



FIGURE 58. Holotype male (left), *G. veintinueve*, paratype (middle) female (S09-71), and color variant (right) male (S02-46).

Habitat. Variable: rocky areas, such as road cuts south of Abilene (S88-34), Osage Co. (S88-44), and Stringtown (S88-47); rocky dam areas at Keystone State Park (S88-42, S01-47 and S07-21) and Grapevine Lake Dam (S01-48); grassy areas E Del Rio (S86-50) and Wichita Mts. Wildlife Refuge (S02-46); and sparse woodland usually with grass at Bentsen Rio Grande Valley State Park (S02-34 and S07-27), Fort Worth Nature Center (S02-39), and Big Springs State Park (S09-71). These crickets climb trees: (1) At Big Springs State Park (S09-71), two males singing from 1–2 m above ground, with a female approaching the singing, higher male. (2) At 3.2 km E Tulsa (S13-68), two males singing from tree trunks 1–2.5 m above ground and a third male 0.3 m above ground on tree trunk but not singing. The 2 singing males moved around the tree trunk before dropping to the ground where they were collected.

Life cycle and seasonal occurrence. No egg diapause: Osage Co. (S88-34) and Big Springs State Park (S09-71). Probably 2 generations/yr. Field collected nymphs matured as followed: late July and 12-viii (Big Springs State Park, S09-71); 18 & 30-viii (Bentsen Rio Grande Valley State Park, S02-34); 5-viii & 10-viii (Tulsa, S13-67), and several in early August (E Tulsa, S13-68) and probably all represent second generation, although variable maturing rates in first generation individuals can't be ruled out without more extensive field work.

Variation. Body length: Largest adults collected at Lake Keystone Dam (S01-47). **Inside hind femur:** Varies from bright orange (Fig. 58) to almost absent (Fig. 58).

DNA. Multilocus G1330 (type locality) and 2015-055 (OK, Love Co.) most closely related to several undescribed Mexican species (Gray *et al.* in prep). In our abbreviated US tree (Fig. 6, p. 28), maps closest to Assimilis Group and *G. locorajo*. DNA helped confirm that one habitat-diverse species is involved here. Does not map close to the three US *Gryllus* species that it, physically, most closely resembles: *G. vernalis*, *G. veletis*, and *G. fultoni*.

Discussion. Occurs with *G. fultoni* at Keystone State Park (S88-42 and S01-47), and around Tulsa (S13-68). Occurs with *G. veletis* around Tulsa (S13-67 and S13-68). In these situations, populations of *G. veintinueve* seem to be peaking when most spring singing *G. fultoni* and *G. veletis* have died out.

The Assimilis Group

G. assimilis (Fabricius) and *G. multipulsator* Weissman.

Sister species with a slow chirp rate typically consisting of 6–9 (*G. assimilis*) or 11–17 (*G. multipulsator*) pulses per chirp (Figs. 60, 61). Separated by geography (Fig. 66 vs Fig. 72), DNA (Fig. 62), and song differences.

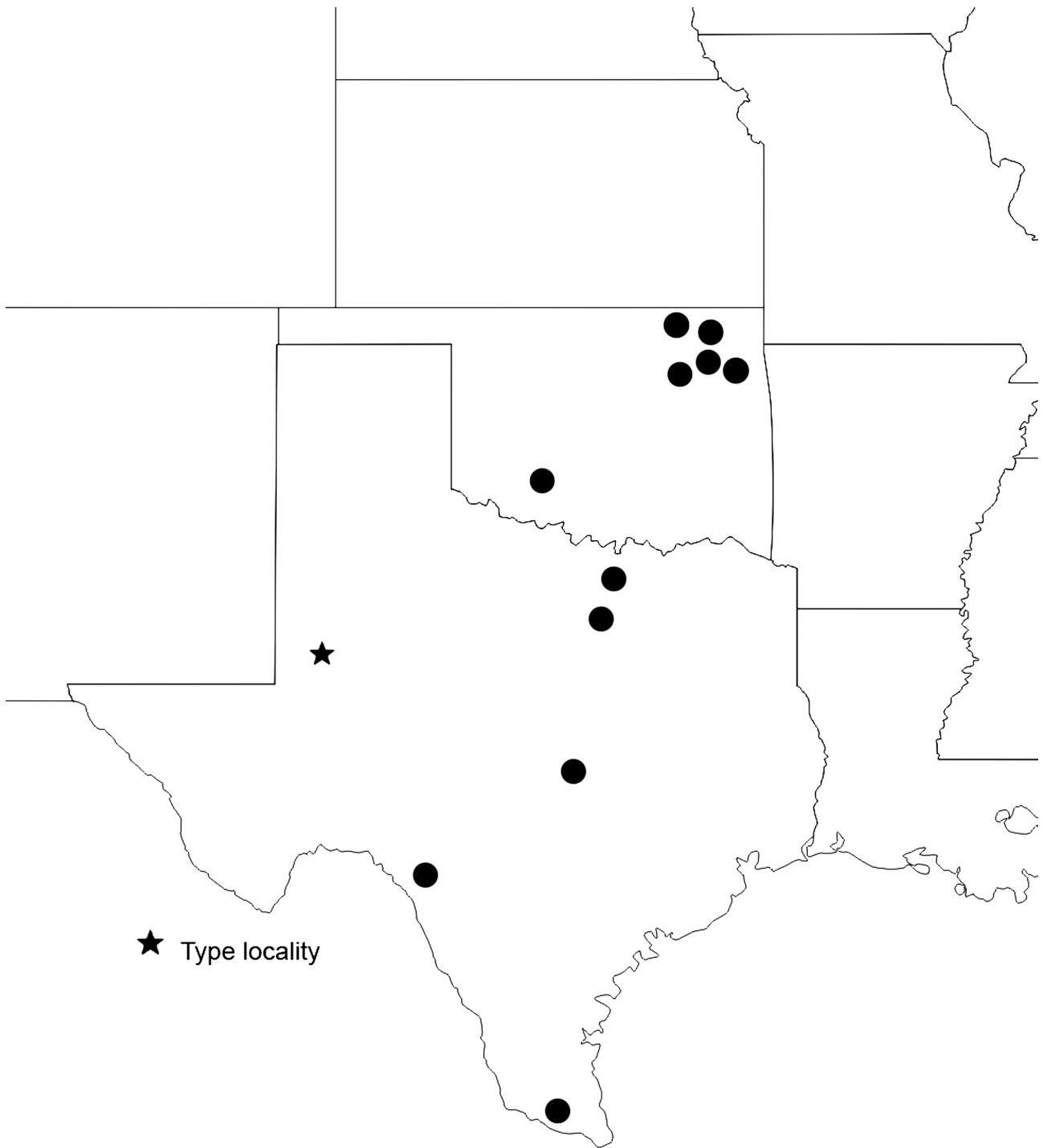


FIGURE 59. Known US distribution of *G. veintinueve*.

***Gryllus assimilis* (Fabricius)**

Jamaican Field Cricket

Figs 54, 60–66, Table 1

1775 *Acheta assimilis*. Systema Entomologiae, p. 280. Type from Jamaica lost, according to Alexander (1957). Neotype male (Fig. 63) selected by Weissman *et al.* 2009: Jamaica, St. Catherine Parish, Worthy Park, 27-xi-1968. T.J. Walker. Type deposited in CAS, Entomology Type #18172.

‘Gryllus #1’, in part, of DBW notebooks.
 2009 *Gryllus assimilis* Weissman *et al.* 2009.
 See Cigliano *et al.* (2019) for complete list of synonyms.

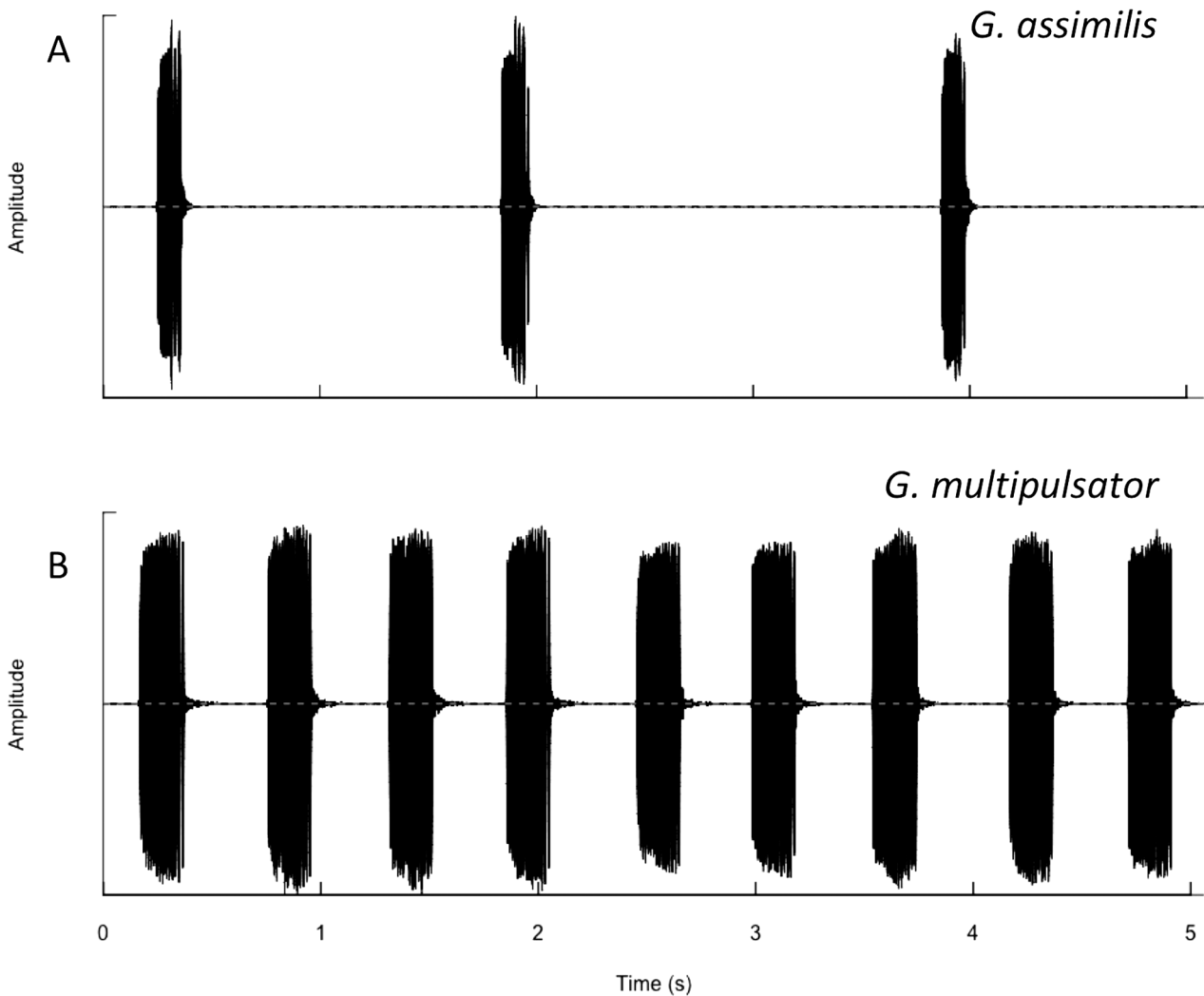


FIGURE 60. Five second waveforms of calling songs of (A) *G. assimilis* and (B) *G. multipulsator*. (A) *G. assimilis*: (R13-231) Rio Hondo, TX (S13-44), at 25°C; (B) *G. multipulsator*: (R15-325) Pima Co., AZ (S15-108), at 25.4°C.

Distribution. Texas and Florida only within the US.

Recognition characters and song. Always macropterous, although rare individuals apterous after shedding hind wings. Medium to large size (Table 1, p. 18), head frequently narrower than pronotum (Fig. 64), dorsal pronotal surface covered with short, fine hairs usually resulting in dull appearance. *Song* (Fig. 65, R13-231, S13-44) loud, 6–9 (rarely 10) p/c, PR for first pulse pair ranges from 50 to 111, PR of last pair ranges from 40 to 83 (Weissman *et al.* 2009). Chirps/second variable, but distinctive and usually <2.5 at 25°C. In the US, only native in southern Texas but introduced in southern Florida (Alexander & Walker 1962). Probably continuous generations. Only sympatric Texas species (and then only in Brackettville (S10-63) and Big Bend (S16-12), TX) with a similar, but distinctive song is *G. personatus*, the latter having a faster chirp rate, a shiny pronotum, different microhabitat requirements, and different head and pronotum color patterns.

Derivation of name. “as” = a copper coin; “similis” = like, resembling, perhaps with reference to an orange/red-dish specimen that reminded Fabricius of the color of a copper coin.

Geographic range. (Fig. 66). Native in southern Texas, introduced in Florida (Alexander & Walker 1962). Fieldwork in 2013 in southern coastal Texas uncovered a much wider distribution than seen in previous years (Weissman *et al.* 2009). Ranges through Mexico and Central America, usually east of the Continental Divide. On many Caribbean Islands (Otte & Perez-Gelabert 2009, Weissman *et al.* 2019), and possibly into South America

(Weissman *et al.* 2009). Widespread sale of this cricket species by US pet-feeder suppliers raises the possibility that feral populations could be established outside its normal US-North American distribution (Weissman *et al.* 2012). Barranco (2012) claims feral populations of *G. assimilis* in Spain but doesn't supply an oscillogram to confirm identification. We believe those crickets could be *G. locorojo* (Weissman *et al.* 2012).

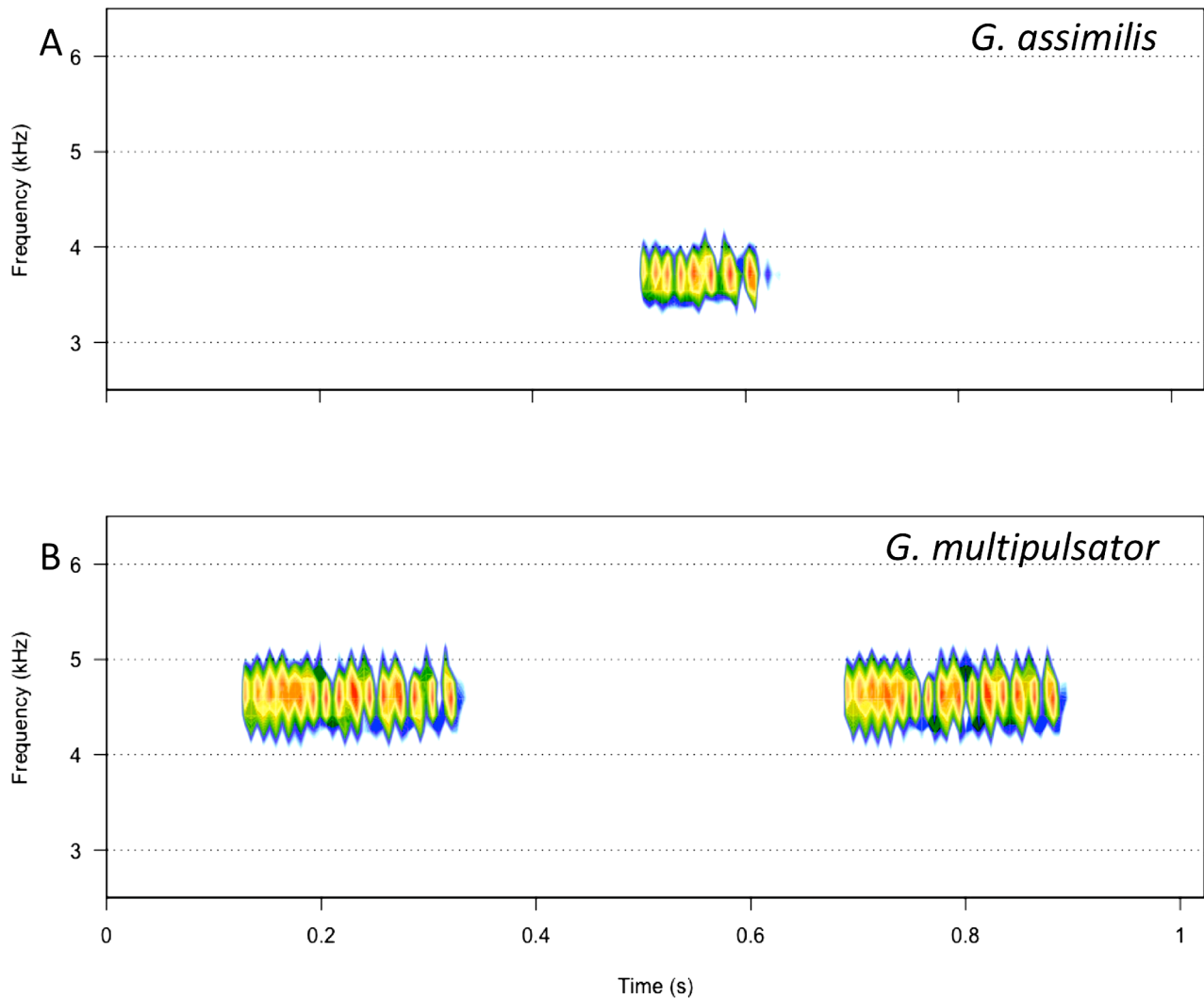


FIGURE 61. One second spectrograms of *G. assimilis* (A) and *G. multipulsator* (B), same males as in Fig. 60.

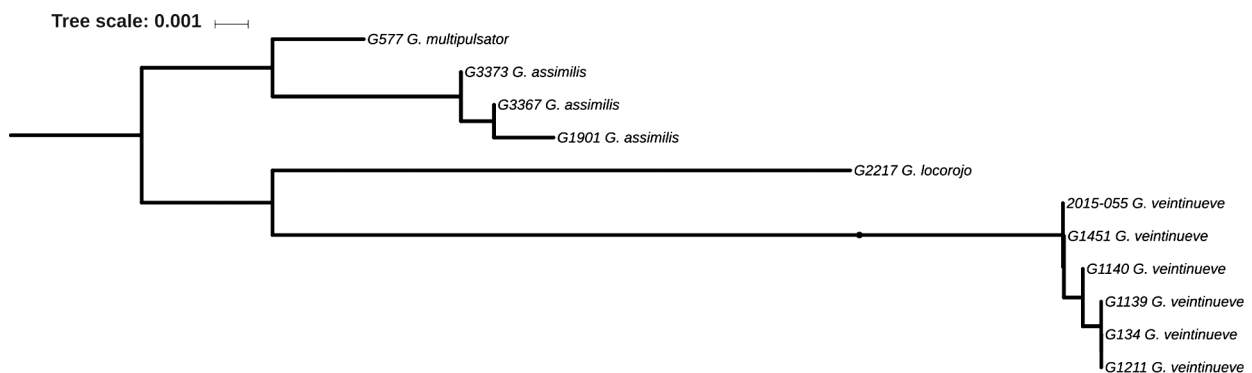


FIGURE 62. ITS2 gene tree. *G. assimilis* samples: S10-64 (G1901); S16-12 (G3367, G3373); *G. multipulsator* sample: S03-41 (G577); *G. locorojo* sample: type locality (Rainbow Mealworms); *G. veintinueve* samples: S02-39 (G134); S07-21 (G1139); S07-27 (G1140, G1211); S09-71 (G1451); OK, Love Co., Hwy 32 at Boggy Creek (2015-055).



FIGURE 63. Neotype male, *Gryllus assimilis*, photographs and labels.



FIGURE 64. Color variation in *G. assimilis* from reddish female (left, Brackettville, TX, S10-63) to dark male (right, Quintana Roo, Mexico, S02-12). Note head narrower than pronotum and hirsute and dull pronotum surface.

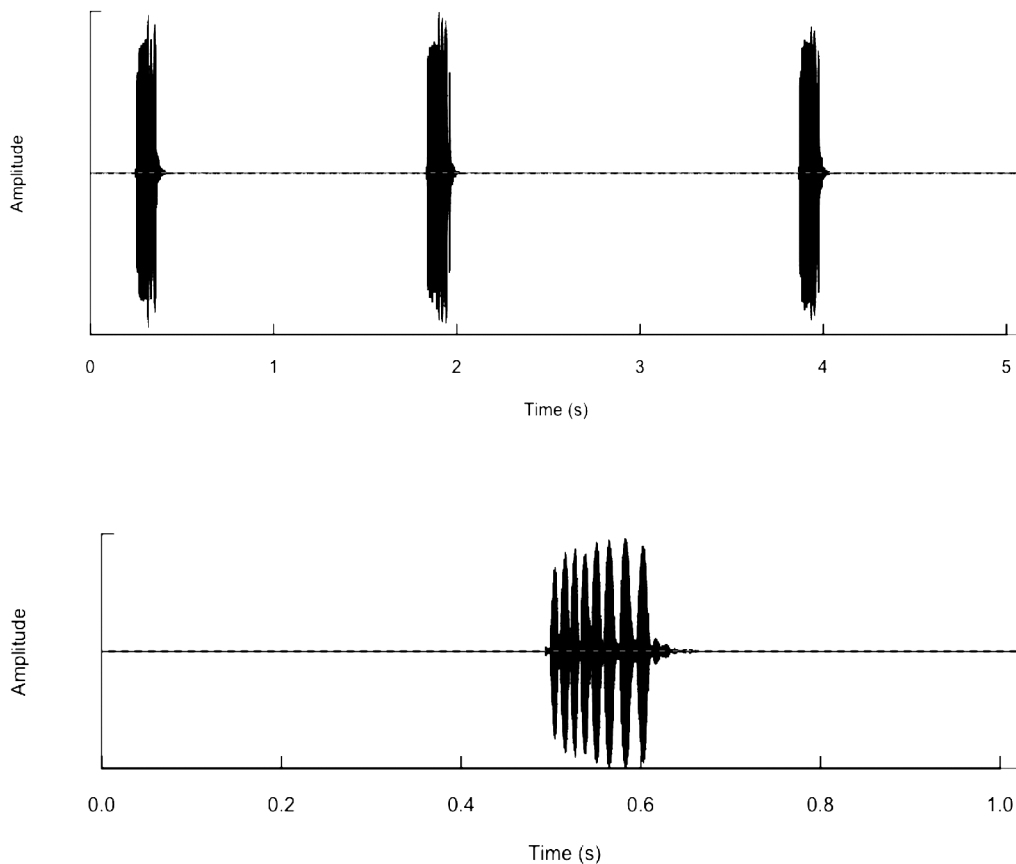


FIGURE 65. Top: Five second waveform of calling song of *G. assimilis* (R13-231) Rio Hondo, TX (S13-44), at 25°C; Bottom: One second waveform of same song showing individual pulses.

Habitat. Almost always associated with people and their watered environs such as lawns, golf courses, school grounds, and in towns. Usually in mowed grassy areas and sometimes in holes.

Life cycle and seasonal occurrence. Diapause unknown for any stage of development. Probably 2 or 3 generations/year with overlap of the continuous generations. Collected early June to mid-September, but obviously present at other times of the year.

Variation. **Color:** Head, pronotum, body, tegmina, and legs from black to tan (Fig. 64). As we have not seen winter/spring individuals, we may be missing darker colored individuals.

Specimens examined. **Texas:** *Bastrop Co.*, Smithville, 325', late September. S.M. Bertram. *Brazoria Co.*, Farm Road 521 5.5 m SE Brazoria, 38', 13-vii-2013 (S13-61). *Brewster Co.*, Big Bend National Park, Rio Grande Village, 1860', 28-v-2016, (S16-12). *Calhoun Co.*, Port Lavaca, 18', 12-vii-2013 (S13-57). *Cameron Co.*, Brownsville, sea level, 3-vi-1991 (S91-38). 3.1 m W Boca Chica State Park on Hwy 4, 10-vi-2007 (S07-26). Rio Hondo, 8m, 10-vii-2013 (S13-44). Intersection Farm Roads 510 and 2480. 2m, 10-vii-2013 (S13-43). *Fayette Co.*, 2 m S Schulenburg, 440', 9-ix-2010 (S10-65). Schulenburg, 460', 9-ix-2010 (S10-66); 14-vii-2013 (S13-66). *Hidalgo Co.*, Benson Rio Grande State Park, sea level, 3-viii-2002 (S02-34); 10-vi-2007 (S07-27). *Jim Wells Co.*, Alice, 171', 11-vii-2013 (S13-48, 49, 50). *Kinney Co.*, Brackettville, 1160', 7-ix, 2010 (S10-63). *Nueces Co.*, Corpus Christi, sea level, 11-vi-2011 (S11-36); 12-vii-2013 (S13-53). *Refugio Co.*, Tivoli, 12', 12-vii-2013 (S13-56). *Val Verde Co.*, Del Rio, 1140', 7-ix-2012 (S10-64). *Victoria Co.*, Victoria, 20', 4-viii-2007 (S02-37). *Willacy Co.*, Raymondville, 10-vii-2013 (S13-47). Farm Road 1420 near intersection FR 498, 15', 10-vii-2013 (S13-46).

DNA. G3373 (Big Bend, TX [S16-12]) in multilocus species tree (Gray *et al.* 2019); *G. multipulsator* is closest DNA relative, at least within our study area. DNA data from a more extensive series is presented in Weissman *et al.* 2009.

Discussion. In Texas, before 2013, we found this species generally uncommon and dispersed, which contrasts

with the situation along the east coast of Mexico where *G. assimilis* is more common. For unknown reasons, collecting in coastal Texas in 2013 uncovered several dense populations and much wider distributions than in previous years. This cricket is loud and singing males are not easily overlooked. Perhaps because of its adaptation to lowland, cool coastal habitats, *G. assimilis* males still sing well at 04:00 when most other *Gryllus* species have long ceased singing.

Bertram & Rook (2011a, b) have studied calling songs and biological aspects in this species from the Austin, Texas area, while Pollack & Kim (2013) and Vedenina & Pollack (2012) studied female phonotaxis and variable courtship song in long-term laboratory cultures. Sturm (2014) and Villarreal *et al.* (2018) examined aspects of mating strategies. Weissman *et al.* (2012) documented efforts by US and European cricket farms to utilize another *Gryllus* species, *G. locorojo*, misidentified as *G. assimilis*, to replace virus-infected *Acheta domesticus* as the preferred pet-feeder cricket.

S.M. Bertram notes (pers. comm. to T.J. Walker, March, 2015) that she and her group have encountered thousands of flying individuals at lights in the fall around Smithville, Bastrop Co., TX, in 2007, 2008 or 2009, and 2014. This situation seems similar to those outbreaks described by Alexander & Walker (1962) in Florida.

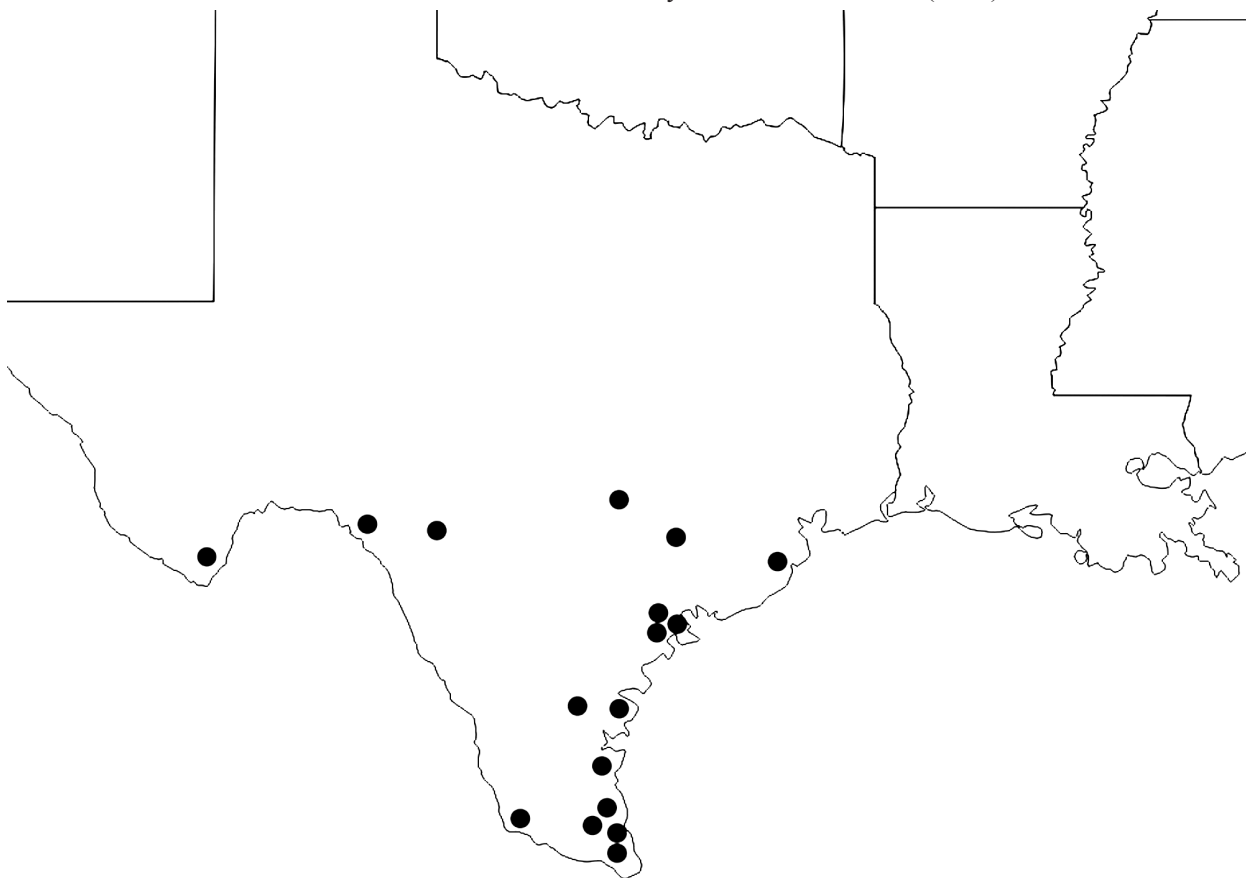


FIGURE 66. Known US distribution, *G. assimilis* within native range (also found introduced in south Florida, see SINA: <https://sina.orthsoc.org/>).

***Gryllus multipulsator* Weissman**

Long-Chirp Field Cricket

Figs 54, 60–62, 67–70, Table 1

2009 *Gryllus multipulsator* Weissman *et al.* 2009, p. 375. Holotype male (Fig. 67): Alpine, San Diego Co., California. Deposited in CAS, Entomology type #18174.

1980 *Gryllus assimilis* Weissman *et al.* 1980.

1981 ‘*Gryllus* I’ Rentz & Weissman 1981.

‘*Gryllus* #1’ in DBW notebooks.

Distribution. Known from southern California, southern Nevada, and southwestern-central Arizona.

Recognition characters and song. Always macropterous (Figs 67, 68), medium to large crickets, head usually narrower than pronotum, pronotum covered with fine hairs resulting in dull appearance. *Song* (Fig. 69; R15-325) loud, unique in US with 11–17 p/c and usually <2 c/s. Individual chirps demonstrate how pulse duration increases during a chirp while pulse rate simultaneously decreases (Fig. 71, and Weissman *et al.* 2009). Body measurements as in Table 1, p. 18. Most similar US song is *G. assimilis* but latter with fewer p/c and found considerably east in Texas.

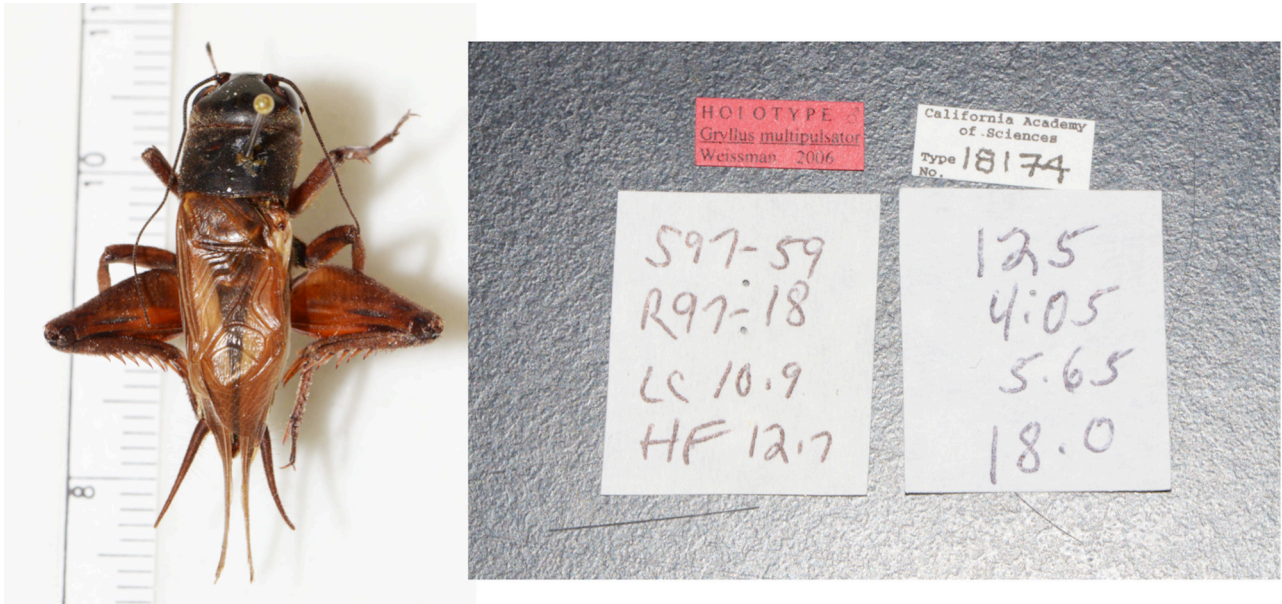


FIGURE 67. Holotype male, *Gryllus multipulsator*; specimen and labels.



FIGURE 68. Color variation in *G. multipulsator*; from reddish male (left, Riverside Co., CA, S03-41); brown female (middle, Santa Cruz Island, CA, S04-65); black male (right, Riverside Co., CA, S03-41).

Derivation of name. Reflecting the high number of pulses in each chirp.

Geographic range. Southern California, far southern Nevada, and southwestern Arizona (Fig. 70), including on the Channel Islands of Santa Cruz and Santa Catalina. Also extends into Mexico west of the Continental Divide (Weissman *et al.* 2009) and throughout much of Baja California, Mexico (Weissman *et al.* 1980).

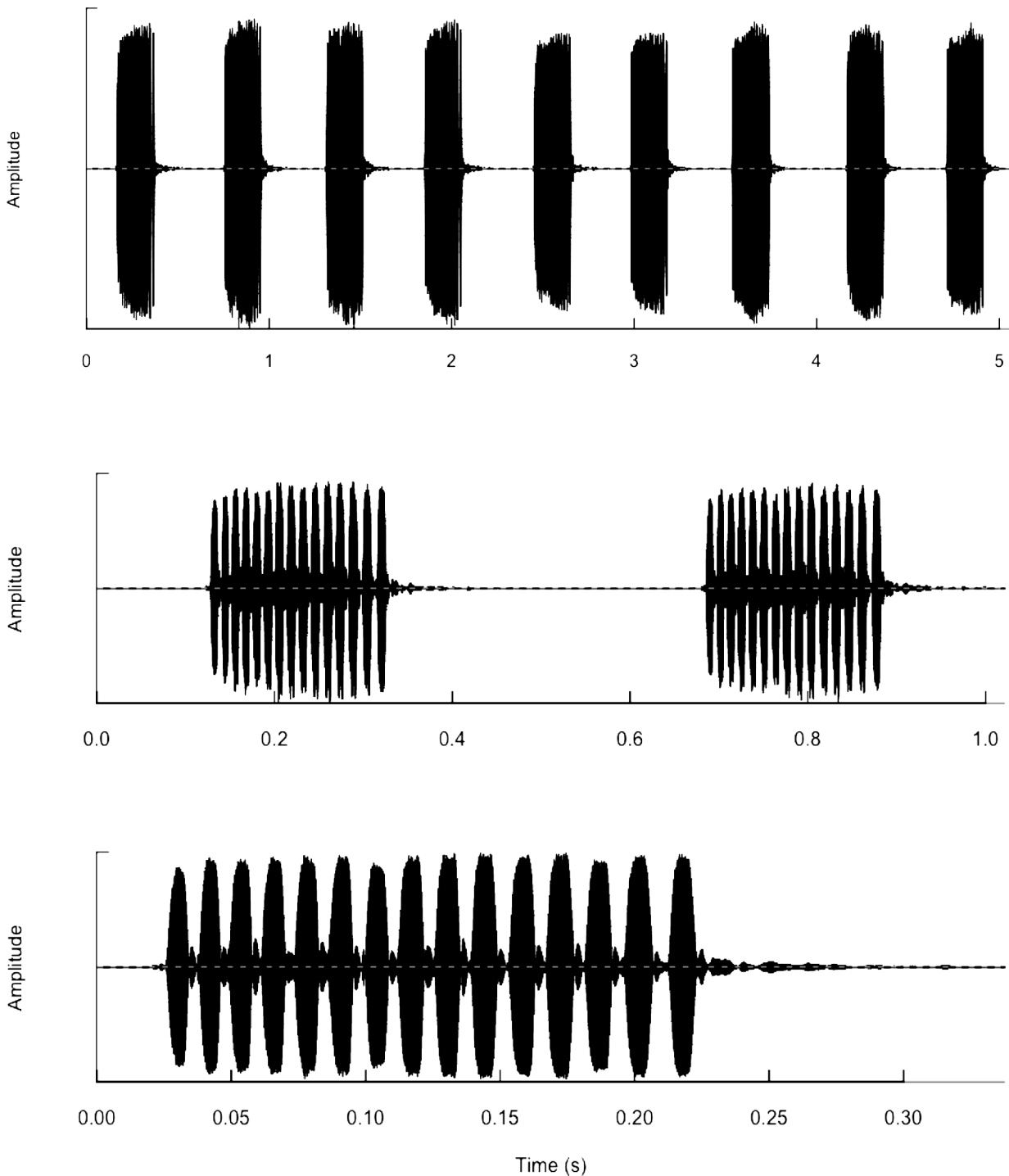


FIGURE 69. Top: Five second waveform of calling song of *G. multipulsator* (R15-325) Pima Co., AZ (S15-108), at 25.4°C; Middle: One second waveform of same song showing individual pulses; Bottom: Expansion of an individual chirp showing decreasing pulse rate towards end of chirp.

Habitat. Almost always associated with people and their watered environs such as lawns, golf courses, schools, around towns but also from salt and fresh water marsh areas. Usually singing from under dense vegetation. Most common in low elevation areas under coastal weather influences but also up to 1700 m at Sky Forest, San Bernardino Co., California.

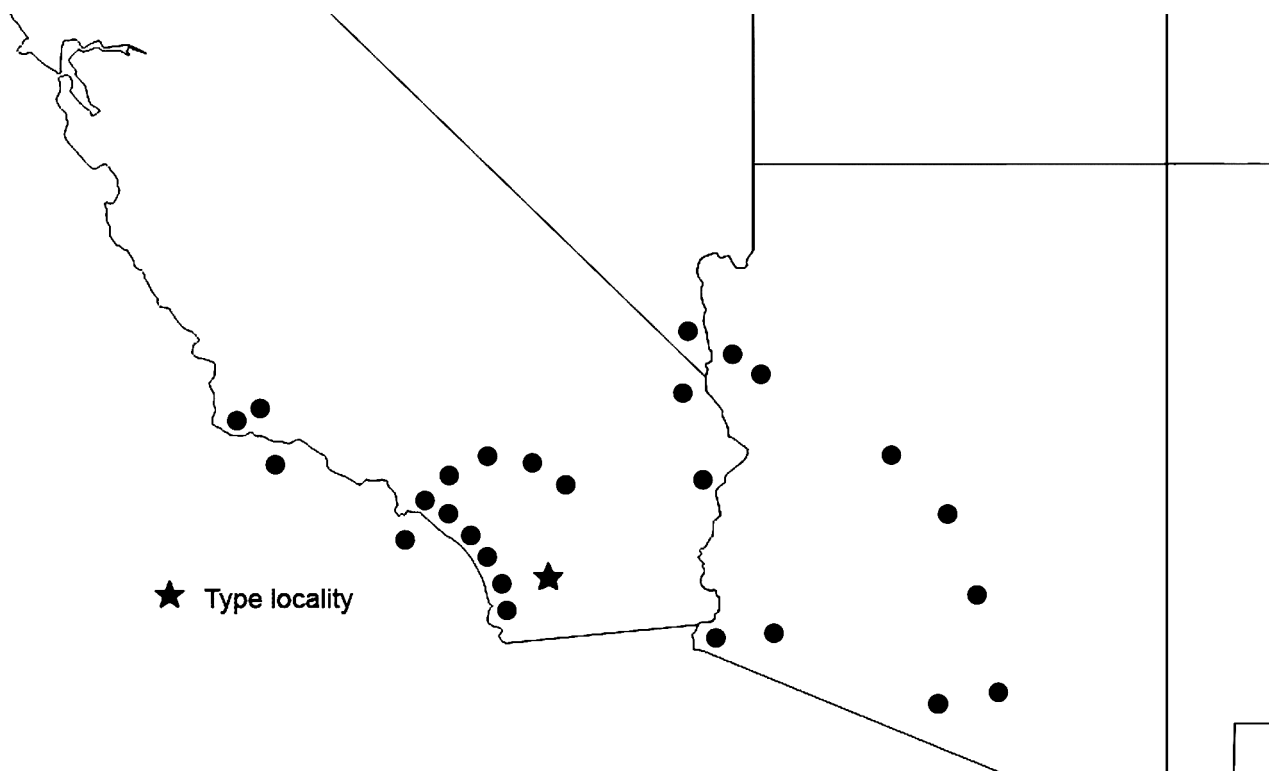


FIGURE 70. Known US distribution, *G. multipulsator*.

Life cycle and seasonal occurrence. No diapause at any stage. Continuous generations with two or three generations/year with adult males heard singing in coastal southern California even in the middle of winter.

Variation. Color: Individuals vary from almost entire body solid black (Fig. 68) to those with tan or reddish body parts. In the latter, the head may have distinctive longitudinal stripes. Tegmina also vary from tan to black, the latter especially common in cooler, moister habitats. Adult females with dark tegmina frequently have a light stripe (tegminial bar) along the forewing angle. It is unknown if colors change with generation and/or time of year maturing.

Specimens examined. **ARIZONA.** *Gila Co.*, Globe, 3544' 25-viii-1982 (S82-103). *Maricopa Co.*, Buckeye, 840' 18-ix-2011 (S11-102). Hwy 85 just E Goodyear, 980' 31-vii-1981 (S81-46). Phoenix, 1140' 16-v-1999 (S99-25). Scottsdale, 22-iv-1985 (S85-41). *Mohave Co.*, Davis Dam, 900' 14-vi-1990 (S90-46). Kingman, 3600' 19-vi-1990 (S90-58). *Pima Co.*, Ajo, 1720' 20-viii-1998 (S98-72). Gila Bend, 1700' 1-viii-2009 (S09-103). Saguaro Rd near Tucson, 2400' 28-vii-1981 (S81-35). Hwy 86 just W Sells, 2276', 29-vii-2015, 31° 57' 25.4" -111° 56' 46.4" (S15-108) 2♂. *Yuma Co.*, Telegraph Pass, 676' 15-ix-2011 (S11-92). Yuma, Western College, 300' 10-viii-1988 (S88-89). Yuma, 156', 1-xi-2003, 32.63011 -114.59740 (2003-333 and 2003-334) A. Izzo. **CALIFORNIA.** *Los Angeles Co.*, Santa Catalina Island, Middle Ranch, 28-iv-1970, 15-vi-1971; 2-vii-1972. Santa Catalina Island, Isthmus, 4-Vvii-1973. Santa Monica Mts., Trancas Reservoir, 18-viii-1973. *Orange Co.*, Newport Beach, Backbay Dr., 7-vii-1976. Irvine, on UC Irvine Campus, 7-vii-1976. *Riverside Co.*, Banning, 2400' 22-viii-2006 (S06-88). Blythe, 400' 26-vi-1980 (S80-47). Indio, 6-viii-1988 (S88-74). Palm Springs, 2-iv-1989 (S89-8); 6-iv-1991 (S91-14). Rancho Mirage, 850' 30-ix-2006 (S06-114). Riverside near UC Riverside Campus, 6-vi-2003 (S03-41). *San Diego Co.*, Alpine, 1900' 5-vi-1997 (S97-59). Borrego Springs, 8-viii-1988 (S88-83.) Camp Pendleton, 10 & 11-vii-1976. Cardiff by the Sea, sea level, 12 and 13-vii-1976; 27-vi-1980 (S80-48). La Jolla, near Prospect and Beach Blvd., sea level, 11-vii-1976. San Diego, Mission Bay, sea level, 18-vi-1994 (S94-34). *San Bernardino Co.*, Essex, 2000' 22-vii-1990 (S90-69). 3 m N Essex, 1680' 21-viii-1998 (S98-75). Mentone, 2000' 25-vii-1981 (S81-28). San Bernardino Mts., Sky Forest, 5600' 17-viii-1982 (S82-64). *Santa Barbara Co.*, Gaviota State Park 14-vii-1976. Santa Cruz Island, Prisoner's Harbor, sea level 11-vii-2004 (S04-65). Santa Ynez Mts., Lake Cachuma, 600' 24-vii-1981 (S81-20). **NEVADA.** *Clark Co.*, Cottonwood Cove, 800' 14-vi-1990 (S90-44).

DNA. Multilocus species tree G1414 (S09-103, Gila Bend) *G. multipulsator* is a sister species of *G. assimilis*—see DNA comparisons in Weissman *et al.* (2009) and in Gray *et al.* (2019). Also, closely related to *G. locorojo* and *G. veintinueve* (Fig. 6, p. 28).

Discussion. When we described this taxon in 2009, it was thought to have the highest number of p/c of any *Gryllus*. Otte (1987) described *G. mzimba* from Malawi with 17p/c and Martins (2009) discussed an undescribed *Gryllus* from southern Brazil (his *G. n. sp. 2*) that has from 13-21 p/c. Because *G. multipulsator*'s distribution ends in central Mexico (Weissman *et al.* 2009), Martins' undescribed cricket will be the new record holder for p/c once published.

Tachinid *Ormia ochracea* emerged from 2 males collected in Yuma, AZ (2003-333 and 334).

The Rubens Group

G. rubens Scudder; *G. texensis* Cade & Otte; *G. regularis* Weissman & Gray, n. sp.

Sister species of trilling field crickets distributed from south-central Arizona into far western Texas (*G. regularis*), from western Texas and the southern Great Plains eastwards to western Florida (*G. texensis*), and from eastern Texas eastwards to Florida and the southeastern Atlantic states (*G. rubens*). The only regular trilling species of *Gryllus* in the US (*G. cohni* is more of an irregular triller), differing from each other most notably in pulse rate (Figs 71 & 72) with *G. regularis* 30-50; *G. rubens* 45-65; and *G. texensis* 62-91. Geography, female morphology, and genetics also useful (Fig. 73, and Gray *et al.* 2019).

Gryllus rubens Scudder

Southeastern Field Cricket

Figs 71–82, 85, 86, 90, Table 1

1902 *Gryllus rubens* Scudder. Psyche 9: p. 295. Holotype female, Auburn, Alabama. Type in ANSP, photos (Fig. 74) courtesy of J.D. Weintraub, ANSP. Plotting Scudder's female holotype measurements of pronotal width of 6 mm and ovipositor length of 16 mm (Scudder 1902) falls within *G. rubens* measurement cluster (Fig. 75).

1957 *Acheta rubens* (Scudder). Alexander, 1957. p. 586.

1964 *Gryllus rubens* Scudder. Randell 1964.

Distribution. One (Fig. 71, R13-220) of only two trilling US *Gryllus* found between 99° longitude (central Texas) and the Atlantic coast. See Walker (2019) and Gray (2011) for additional eastern localities.

Recognition characters and song. Medium sized, short or long hind winged crickets with an average PR of ~55 at 25°. Distinguished from morphologically similar and trilling, sometimes sympatric, *G. texensis* in that the latter has an average PR of ~80 at 25° (Figs 71, 84), more teeth in the file (Figs 78, 79), a shorter ovipositor (Gray *et al.* 2001), and frequently, but not always, shorter bursts of pulses. Pulse rate at a given temperature faster, but with greater separation from *G. texensis*, in the late summer/fall generation than in the spring generation (Walker 1998).

Along coastal Texas, in 2013, we found no overlap in dominant frequency, in many males, which was <5000 Hz in *G. rubens* but >5000 HZ in *G. texensis*. Yet around Tulsa, Oklahoma (S13-68), there is overlap and we wonder if this might reflect hybridization, environmental effects during development, or both. Additionally, Blankers (pers. comm.) stated that dominant frequency values that he used in Blankers *et al.* (2015) had a range of 4.18–5.88 KHz in *G. rubens* and 4.66–5.56 KHz in *G. texensis*. Unfortunately, these measured males were all from laboratory generations with unknown effects on the song.

Derivation of name. “rubens” apparently for the general reddish and rufo-testaceous markings on Scudder's unique, long tegmina female specimen.

Geographic range. (Fig. 76.) Most of our collection localities are near the western and northwestern boundaries of *G. rubens*' distribution. See Gray (2011) and Walker (2019) for more complete eastern US distribution maps. Our most western locality is Bastrop State Park (S91-23), Texas, where *G. rubens* occurred with *G. texensis*. There we collected one male *G. rubens* (R91-39) with a PR of 53 at 25°C and with 100 file teeth and three *G. texensis*