly identified them consistently as *M. femurrubrum* (De Geer, 1773), which happens to be the species that Vickery (1969) compared *M. gordonae* against even though it is not found in Alaska (Vickery used specimens from British Columbia, Canada). Despite this, a colleague with over 40 years of rangeland grasshopper-identifying experience also closely examined the UAM specimens, ran them through the same keys and still came to *M. femurrubrum*, but noted that *M. borealis* (Fig. 4G&H) would be a better fit in terms of overall habitus (Reuter, personal observations).

To further support this, several morphological features of the unidentified UAM specimens, including shape variation of the male subgenital plate, female subgenital plate similarities, overall cerci shape, supra-anal plate similarities, and larger body size (Figs. 4A-D, G&H; 5A-F, L), combined with their geographic location, suggested greater similarity between *M. gordonae* and *M. borealis* than *M. gordonae* and *M. femurrubrum*. However, the primary distinctions between *M. gordonae* and *M. borealis* were three-fold: 1) subgenital plate shape in males (Fig. 5C&F), 2) slight banding on outer hind femora of females (Fig. 4C) (seemingly absent in *M. borealis* (Fig. 69)), and 3) wing length in both sexes (Fig. 4A-D, G&H). This latter character is what particularly stymied us and Reuter because, according to the three keys and other reliable sources of information (e.g., Pfadt 2002), the wings of *M. borealis* rarely extend beyond the apices of hind femora. These conflicts are what prompted the decision to borrow the type specimens of *M. gordonae* and compare the internal genitalia of the holotype to those of some of the UAM specimens and the internal genitalia of multiple male specimens of *M. femurrubrum* and *M. borealis* (all with hind wings not extending beyond the apices of hind femora). The holotype's internal genitalia (Figs. 5G-I; 6A&C) closely matched those of the UAM males, which, in turn, all closely matched those of *M. borealis* (Figs. 5J&K; 6B&D), both short and long-winged morphotypes. Differences in internal genitalia, particularly the shape of the valves of aedeagus, are often quite useful for delimiting Caelifera species, particularly melanoplines (Hubbell 1932), which certainly appears to be the case here.

Additional support for *M. gordonae* actually being *M. borealis* came from several other sources, the first being Gurney and Brooks (1959) who noted that *M. borealis borealis* (*M. borealis* has a complex taxonomic history and its subspecies are no longer recognized (Cigliano et al. 2020)) has variable wing length, which can be both shorter or longer than the abdomen. This species is found throughout Canada, across Alaska, and in several other northern U.S. states (Gurney and Brooks 1959; Vickery and Kevan 1985 (1986); Pfadt 2002; Catling 2008), meaning its known distribution encompasses that of *M. gordonae*. Several longer-winged specimens of *M. borealis* were confirmed by colleagues to exist in two reputable collections: the Pfadt Collection at the University of Wyoming (Wyoming specimens) and the National Museum of Natural History's melanopline collection. To further test our conspecificity hypothesis, we asked the colleague overseeing the latter collection to dissect the internal genitalia of two of these specimens from Fairbanks and Beaver, Alaska, and they were confirmed to be remarkably similar to the *M. gordonae* holotype.

Therefore, the preponderance of morphological evidence (similar body size, similar shape of male terminalia structures, wing length) support the synonymizing of *M. gordonae* with the earlier-named *M. borealis*. Two odd details do remain: **1)** the trilobate apex of *M. gordonae's* subgenital plate in the holotype (Fig. 5C) and **2)** the slight banding on the outer face of *M. gordonae's* hind femur in the allotype (Fig. 4C). But both of these can be explained as unusual population variation details, especially since the past use of the subspecies concept for *M. borealis* was based on high levels of population variation across regions. Some of the previously unidentified UAM male specimens do exhibit vague similarities and a range of variation (same for the previously identified *M. borealis* specimens examined) of the aforementioned unique male character, but none are admittedly as eye-catching as the specimen Vickery (1969) used to describe *M. gordonae*. Vickery (1969) simply seems to have gotten very lucky and would probably have noticed sufficient variation that might have led him to draw different conclusions if he had a larger series of specimens to examine. Finally, it should be noted that several collecting efforts made by AH and DSS in the type locality have only yielded *M. borealis* specimens: long-winged males and short-winged females (curiously, conversely to the *M. gordonae* allotype). Based on this and other Alaska-collected long-winged *M. borealis* specimens suggests that the region may contain relatively high numbers of this particular morphological variation, which warrants further investigation.

DNA Barcoding

Identification of Orthoptera via DNA barcoding can be challenging because of incomplete lineage sorting, hybridization, numt insertions (non-functional nuclear copies of mitochondrial genes), and *Wolbachia* infection. All of these can commonly obscure barcode results in Orthoptera (Hawlitschek et al. 2017; Moulton et al. 2010). Nevertheless, barcoding successfully identified 76% of species in a trial of European Orthoptera (Hawlitschek et al. 2017). The BOLD database currently contains 31,473 orthopteran barcode sequences from around the world, representing 2,953 species forming 3,485 Barcode Index Numbers (BINs) (as of 16 February 2020) (Ratnasingham and Hebert 2013).

Alaska has one of the most complete non-marine arthropod DNA barcode libraries of any state or province in North America, with over 48.5% of the known nonmarine arthropod species represented by DNA barcode sequences (Sikes et al. 2017). Barcode-compliant sequences have been obtained for 12 of the 18 Alaskan orthopteran species (67% of the Orthoptera fauna), two of which are the only members of their BINs (Table 3). Of the six un-sequenced species, barcoding was attempted, but failed, for *Tetrix ornata* and *Tropidischia xanthostoma*. *Bohemanella frigida* and *M. bruneri* were not attempted because of the ambiguous results we received from prior melanoplines. No specimens of *Xanthippus brooksi* or *M. kennicottii* were available for sequencing.

Stethophyma lineatum was originally thought to be present in Alaska, based on three specimens, two collected near Fairbanks and one near Beaver on the Yukon River. However, a combination of molecular and morphological data we generated revealed that these specimens are not actually this species. One Fairbanks specimen was barcoded and the sequence clusters with the Palearctic *Stethophyma grossum* (Linnaeus, 1758) (BOLD:AAI0053), which has a genetic distance of 4.02% to the BIN containing *S. lineatum* (BOLD:AAG9096). Further investigation confirmed that all three Alaskan specimens key out to *S. grossum* using the key of Storozhenko and Otte (1994) because of their distinctive tibial coloration. The hind tibia of *S. grossum* females has a black base and black spot in the basal third. In contrast, *S. lineatum* females have a dark brown tibial base with or without a trace of a black spot. We therefore concluded that these specimens are *S. grossum*. This species is widespread throughout Europe and

Table 3. Summary of BOLD records for Alaskan DNA barcoded Orthoptera as of 16 February 2020.

Identification	Process ID	Institution	Museum ID	BIN #	Member count	Max distance w/in BIN (p-dist)	Distance to nearest neighbour (p-dist)
Aeropedellus arcticus	UAMIC601-13	UAM	UAM:Ento:103041	ACE7981	5	0.77%	1.14%
Arphia conspersa	UAMIC582-13	UAM	UAM:Ento:84141	AAD7721	26	2.01%	1.61%
	UAMIC589-13	UAM	UAM:Ento:96690	AAD7721	26	2.01%	1.61%
Camnula pellucida	UAMIC3719-19	UAM	UAM:Ento:146222	AAA8764	117	2.41%	5.87%
	UAMIC3733-19	UAM	UAM:Ento241070	AAA8764	117	2.41%	5.87%
	UAMIC3736-19	UAM	UAM:Ento312305	AAA8764	117	2.41%	5.87%
	UAMIC3738-19	UAM	UAM:Ento340665	AAA8764	117	2.41%	5.87%
	UAMIC590-13	UAM	UAM:Ento:96692	AAA8764	117	2.41%	5.87%
	UAMIC591-13	UAM	UAM:Ento:96696	AAA8764	117	2.41%	5.87%
Chloealtis abdominalis	UAMIC3729-19	UAM	UAM:Ento:340655	AAC8496	21	0.52%	6.19%
	UAMIC607-13	UAM	UAM:Ento:106209	AAC8496	21	0.52%	6.19%
	UAMIC608-13	UAM	UAM:Ento:106211	AAC8496	21	0.52%	6.19%
Melanoplus borealis	UAMIC711-13	UAM	UAM:Ento:119366	AAA4555	1896	6.78%	1.11%
	UAMIC712-13	UAM	UAM:Ento:119367	AAA4555	1896	6.78%	1.11%
Melanoplus fasciatus	UAMIC585-13	UAM	UAM:Ento:92935	AAA4555	1896	6.78%	1.11%
	UAMIC586-13	UAM	UAM:Ento:92936	AAA4555	1896	6.78%	1.11%
Melanoplus sanguinipes	UAMIC605-13	UAM	UAM:Ento:106207	AAA4555	1896	6.78%	1.11%
	UAMIC606-13	UAM	UAM:Ento:106208	AAA4555	1896	6.78%	1.11%
Pristoceuthophilus cercalis	UAMIC710-13	UAM	UAM:Ento:116244	AAG2718	42	3.54%	7.73%
	UAMIC836-13	UAM	UAM:Ento:214244	AAG2718	42	3.54%	7.73%
Pseudochorthippus curtipennis	UAMIC578-13	UAM	UAM:Ento:71788	ACL2935	1	N/A	3.88%
Stethophyma grossum	UAMIC1077-13	UAM	UAM:Ento:85002	AAI0053	15	1.09%	4.17%
Tetrix brunnerii	UAMIC3714-19	UAM	UAM:Ento:142469	AAG2982	54	1.16%	9.62%
	UAMIC3734-19	UAM	UAM:Ento:261755	AAG2982	54	1.16%	9.62%
	UAMIC3744-19	UAM	UAM:Ento:365660	AAG2982	54	1.16%	9.62%
	UAMIC699-13	UAM	UAM:Ento:106212	AAG2982	54	1.16%	9.62%
Tetrix subulata	UAMIC3716-19	UAM	UAM:Ento:320868	AAY6671	10	0.32%	1.92%
	UAMIC3723-19	UAM	UAM:Ento:313776	AAY6671	10	0.32%	1.92%
	UAMIC3725-19	UAM	UAM:Ento:167743	AAY6671	10	0.32%	1.92%
	UAMIC3740-19	UAM	UAM:Ento:313803	AAY6671	10	0.32%	1.92%
	UAMIC3741-19	UAM	UAM:Ento:321926	AAY6671	10	0.32%	1.92%
	UAMIC3742-19	UAM	UAM:Ento:323142	AAY6671	10	0.32%	1.92%
	UAMIC3747-19	UAM	UAM:Ento:313804	AAY6671	10	0.32%	1.92%
	UAMIC3750-19	UAM	UAM:Ento:365088	AAY6671	10	0.32%	1.92%
	UAMIC3753-19	UAM	UAM:Ento:323161	AAY6671	10	0.32%	1.92%
	UAMIC573-13	UAM	UAM:Ento:15722	ACJ7497	1	N/A	2.41%

Siberia, but these are the first records in North America. In Europe, it is associated with wetlands and listed as Vulnerable or Near Threatened in Poland, Austria, Switzerland, Denmark, the United Kingdom, and part of the Czech Republic due to habitat loss (Hochkirk et al. 2016). More work is needed to determine the limits of its distribution in North America, its habitat preferences, and if it occurs sympatrically with *S. lineatum* over any of its range. A specimen of *S. lineatum* in the University of British Columbia Spencer Entomological Collection, collected from Halfway Lake, near Mayo, Yukon, needs verification because this locality is close to the eastern boundary of Beringia and disjunct from the majority of *S. lineatum* records (Catling 2008).

Two sequences, from specimens identified as *Tetrix subulata* and *Pseudochorthippus curtipennis* (Harris, 1835), are the only members of their BINs. *Tetrix subulata* is a widely occurring Holarctic species. The BOLD database contains 47 sequences of *T. subulata,* forming three monospecific BINs and one taxonomically discordant BIN (BOLD:AAG2982) that contains several *Tetrix* species but likely represents *Tetrix brunnerii.* Of the monospecific BINs, one contains all of the Palearctic sequences (BOLD:AAC3440), one contains almost all of the Nearctic sequences, including nine from Alaska (BOLD:AAY6671), and the final BIN contains a single sequence from Fairbanks, Alaska (BIN BOLD:ACJ7497). This lone sequence is not geographically isolated from the other Alaskan sequences, some of which were also collected near Fairbanks.

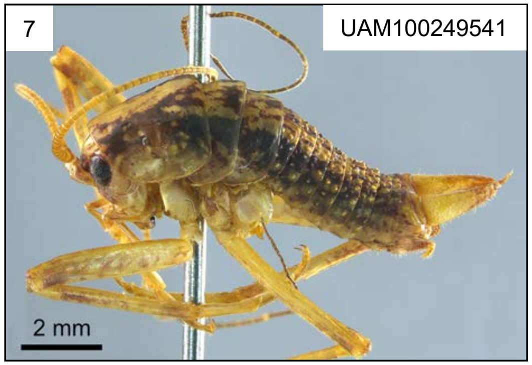
The *P. curtipennis* sequence, in BIN BOLD:ACL2935, came from one of four UAM specimens collected near Naknek, Alaska. Its nearest neighbor, at 3.88% distant, is a BIN (BOLD:AAG5331) containing sequences from four Canadian specimens identified as *Pseudochorthippus montanus* (Charpentier, 1825). However, *P. montanus* is not known from North America, so these specimens may be misidentified *P. curtipennis*. Unfortunately, attempts to sequence nine other Alaskan specimens failed, so we do not know if this specimen is representative of all Alaskan *P. curtipennis.* All other *P. curtipennis* sequences in the BOLD database cluster into three closely related BINs.

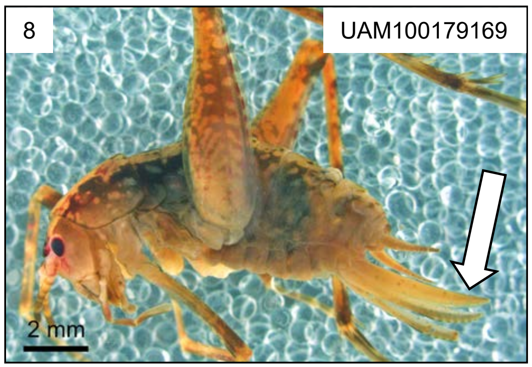
Sequences from the three *Melanoplus* species that we obtained DNA barcodes for cluster into a single taxonomically discordant BIN (BOLD:AAA4555) shared with 23 congeneric specimens. The maximum within-BIN distance is high (>2%) and exceeds the distance to its nearest neighbor. Other sequences from these species in the BOLD database cluster into several other discordant BINs. *Melanoplus* diversity is the result of a recent radiation during the Pleistocene (Knowles 2000; Knowles and Otte 2000), and incongruence between gene trees and species trees is well established in the genus (Carstens and Knowles 2007; Knowles 2001). Misidentification could also be a contributing factor.

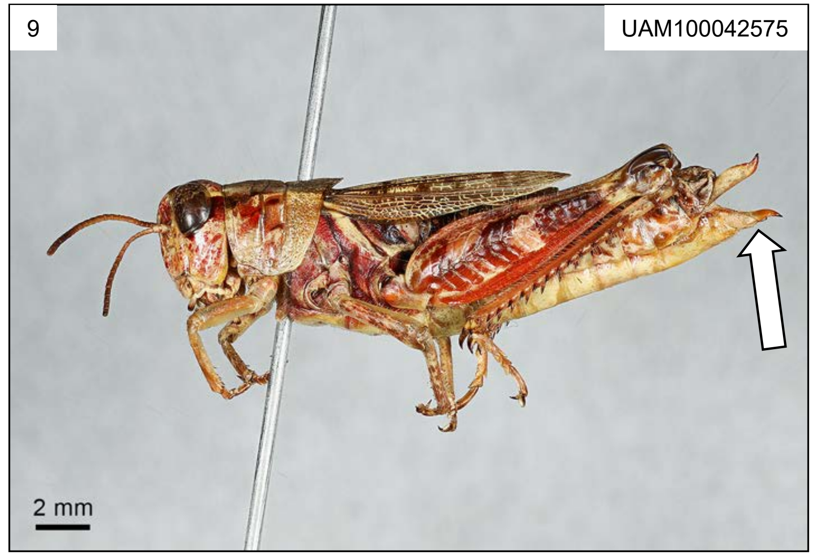
These preliminary barcode results suggest that non-Melanoplini grasshoppers are suitable taxa for phylogeographic studies of Pleistocene glacial cycles. *Stethophyma grossum* displays a classic Beringian distribution with disjunct Palearctic and Nearctic populations, likely separated by the flooding of the Bering Land Bridge. *Tetrix subulata* and *Pseudochorthippus curtipennis* show evidence for divergent Alaskan clades, consistent with findings in other Beringian taxa (Shafer et al. 2010). However, barcoding efforts to date have focused on creating a simple species inventory, and more thorough work is needed to place Alaskan grasshoppers in the broader context of northwestern North American and to test phylogeographic hypotheses.

Article continues on next page

Photographic key to the Orthoptera of Alaska





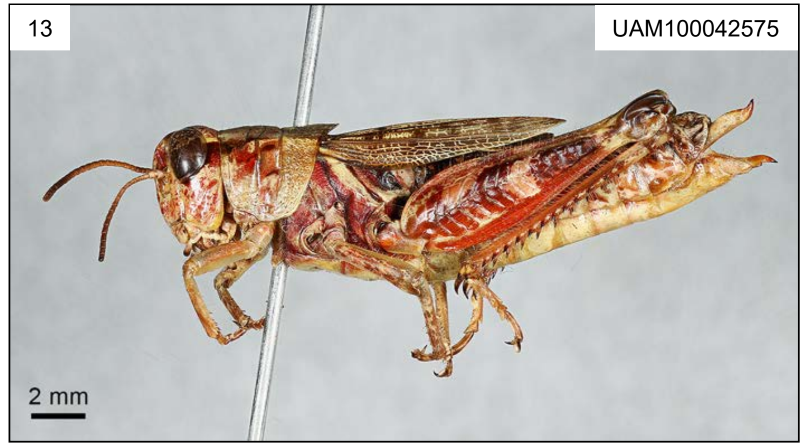


1A	Antennae long, usually longer than body (**Fig. 7**); ovipositor long (**Fig. 8**).	2
1B	Antennae and ovipositor short (**Fig. 9**).	3

Photographic key to the Orthoptera of Alaska

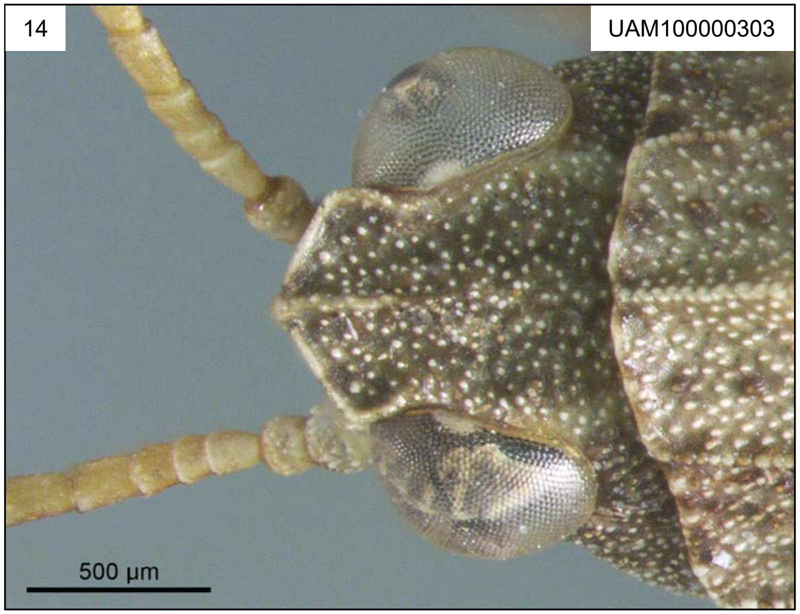
2A (1A)	Hind tibia round in cross-section, with 2 rows of unequally-sized spines (**Fig. 10**).	*Pristoceuthophilus cercalis*
2B (1A)	Hind tibia square in cross-section with 4 rows of equally-sized spines (**Fig. 11**).	*Tropidischia xanthosoma*

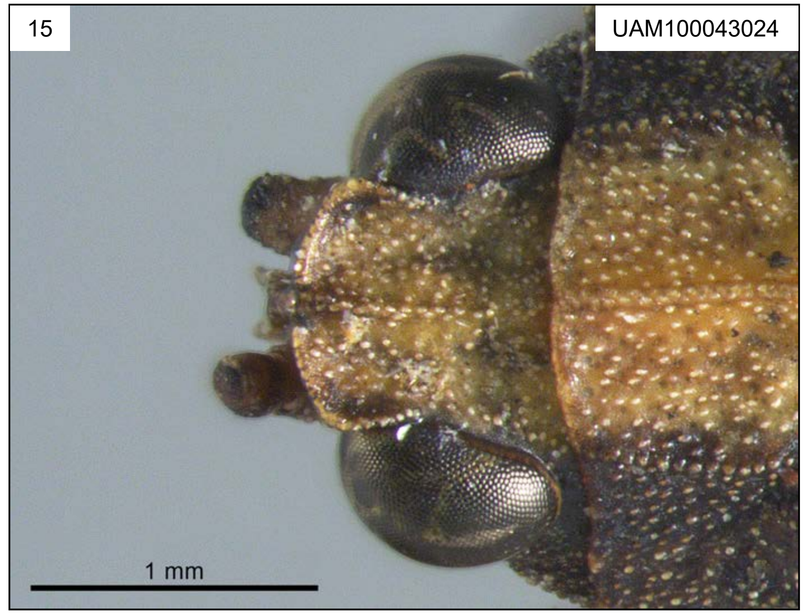
Photographic key to the Orthoptera of Alaska



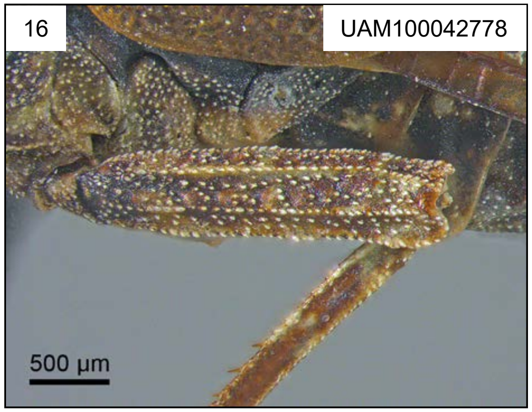
3A (1B)	Pronotum extended backwards over abdomen (**Fig. 12**).	4
3B (1B)	Pronotum not extended backwards abdomen (**Fig. 13**).	6

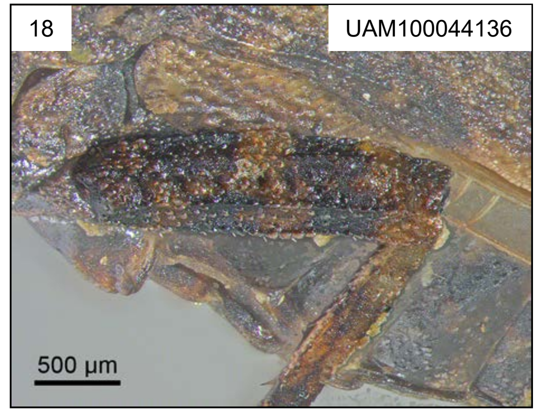
Photographic key to the Orthoptera of Alaska

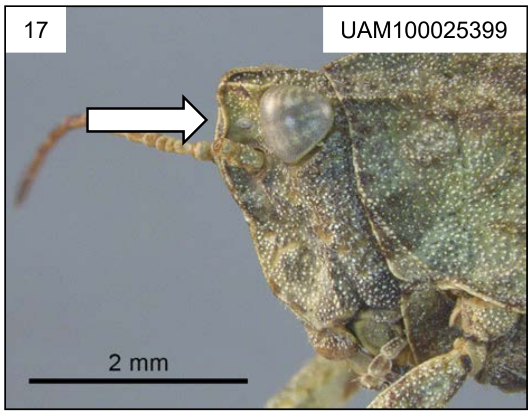


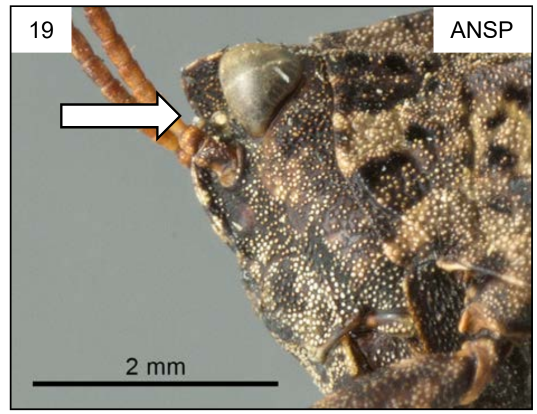


4A (3A)	Fastigium rectangulate from above with median carina not projecting (**Fig. 14**).	5
4B (3A)	Fastigium truncate to convex from above with median carina projecting (**Fig. 15**).	*Tetrix ornata*



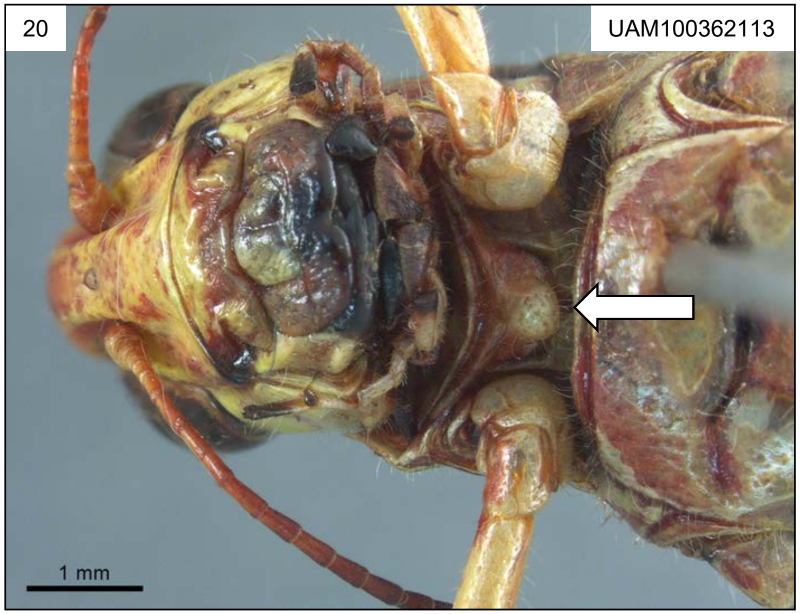


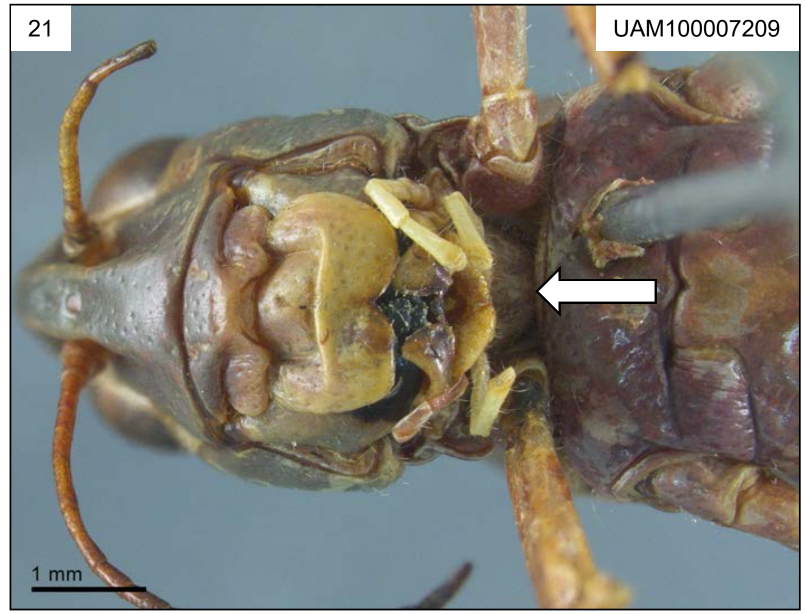




5A (4A)	Middle femur 3.8 – 4.7 times as long as broad (**Fig. 16**). Top of face weakly emarginated (**Fig. 17**).	*Tetrix subulata*
5B (4A)	Middle femur 3.0 – 3.4 times as long as broad (**Fig. 18**). Top of face predominantly emarginated (**Fig. 19**).	*Tetrix brunnerii*

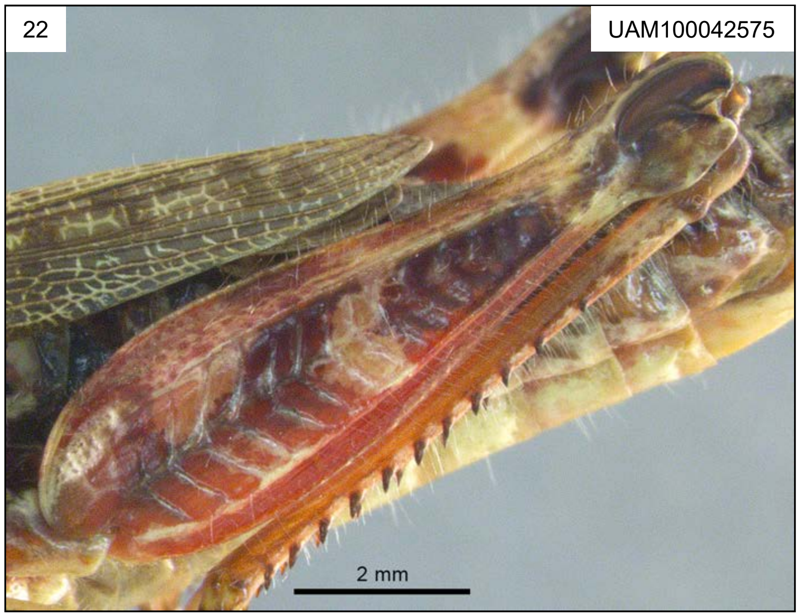
Photographic key to the Orthoptera of Alaska





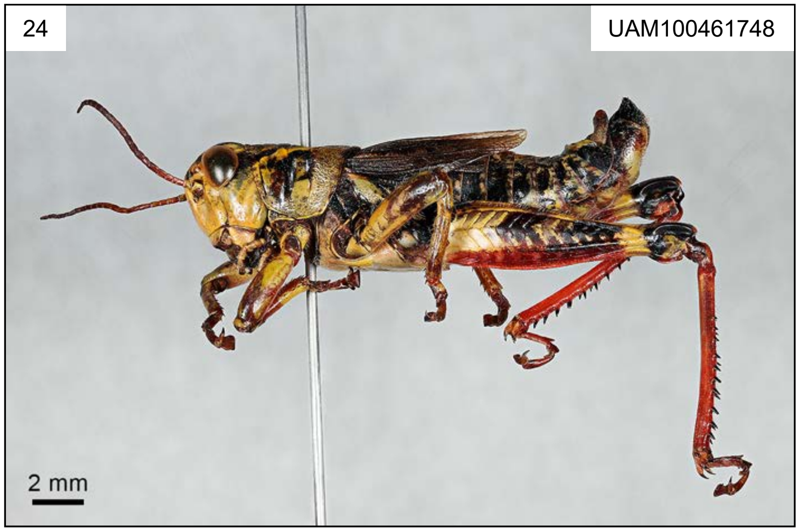
6A (3B)	Prosternal spur at base of neck (**Fig. 20**). Melanoplinae.	7
6B (3B)	No prosternal spur at base of neck (**Fig. 21**).	14

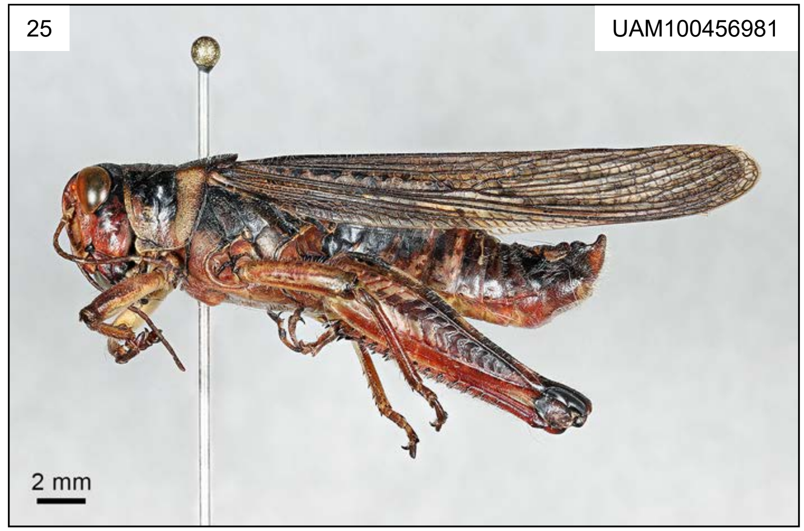
Photographic key to the Orthoptera of Alaska



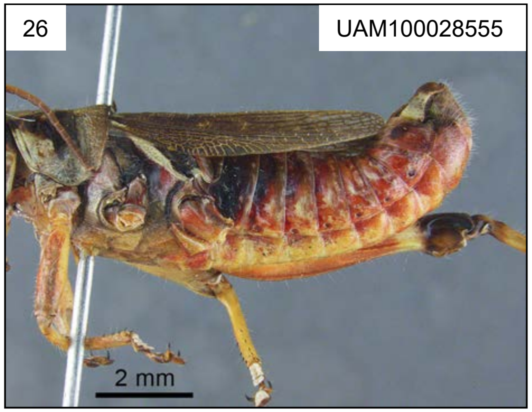
7A (6A)	Hind femur banded on outer face (**Fig. 22**).	8
7B (6A)	Hind femur not banded on outer face (**Fig. 23**).	*Melanoplus borealis*

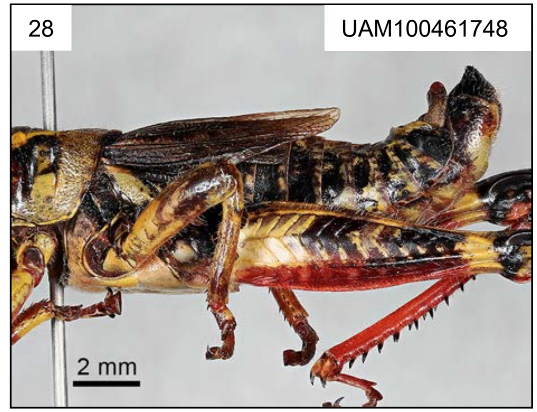
Photographic key to the Orthoptera of Alaska

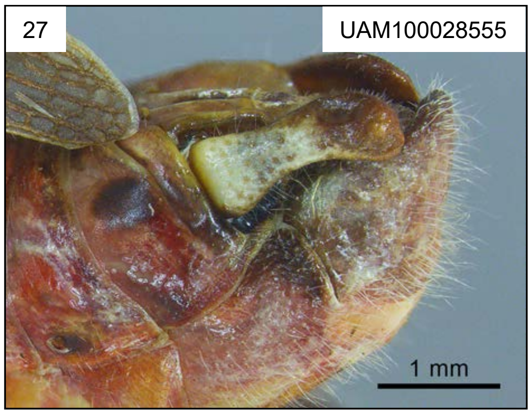


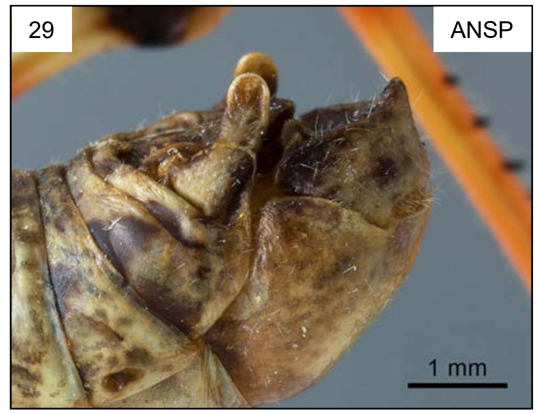


8A (7A)	Wings not, or barely, reaching tip of abdomen (**Fig. 24**).	9
8B (7A)	Wings extending beyond tip of abdomen (**Fig. 25**).	10



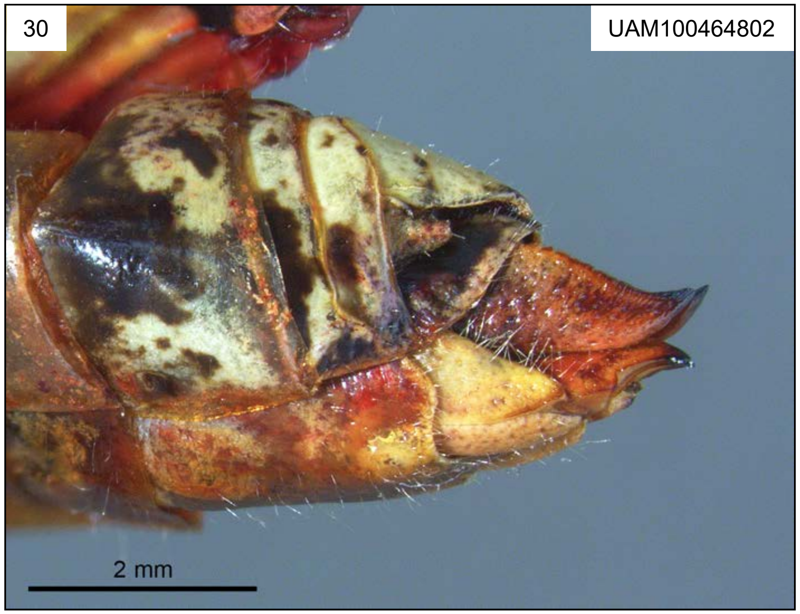


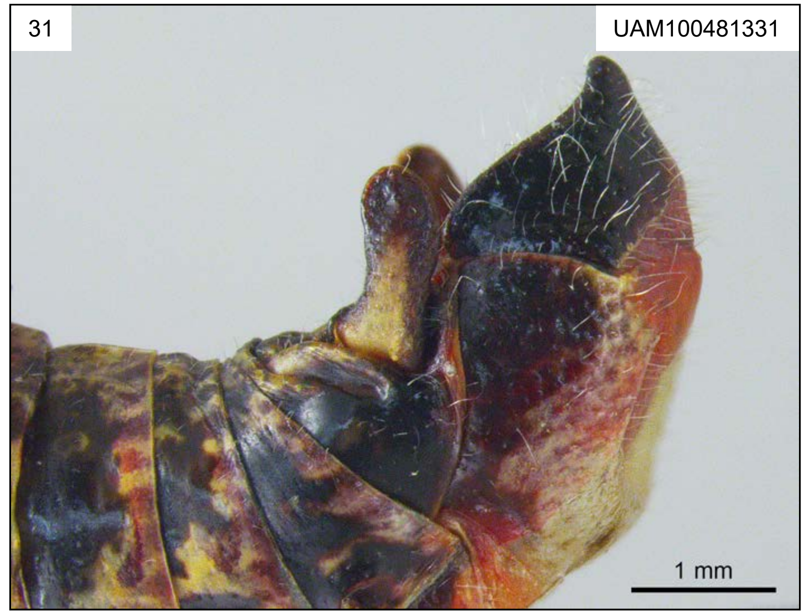




9A (8A)	Wings extending beyond 6th abdominal segment (**Fig. 26**). Male cerci down-curved (**Fig. 27**).	*Melanoplus fasciatus*
9B (8A)	Wings reaching 4th abdominal segment (**Fig. 28**). Male cerci up-curved (**Fig. 29**).	*Bohemanella frigida*

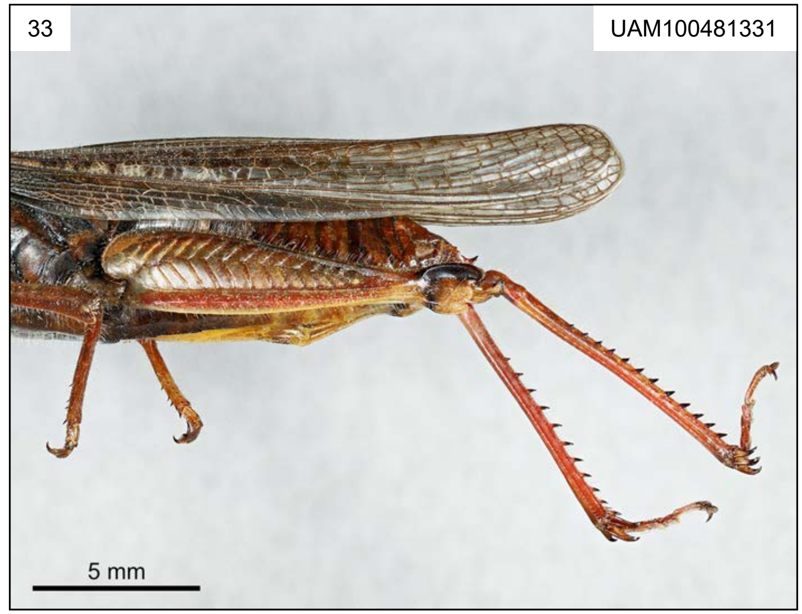
Photographic key to the Orthoptera of Alaska



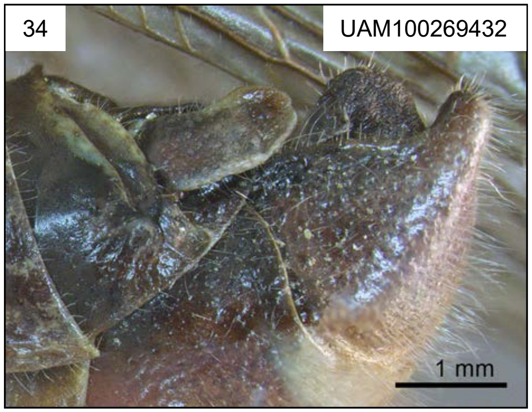


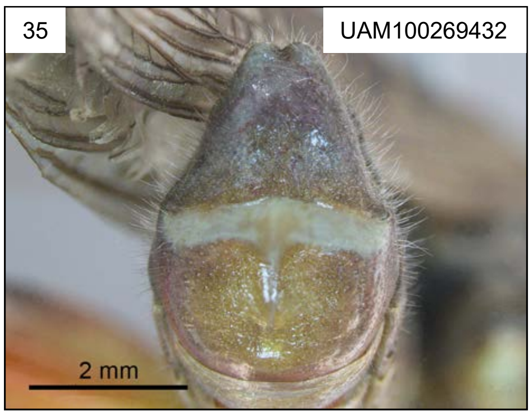
10A (8B)	Female (**Fig. 30**).	11
10B (8B)	Male (**Fig. 31**).	12

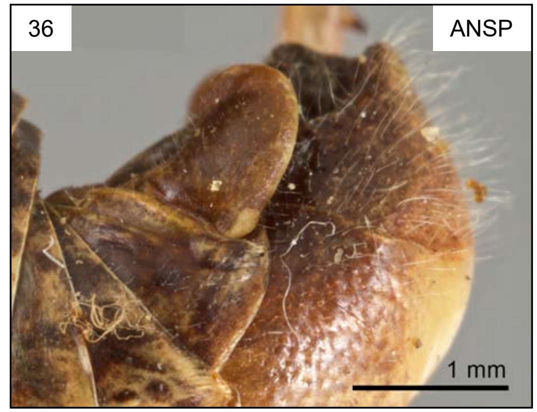
Photographic key to the Orthoptera of Alaska

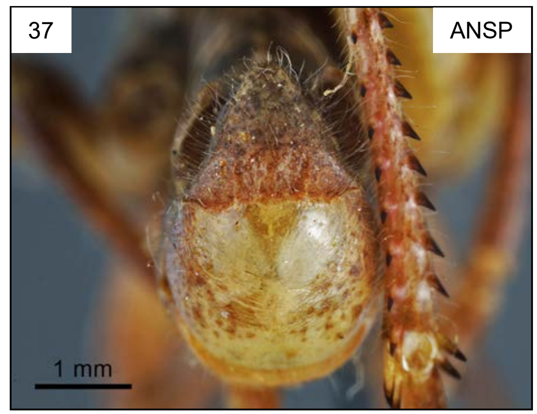


11A (10A)	Wings not exceeding tip of hind femur (**Fig. 32**).	*Melanoplus kennicottii*
11B (10A)	Wings exceeding tip of hind femur (**Fig. 33**).	*Melanoplus sanguinipes* *or* *Melanoplus bruneri*

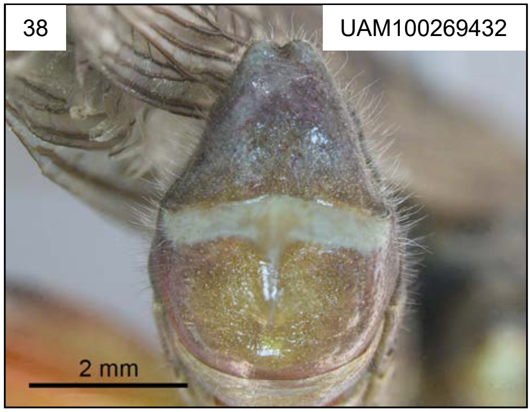


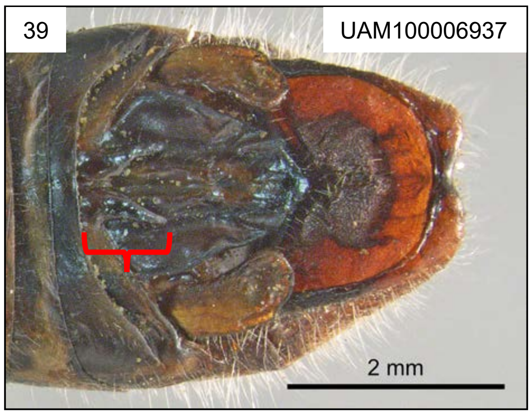


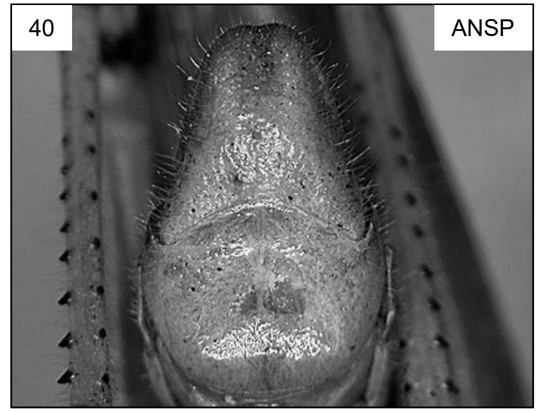


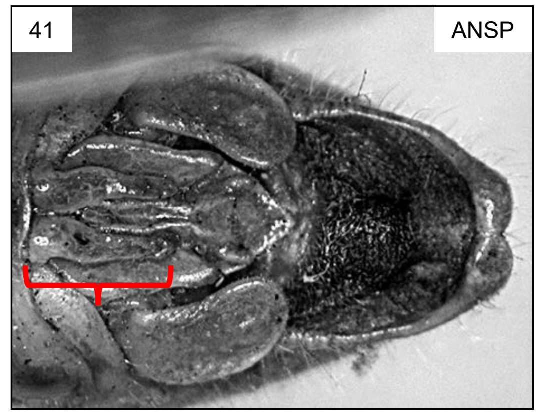


12A (10B)	Cercus small and flat (**Fig. 34**). Subgenital plate notched (**Fig. 35**).	13
12B (10B)	Cercus large with rounded apex bent dorsally (**Fig. 36**). Subgenital plate rounded or truncate (**Fig. 37**).	*Melanoplus kennicottii*



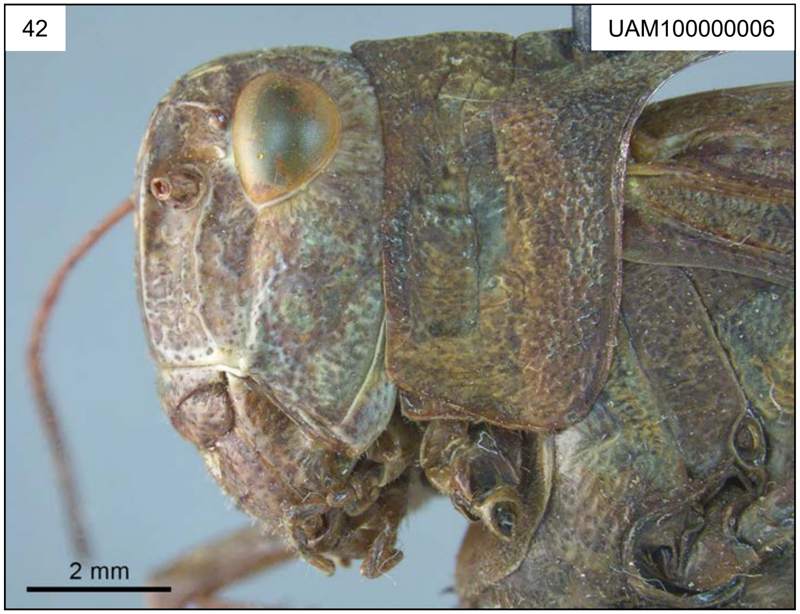


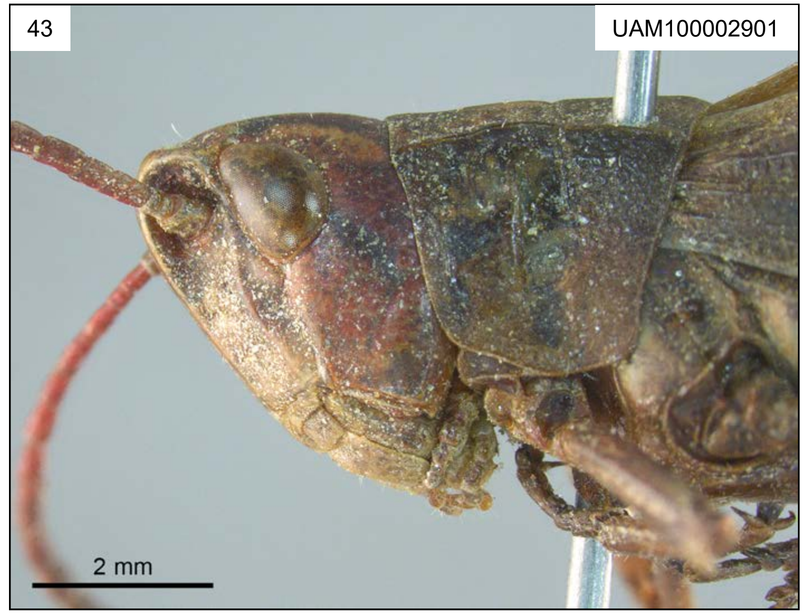




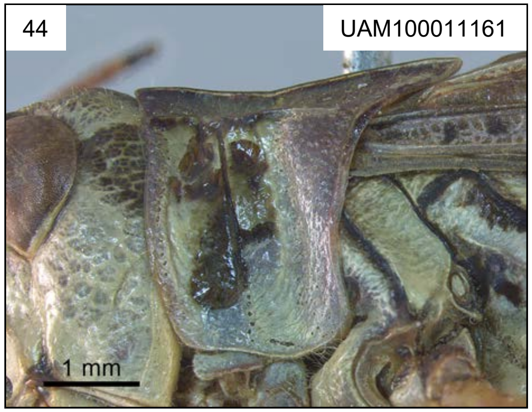
13A (12A)	Subgenital plate wider than long (**Fig. 38**); furculae less than 1/3 as long as supra-anal plate (**Fig. 39**).	*Melanoplus sanguinipes*
13B (12A)	Subgenital plate as wide as long (**Fig. 40**); furculae more than 1/3 as long as supra-anal plate (**Fig. 41**).	*Melanoplus bruneri*

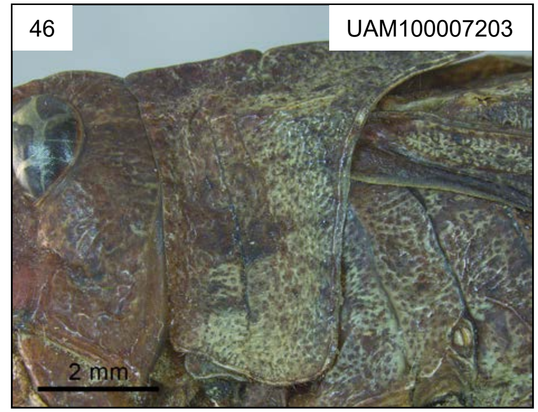
Photographic key to the Orthoptera of Alaska

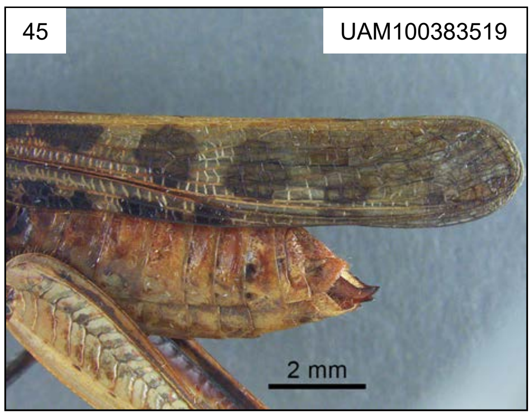


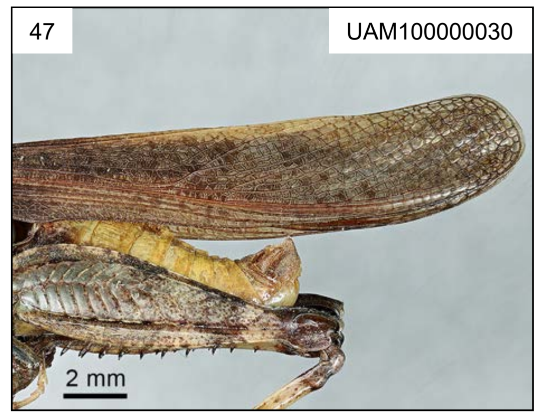


14A (6B)	Lateral profile of head more or less vertical (**Fig. 42**).	15
14B (6B)	Lateral profile of head oblique (**Fig. 43**).	17









15A (14A)	Pronotum with median carina low (**Fig. 44**). Tegmina with large “leopard” spots (**Fig. 45**).	16
15B (14A)	Pronotum with median carina prominent (**Fig. 46**). Tegmina with small spots (**Fig. 47**).	*Arphia conspersa*

Photographic key to the Orthoptera of Alaska

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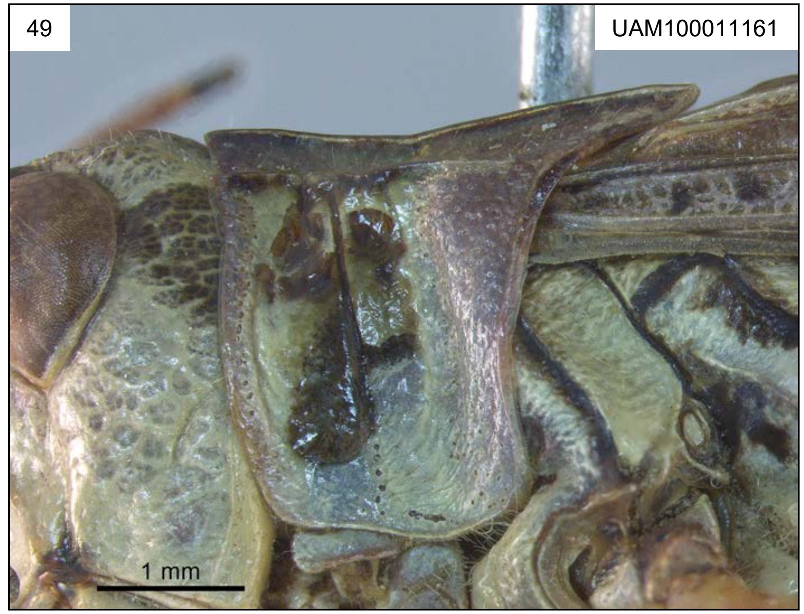
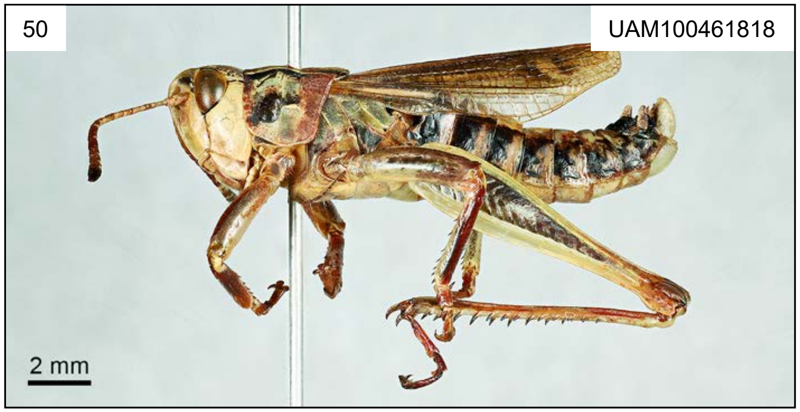
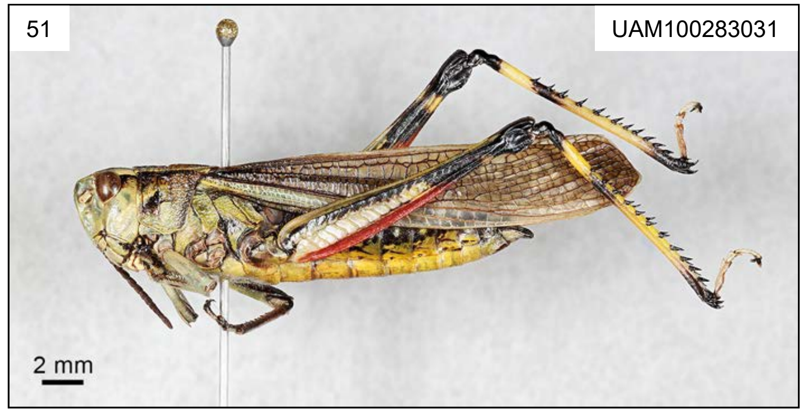


16A (15A)	Pronotum roughened in front, posterior half with tubercles (**Fig. 48**). Hindwing pale yellow.	*Xanthippus brooksi*
16B (15A)	Pronotum smooth or slightly wrinkled in front, posterior half without tubercles (**Fig. 49**). Hindwing transparent.	*Camnula pellucida*

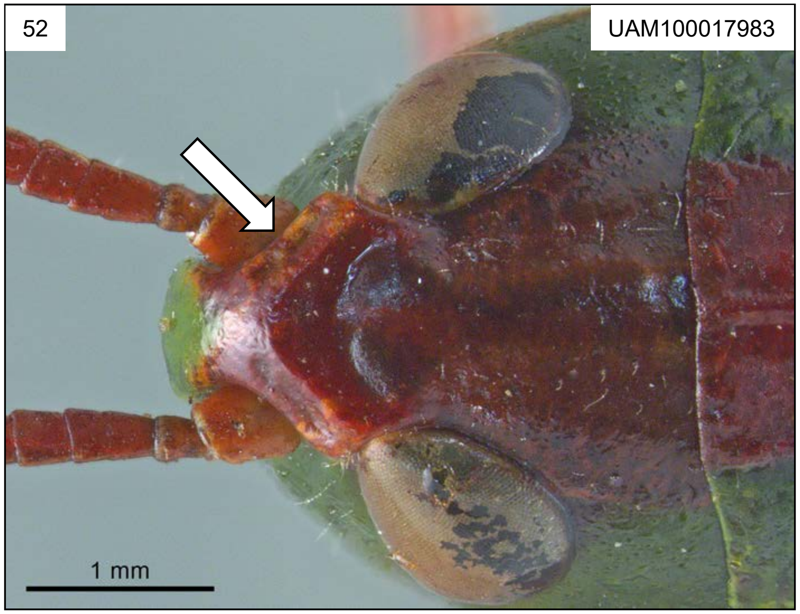
Photographic key to the Orthoptera of Alaska

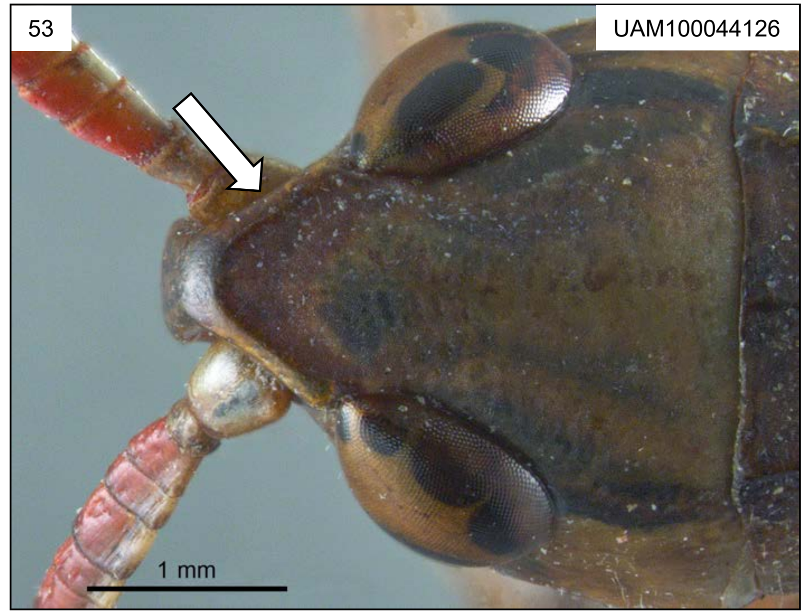




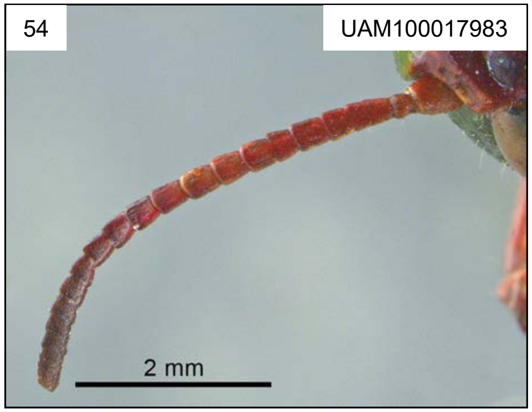
17A (14B)	Body small: 12-28mm; wings not extending beyond tip of abdomen (**Fig. 50**).	18
17B (14B)	Body medium sized: 19-36mm; wings extending beyond tip of abdomen (**Fig. 51**). The hind tibia of *S. grossum* females has a black base and black spot in the basal third. In contrast, *S. lineatum* has a dark brown tibial base without or with only a trace of a black spot.	*Stethophyma grossum*

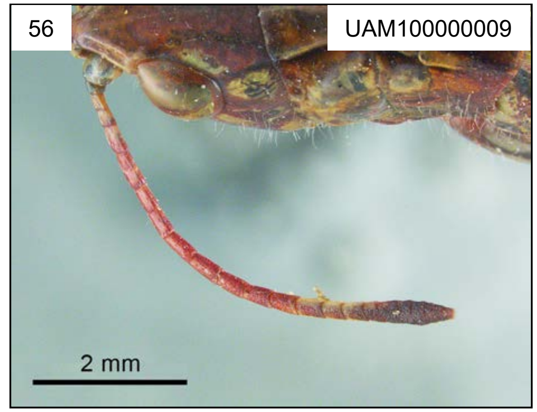
Photographic key to the Orthoptera of Alaska

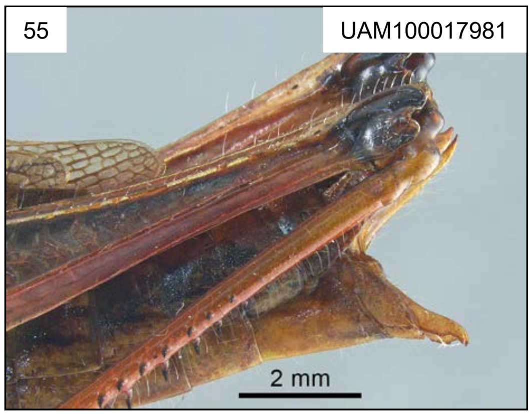


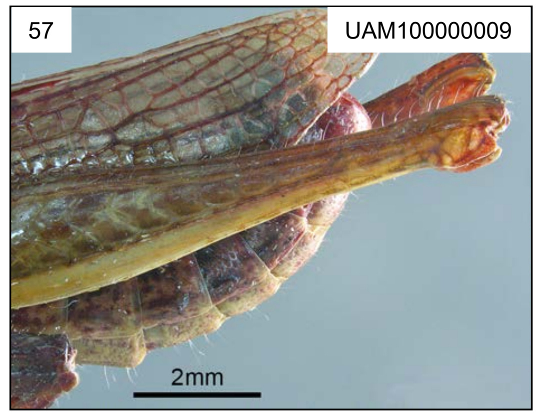


18A (17A)	Fastigium with foveolae visible from above (**Fig. 52**).	19
18B (17A)	Fastigium without foveolae (**Fig. 53**).	*Chloealtis abdominalis*









19A (18A)	Antennae not clubbed (**Fig. 54**); tip of femur black (**Fig. 55**).	*Pseudochorthippus curtipennis*
19B (18A)	Antennae clubbed, especially in males (**Fig. 56**); tip of femur not black (**Fig. 57**).	*Aeropedellus arcticus*

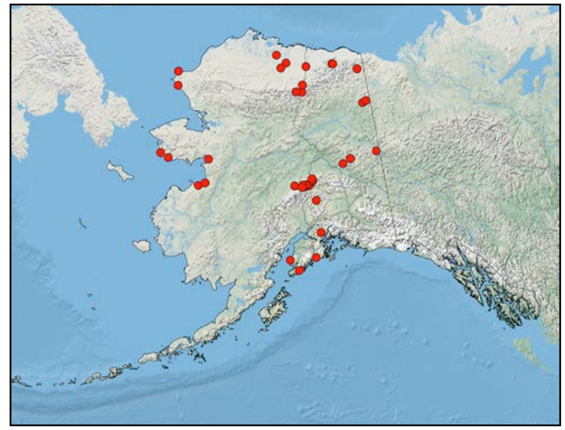
Aeropedellus arcticus Hebard, 1935

Arctic club-horned grasshopper

Family: Acrididae
Subfamily: Gomphocerinae

This widely distributed grasshopper can be distinguished from other Alaskan gomphocerines by a combination of frontal foveolae and clubbed antennae. It is abundant above tree line in the Alaska Range. This species has also been reported from the Yukon and Northwest Territories (Catling 2008).

Males: 12–21 mm; **Females:** 12–21 mm
BOLD DNA Barcode records from Alaska:
UAMIC601-13



Map 1: Alaskan distribution

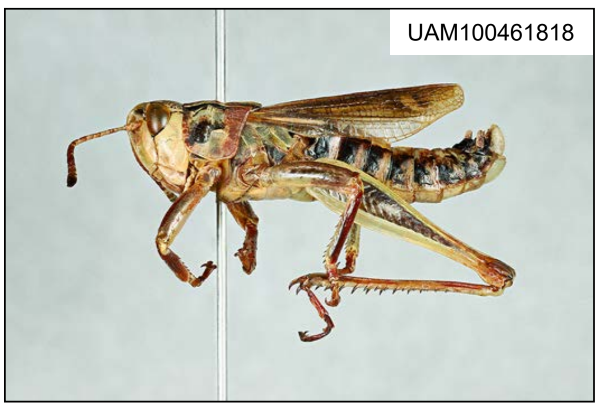


Figure 58: Male

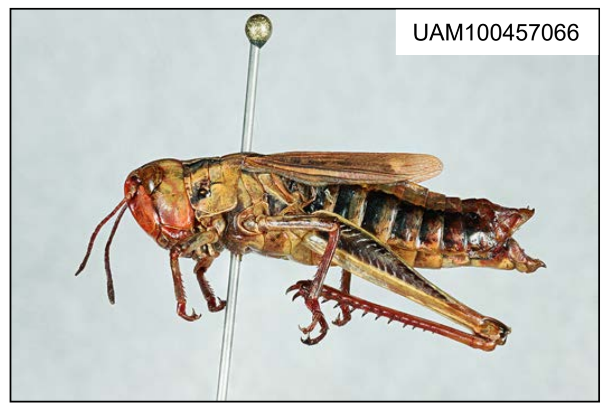


Figure 59: Female

doi:10.3752/cjai.2021.44

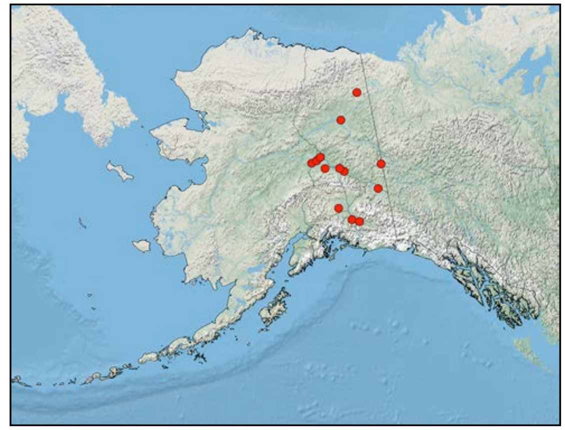
Arphia conspersa Scudder, 1875

speckled rangeland grasshopper

Family: Acrididae
Subfamily: Oedipodinae

Arphia conspersa is an inhabitant of grasslands and forest clearings. They generally overwinter as nymphs and may have a one or two-year life cycle (Vickery and Kevan 1985 (1986)). Adults can be collected in the spring. This species ranges east to the Great Lakes and south to Mexico (Catling 2008).

Males: 19–21 mm; **Females:** 22–28 mm
BOLD DNA Barcode records from Alaska:
UAMIC582-13, UAMIC589-13



Map 2: Alaskan distribution

Figure 60: Male. Photo by B. Lotze.

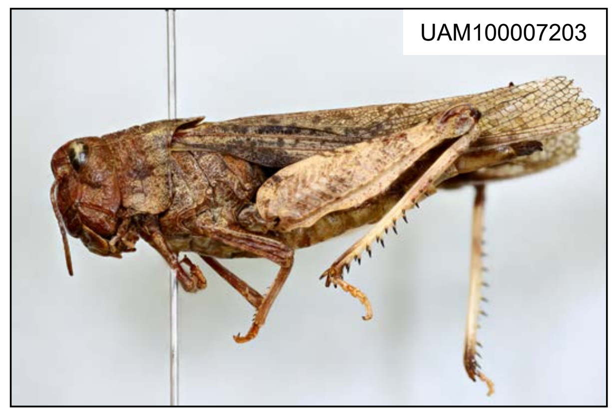


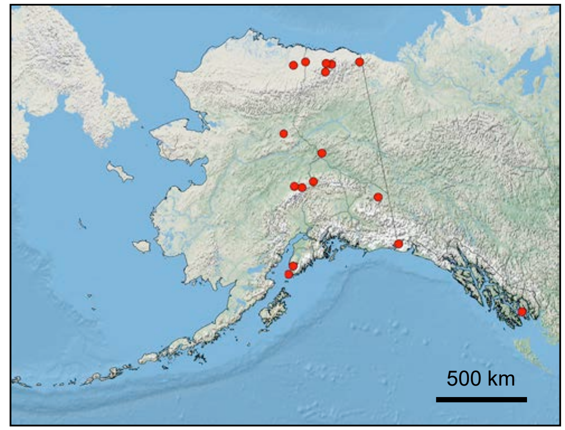
Figure 61: Female

Bohemanella frigida (Boheman, 1846)
tundra grasshopper

Family: Acrididae
Subfamily: Melanoplinae

This is a flightless Beringian species. Males can be distinguished from *M. fasciatus* by up-turned cerci and an elevated round projection at the apex of the subgenital plate. It inhabits tundra and can be found at high elevations and above the Arctic Circle. This species has also been reported from the Yukon and Northwest Territories (Catling 2008).

Males: 17–21 mm; **Females:** 22–27 mm
BOLD DNA Barcode records from Alaska: none



Map 3: Alaskan distribution

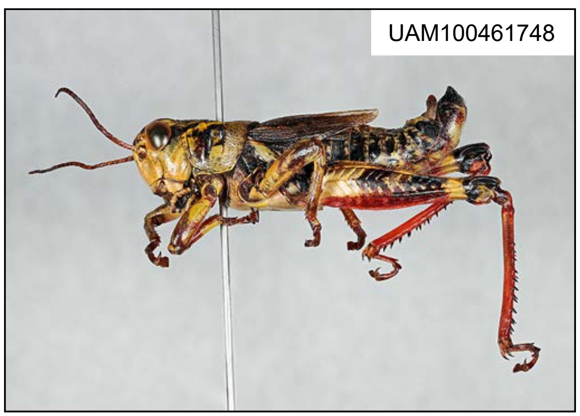


Figure 62: Male

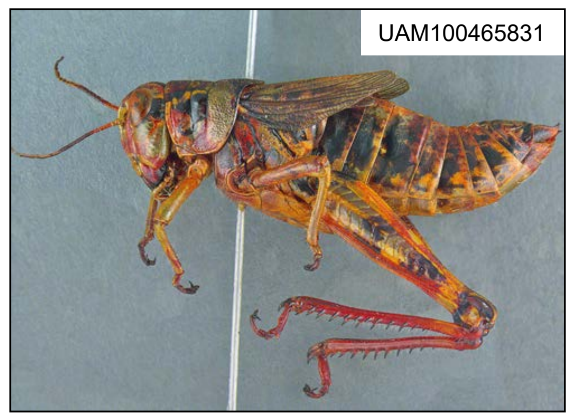


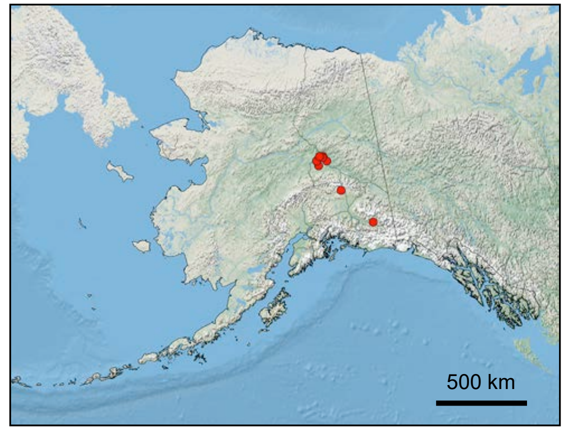
Figure 63: Female

Camnula pellucida (Scudder, 1862)
clearwinged grasshopper

Family: Acrididae
Subfamily: Oedipodinae

This grasshopper is considered a significant agricultural pest of cereal grains in Alaska (Pfadt 2002). The pronotum is smooth in this species and, as the common name suggests, the hind wing is transparent. It is univoltine and overwinters in the egg stage (Vickery and Kevan 1985 (1986)). It is widely distributed throughout Canada and the western United States (Catling 2008).

Males: 17–21 mm; **Females:** 19.5–29 mm
BOLD DNA Barcode records from Alaska:
UAMIC3719-19, UAMIC3733-19, UAMIC3736-19
UAMIC3738-19, UAMIC590-13, UAMIC591-13



Map 4: Alaskan distribution

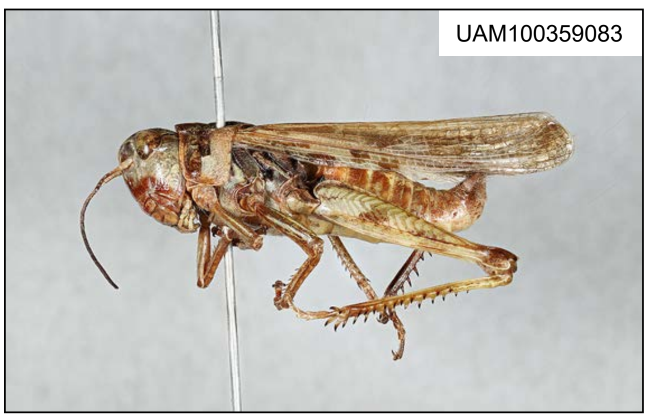


Figure 64: Male

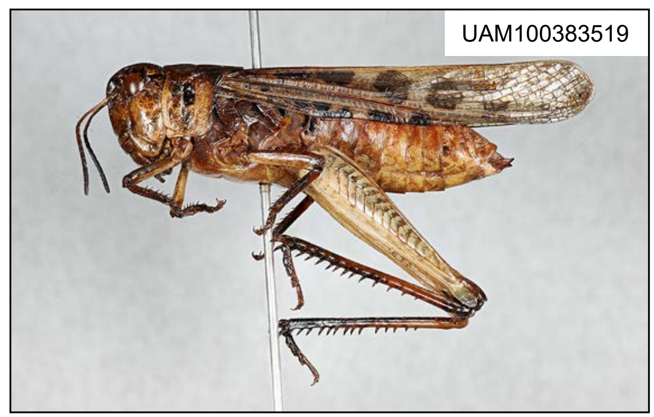


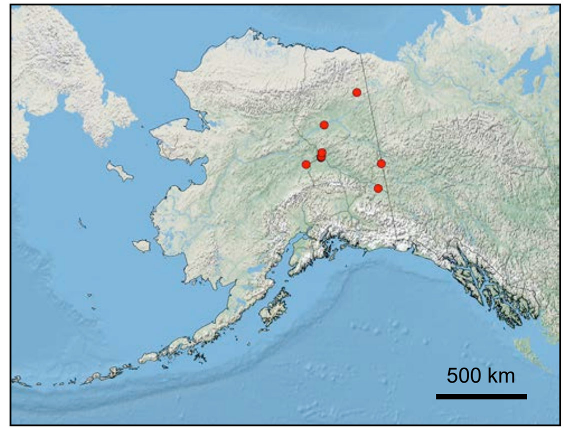
Figure 65: Female

Chloealtis abdominalis (Thomas, 1873)
cow grasshopper

Family: Acrididae
Subfamily: Gomphocerinae

Unlike *Aeropedellus arcticus* and *Pseudochorthippus curtipennis*, this species lacks foveolae on top of the fastigium. It primarily inhabits parklands and dry forests with grassy clearings, where it feeds on grasses and sedges (Vickery and Kevan 1985 (1986)). It is widely distributed throughout Canada and the United States (Vickery and Kevan 1985 (1986)).

Males: 18–19 mm; **Females:** 23–28 mm
BOLD DNA Barcode records from Alaska:
UAMIC3729-19, UAMIC607-13, UAMIC608-13



Map 5: Alaskan distribution

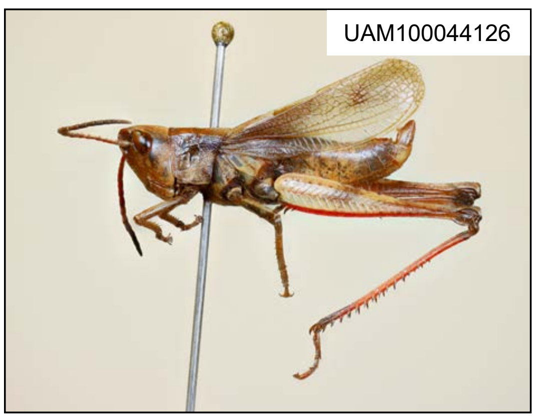


Figure 66: Male

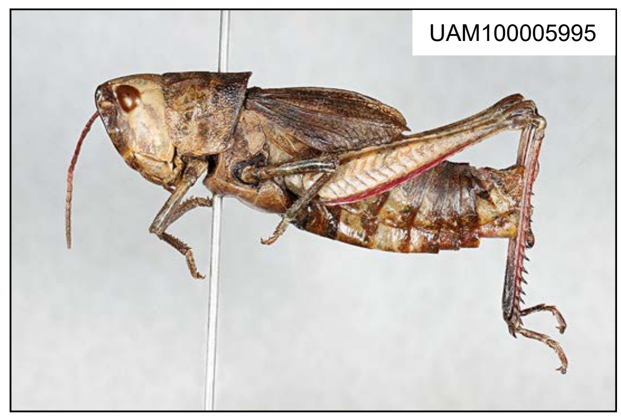


Figure 67: Female

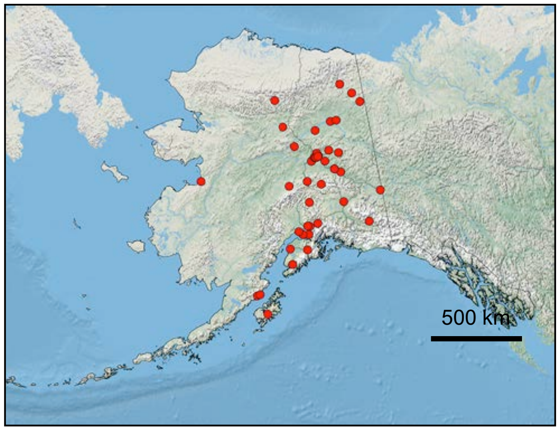
Melanoplus borealis (Fieber, 1853)
northern grasshopper

(= *Melanoplus gordonae* Vickery, 1969, **syn. nov.**)

Family: Acrididae
Subfamily: Melanoplinae

Among the first species documented in Alaska. In Alaska, it over-winters as an egg, emerges in mid-June, and reaches maturity by late July (Kaufmann 2017). It feeds primarily on forbs but will also eat graminoids and as such is considered an agricultural pest (Pfadt 2002; Kaufmann 2017). This species is highly variable in color and wing morphology. Both long and short-winged morphotypes are present in Alaska. This species ranges east to Newfoundland and as far south as Colorado and Massachusetts (Vickery and Kevan 1985 (1986)).

Males: 16–20 mm; **Females:** 20–24 mm
BOLD DNA Barcode records from Alaska:
UAMIC711-13, UAMIC712-13



Map 6: Alaskan distribution

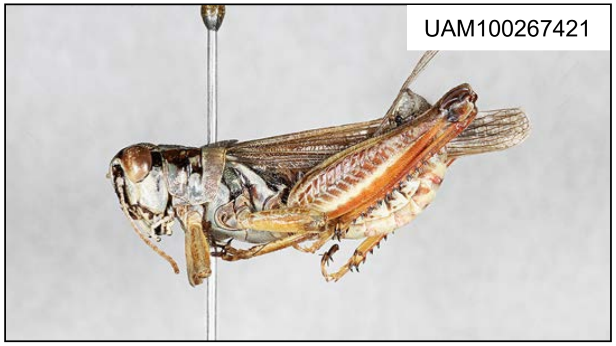


Figure 68: Male

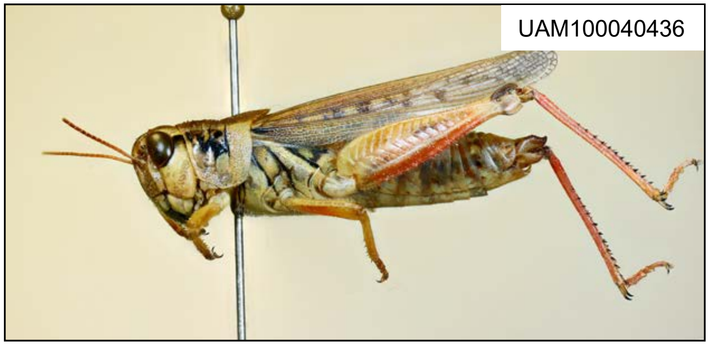


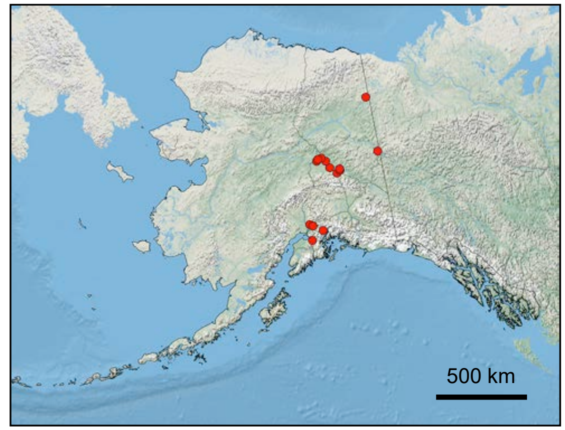
Figure 69: Female

Melanoplus bruneri Scudder, 1897
Bruner's grasshopper

Family: Acrididae
Subfamily: Melanoplinae

Specimens of this species can be difficult to tell apart from the more common *M. sanguinipes.* They may have a two-year life cycle in Alaska (Vickery and Kevan 1985 (1986)). This species can be found throughout Canada but is more common in the west (Catling 2008). It also occurs in the western United States, as far south as Arizona (Vickery and Kevan 1985 (1986)).

Males: 20–25 mm; **Females:** 22–29 mm
BOLD DNA Barcode records from Alaska: none



Map 7: Alaskan distribution

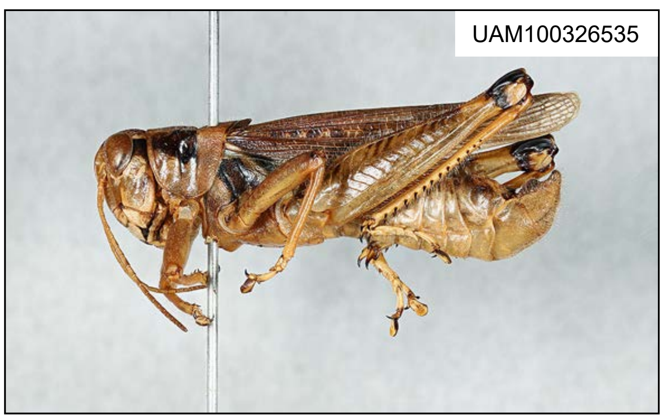


Figure 70: Male

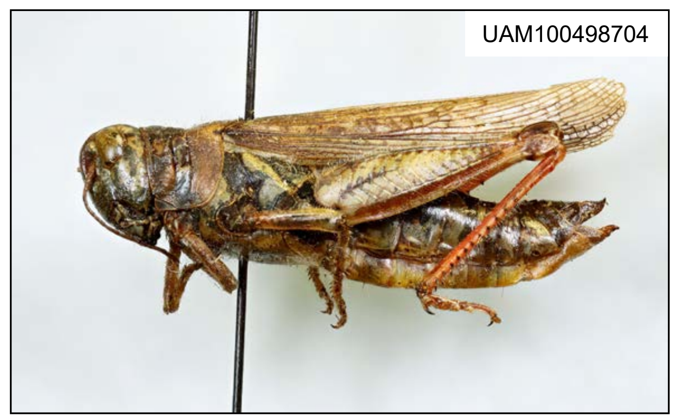


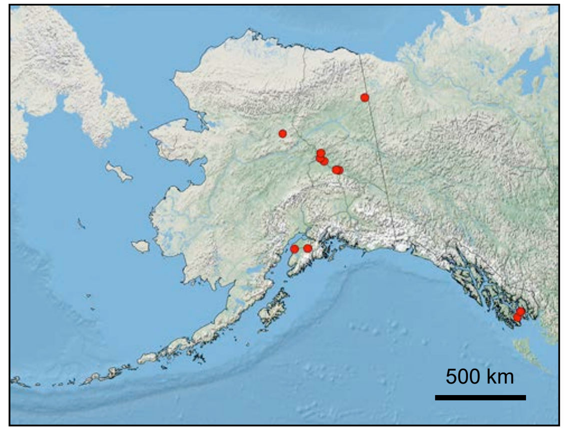
Figure 71: Female

Melanoplus fasciatus (Walker, 1870)
huckleberry grasshopper

Family: Acrididae
Subfamily: Melanoplinae

Males, and some females, of this species have short wings. Males can also be recognized by down-turned cerci, and a broadly rounded tip of the subgenital plate. It is associated with blueberries and other heath plants (Vickery and Kevan 1985 (1986)). This species ranges east to Newfoundland and south to Washington, Colorado, and Massachusetts (Vickery and Kevan 1985 (1986)).

Males: 17–20 mm; **Females:** 20–25 mm
BOLD DNA Barcode records from Alaska:
UAMIC585-13, UAMIC586-13



Map 8: Alaskan distribution

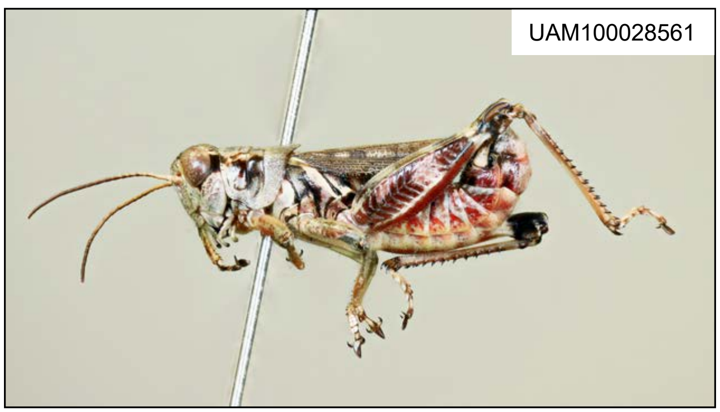


Figure 72: Male

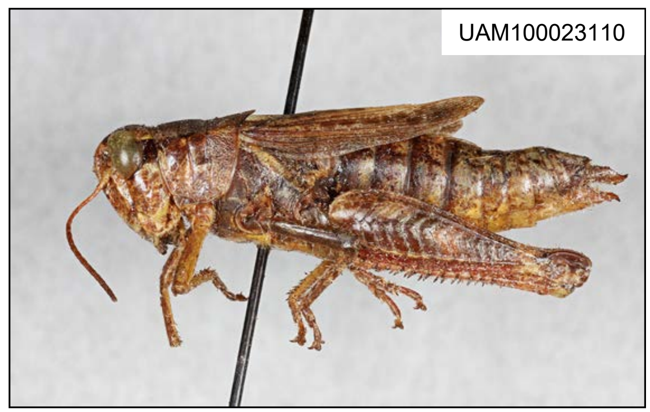


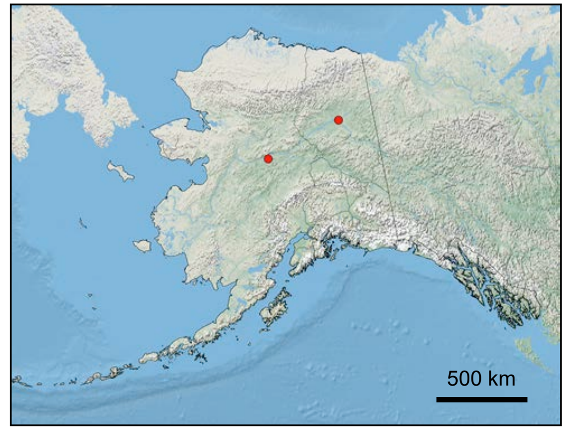
Figure 73: Female

Melanoplus kennicottii Scudder, 1878
Kennicott's grasshopper

Family: Acrididae
Subfamily: Melanoplinae

Named for the early Alaskan explorer Robert Kennicott. It can be distinguished from other Alaskan Melanoplini by its cerci which are smoothly rounded on the lower side and bent dorsally. It occurs throughout the grasslands of western Canada with disjunct populations in the dry grasslands of the far north (Catling 2008).

Males: 17–23 mm; **Females:** 17–23 mm
BOLD DNA Barcode records from Alaska: none



Map 9: Alaskan distribution

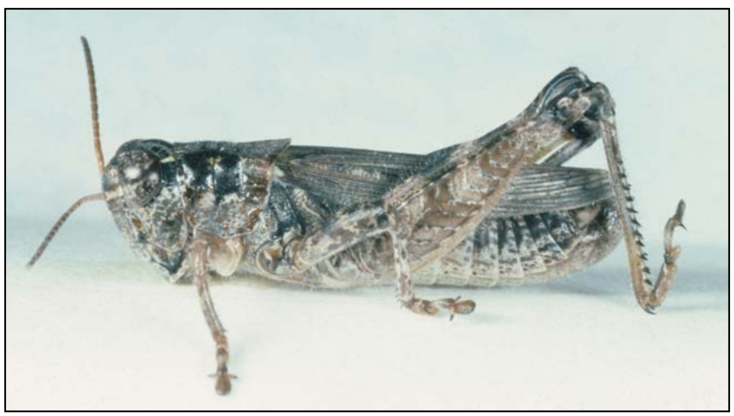


Figure 74: Male. Photo from Pfadt (2002).

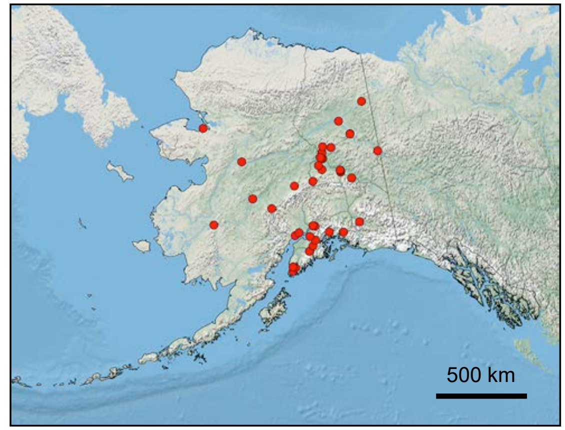
Figure 75: Female. Photo by J.D. Weintraub.

Melanoplus sanguinipes (Fabricius, 1798)
migratory grasshopper

Family: Acrididae
Subfamily: Melanoplinae

This is Alaska's most abundant grasshopper and most significant agricultural pest, responsible for several notable outbreaks in the 1950s (Washburn 1965). Their diet is flexible and includes both forbs and graminoids. Both males and females have long wings. This species ranges throughout Canada and the northern United States, as far south as northern California and New Jersey (Vickery and Kevan 1985 (1986)).

Males: 17–21 mm; **Females:** 16–27 mm
BOLD DNA Barcode records from Alaska:
UAMIC605-13, UAMIC606-13



Map 10: Alaskan distribution

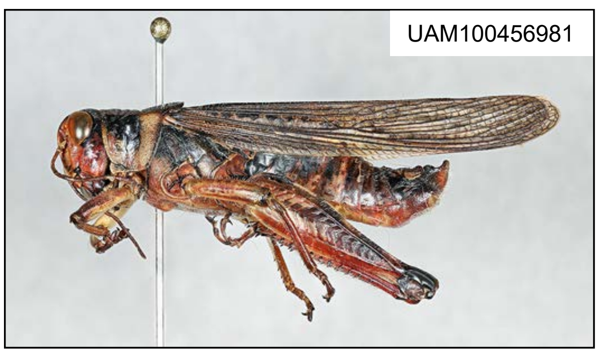


Figure 76: Male

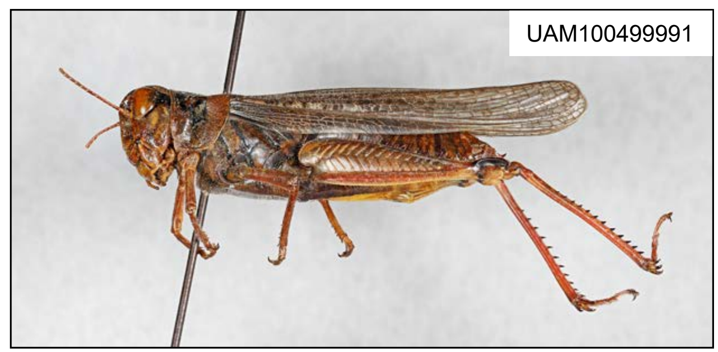


Figure 77: Female

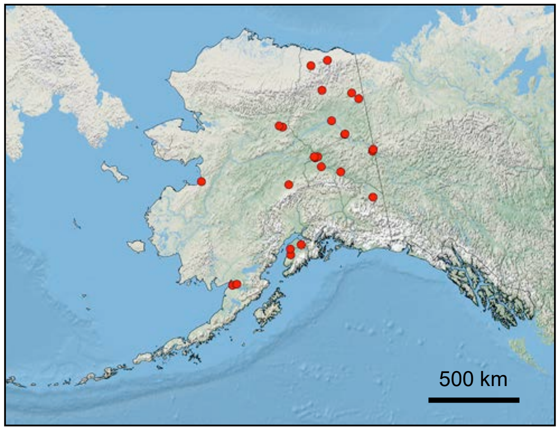
Pseudochorthippus curtipennis (Harris, 1835)

marsh meadow grasshopper

Family: Acrididae
Subfamily: Gomphocerinae

This small grasshopper is easily recognized by its distinctive black-tipped femora. This species is widespread, occurring throughout Canada and the United States, and found in a variety of habitats, including bogs, fens, and tundra (Catling 2008). Long-winged individuals are known from eastern North America but have not been documented in Alaska (Catling 2008).

Males: 12.5–16 mm; **Females:** 16–22 mm
BOLD DNA Barcode records from Alaska:
UAMIC578-13



Map 11: Alaskan distribution

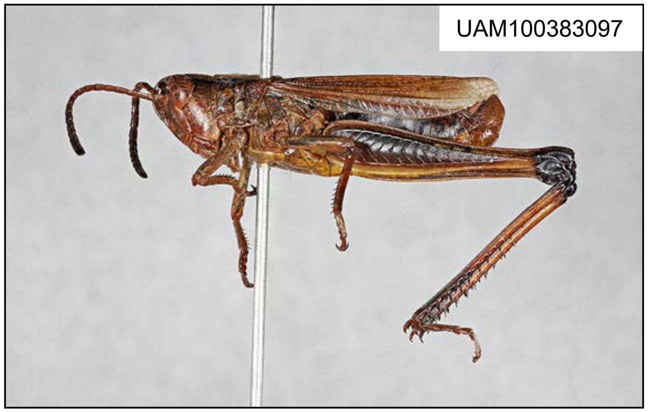


Figure 78: Male

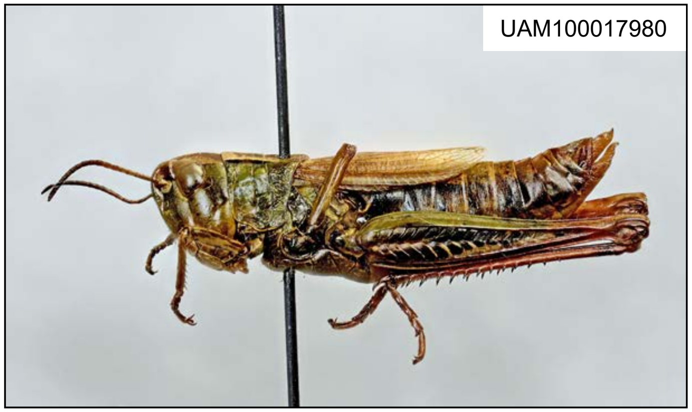


Figure 79: Female

Stethophyma grossum (Linnaeus, 1758)
large marsh grasshopper

Family: Acrididae
Subfamily: Oedipodinae

Alaskan specimens were originally misidentified as *Stethophyma lineatum.* However, DNA barcoding and morphology indicate these are *S. grossum,* previously known only from the Palearctic. This large and conspicuous grasshopper inhabits wetlands and is of conservation concern in several European countries (Hochkirk et al. 2016). The extent of its North American range is unknown.

Males: +/- 26 mm; **Females:** +/- 36 mm
BOLD DNA Barcode records from Alaska:
UAMIC1077-13

Map 12: Alaskan distribution

Figure 80: Male. Photo by N. Takebayashi.

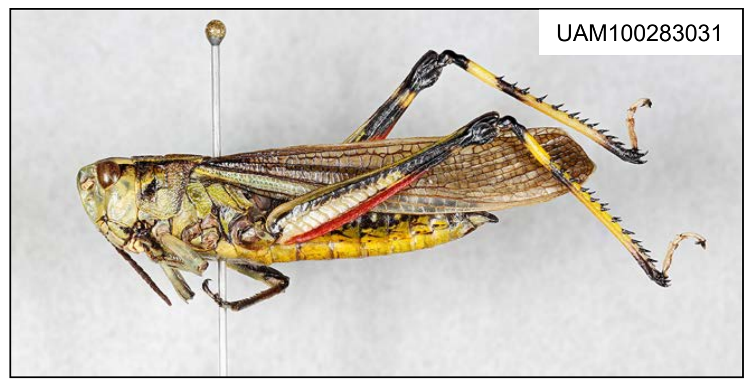


Figure 81: Female

Xanthippus brooksi Vickery, 1967

Brook's pink-shanked grasshopper

Family: Acrididae
Subfamily: Oedipodinae

This species is confined to eastern Alaska, southwestern Yukon, and the Mackenzie Delta of Northwest Territories (Vickery and Kevan 1985 (1986)). This large grasshopper can be recognized by its roughened pronotum, yellow tibia, and pale-yellow hind wing.

Males: +/- 23 mm; **Females:** +/- 37 mm
BOLD DNA Barcode records from Alaska: none

Map 13: Alaskan distribution

Figure 82: Male. Photo by J.D. Weintraub.

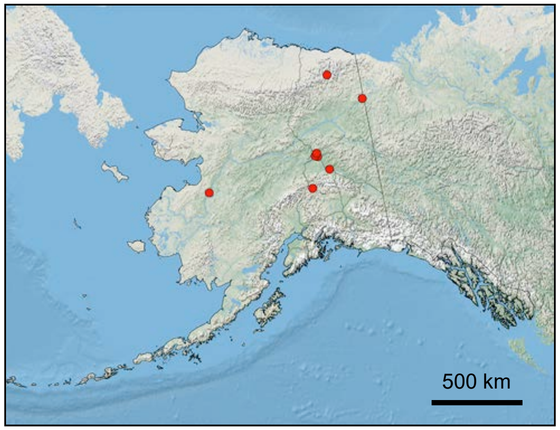
Figure 83: Female. Photo by J.D. Weintraub.

Tetrix brunnerii (Bolivar, 1887)
Brunner's grouse grasshopper

Family: Tetrigidae

Similar in appearance to *Tetrix subulata*, it can be distinguished from other Alaskan tetrigids by its deeply emarginated face. It prefers moist habitats, such as bogs, in forested regions (Vickery and Kevan 1985 (1986)). Alaskan tetrigids overwinter as adults. Nymphs (Figure 80) can be found in mid-summer. This species has been reported throughout Canada, except the prairie region (Catling 2008).

Males: 8–12 mm; **Females:** 9.5–13.5 mm
BOLD DNA Barcode records from Alaska:
UAMIC3714-19, UAMIC3734-19, UAMIC3744-19, UAMIC3699-13,



Map 14: Alaskan distribution

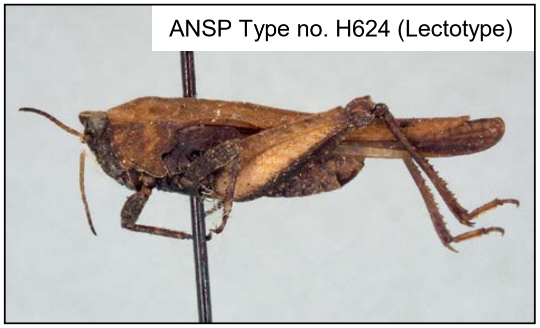


Figure 84: Male

Figure 85: Female. Photo by J.D. Weintraub.

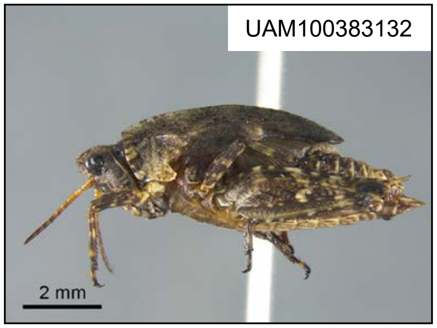


Figure 86: Nymph

Tetrix ornata (Say,1824)
ornate grouse grasshopper

Family: Tetrigidae

This grasshopper is variable in form but similar to the other tetrigids except for its fastigium, which is rounded or truncate when viewed from above. Like all Alaskan tetrigids, this species overwinters as an adult. Adult abundance peaks in spring and again in late summer (Vickery and Kevan 1985 (1986)). 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 (Vickery and Kevan 1985 (1986)).

Males: 8–10 mm; **Females:** 9–10.4 mm
BOLD DNA Barcode records from Alaska: none

Map 15: Alaskan distribution

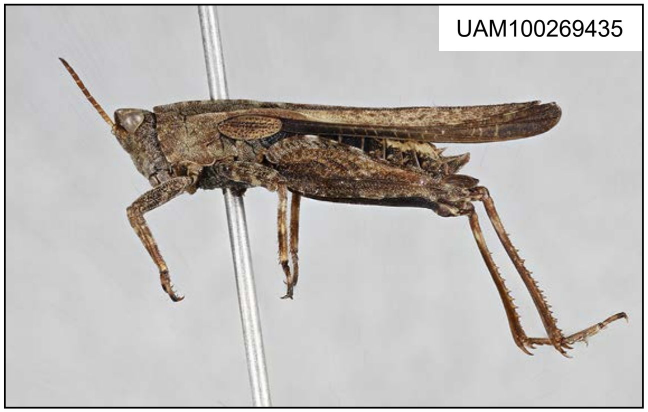


Figure 87: Male

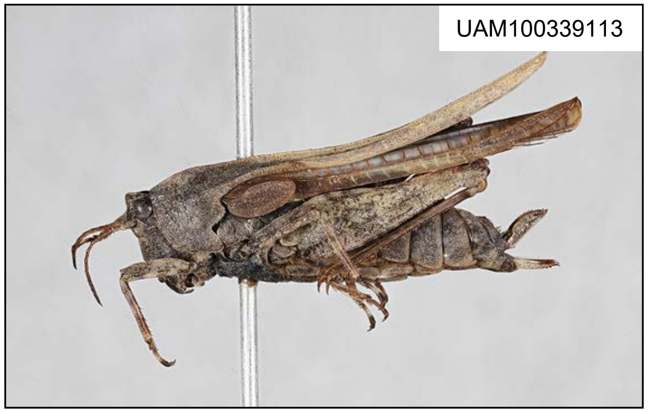
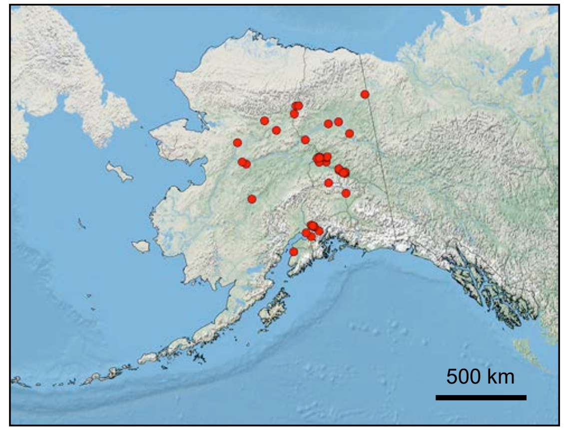


Figure 88: Female

Tetrix subulata (Linnaeus, 1758)
granulated grouse grasshopper

Family: Tetrigidae

This species shows high morphological dimorphism in color, size, fastigium shape, and even wing length, which can make separating it from the other tetrigids difficult. Melanism is particularly common in the boreal forest. In general, the face is less strongly emarginated than in *T. brunnerii* and the femur is less robust. This is a widely occurring Holarctic species and it ranges throughout North America south to Mexico (Vickery and Kevan 1985 (1986)).



Map 16: Alaskan distribution

Males: 10–10.5 mm; **Females:** 12–13 mm
BOLD DNA Barcode records from Alaska:
UAMIC3716-19, UAMIC3723-19, UAMIC3725-19, UAMIC3740-19, UAMIC3741-19, UAMIC3742-19, UAMIC3747-19, UAMIC3750-19, UAMIC3753-19, UAMIC573-13

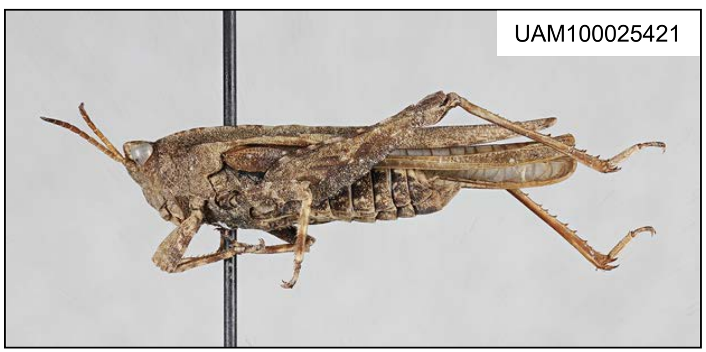


Figure 89: Male

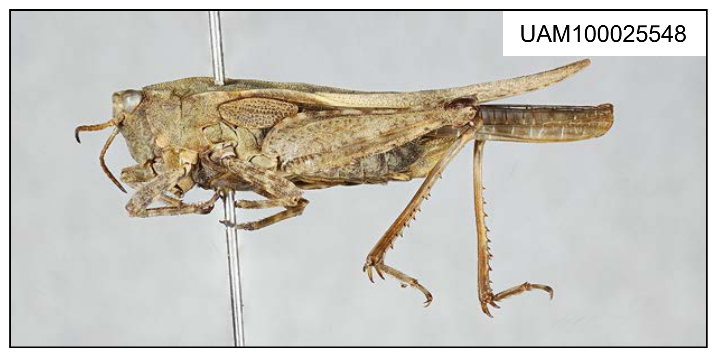


Figure 90: Female

Pristoceuthophilus cercalis Caudell, 1916
camel cricket

Family: Rhaphidophoridae
Subfamily: Tropidischiinae

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 and Alberta (Vickery and Kevan 1985 (1986)).

Males: 10–15 mm; **Females:** 9–13 mm
BOLD DNA Barcode records from Alaska: UAMIC710-13, UAMIC836-13

Map 17: Alaskan distribution

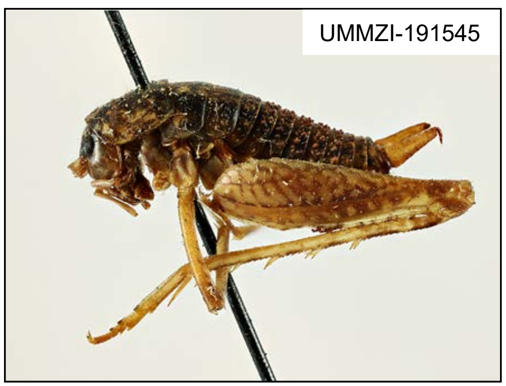


Figure 91: Male. Photo by E. Tucker.

Figure 92: Male

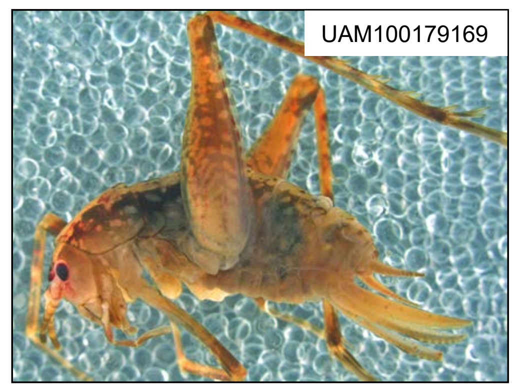


Figure 93: Female

Tropidischia xanthostoma (Scudder, 1861)
square-legged camel cricket

Family: Rhaphidophoridae
Subfamily: Ceuthophilinae

This relatively rare species is easily distinguished from all other Alaskan orthopterans by its extremely long hind legs. This species has also been reported from coastal British Columbia, Washington, and Oregon (Vickery and Kevan 1985 (1986)).

Males: 14 mm (single specimen); **Females:** 16-21 mm
BOLD DNA Barcode records from Alaska: none

Map 18: Alaskan distribution


Figure 94: Male. Photo by S. Wise-Eagle.


Figure 95: Female. Photo by D. Rentz (Cigliano et al. 2020).

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