

2000) which demonstrated an increase in PR of 3.5 for every 1°C increase in recording temperature; influence of photoperiod on signaling (Bertram & Bellani 2002); female cricket mating preferences (Wagner *et al.* 1995, Blankers *et al.* 2015); life history trade-offs (Guerra & Pollack 2007); hybridization studies (Cade & Tyshenko 1990); predator-induced stress responses (Adamo *et al.* 2013), courtship songs (Fitzpatrick & Gray 2001); peripatric speciation (Gray *et al.* 2008, Blankers *et al.* 2018); and interactions between temperature, reproduction and immune function (Adamo & Lovett 2011).

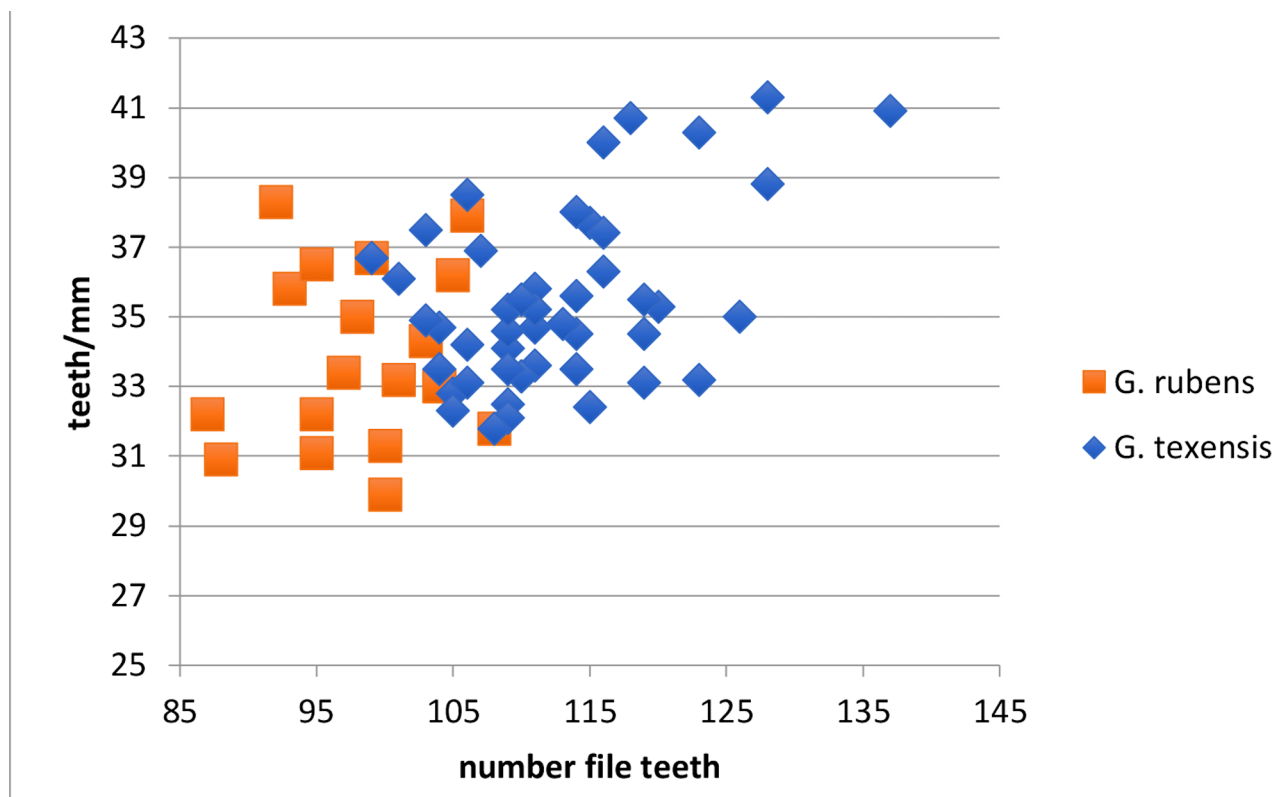


FIGURE 90. Regression of file teeth vs. teeth/mm showing separation of sympatric *G. rubens* from *G. texensis*.

***Gryllus regularis* Weissman & Gray, n. sp.**

Southwest Regular-Trilling Field Cricket

Figs 71–73, 91–95, 168, Table 1

‘*Gryllus* #14’ in DBW notebooks.

‘Arizona triller’ of Sakaguchi & Gray (2011).

‘*G.* #14’ of Blankers *et al.* 2015.

Distribution. Known from central-southeastern Arizona, southwestern New Mexico, and western Texas.

Recognition characters and song. Medium to large, usually short hind winged crickets with a broad and usually shiny pronotum. **Song** (Fig. 91, R99-211) a long trill with pulses evenly spaced, PR 30–45 at 25°C. Distinguished from the two other sympatric, trilling *Gryllus*, as follows: from *G. cohni*, the latter is smaller and has an irregular trill with groupings of 2 to 11 pulses that results in a slower CR, usually has long hind wings, and a narrower (Fig. 92), hirsute and slightly dull pronotum.

Trilling *G. texensis* is sympatric with sister species *G. regularis* only at Alpine, TX (S07-41), but the former has a PR above 70 at 25°C. The only other western US trilling *Gryllus* is the always allopatric, sister species *G. rubens* from central Texas to Florida and which, while also medium to large in body size, has a higher PR (45–65), non-overlapping file teeth number, and narrower pronotum. Rarely, Arizona males of *G. armatus* trill (see Fig. 109, p. 115), but can be separated from *G. regularis* by their higher pulse rate (60–100), narrower pronotum and file characters.

Holotype. Male (Fig. 93). USA, Arizona, Yavapai Co., Sedona, Sky Ranch Lodge Motel grounds by Sedona

Airport. 15-vi-2007. 5120'. 34° 51.146', -111° 47.415'. D.B. Weissman, D.C. Lightfoot. S07-61, R07-11, DNA sample G1098. 16S GenBank accession # MK446613. BL 20.48, HF 11.43, RC 10.21. Right tegmen removed: 120 teeth, file length 3.35, TL 12.1, TW 4.55. Type deposited in CAS, Entomology Type #19270.

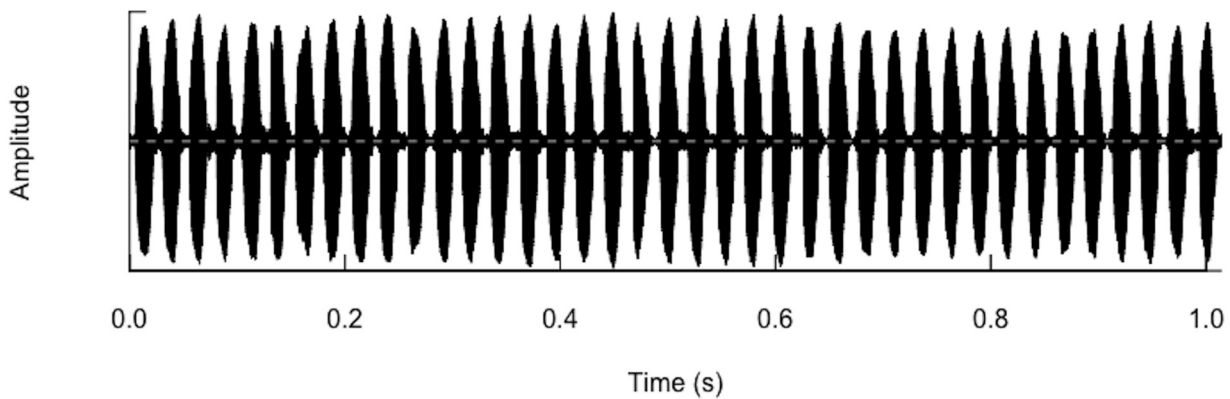


FIGURE 91. One second waveform, pulse rate of 39, of calling song of *G. regularis* (R99-211) from Sinaloa, MX (S99-86), recorded at 25.5°C

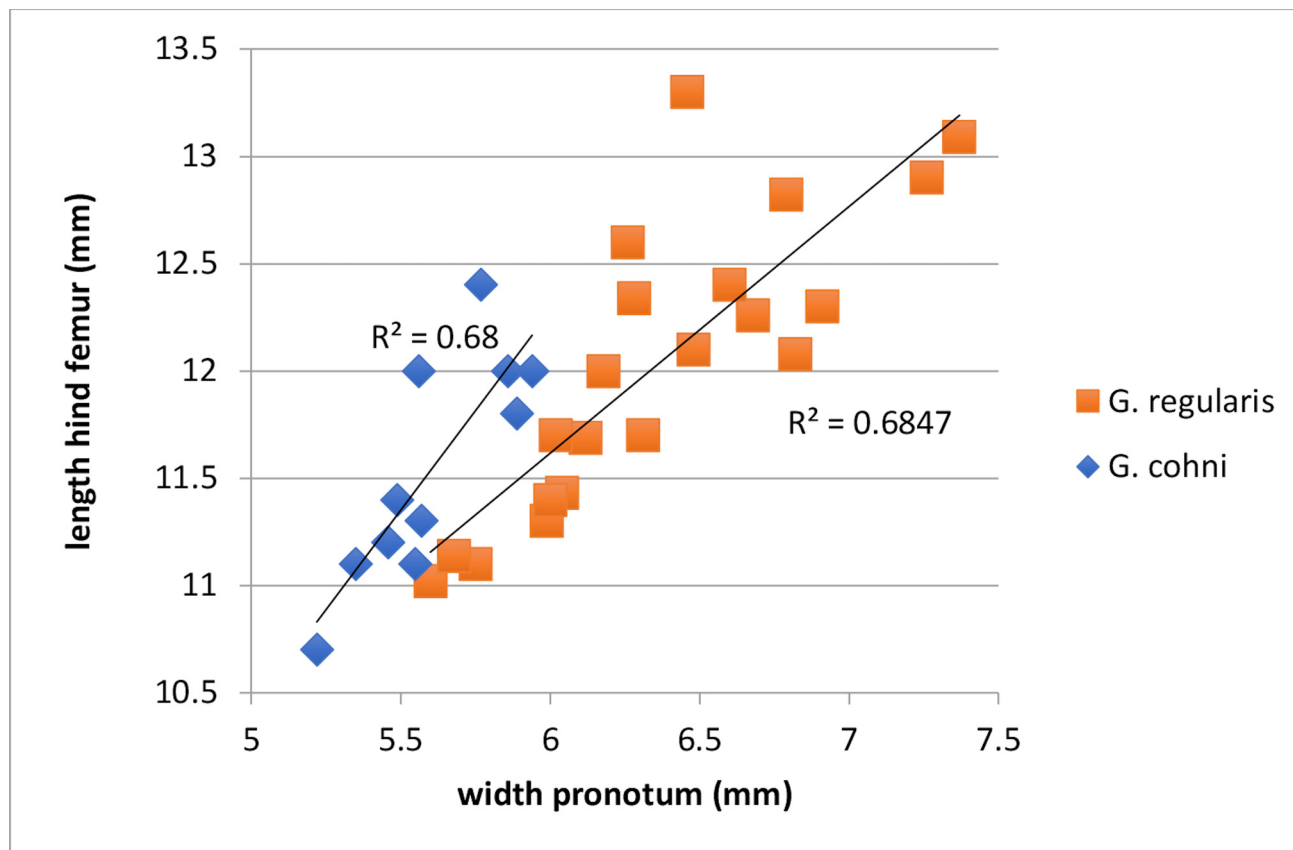


FIGURE 92. Regression of width pronotum vs. hind femur length in *G. regularis* vs. *G. cohni* showing narrower pronotum in the latter.

Paratypes. (Total: 25♂ 11♀). **Arizona.** *Coconino Co.*, Sedona, north end of town, 4400', 25-vi-1980 (S80-45) 3♂ 2♀; 15-vi-1990 (S90-49) 1♂; 5-viii-1991 (S91-78) 2♂; 30-vi-1994 (S94-35) 1♂. *Gila Co.*, Globe, 3544', 25-viii-1982 (S82-103) 1♂. *Graham Co.*, Hwy 366 near intersection Hwy 191, 3333', 32° 43' 04.6" -109° 43' 34.9" 28-vii-2015 (S15-102) 1♂. *Yavapai Co.*, Agua Fria National Monument 3705', 34° 14' 25.0" -112° 01' 33.4", 19-ix-2011 (S11-105) 1♂; 12-vi-2012 (S12-24) 1♂. Agua Fria National Monument 3200', 34° 14' 50.2" -112° 03' 28.5",

12-vi-2012 (S12-25) 1♀. Camp Verde, 3151', 21-viii-2012 (S12-107) 1♂. Cordes Junction, gas station, 3802', 18-viii-2004, 2004-115, 1♀. Sedona, Sky Ranch Lodge Motel grounds by Sedona Airport, 5120', 12-vi-1996 (S96-61) 5♂ 4♀; 15-vi-2007 (S07-61) 5♂ 2♀. Forest Road 525 near Sedona, 4507', 16-viii-2004, 34.91855° -111.91090°, 2004-111, 1♀. 2.5 m W Clear Creek "Bull Pen", 3502', 11-viii-2011, 34.54646° -111.74417°, 2011-097, 1♂. **Texas.** *Brewster Co.*, Alpine, 12-vi-2007, 4270' 30° 35' 49.86" -103° 53' 11.81" (S07-41) 1♂. *Jeff Davis Co.*, Fort Davis, Fort Davis National Historic Site, 4852', 30° 35' 49.86" -103° 53' 11.81", 1-vii-2015 (S15-67) 1♂.

Song records only. **Arizona.** *Cochise Co.*, Apache Pass, 5106', 10-vii-2002, Recording DAG2002-044. 1♂. Subsequent collecting here 2-vi-2013 yielded only nymphs of *G. lightfooti*. **New Mexico.** *Hidalgo Co.*, Coronado National Forest Road 63 (Geronimo Trail), 5330', 31.529° -108.897°, 12-iv-2013. No recording. 1♂ heard.

Derivation of name. "regularis" in reference to the regular spacing of pulses in the trilling song.

Geographic range. Fig. 94. Also into adjacent Mexico.



FIGURE 93. Holotype male (left) and paratype female (right), both from the type locality (S07-61).

Habitat. Mostly known from areas of human disturbance (including rangeland disturbed by cattle grazing), usually in cracks in the soil or in shelter associated with structures, from 960-1560m. Population at type locality fairly dense with deep cracks providing good refuge for singing males.

Life cycle and seasonal occurrence. Adults known from June through October. The Double Tank area (34° 14' 23.64" -112° 01' 37.49") of Agua Fria National Monument, AZ, has two large, man-made cisterns for cattle water in an area of open Sonoran Desert scrub. The 3 common species (*staccato*, *cohnii*, and *regularis*) of *Gryllus* there have been part of a multiyear study on parasitoid tachinid *Ormia* flies (Sakaguchi & Gray 2011). As such, we have multiple collection dates for this area which indicate that there are apparently two field generations/year based on the following collections: (1) adults and late instar nymphs collected in mid-June, 2012, and molting to adult late June and early July and (2) 9 male and 11 female late instars collected 9-x-2010 molting to adult mid-November through early December, 2010. Agreeing with this pattern, from the type locality (S96-61) on 12-vi-1996, adults and many late instars attracted to oatmeal with the nymphs molting to adult in late June/early July that same year.

We also suspect that rainfall patterns can significantly affect these schedules. In the laboratory, no diapause at any developmental stage (Agua Fria, AZ) where they can have 3 or 4 generations/year.

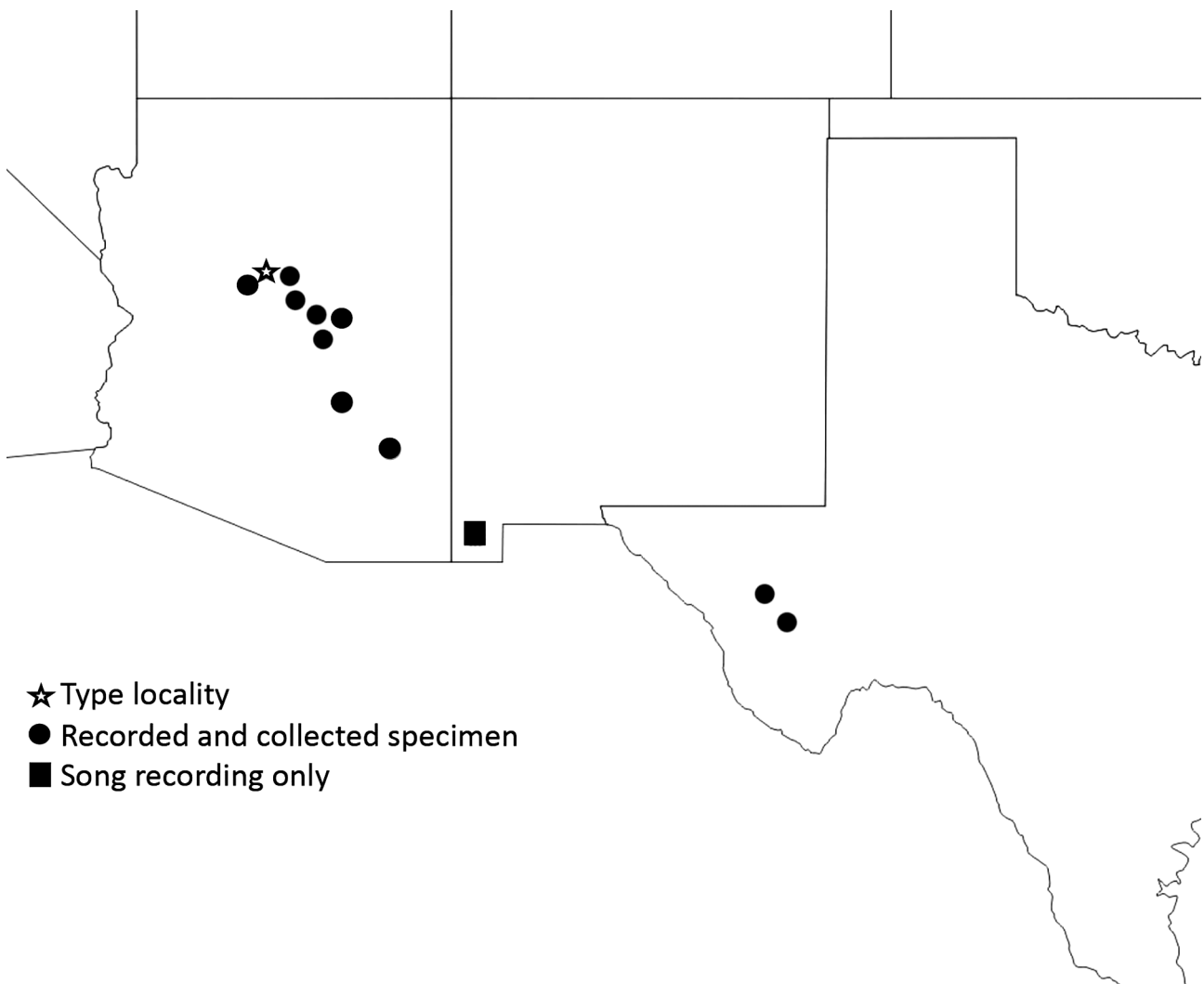


FIGURE 94. Known US distribution of *G. regularis*.

Variation. Color: Generally black head and pronotum with dark brown tegmina. **Hind wing length:** Of 37 total field collected adults, only 1 male each from the Arizona localities of Globe (S82-103), Camp Verde (S12-107) Clear Creek (2011-097), and Graham Co. (S15-102) long winged. Late instars brought into the laboratory, usually molt to adult with short hind wings. In contrast, adults reared from eggs, in the laboratory, are all, or almost all, long hind winged. **Song:** Of 27 recorded males, all with 1 p/c except for a male (Fig. 95, R11-167) from Agua Fria (S11-105). This male had short bursts of a “pure” trill of 1 p/c and then switched to 2 p/c. His 16S gene (G2443) mapped with *G. regularis* from other Arizona localities.

DNA. Multilocus 2016-037 from Agua Fria National Monument, 9-viii-2016. Nearest multilocus relatives (Gray *et al.* 2019) are *G. rubens* and *G. texensis*. In the ITS2 gene tree (Fig. 73), the two samples from west Texas (G3154, S15-67, Jeff Davis Co.; and G1085, S07-41, Brewster Co.) appear closer to *G. texensis*. Without further data, we are not sure how to interpret this result.

Discussion. Singing males frequently located deep in extensive soil cracks at Agua Fria and Sedona Airport localities and almost impossible to flush with water. Oatmeal trails through the habitat of singing males can help pull in wandering adult females, nymphs, and occasionally adult males. At the north end of Sedona, Arizona, *G. regularis* occurs with 5 other species of *Gryllus*.

In Alpine, TX (S07-41), *G. regularis* occurred with both faster trilling *G. texensis* and 2p/c *G. armatus*. We have only collected *G. regularis* there once and its distinctive long trilling song and short hind wings were recognized when collected and documented in field notes.

Males are easy to approach in the field and sing well in the laboratory. Because of a similar dominant frequency and long, uninterrupted trills, we have confused this *Gryllus*, in the field, with sympatric trilling *Oecanthus* tree crickets.

Male *G. regularis* parasitized by tachinid *Ormia ochracea* at Agua Fria (Sakaguchi & Gray 2011).

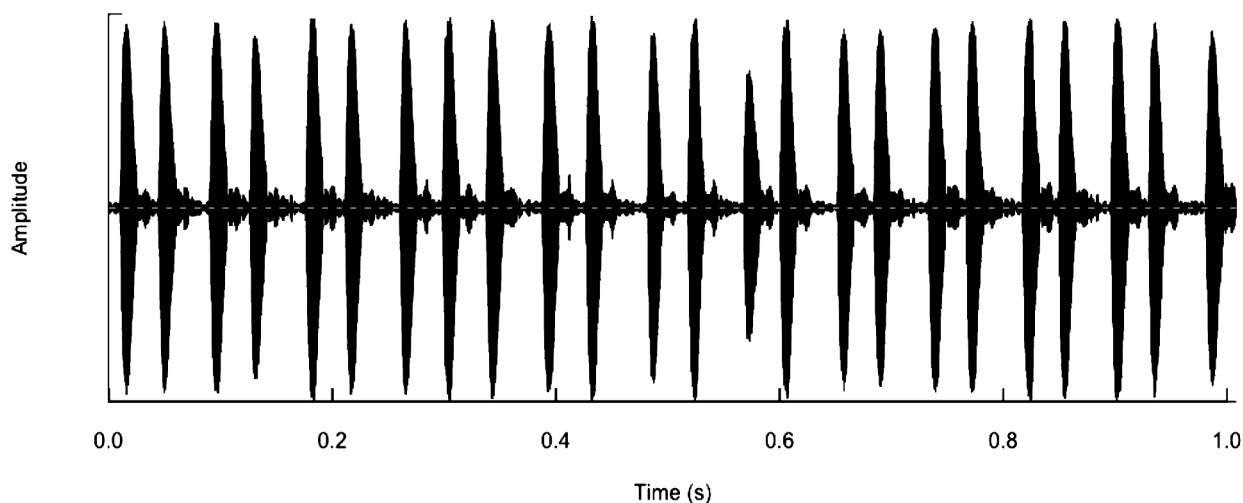


FIGURE 95. *G. regularis* with subtle pairing of pulses (R11-167), from Yavapai Co., AZ (S11-105), at 21°C.

The Integer Group

G. integer Scudder and *G. armatus* Scudder.

Sister species with a series of very fast 2-3 pulse chirps concatenated together (Fig. 96) such that they can sound like an irregular ‘stutter-trill’ despite not being a true trill as defined here (p. 25). Separated by geography (Fig. 100), DNA (Fig. 98), and song differences (Fig. 96).

Gryllus integer Scudder

Mud Crack Field Cricket

Figs 96–104, 106, Table 1

1901 *Gryllus integer* Scudder. Psyche 9: p. 268. Lectotype male (Fig. 99) designated by Weissman *et al.* 1980: “W. Berkeley, Calif., Aug 20, 1897. S.H. Scudder coll. *Gr. integer*; Scudder’s type 1901. Red label, type 14065.” Specimen labeled Weissman and Rentz cotype #1). Type in ANSP.

‘*Gryllus* VI’ of Weissman & Rentz (1977a) and Rentz & Weissman (1981).

G. integer (in part) of Weissman *et al.* (1980).

‘*Gryllus* #6’ of DBW notebooks.

Distribution. California (except for southeastern deserts) north into Washington, east into Idaho and Wyoming and south into western Colorado, northern and central Utah, and Nevada (Fig. 100). Also known from 5 California Channel Islands.

Recognition characters and song. A medium sized, short hind femur, always solid black headed, long and narrow tegmina, long hind winged cricket. Song usually with intermittent bursts of 3 (range 2–4) p/c, usually without an introductory, short trill (Figs 101, 102; R16-60, S16-21), 1000 c/m, PR usually >70. But these general patterns are not fixed in that many populations are a composite of calls including individuals with a pure trill (discussed below), a short introductory trill that changes to 3p/c, and a 2p/c song. Morphologically indistinguishable from sister species *G. armatus* but separated by habitat and geography, slight song differences, and consistent DNA differences, as follows: (1) *G. armatus* is from hotter, more southern desert US locations (see Fig. 100); (2) Most, but not all *G. armatus*,