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FIRST RECORD OF THE CICADA *TIBICEN PRUINOSUS* IN COLORADO,
WITH A KEY TO COLORADO SPECIES OF *TIBICEN*
(HEMIPTERA: CICADIDAE)

Brian Stucky¹

ABSTRACT.—*Tibicen pruinosus* (Say)—a large, arboreal cicada typically found in the central United States—is reported for the first time from Colorado. This new state record represents a significant western extension of this cicada's known range. Also reported are new records from Kansas that link the Colorado population to the previously known distribution of *T. pruinosus*. These results suggest that *T. pruinosus* has expanded its range westward, likely facilitated by human-induced changes in vegetation on the Great Plains. They also indicate the effectiveness of acoustic surveys as a tool for studying cicada distributions. Finally, an updated key including all 7 species of *Tibicen* now known from Colorado is provided.

RESUMEN.—Por primera vez se ha reportado en Colorado la cicada *Tibicen pruinosus* (Say), una especie arbórea y grande que comúnmente se encuentra en la parte central de los Estados Unidos. Este nuevo registro estatal representa una extensión hacia el occidente bastante significativa del rango que se conoce de esta cicada. También se reportan nuevos registros en Kansas que vinculan la población de Colorado con la distribución que se conocía previamente de la *T. pruinosus*. Estos resultados sugieren que *T. pruinosus* ha expandido su territorio hacia el oeste, posiblemente debido a que lo han facilitado los cambios provocados por el hombre en la vegetación de las Grandes Llanuras. También, demuestran la eficacia de los monitores acústicos como herramienta para estudiar la distribución de cicadas. Finalmente, se provee de una clave actualizada que incluye a las 7 especies de *Tibicen* que ahora se conocen en Colorado.

Tibicen Latreille is a genus of large, mostly arboreal cicadas with the greatest species diversity found in central and eastern North America (Davis 1930). Six species of *Tibicen* have been well documented in Colorado: *Tibicen bifidus* (Davis), *T. dealbatus* (Davis), *T. dorsatus* (Say), *T. duryi* Davis, *T. inauditus* Davis, and *T. tremulus* Cole (Davis 1921, Kondratieff et al. 2002, Cole 2008). In the summer of 2010, I found a population of *Tibicen pruinosus* (Say) in Yuma County in northeastern Colorado, providing the first record of this insect from the state and revealing a significant western extension of its known range. Additionally, I report new records of *T. pruinosus* in northwestern Kansas that further document the western edge of this cicada's distribution and link the Colorado locality to known museum and literature records.

Tibicen pruinosus is a large cicada that is mostly black with green markings on the head and thorax. It is an arboreal species associated with a variety of deciduous trees (Beamer 1925, 1928) and is widely distributed in the central United States (Davis 1918). *Tibicen pruinosus* was first described by Say (1825) as *Cicada*

pruinosa and later transferred to the genus *Tibicen* by Van Duzee (1916).

METHODS

During the summers of 2009, 2010, and 2011, I visited several sites in northwestern Kansas and northeastern Colorado as part of an effort to better document the range of *Tibicen pruinosus*. Cicadas were identified primarily by the calling songs of the males. *Tibicen pruinosus* has a distinctive amplitude- and frequency-modulated call that is unlike the calling song of any other cicada species found in the central and western Great Plains (B. Stucky personal observation). Audio recordings of calling male cicadas were gathered using a Sennheiser ME66 shotgun microphone with a Sony MZ-M200 digital recorder. All recordings were made as uncompressed, 16-bit PCM audio and are currently in the author's collection. Geographic locations were determined using a Garmin nüvi 260 GPS receiver.

The distribution map was created using Quantum GIS (<http://www.qgis.org/>) and PostgreSQL

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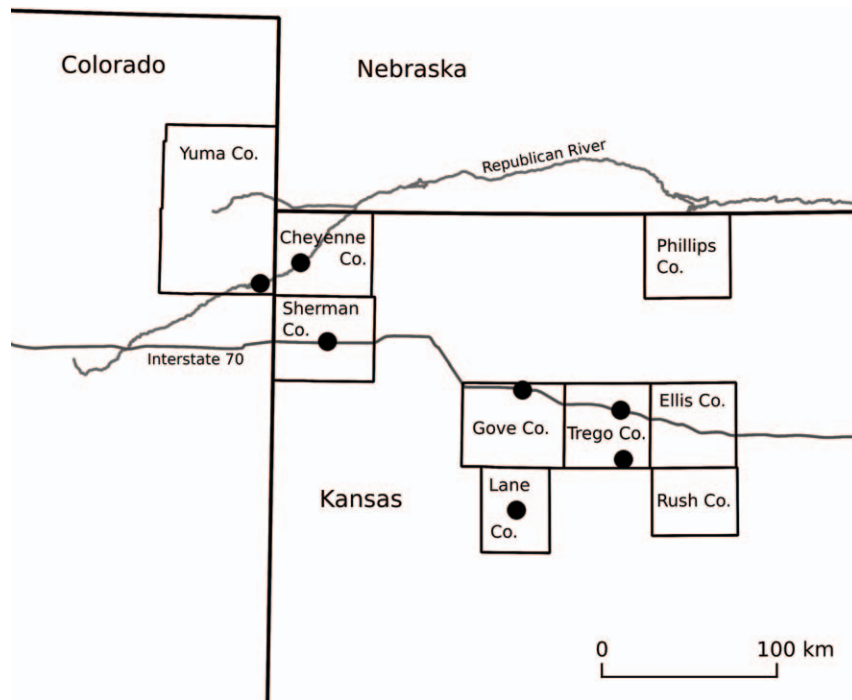


Fig. 1. New records of *Tibicen pruinosus* (black circles) in Colorado and northwestern Kansas.

(<http://www.postgresql.org/>) with PostGIS (<http://postgis.refractor.net/>). The audio spectrogram and oscillogram were created using custom software written by the author.

The key to Colorado species of *Tibicen* in Kondratieff et al. (2002) was rewritten to include *T. tremulus*, which was described after the key's publication, and *T. pruinosus*. The new key was generated from Colorado specimens of *Tibicen* in the author's collection and the Entomology Collection of the University of Colorado, Museum of Natural History. Since no Colorado specimens of *T. pruinosus* have yet been collected, specimens of *T. pruinosus* in the author's collection from central and western Kansas were used.

RESULTS AND DISCUSSION

On 21 August 2010, I recorded several calling male *T. pruinosus* at the South Republican State Wildlife Area, Yuma County, in northeastern Colorado at 39.63045°N, 102.14252°W, elevation 1095 m (Fig. 1). A spectrogram and oscillogram from one of these recordings is illustrated in Fig. 2. Unfortunately, the cicadas were high enough in the trees to make collecting specimens

impractical. At this locality, *T. pruinosus* was not as abundant as it often is in central and eastern Kansas, where many males can sometimes be heard calling together in each tree. Nevertheless, the Colorado population appeared to be well established because I could hear numerous male cicadas calling during the evening. At this site, *T. pruinosus* was sympatric with the cicadas *T. dealbatus* (Davis) and *T. dorsatus* (Say), 2 species that are widespread in the central and western Great Plains (Davis 1935, Cole 2008).

I also documented *T. pruinosus* at the following locations in northwestern Kansas: *Cheyenne Co.*—St. Francis Wildlife Area [39.74095°N, 101.88100°W, 1033 m]; *Gove Co.*—I-70 rest area [39.09970°N, 100.42562°W, 854 m]; *Lane Co.*—Highway 96 in Dighton [38.4822°N, 100.4619°W, 855 m]; *Sherman Co.*—Old Highway 24 in Goodland [39.3370°N, 101.6976°W, 1115 m]; *Trego Co.*—I-70 rest area [38.99635°N, 99.78860°W, 737 m], Cedar Bluff Wildlife Area [38.74320°N, 99.77127°W, 663 m] (Fig. 1).

At the Colorado locality, *T. pruinosus* was found in a wooded area near the South Fork Republican River. Trees at this site included ash (*Fraxinus* sp.), cottonwood (*Populus deltoides*),

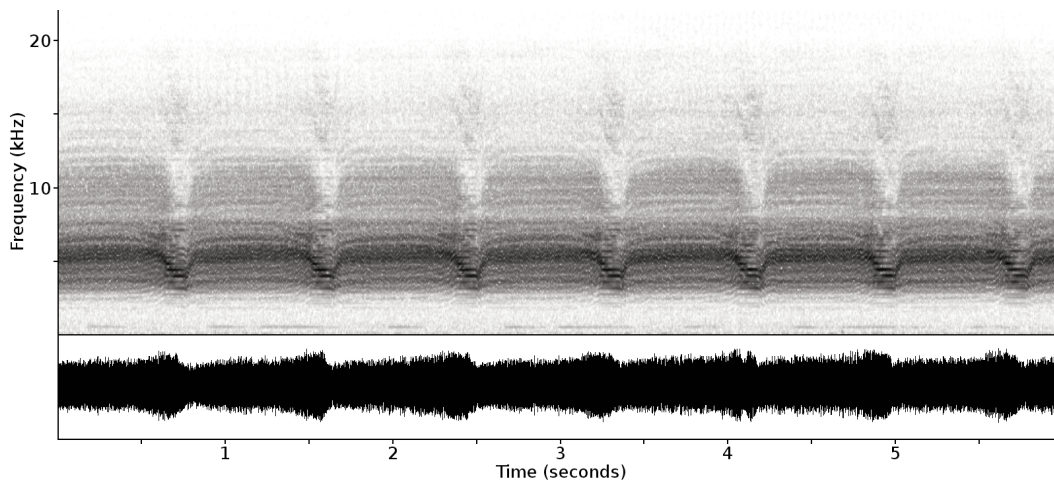


Fig. 2. Spectrogram (top) and oscillogram (bottom) of 6 seconds of the calling song of a male *Tibicen pruinosus* at the South Republican State Wildlife Area in Yuma Co., Colorado, recorded on 21 August 2010 at 20:25. For reference spectrograms of the *T. pruinosus* calling song, see Alexander (1960) and Elliott and Hershberger (2006).

mulberry (*Morus* sp.), and Siberian elm (*Ulmus pumila*). The *T. pruinosus* individuals observed in Cheyenne County, Kansas, were also found near the South Fork Republican River in habitat that was qualitatively similar to that at the Colorado locality. At Cedar Bluff Wildlife Area in Trego County, Kansas, *T. pruinosus* was found in a variety of tree species growing near Cedar Bluff Reservoir. In contrast, the populations in Gove County, Kansas, and northern Trego County, Kansas, were in small stands of trees planted for landscaping purposes at interstate highway rest areas, while those at the Lane and Sherman County localities inhabited trees growing in urban environments.

These new records represent western extensions of the known range of *T. pruinosus*. A search of *T. pruinosus* specimens in the collections of Kansas State University's Museum of Entomological and Prairie Arthropod Research (KSUC), the University of Kansas's Snow Entomological Museum (SEMC), the University of Colorado Museum of Natural History (UCMC), and Colorado State University's C.P. Gillette Museum of Arthropod Biodiversity (CSUC) determined that the specimens collected nearest to these new records were from Phillips [SEMC], Ellis [KSUC, SEMC], and Rush [KSUC] counties in Kansas. These counties are more than 215 km (133 miles) away from the Colorado population of *T. pruinosus* (Fig. 1). The westernmost literature records for this species are from Ellis County, Kansas (Lawson

1920; see Fig. 1) and Hydro, Oklahoma (Davis 1923; approximately 98.578°W).

It seems likely that *T. pruinosus* has expanded its range westward in recent history. While the western prairies were originally a mostly treeless landscape (Licht 1997), human activity has greatly increased the number of trees growing in and around towns and farms. Development of water resources and alteration of river flows have also caused the proliferation of riparian woodland along major rivers of the western Great Plains (Nadler and Schumm 1981, Johnson 1994). These changes have evidently created new habitats suitable for *T. pruinosus* in a landscape that would have been largely, if not entirely, uninhabitable by this cicada. The populations of *T. pruinosus* at the rest areas along I-70 in northwestern Kansas are clear examples of this cicada's ability to invade novel, human-created habitats in the High Plains. These habitats are sometimes surrounded by long stretches of treeless plains in all directions, as was the case with the rest area in Trego County. I have often observed *T. pruinosus* in similar habitat islands elsewhere in western Kansas. How *T. pruinosus* colonizes these small, isolated stands of trees is unknown.

These results also add to recent literature that highlights the effectiveness of using acoustic surveys to study the biogeography of cicadas (e.g., Marshall et al. 1996, Bunker et al. 2007, Hill and Marshall 2009). *Tibicen pruinosus* tends to limit its acoustic activity to a relatively short

period of time just before dusk and may exhibit little or no significant calling activity during the rest of the day, creating a narrow window of time in which to listen for the species (B. Stucky personal observation). Nevertheless, documenting the presence of *T. pruinosus* by recording calling males can be much more efficient than collecting specimens, especially when population densities are low or the cicadas are high in the forest canopy.

Broadcasting a recorded calling song at sufficient amplitude can often stimulate male cicadas to call, even at times when they would not usually be acoustically active (Alexander and Moore 1958, Villet 1992). For instance, I used this method to confirm the presence of *T. pruinosus* at St. Francis Wildlife Area. For cicadas with relatively short diel chorus times, this technique has the potential to improve the efficiency of acoustic surveys and deserves further research. I am unaware of any published study that used call broadcasts to investigate cicada distributions, even though this approach has been successful with other animals, such as birds (Soehren et al. 2009). It is important to note, however, that cicadas do not always respond to a call broadcast, even when adults are present (Villet 1992, B. Stucky personal observation), so negative broadcast records alone do not provide reliable evidence of absence.

The new records for *T. pruinosus* reported here clearly indicate that further work is needed to determine the western limits of this cicada's range. Careful listening along Colorado's eastern border with Kansas and Nebraska will likely reveal additional populations of *T. pruinosus* in Colorado. More thorough knowledge of this cicada's distribution could provide better insight into what factors influence its ability to successfully colonize new habitats on the western Plains.

KEY TO COLORADO SPECIES OF *TIBICEN*

1. Pronotal collar mostly green; basal membranes of forewings dark gray *T. pruinosus*
- 1'. Pronotal collar mostly black, brown, or yellowish; if pronotal collar green, then basal membranes of forewings orangish 2
- 2(1'). Pronotal collar mostly green or brown 3
- 2'. Pronotal collar mostly black with posterior margin yellowish or orange 6
- 3(2). Forewing length less than 35 mm; in males, opercula tapering to a rounded apex and

greatly elongated, usually reaching or exceeding sternite IV *T. bifidus*

- 3'. Forewing length 38 mm or more; in males, opercula much shorter with a broadly rounded posterior margin 4
- 4(3'). Posterior margin of abdominal tergites brown to yellow, lighter than anterior margin; usually associated with riparian areas or woodlands of the Great Plains and foothills *T. dealbatus*
- 4'. Posterior margin of abdominal tergites not lighter than anterior margin; usually associated with open grasslands of the Great Plains 5
- 5(4'). Radius + subcostal vein in forewing noticeably darker than costal vein where they border the radial cell; tymbal covers in males light brown; anterior arms of cruciform elevation enclosing 2 triangular pruinose spots *T. dorsatus*
- 5'. Radius + subcostal and costal veins in forewing about the same color where they border the radial cell; tymbal covers in males black; anterior arms of cruciform elevation enclosing a single diamond-shaped pruinose marking *T. tremulus*
- 6(2'). Basal membranes of forewings orange to red, abdominal sternites orange *T. duryi*
- 6'. Basal membranes of forewings gray or brownish, abdominal sternites light brown to tan *T. inauditus*

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