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Range extension for *Melanoplus punctulatus* (Uhler) (Acrididae) in western Nebraska collected on green ash

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Abstract

Melanoplus punctulatus (Uhler) occurs only in the USA and Canada, where its current known distribution extends west only to the eastern quarter of the Great Plains States. In 2014, we discovered two new populations of *M. punctulatus* in the Pine Ridge area of western Nebraska. This discovery extends the known range of this species westward by over 600 km. The species appears to be strongly associated with green ash (*Fraxinus pennsylvanica*) in the western part of its range. Our results suggest that *M. punctulatus* may have been previously overlooked, due to its behavior and crypsis, and may actually occur across much of the Great Plains in woodland areas.

Key words

Melanoplus punctulatus, range extension, western Nebraska, *Fraxinus pennsylvanica*

Introduction

Melanoplus punctulatus (Uhler) is a North American grasshopper species, known from 33 states and Canada, but not Mexico (Scudder 1897, Hebard 1934, Orthoptera of the Northern Great Plains 2007, Brust *et al.* 2008, BugGuide 2015). Its range and biology are poorly described. It has been recorded in association with pines (*Pinus* spp.), tamarack (*Larix* spp.), beech (*Fagus* spp.), and oak (*Quercus* spp.) (Cantrall 1968, Vickery & Kevan 1985, Kirk & Bomar 2003) but its feeding habits are largely undocumented. Because of its general rarity, it is considered a species of conservation concern in Arkansas and Wisconsin (Natureserve 2014), and among all Canadian provinces it is ranked at S3 or below (Natureserve 2014). Thus, *M. punctulatus* appears to be a broad-ranging, but rare and poorly understood woodland grasshopper species.

Three subspecies, *Melanoplus punctulatus arboreus* Scudder, *M. p. griseus* (Thomas), and *M. p. punctulatus* (Uhler) are recognized (Eades *et al.* 2015). As numerous former acridid subspecies have recently been elevated to full species (Otte 2012), it is possible that one or more of these three subspecies could eventually be elevated to full species. Therefore, future studies within *M. punctulatus* and its geographical variation are warranted.

M. punctulatus is primarily documented from the eastern United States, and the known distribution of this species in the Great Plains region is extremely limited. It is known from the eastern parts of Texas, Oklahoma, Kansas, Nebraska, and South Dakota (Scudder 1897, Hebard 1934, Orthoptera of the Northern Great Plains 2007, Brust *et al.* 2008, BugGuide 2015). In South Dakota and Kansas, it is recorded from only one and two counties respectively (Hebard 1934, Orthoptera of the Northern Great Plains 2007, BugGuide 2015). Until this current paper, the most western population of *M. punctulatus* was recorded from Bon Homme County, South Dakota (Orthoptera of the Northern Great Plains 2007). This species was first recorded in Nebraska in 2007 (Brust *et al.* 2008), from the southeasternmost part of the state (Richardson County), and in 2008 a nymph was photographed and collected in Otoe County. More recently, a few pictures have been found on BugGuide.net showing this species from Fontenelle Forest in Sarpy County (BugGuide 2015). Unfortunately, only photographs and no voucher specimens were taken from Sarpy County. However, these photographs are clearly of *M. punctulatus*, as no similar species occur in the region. Previous to this current paper, all Nebraska records of this grasshopper were associated with mature deciduous woodlands along the Missouri River on the eastern edge of the state (Fig. 1).

Methods and results

During July of 2014, while collecting insects near Chadron, Nebraska, we observed several 2nd and 3rd instar *M. punctulatus* on the top surfaces of the lower leaves of common hackberry (*Celtis occidentalis* L.) and wild grape (*Vitis riparia* Michx.). These nymphs were noted at Chadron State Park, about 14.5 km (9 miles) south of Chadron, Nebraska in Dawes County, and along King Canyon Road, about 9.7 km (6 miles) south of Chadron, also in Dawes County. Two of these nymphs, both from King Canyon Road, were collected. One 4th instar was observed after it was attracted to a fermented mix of bananas and beer used to collect underwing moths on the trunk of a green ash tree (*Fraxinus pennsylvanica* Marsh.) at Chadron State Park. Several additional collecting trips to this site in July and August failed to detect the species. While nymphs of most melanopline grasshoppers are notoriously difficult to identify to species, those of *M. punctulatus* are distinct in being generally dull greenish gray in color with a poorly developed light marking on the side of the pronotum. The most distinctive character of the nymphs are the blackish bands on the outer hind femur, a trait not seen in any other regional melanopline species (Fig. 2).

On August 31, 2014, careful examination of tree trunks at Chadron State Park discovered two adult males and three adult females in a 2-h period. An additional adult male was collected on September 2. At least two additional adult females were also observed. While the trunks of several tree species were examined, including those of American elm (*Ulmus americana* L.), common hackberry, boxelder (*Acer negundo* L.), and peachleaf willow (*Salix amygdaloides* Andersson), adults were found exclusively on the trunks of green ash. Adults were very cryptic against bark (Fig. 6), and were found at heights ranging from 0-2 m (1-7 ft) above the ground, and generally went unnoticed unless they moved (Figs 3-5). The

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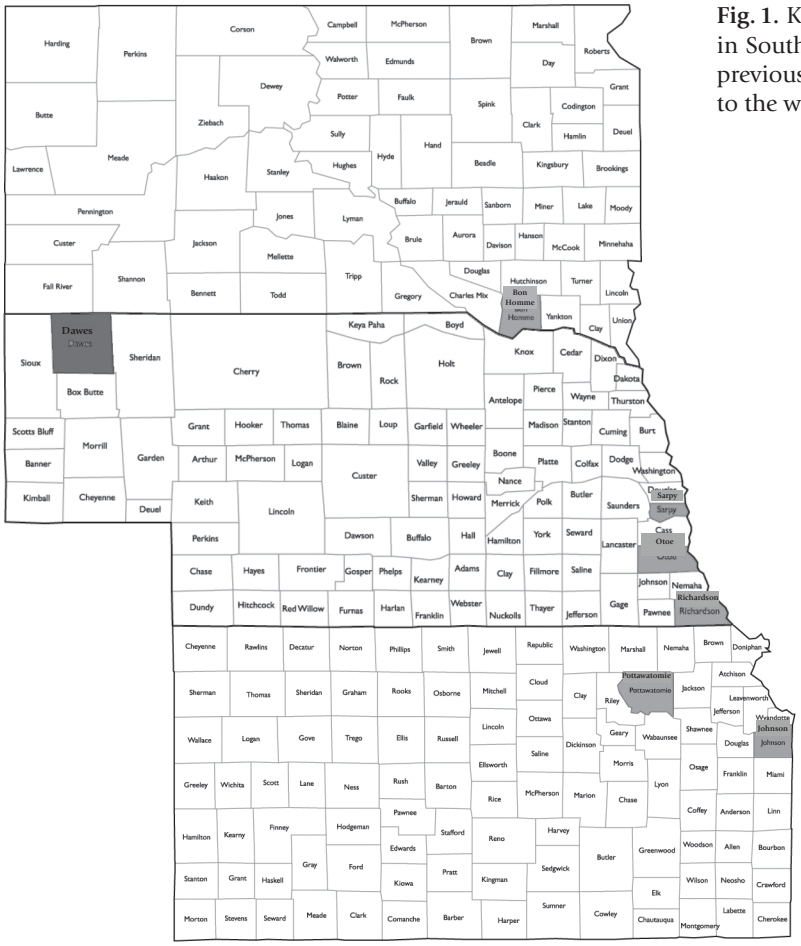

Fig. 1. Known county-level distribution of *Melanoplus punctulatus* in South Dakota, Nebraska, and Kansas. Light gray represents previous records, while the dark gray represents the new record to the west.

habitat consisted of mixed riverine hardwood forest with extensive areas of Ponderosa pine (*Pinus ponderosa* Douglas ex P. Lawson & C. Lawson) nearby. The forest in which the grasshopper were found was relatively open and dominated by mostly younger trees less than 15 m (50 ft) in height. Trees found in the immediate area included green ash, American elm, common hackberry, peachleaf willow, and boxelder. Grasshoppers were most often found in areas exposed to direct sunlight, but this was not always the case.

On September 2, 2014, we surveyed Monroe Canyon in Sioux County, Nebraska, which is about 80 km (50 miles) west of Chadron, Nebraska. Despite searching the trunks of over 50 green ash trees during ~ two hours, no *M. punctulatus* were found. Thus, Dawes County may represent the westernmost limit of *M. punctulatus* in Nebraska.

Fig. 2. Second instar *Melanoplus punctulatus*, photographed on July 17, 2014 at Chadron State Park, elevation ~ 1060 m above sea level.

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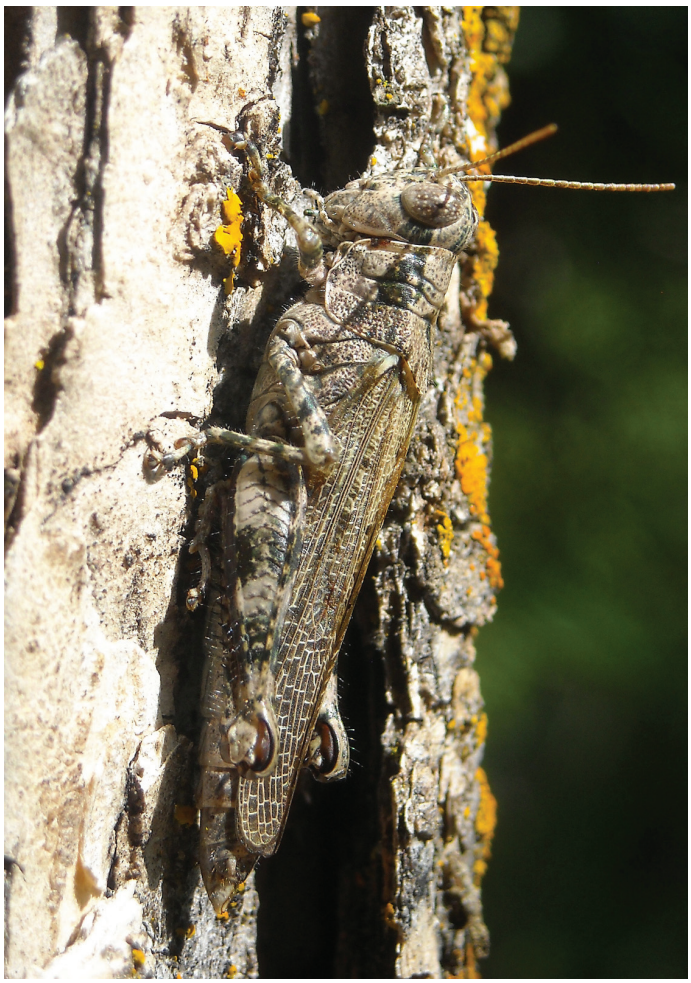

Fig. 3. Female *Melanoplus punctulatus* photographed at Chadron State Park on bark of green ash.

On October 14, 2014, we returned to Chadron State Park. By this date, the green ash trees had lost virtually all of their leaves. During a 30-min walk, 12 males and two females were collected and three additional females were observed, all adult. All were found on the ground, mostly along the edge of a trail. Two additional adult males were collected on October 18, 2014, along the same trail. A single adult male was also collected by H. R. Lawson on his garage door on the morning of October 15, 2014, approximately two miles east of Chadron near Little Bordeaux Creek. For a full listing of specimens collected and observed, see Table 1.

All of the collected specimens are currently housed in the Chadron State College entomological collection, with the exception of three adult males, sent to Daniel Otte at Drexel University.

Discussion

These records from Dawes County, Nebraska, represent a 640 km (400 mile) westward range extension for *M. punctulatus* in North America. The other westernmost collections in North America are recorded from Bon Homme County in South Dakota (Orthoptera of the Northern Great Plains 2007), Johnson and Pottawatomie Counties in Kansas (Hebard 1934, BugGuide 2015), and Richardson and Otoe Counties in Nebraska (Brust *et al.* 2008). However, it is likely that many other undetected populations of this species exist, in riverine woodlands throughout the central United States, for a variety of reasons. First, *M. punctulatus* populations tend to be rare, small, isolated, and low-density, making it hard to locate populations. Secondly, their cryptic color and behavior make them extremely difficult to spot against bark (Fig. 6). Third, they may be overlooked during general surveys because tree trunks are an atypical habitat for grasshoppers. Fourth, adult *M. punctulatus* may actually be somewhat arboreal (feeding on tree leaves), and this habitat is difficult to survey.

Little is known about the ecology of *M. punctulatus*. Hence, it remains unclear if *M. punctulatus* is mostly associated with green

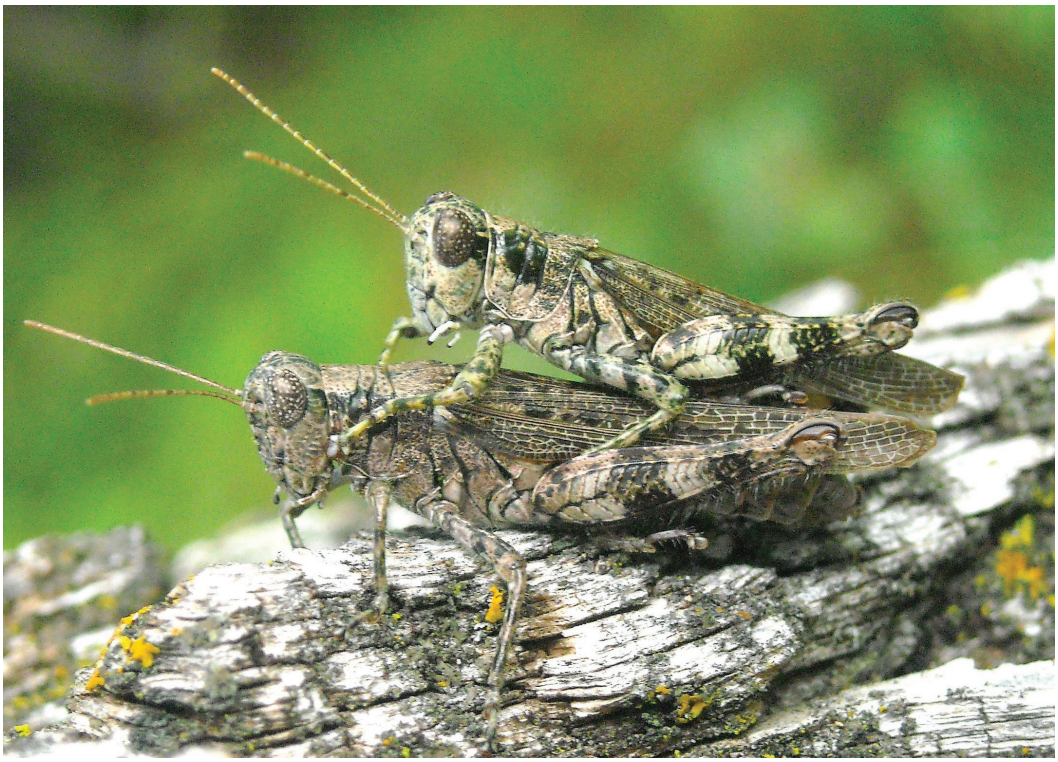

Fig. 4. Mating pair of *Melanoplus punctulatus* photographed at Chadron State Park on bark of green ash, photographed on August 31, 2014.

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Fig. 5. Male *Melanoplus punctulatus* photographed on soil of campground trail at Chadron State Park.

ash throughout the Great Plains, or if it associates with other plant species. The specimen from Richardson County in 2008 was collected from the trunk of an oak (*Quercus* sp.) tree (Brust *et al.* 2008), and we found them on hackberry and wild grape (see above).

The association between *M. punctulatus* and green ash in western Nebraska is cause for some conservation concern. While emerald ash borer (*Agrilus planipennis* Fairmaire) has not yet reached western Nebraska, it has now been recorded within several hundred miles. For example, an infestation was discovered in Wyandotte County, Kansas (near Kansas City) in 2012, and as well as in Boulder County, Colorado (Boulder) in 2013 (Colorado Department of Agriculture 2015, Kansas Natural Resources Conservation Service 2015). It is plausible that the emerald ash borer could spread to western Nebraska within the next decade, and if green ash is the sole native host for adult *M. punctulatus* in this region, emerald ash borer may pose a direct threat to the survival of this grasshopper in western Nebraska.

Little is known about behavior and microhabitat selection in this species. Including the previous specimens collected by the first author prior to 2009 (Brust *et al.* 2008), only a total of 25 adults and two nymphs have been collected in Nebraska. All of the adult individuals observed by us in Nebraska were found on either tree trunks or on the ground, and most were in sunlight. However, these observations may be due to restricted sampling: we did not sample at dawn, dusk, or night, and we did not sample high foliage. Hence, it is possible that *M. punctulatus* individuals are scattered throughout trees (not just on lower trunks) during the day. Thus this species may occur at higher abundance than collections only from tree trunks would suggest. It is also possible that at the end of the season, following leaf-fall from preferred host trees, adults migrate to the ground to feed on ground vegetation, mate and oviposit (in soil). We will continue to investigate this species in coming years to locate additional populations and to study their ecology and behavior.

Acknowledgements

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Table 1. Data for all *Melanoplus punctulatus* specimens collected during this study. The symbols ♂ and ♀ refer to adults.

County	Location	Date	Collector	Specimens collected	Additional observed
Dawes	9.5 km (6.0 mi.) S of Chadron, King Canyon Rd.	July 17, 2014	M. L. Brust	2nd instar=1, 3rd instar=1	none
Dawes	14.5 km (9.0 mi.) S of Chadron, Chadron State Park	August 31, 2014	M. L. Brust	2♂, 3♀	2♂, 3♀
Dawes	14.5 km (9.0 mi.) S of Chadron, Chadron State Park	September 2, 2014	M. L. Brust	1♂	2♀
Dawes	14.5 km (9.0 mi.) S of Chadron, Chadron State Park	October 14, 2014	M. L. Brust	12♂, 2♀	3♀
Dawes	3.0 km (2.0 mi.) E of Chadron, Beaver Valley Rd.	October 15, 2014	H. R. Lawson	2♂	none
Dawes	14.5 km (9.0 mi.) S of Chadron, Chadron State Park	October 18, 2014	M. L. Brust	1♂	none
Total				2 nymphs, 18♂, 5♀	2♂, 8♀

Fig. 6. Female *Melanoplus punctulatus* photographed at Chadron State Park on bark of green ash. Individuals are extremely cryptic when on this substrate. Female is located at exact center of figure.

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