NEW SPECIES RECORDS OF MANTODEA, ORTHOPTERA, AND PHASMATODEA IN THE STATE OF TEXAS (USA)

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Abstract.–With its large size and range of habitats, Texas has one of the most diverse insect faunas of the United States with many endemic species. Despite more than a century of active study, knowledge of the insect diversity in Texas remains incomplete. Here, we report 19 species and subspecies records of Mantodea, Orthoptera, and Phasmatodea for the first time in Texas (USA) based on museum specimens. These records include several significant geographic range extensions (from eastern, southern, and western species) such as the phasmid *Diapheromera carolina* Scudder, the band-winged grasshopper *Arphia granulata* Saussure, and the mantid *Stagmomantis montana* Saussure & Zehntner. These records also include the first documentation of *Melanoplus torridus* (Roberts) and *Phaedrotettix gracilis* (Bruner) in the United States and the first records of the invasive cricket *Velarifictorus micado* (Saussure) in Texas. While some of these discoveries only extend known ranges somewhat, others represent disjunct and ecologically different populations.

Keywords: insect, grasshopper, praying mantis, range extension, state record, stick insect

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Reports and descriptions of the species of Orthoptera, Mantodea, and Phasmatodea in Texas extend back over a century and continue today. While those faunas are fairly well known, our study of those insect clades in the state of Texas over more than 35 years has brought about the discovery of new species (e.g., Stidham & Stidham 2001b; 2018) and better recognition of the geographic distribution of over 500 species (e.g., Stidham & Stidham 2001a; 2002; 2007). The documentation of described species continues and includes the discovery of species previously unknown within the borders of Texas. The listing below provides some of the locality data and dates of

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occurrence for these new records for Texas. The geographic range extensions of these species (and subspecies) document increases in distributions otherwise known to the east, west, and south, and include largely domestic North American species, as well as one invasive introduced taxon. Our goal is to place knowledge of the existence of these various insect populations in Texas (supported by museum deposited specimens) in the peer-reviewed literature for future use by scientists, government officials, and the interested public.

MATERIALS & METHODS

There are more than 500 species of phasmids, orthopterans, and mantodeans that have been recorded in Texas (for a full referenced listing see Stidham & Stidham 2001a), but further study of the diverse habitats found across this large state continues to produce new species, along with geographic range extensions such as first state records. The specimens that form the basis of these new Texas records were collected largely by one (JAS) or both authors on collecting trips across the state of Texas over the last ~35 years. Unless otherwise annotated with a particular repository below after the date of collection, all unlabeled voucher specimens were collected and identified by the authors, and will be placed in the Museum of Entomology collection at Texas A&M University in College Station (USA). A smaller number of additional specimens in existing museum collections (denoted below as BYU – Brigham Young University Arthropod Collection, Provo, USA; KU - Snow Entomological Museum, University of Kansas, Lawrence, USA; MNRJ – Coleção Entomológica do Museu Nacional / UFRJ, Rio de Janiero, Brazil; TAMU – Museum of Entomology, Texas A&M University, College Station, USA, TTU – Texas Tech University, Lubbock, USA; UMMZ – Museum of Zoology, University of Michigan, Ann Arbor, USA; and UT - University of Texas at Austin Biodiversity Center Entomology Collection, Austin, USA) provided additional records for Texas. All individual insect specimens that we collected or are deposited currently in Texas based museum collections

(and some of those outside of Texas) were identified or verified to the individual taxa through personal inspection by one of the authors (JAS). The records provided below include those listed in the Global Biodiversity Information Facility (GBIF), as well those we personally have collected and observed in museums. At present, we have not personally verified all of the specimens deposited in collections outside of Texas, but their geographic locations and collection dates appear consistent with the new records we report here.

RESULTS

The following new records are documented for the State of Texas (USA):

Order Phasmatodea Jacobson & Bianchi 1902

Family Diapheromeridae Kirby 1904

Diapheromera carolina Scudder 1901

Stick insect species of *Diapheromera* are diverse and relatively well known in Texas (Stidham & Stidham 2001a; 2018). Previously specimens of the Carolina walkingstick have been known only from the southeastern United States (Helfer 1987). *Diapheromera carolina* has been found in the dense forest in far eastern Texas, and it occurs early in the year for a stick insect which may explain its rarity in collections.

Texas record: Texas State Highway 87, north of Burkeville, Newton Co., Texas, VI/3/1995.

Order Mantodea Latrielle 1802

Family Mantidae Latrielle 1802

Stagmomantis montana montana Saussure & Zehntner 1894

The mountain mantis has a relatively wide geographic range from across Mexico south to Costa Rica, and it has a few verified records in the United States (Maxwell 2014). Only the subspecies *S. montana*

montana is known from the United States (Maxwell 2014). This mantid species is rare in the United States, and its Texas population occurs as adults in a dry, weedy area between San Antonio and Corpus Christi during the fall season.

Texas records: U.S. Highway Alternate 281/ Interstate Highway 37, Atascosa Co., Texas, IX/18/1992, X/14/94, VIII/20/1993–immature.

Order Orthoptera Latrielle 1793

Family Acrididae MacLeay 1821

Subfamily Oedipodinae Walker 1871

Arphia granulata Saussure 1884

The southern yellow-winged grasshopper previously has been found most commonly in Florida and Georgia (Otte 1984). In Texas, it occurs in the northeastern part of the state (Fig. 1) on sandy hillsides in the early spring. These widely separated records suggest that this band-winged grasshopper species might have a broader distribution along the Gulf Coast.

Texas records: Tyler, outside of Tyler State Park, Smith Co., Texas, IV/3/1982; Tyler, north of Interstate Highway 20, Smith Co., Texas, III/6/1983; Brewster Co., Texas, unknown date (MNRJ – likely lost during the 2018 museum fire; Hoffmann & Mello-Patiu 2018).

Trimerotropis agrestis McNeill 1900

This band-winged grasshopper previously has been recorded in eastern New Mexico, Nebraska, Colorado, and Idaho (Otte 1984). It occurs in the Monahans Sandhills area of western Texas (Fig. 1) in the low areas between the dunes. It is a low flier and is difficult to see with its camouflage coloration.

Texas records: Interstate Highway 20, Monahans Sandhills, Ward Co., Texas, VIII/21/1983; Monahans Sandhills State Park, Ward Co., Texas, VIII/31/1985 (TAMU); VII/10/1994 (TAMU); VII/01/1999 (BYU).

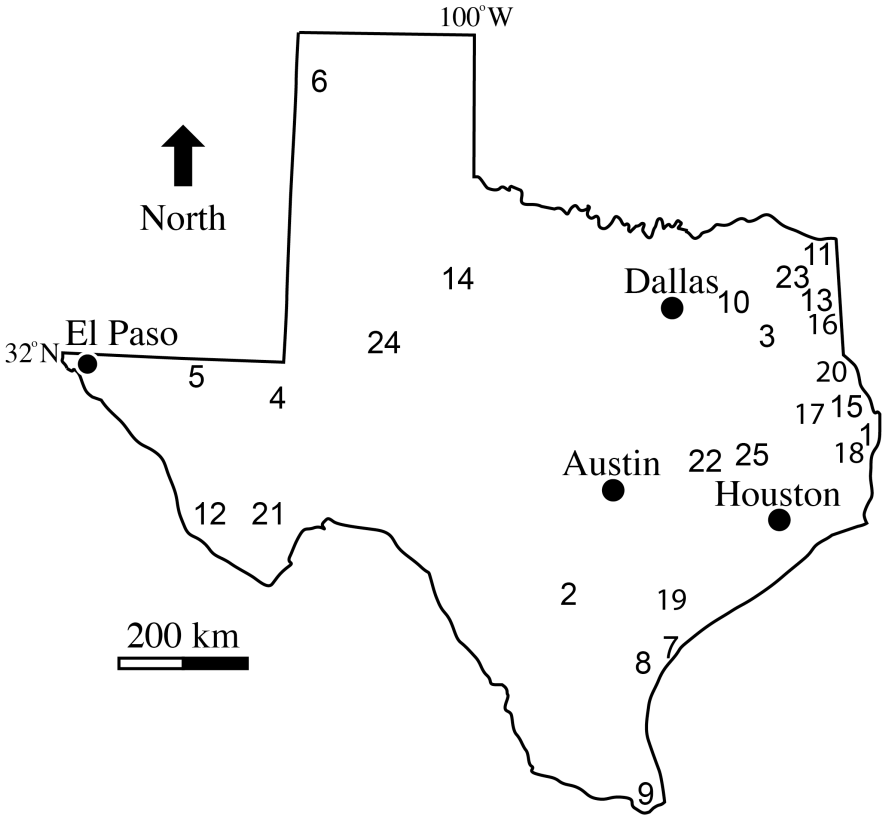

Figure 1. Map of the State of Texas (USA) with county locations containing new insect records numbered. Key to numbering: 1. Newton County (*Diapheromera carolina*, *Inscudderia taxodii*, *Orchelimum erythrocephalum*); 2. Atascosa County (*Stagmomantis montana* spp.); 3. Smith County (*Arfia granulata*, *Pterophylla camellifolia dentifera*, *Velarifictorus micado*); 4. Ward County (*Trimerotropis agrestis*, *Arethaea mescalero*); 5. Culberson County (*Melanoplus franciscanus*); 6. Hartley County (*Melanoplus keeleri luridus*); 7. Aransas County (*Melanoplus torridus*); 8. San Patricio County (*Melanoplus torridus*); 9. Cameron County (*Phaedrotettix gracilis*, *Turpilia rostrata*, *Orchelimum unispina*); 10. Rains County (*Atlanticus testaceus*); 11. Bowie County (*Atlanticus testaceus*); 12. Presidio County (*Eremopedes balli*); 13. Marion County (*Pterophylla camellifolia dentifera*); 14. Stonewall County (*Arethaea mescalero*); 15. Sabine County (*Microcentrum louisianum*, *Orchelimum fidicinium*, *Velarifictorus micado*); 16. Harrison County (*Microcentrum louisianum*); 17. Angelina County (*Microcentrum louisianum*); 18. Jasper County (*Velarifictorus micado*, *Orchelimum erythrocephalum*); 19. Victoria County (*Camptonotus carolinensis*); 20. Shelby County (*Camptonotus carolinensis*). 21. Brewster County (*Arphia granulata*); 22. Brazos County (*Melanoplus keeleri luridus*, *Orchelimum erythrocephalum*); 23. Morris County (*Pterophylla camellifolia dentifera*); 24. Howard County (*Arethea mescalero*); 25. Walker County (*Orchelimum erthhrocephalum*).

Subfamily Melanoplinae Scudder 1897

Melanoplus keeleri luridus (Dodge 1876)

The Keeler grasshopper occurs widely in the United States from Texas and the Midwest to the Atlantic Coast (Helfer 1987). The small subspecies *M. keeleri luridus*, previously known from areas north and northeast of Texas (Helfer 1987), has been found in the far northwestern part of the Texas panhandle. It is a midsummer species found in fallow weedy fields.

Texas record: Junction of Texas Farm to Market Road 767 and U.S. Highway 54, Hartley Co., Texas, VIII/6/1989; Brazos Co., Texas, X/14/1922 (TAMU). Two specimens in the Swedish Natural History Museum are from an unknown date and location in Texas (Holston 2021).

Melanoplus torridus (Roberts 1947)

This species is a flightless grasshopper in the plebejus species group that is known from eastern Mexico (Roberts 1947). In Texas, it occurs along the south central coast (Fig. 1) adjacent to its distribution in Mexico. These specimens represent a first record of this species in the United States.

Texas records: Aransas Pass, Aransas Co., Texas, VIII/1/1999; Texas State Highway 35, Aransas Pass, San Patricio Co., Texas, XI/12/1983.

Phaedrotettix gracilis (Bruner 1908)

The graceful narrow-winged locust is a tiny grasshopper known from Mexico (Barrientos-Lozano et al. 2009). This species is rare in the United States and found only in the southernmost tip of Texas (Fig. 1). This report is the first record of this species in the United States.

Texas record: Texas Farm to Market Road 106, east of Harlingen, Cameron Co., Texas, V/30/1993.

Family Tettigoniidae Krauss 1902

Subfamily Tettigoniinae Krauss 1902

Atlanticus testaceus (Scudder 1901)

The short-legged shield-bearer is a species that is widely distributed and has been reported from the eastern coast of the United States through the Midwestern states and into the eastern part of Canada (Capinera et al. 2004). This early spring species occurs along the edge of wooded areas under the leaf litter in the northeast corner of the state (Fig. 1). The Texas occurrence is a slight southwestern range extension for the species.

Texas records: Texas State Highway 19, south of Emory, Rains Co., Texas, V/21/1989; U.S. Highway 259, north of Interstate Highway 30, Bowie Co., Texas, VII/16/1988.

Eremopedes balli Caudell 1902

This flightless species of katydid is known from Colorado and Arizona (Helfer 1987), and it occurs most commonly west of the state of Texas. The only known Texas specimen is housed in the University of Michigan Museum of Zoology entomology collection in Ann Arbor, and it represents a southeastern range extension.

Texas record: Presidio, Presidio Co., Texas, XI (UMMZ).

Subfamily Pseudophyllinae Burmeister 1838

Pterophylla camellifolia dentifera Hebard 1941

While the species is widely distributed across the eastern and midwestern parts of the United States (including Texas) and into Canada (Walker 2020), this subspecies of *P. camellifolia* has not been recorded in Texas before. It is rarely found and is otherwise known from Arkansas (Hebard 1941). It occurs mostly on oak trees in northeastern Texas.

Texas records: Interstate Highway 20, 16 km (10 miles) west of Tyler, Smith Co., Texas, VII/1/1995; Texas State Highway 43, 24 km

(15 miles) north of Karnack, Marion Co., Texas, VII/1/1995; Daingerfield State Park, Morris Co., Texas, VIII/16/1961 (UMMZ).

Subfamily Phaneropterinae Burmeister 1838

Arethaea mescalero Hebard 1936

The Mescalero thread-legged katydid is known from New Mexico (Walker 2020). In Texas, it is found on sandy soil environments. It is not a common species in Texas, but this population is an eastern range extension of the species (Fig. 1).

Texas records: Interstate Highway 20, Monahans Sandhills, Ward Co., Texas, VII/1/1985; U.S. Highway 380, west of Aspermont, Stonewall Co., Texas, V/26/1986; Big Springs, Howard Co., Texas VI/20/1947 (KU); Monahans, Ward. Co, Texas, V/16/2010 (TTU).

Inscudderia taxodii Caudell 1921

The water cypress katydid is known from states along the Mississippi River Valley (Walker 2020). This species of katydid occurs along the eastern border of Texas (Fig. 1). It lives near lakes and has been found at lights at night.

Texas record: 24 km (15 miles) northeast of Buna, Newton Co., TX, XI/25/1950 (UT).

Microcentrum louisianum Hebard 1939

The Louisiana angle-wing is known from Louisiana, Arkansas, and Tennessee (Walker 2020). This species of katydid occurs in the forests of eastern Texas and represent a western range extension for the species. We have collected specimens by beating tree branches and using UV lights at night to attract individuals.

Texas records: Texas State Highway 87, 16 km (10 miles) north of Milam, Sabine Co., Texas, IX/9/1995; Texas State Highway 43, north of Marshall, Harrison Co., Texas, IX/3/1995; Texas State Highway 103, west of Lufkin, Angelina Co., Texas, VII/28/1985.

Turpilia rostrata (Rehn and Hebard 1905)

The narrow-beaked katydid has a distribution across much of Mexico and was first described from the disjunct population in Florida (Capinera et al. 2004). It occurs in Texas only in the tiny remnant of southernmost semitropical forest adjacent to Mexico (Fig. 1). The construction of a border wall to the north of the sanctuary likely impacted this population.

Texas record: The Gorgas Science Foundation Sabal Palm Sanctuary, Brownsville, Cameron Co., Texas, XI/10/1995. Estelline, Hall Co., Texas X/12/1968 (TTU).

Subfamily Conocephalinae Burmeister 1838

Orchelimum erythrocephalum Davis 1905

The red-headed meadow katydid is known from the southeastern portions of the United States (Capinera et al. 2004). This species of meadow katydid occurs in far eastern Texas (Fig. 1) on hillsides and along streams and represents a western range extension for the species.

Texas record: Texas State Highway 87, 3 km (2 miles) south of Newton, Newton Co., Texas, X/24/1998; Lick Creek Park, College Station, Brazos Co., Texas, IX/06/2005 (TAMU); Sam Houston State University field station, Huntsville, Walker Co., Texas, X/23/2005 (TAMU); 5.5 km SE Boykin Springs Campground, Angelina National Forest, Forest Service Road 376, Jasper Co., Texas, IX/16/2005 (TAMU).

Orchelimum fidicinium Rehn & Hebard 1907

The seaside meadow katydid is well known from the Atlantic coastal states of the eastern United States (Capinera et al. 2004). This meadow katydid occurs only in far northeastern Texas near lakes (Fig. 1), and those individuals represent a southwestern range extension for the species.

Texas record: Texas State Highway 87, 8 km (5 miles) north of Milam, Sabine Co., Texas, IX/3/1995.

Orchelimum unispina (Saussure & Pictet 1898)

The Arizona meadow katydid is known from southern Mexico to Arizona in the north (Walker 2020). The Texas population in the Rio Grande Valley in southernmost Texas (Fig. 1) represents a northeastern range expansion. In Arizona, this species is found along streambeds on mountainsides, but in Texas it occurs in marshy areas near the coast. Clearly given the wide differences in the habitats occupied by the U.S. populations of this species, they must differ in other aspects of their diet and ecology.

Texas record: Texas State Highway 4, east of Brownsville, Cameron Co., Texas, V/4/1986.

Family Gryllidae Laicharting 1781

Velarifictorus micado (Saussure 1877)

The Japanese burrowing cricket is originally from Asia, but was introduced to the eastern part of the United States as a bait insect and has spread through the region (Alexander & Walker 1962). This species occurs along streams in eastern Texas (Fig. 1) and demonstrates the western expansion of this invasive species' range in the United States.

Texas records: U.S. Highway 96, north of Buna, Jasper Co., Texas, IX/9/1995; Texas State Highway 87, 8 km (5 miles) south of Milam, Sabine Co., Texas, IX/9/1995; Interstate Highway 20, Tyler, Smith Co., Texas, IX/21/1997.

Family Gryllacrididae Blancard 1895

Camptonotus carolinensis (Gelstecker 1860)

The wingless Carolina leaf-rolling cricket is known from the eastern part of the United States and Canada (Capinera et al. 2004). This cricket is arboreal and folds leaves for shelter. It occurs in forested areas across

eastern and south central Texas (Fig. 1) and represents a southwestern range expansion.

Texas records: U.S. Highway 77, east of Victoria, Victoria Co., Texas, VI/10/1995; U.S. Highway 96, Center, Shelby Co., Texas, VI/3/1995.

DISCUSSION

The new species and subspecies records for Texas demonstrate that there is a great deal more to learn about insect biodiversity within the state. While some of these state records represent smaller range extensions because they are physically close or adjacent to areas in Mexico and neighboring states where the species occur, other (disjunct) geographic distributions (such as that of *Diapheromera carolina* and *Arphia granulata*) suggest that some species' populations may occupy even larger geographic areas, but have yet to be documented in the intervening spaces. The factors that have led to these 'new' records likely are diverse. Some other populations in intervening areas might be present, but they remain undiscovered because of the lack of survey effort by entomologists. Others could represent actual historic range increases through the immigration of populations into new geographic areas. The role of climate and environmental change in such recent expansions is not known, but is a field worthy of study.

Worrisome is the continued geographic spread of the invasive Japanese burrowing cricket, now documented from Texas. In addition, some of these Texas populations potentially are under threat from human activity including the ones in the Monahans Sandhills area with its active petroleum production activities and limited protected areas, and the populations along the Mexican border with ongoing construction in the restricted remaining habitats. It is only with the ongoing discovery and study of these populations that the biodiversity of Texas can be protected for future generations and their roles in the ecosystem can be secured.

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