The multilocus analysis also varies in placement of *G. montis* Clade 1 depending upon analysis method: concatenated analysis places *G. montis* Clade 1 within the Veletis Group, whereas Astral analysis places *G. montis* Clade 1 with *G. montis* Clade 2. Given the apparent capture of *G. veletis* mtDNA by *G. montis* Clade 1 and *G. lightfooti* mtDNA by *G. montis* Clade 4, and the inconsistency between the concatenated and the Astral analyses, we predict that further more detailed genetic data, e.g. RAD-seq, will reveal a history of hybridization among the southwestern montane species of *Gryllus*.

During altitudinal transects in Arizona, starting in high elevation trees, one hears *G. montis* seamlessly transition to lower elevation, more open grassland *G. lightfooti* on Kitt Peak, Mt. Lemmon, Mt. Graham, Madera Canyon, and the Sedona area, with no or a very narrow zone of overlap. Also, *G. montis* can be narrowly sympatric, during such transects, with the lower elevation slow chirper *G. longicercus* (Kingman, Bisbee, Kitt Peak, Mt. Lemmon). *G. montis* microsympatric with both *G. lightfooti* and *G. longicercus* at 8.4 km SE Hualapai Mt. Park (S90-56) at 1524m, and in the town of Bisbee (S13-18). All 3 sympatric slow chirpers are acoustically distinguishable as follows: *G. longicercus* with individual pulses countable, both *G. montis* and *G. lightfooti* with pulses not countable but chirp rate some 50% slower in former compared to latter.

Hualapai Mt. Park, Mohave Co., AZ, is at 1829m, in good forest, and *G. montis* is common there. As one drives down Hualapai Mt. Road toward Kingman, female field crickets are occasionally observed wandering on the road. We can thus easily see the transition from almost all black *G. montis,* without tegminal bars, while under the tree canopy, to *G. lightfooti,* with tegminal bars, once into more open shrub-grassland. This shift is also seen while driving out of Madera Canyon in the Santa Rita Mountains. For example, at Bog Springs campground area under tree cover at 1527 m elevation, *G. montis* and *G. longicercus* found microsympatric (19-viii-2004); within 2.2 km linear distance into Sonoran grassland on Proctor Road at 1333 m elevation, both species completely replaced by *G. lightfooti* (10-ix-2010). The same situation occurs as one loses elevation going east from the Southwestern Research Station, near Portal, toward New Mexico.

Even surprising for a cricket species that lives at high elevations, repeated attempts to kill adults from Herb Martyr Dam, Chiricahua Mts. (S08-51), by placing them in a home freezer (-15°C) for 1-2 hours duration, all failed. Such treatment normally kills adult *Gryllus* of all species. On the fourth try, freezing them overnight succeeded.

Parasitized by tachinid *Exoristoides johnsoni* at both 40 km NE Prescott (S94-38, 2 males: one with 2 and second with 3 larvae); and 3.5 km SW Reserve (S94-51, 2 males: one with 1 and second with 2 larvae). Parasitized by mermithids: 1 female Ramsey Canyon (S13-17). One of seven males collected 26-vii-2005 at Miller Canyon, Huachuca Mountains (31.42620°, -110.25816°) parasitized by tachinid *Ormia ochracea* (1 larvae).

The Lightfooti Group

G. lightfooti Weissman & Gray, n. sp.; *G. sotol* Weissman & Gray, n. sp.; *G. transpecos* Weissman & Gray, n. sp.

Sister species of chirping field crickets found primarily in Sonoran and Chihuahuan Desert scrub grasslands (*G. lightfooti*); the Organ Mountains of southern New Mexico (*G. sotol*); and in western Texas (*G. transpecos*). Songs similar, typically 3-5 pulse chirps (Figs 207, 208); best separated from each other by combination of distribution, habitat, morphology, and DNA (Gray *et al.* 2019, Fig. 209).

Gryllus lightfooti Weissman & Gray, n. sp.

Arboreal Desert Field Cricket
Figs 205, 207–212, Table 1

'G. #23', 'yucca Gryllus' in DBW notebooks.

Distribution. Southeastern California through central and southern Arizona and New Mexico, into western Texas.

Recognition characters and song. A frequently arboreal, locally common field cricket that ranges from southeastern California through central and southern Arizona and New Mexico, into western Texas. Typically, a desert grassland species, extending into desert scrub and upper desert grassland/oak conifer zones. They can also colonize

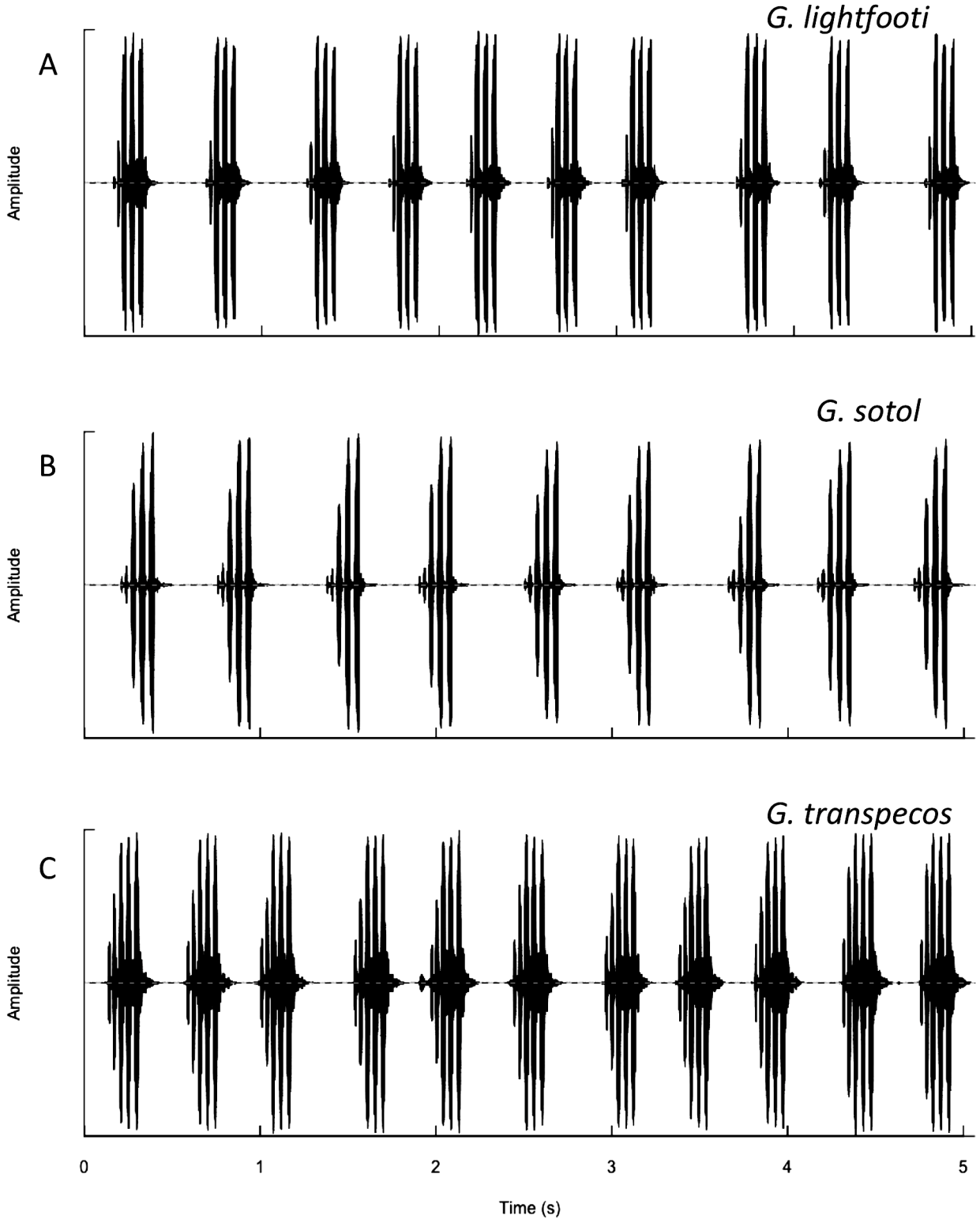

FIGURE 207. Five second waveforms of typical calling songs of (A) *G. lightfooti*, (B) *G. sotol*, and (C) *G. transpecos*. (A) *G. lightfooti*: (R09-69) Cochise Co., AZ (S09-55), at 24°C; (B) *G. sotol*: (R17-44) from type locality (S17-4), at 24.1°C; (C) *G. transpecos*: (R09-93) Culberson Co., TX (S09-64), at 25°C.

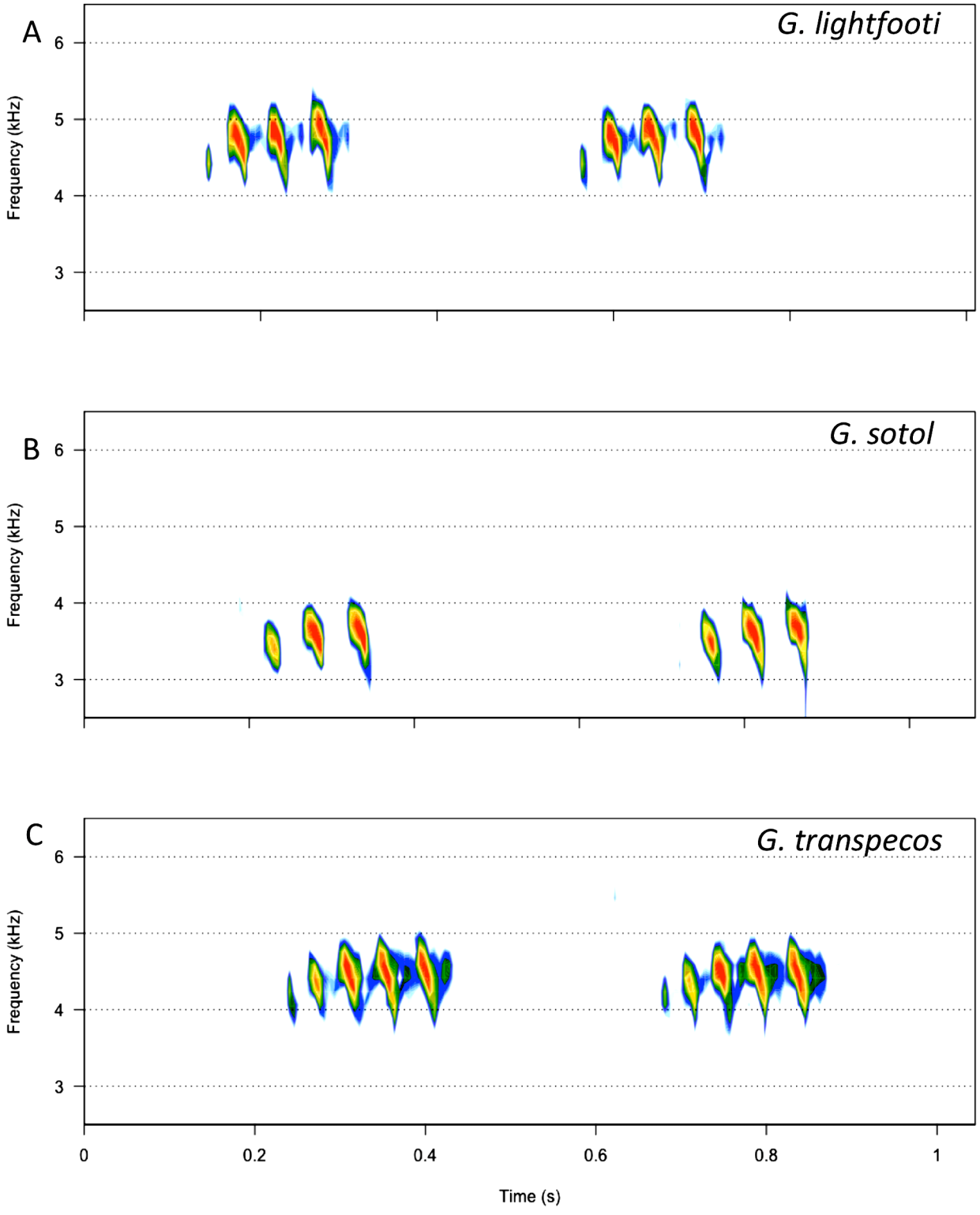

FIGURE 208. One second spectrograms of typical calling songs of (A) *G. lightfooti*, (B) *G. sotol*, and (C) *G. transpecos*, same males as in Fig. 207.

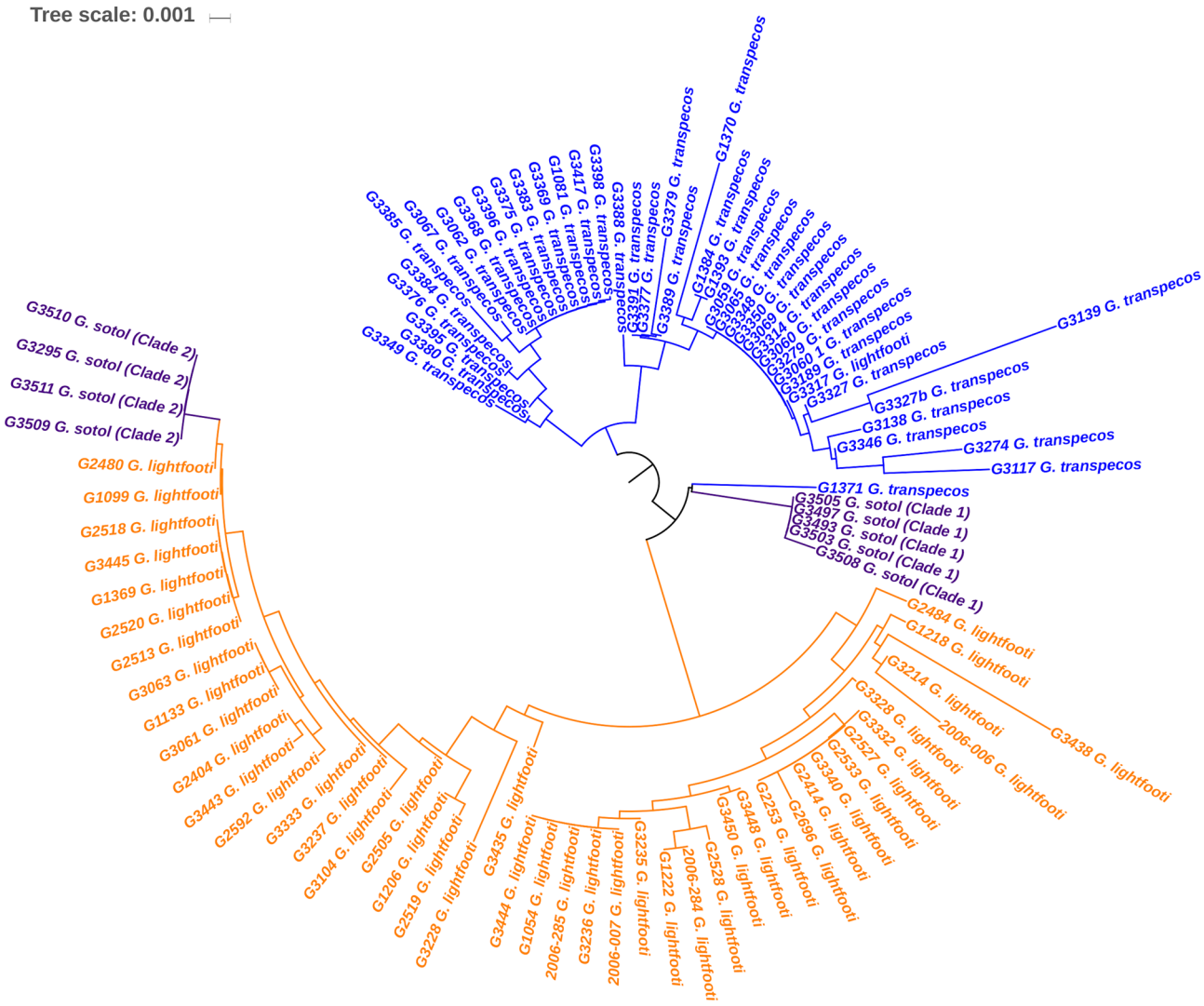

FIGURE 209. ITS2 gene tree. Collection stop numbers for ***G. lightfooti*** samples (orange): S07-61 (G1099, G1206); S07-66 (G1218); S07-67 (G1222); S07-68 (G1133); S09-55 (G1369); S12-19 (G2253); S12-102 (G2404); S12-103 (G2414); S13-13 (G2518, G2528); S13-16 (G2480, G2513, G2519, G2520); S13-18 (G2484, G2696); S13-19 (G2505, G2527, G2533, G2592); S15-49 (G3104); S15-75 (G3061, G3063); S15-100 (G3340); S15-104 (G3328); S15-105 (G3317, G3332); S15-109 (G3333); S15-110 (G3214, G3228, G3235, G3236, G3237); S16-24 (G3435, G3445, G3448, G3450); S16-31 (G3438, G3444); S16-33 (G3443). Collection stop numbers for ***G. sotol*** samples (purple): S15-77 (G3295); S17-4 (G3493, G3497, G3503, G3505, G3508, G3509, G3510, G3511). Collection stop numbers for ***G. transpecos*** samples (blue): S07-36 (G1081); S09-64 (G1370, G1384, G1393); S15-61 (G3189, G3279, G3346); S15-64 (G3314, G3348, G3349); S15-65 (G3117, G3138, G3139, G3274, G3327); S15-68 (G3062); S15-69 (G3067); S15-72 (G3059, G3060, G3065, G3069, G3350); S16-2 (G3376, G3377, G3383, G3384, G3389, G3391); S16-3 (G3379, G3385, G3388, G3395); S16-7 (G3375); S16-8 (G3368, G3417); S16-9 (G3396); S16-10 (G3369); S16-12 (G3398); S16-14 (G3380). Note the two ITS2 clades of *G. sotol*.

suburban neighborhoods. A small (especially when in sandy desert habitats) to large cricket separated, sometimes with difficulty, from similar looking, occasionally sympatric chirping species by a combination of habitat, behavior, female color patterns, DNA, and song. Almost always with short hind wings (Fig. 210); cerci in situ nearly as long as, to just longer than tip of ovipositor; females (and some males) typically with "tegminal bars", a pale longitudinal strip on the anterior dorsal-lateral margins of the forewings (Fig. 210), especially visible when tegmina are dark. Males frequently sing off the ground, in vegetation, especially during the daytime from within *Yucca elata*, and also from within pack rat (*Neotoma* spp.) nests. *Song* (see Fig. 211, R09-69) a medium-fast chirp (frequently over 150 c/m), generally 3-5 p/c, PR 18-29 at 25°C. Distinguished from other US western slow chirping *Gryllus*, some that can be sympatric, as follows: From the *G. montis* complex: the latter occur in sky islands, under a tree canopy, where males have a slower CR and whose cerci are never longer than the ovipositor. Also, despite being at higher,

cooler elevations, *G. montis* molts to adult several weeks before *G. lightfooti*. One can conduct elevational transects at several places in Arizona (e.g. Madera Canyon, Kitt Peak, Mt. Lemmon, Hualapai Mt. Park) and hear an almost seamless transition of slow chirpers when descending from tree covered sky island habitats, where *G. montis* lives, to the open grassland-shrub habitats of *G. lightfooti*. Once below tree cover on these elevation-transects, wandering adult females of Arboreal Desert Field Crickets with tegminal bars can occasionally be seen on the roads, although at Hualapai Mountain Road, both species continue to occur sympatrically, in interior chaparral habitat, as Kingman is approached. Separated from sometimes microsympatric *G. longicercus* by no overlap in PR, minimal overlap in tooth number and cerci length, and association with rocky habitats in *G. longicercus*. In elevation-transects on Mt. Lemmon and Kitt Peak, both taxa can occur together in areas of rocky road cuts. Separated from *G. transpecos*, where the two taxa could overlap in western Texas, although no such locality known, by, in *G. transpecos*, cerci in situ almost always longer than ovipositor tip, female tegminal bars usually absent, associated with rocks, small but consistent ITS2 DNA differences, and never climb into vegetation to hide or sing. Separated from *G. saxatilis,* which is microsympatric with *G. lightfooti* in desert washes in the eastern California Mojave Desert at Mt Pass (S91-71) and Halloran (S91-70), by, in *G. lightfooti,* presence of tegminal bar in females, fewer teeth and teeth/mm (but still with overlap), climbing into vegetation, and DNA. Distinguished from *G. veletis* by the latter's shorter cerci and association with more vegetated habitat. Additionally, nymphs and adults of *G. veletis* are never tan-mottled in color, while those of *G. lightfooti* are. Distinguished from *G. sotol*, which is only known from the Organ Mts. of south-central New Mexico, by *G. sotol*'s shorter cerci, non-grassland habitat, and association with sotol. Distinguished from *G. planeta* of the Davis Mts., in western Texas, by the latter's shorter cerci and sky island forested habitat.

FIGURE 210. Holotype male of *G. lightfooti.* Female from Pima Co., AZ (S15-108). Note the presence of tegminal bars (arrow), especially on female.

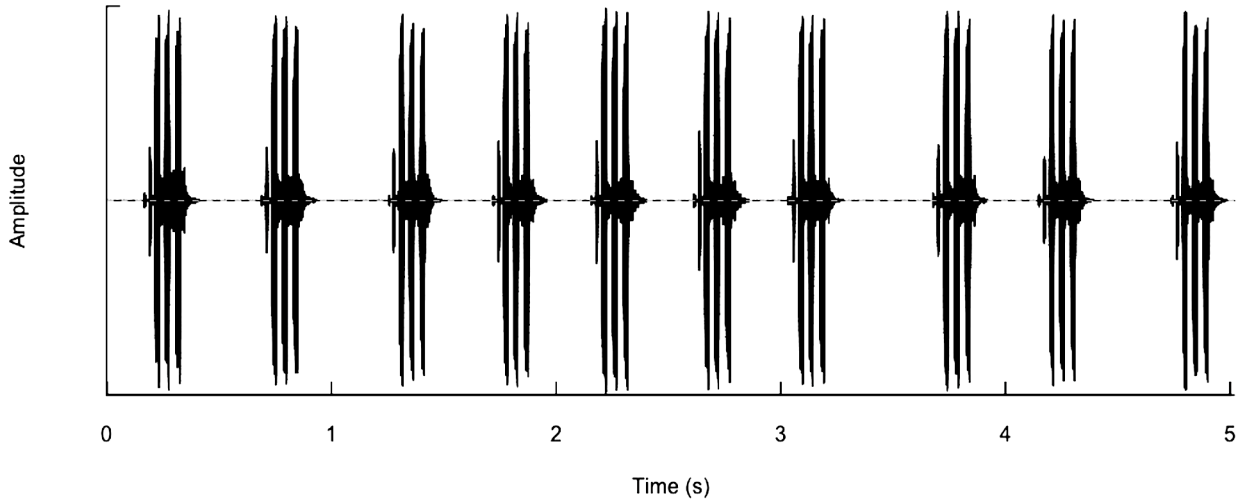

FIGURE 211. Calling song (R09-69) of *G. lightfooti* from Cochise Co., AZ (S09-55), recorded at 24°C.

Holotype. Male (Fig. 210): New Mexico, Dona Ana Co., USDA Jornada Experimental Range, ~5 m E Las Cruces off Highway 70. 3-vii-2015, 4300', 32° 28' 33.33" -106° 44' 10.86", DBW and DW Weissman. S15-75, R15-139, G3061. 16S GenBank accession # MK446528 BL 17.98, HF 10.0, LC 10.89. Right tegmen removed: 123 teeth, file length 2.8, TL 9.5, TW 4.0. Deposited CAS Entomology #19264.

Paratypes. (Total 259♂ 227♀) **Arizona**: *Cochise Co*., Apache Pass, 5106', 32° 09' 07.8" -109° 28' 52.6", 2-vi-2013 (S13-20) 2♂ 2♀. Bisbee, 5500', 31° 26' 46.9" -109° 55' 37.9", 1-vi-2013 (S13-18) 4♂ 1♀. Fort Bowie parking lot 2 m NE Apache Pass, 4723', 32° 09' 23.8" -109° 27' 09.9", 2-vi-2013 (S13-19) 13♂ 9♀. Southwestern Research Station, 5423', 31° 53' 04.19" -109° 12' 25.75, 20-viii-2012 (S12-103) 1♂. Willcox Playa, 4155', 32° 11' 55.5" -109° 52' 42.4", 29-vii-2015 (S15-104) 1♂ 1♀; 4140' 32° 11' 57.2" -109° 52' 32.4", 28-vi-2009 (S09-55) 4♂ 3♀. *Coconino Co*., Hwy 89A 1 m S Sedona, 4420', 30-vi-1994 (S94-36) 1♂ 1♀. *Gila Co.,* Globe, 3660', 10-vi-2012 (S12-21) 1♂. Miami, 3500', 16-vi-1990 (S90-50) 1♂. *Graham Co*., Safford, 2920', 16-vi-1990 (S90-51) 2♂. Pinaleno Mts, Mt. Graham, Hwy 366 at mile post 116.2, 3700', 4-vii-1994 (S94-55) 9♂ 6♀; Hwy 366 at mile post 120.6, 5000', 32° 40' 10.2" -109° 47' 20.0", 10-vi-2012 (S12-19) 4♂; Hwy 366 at mile post 116.9, 3782', 32° 41' 40.1" -109° 44' 59.0", 28-vii-2015 (S15-100), 7♂ 9♀. Hwy 191 S Safford, around Roper Lake State Park, 4-vii-1994 (S94-56) 1♂. *La Paz Co.,* Alamo Lake, 1400', 34° 14' 05.6" -113° 33" 16.1", 14-ix-2011 (S11-86) 1♂ 1♀. Hwy 60 9.9 m SW Wenden, 1752', 33° 44' 15.9" -113° 40' 35.4, 14-ix-2011 (S11-88) 1♂ 1♀. *Maricopa Co.,* Painted Rock Petroglyph Site, 16-ix-2006, 2♂. *Mohave Co.,* Kingman, 13-vi-2012 (S12-33) 1♀. Hualapai Mt. Road SE Kingman, 5135' 35° 07.859' -113° 55.142', 16-vi-2007 (S07-66) 1♂; 4918', 35° 08' 33.6" -113° 55' 36.2", 13-vi-2012 (S12-32) 2♂ 2♀. *Pima Co.,* Ajo, 1760', 20-viii-1998 (S98-74) 2♂ 1♀; 29-vii-2015 (S15-109) 1♂. Hwy 85 8 m S Ajo, 20-viii-1998 (S98-70) 1♂ 1♀. Baboquivari Mts., Brown Canyon, 3960-4080', 6-vii-1994 (S94-58) 13♂ 6♀; 3786', 31° 45' 37.0" -111° 31' 58.8", 29-vii-2015 (S15-105) 5♂ 13♀. Hwy 85 13m N Ajo, 1255', 32° 32' 44.1" -112° 52' 48.4, 30-vii-2015 (S15-110) 5♂ 4♀. Hwy 86 W Sells, 2276', 31° 57' 25.4 -111° 56' 46.4", 29-vii-2015 (S15-108) 2♂ 11♀. Madera Canyon, 4200', 26-vii-1990 (S90-80) 5♂ 7♀. Mt. Lemmon Recreation Area, Mile 7.5, 4600', 27-vii-1990 (S90-82) 8♂ 7♀; Mile 9, 5240', 32° 21' 21.4" -110° 43' 34.7", 27-vi-2009 (S09-51) 1♂. Tucson, 2375', 18-vi-1990 (S90-53) 4♂ 2♀; 2600', 27-vii-1990 (S90-84) 2♂; 2780', 32° 16' 44" -110° 46' 18.4", 27-vi-2009 (S09-52) 1♂. Tucson, 3.9 m N I10, 3040', 32° 07' 0.4" -110° 46' 16.8", 27-vi-2009 (S09-53) 1♀. *Pinal Co*., Oracle, 4260', 18-viii-1998 (S98-64) 1♂. *Yavapai Co.,* Agua Fria National Monument, 3200', 34° 14' 50.2" -112° 03' 28.5", 31-v-2013 (S13-13) 20♂ 12♀; 3529', 34° 15' 57.5" -112° 05' 28.9", 21-viii-2012 (S12-106A) 1♂ 3♀. Cottonwood, 3320', 30-vi-1994 (S94-37) 1♂ 2♀. Sedona, Sky Ranch Lodge Motel by airport, 5120', 34° 51.146' -111° 47.415', 15-vi-2007 (S07-61) 1♂. Hwy 179 eastern outskirts Sedona, 4000', 31-v-2013 (S13-16) 4♂. Camp Verde, 3146', 12-vi-2012 (S12-29) 5♂ 2♀. 7 m N Prescott, 5060', 30-vi-1994 (S94-39) 1♂. *Yuma Co*., Kofa National Wildlife Refuge, Hwy 95 at mile post 76.8, 10-viii-1988 (S88-88) 1♂; near 33° 14' 59.93 -114° 12' 54.40", 1710', 10-viii-1988 (S88-87) 5♂ 6♀. Telegraph Pass, mile post 18.6, 676', 32° 39' 30.7" -114° 20' 14.2", 15-ix-2011 (S11-92) 1♂. **California:** *Imperial Co.,* Algodones Dunes, 240', 33° 01' 13.4" -115° 07' 25.3", 15-ix-

2011 (S11-91) 2♀. *San Bernardino Co.,* Kelso Dunes, 2500', 13-iii-1985 (S85-28) 2♂, molt to adult late June. Mt. Pass, 4600', 4-viii-1991 (S91-71) 1♂. I15 at Cima Road exit, 3673', 35° 26' 30.54" -115° 40' 24.70", 22-vii-2016 (S16-24) 6♂ 3♀. 13.6 m N I40 on road to Providence Mts. State Rec. Area, 3437', 34° 56' 29.99" -115° 28' 53.30, 23-vii-2016 (S16-31) 4♂ 1F3. First wash n I15 on road to Halloran Springs Microwave Station, 2900' 4-viii-1991 (S91-70) 1♂ 2♀. Essex, washes around town, 2000', 22-vii-1990 (S90-69) 6♂ 1♀. Essex Road, 17.6 m NW Essex, 2900', 5-vi-1989 (S89-29) 4♂ 2♀. **New Mexico:** *Bernalillo Co.,* Albuquerque, Tingley Beach, 4950', 35° 25' 16.35 -106° 44' 33.49", 29-vi-2015 (S15-49) 2♂ 3♀. *Chaves Co.,* Hwy 82 ~33m W Artesia, 4824', 32° 51' 55.02 -104° 58' 51.76", 30-vi-2015 (S15-56) 4♂ 8♀. Hwy 380 7.3 m E Roswell, 3960', 33° 23' 46.4" -104° 22' 32.4", 28-vi-2009 (S09-59) 9♂ 4♀. *Dona Ana Co.,* Las Cruces, 16-vi-1986 (S86-40) 2♂; 27-vi-1988 (S88-58) 1♂. USDA Jornada Experimental Range, ~5 m E Las Cruces off Highway 70, 4300', 32° 28' 33.33" -106° 44' 10.86", 5-vii-1987 (S87-82), DC Lightfoot, 2♂ 6♀; 10-viii-1990 (S90-90) 1♂ 4♀; 3-vii-2015 (S15-75) 6♂ (including holotype) 6♀. *Eddy Co.,* Hope, 4095', 32° 48' 37.73 -104° 44' 15.00, 30-vi-2015 (S15-57) 3♂ 2♀. *Lincoln Co.,* Valle del Sol Municipal Golf Course, 5519', 33° 38' 18.97 -105° 51' 37.79", 30-vi-2015 (S15-55) 1♂ 4♀. *Otero Co.,* Hwy 54 ~16 m N Texas border, 4105', 32° 12' 20.27" -106° 11' 37.48", 3-vii-2015 (S15-74) 10♂ 8♀. *Socorro Co.,* Acamilla rest stop on E side I25 1 m S La Joya, 4850', 15-viii-1993 (S93-68) 2♀. Goat Draw, Los Pinos Mts, 6440', 34° 22' 10" -106° 32' 0", 16-viii-1993 (S93-69) 14♂ 6♀. Sevilleta National Wildlife Refuge, Site 222, 5145', 34° 24' 30" -106° 56' 43", 15-viii-1993 (S93-66) 4♂ 9♀. Sevilleta National Wildlife Refuge, Rio Salado sand dunes, 4500', 34° 18.515' -106° 59.316', 15-viii-1993 (S93-67) 3♂ 1♀. Socorro, 4420', 13-vi-2007 (S07-50) 4♀; 29-vi-2015 (S15-54) 5♂ 6♀. Hwy 60 12 m W intersection Hwy 60 and 47, 4958', 34° 25' 16.35" -106° 44' 33.49", 29-vi-2015 (S15-50) 7♂ 5♀. Hwy 60 at milepost 185.8, 6004', 34° 24' 12.07" -106° 30' 29.16", 29-vi-2015 (S15-53) 4♂ 13♀. Hwy 380 6.8 m W Carrizozo, 5160', 33° 43.276' -105° 57.471', 13-vi-2007 (S07-47) 1♂ 1♀. Hwy 380 37.5 m W Carrizozo, 5200', 33° 53.139' -106° 24.785' (S07-48) 1♂ 2♀. **Texas:** *Culberson Co.,* Guadalupe Mts., 4.4 km NE Pine Springs, 5240' 31° 54.400' -104° 46.920', 13-vii-2001 (S01-63) 5♂ 5♀; 3.2 km SW Pine Springs, 5360', 13-vii-2001 (S01-64) 2♂. Van Horn, 4100', 6-vi-1991 (S91-48) 4♂ 2♀.

Sound records only. **Arizona:** *Maricopa Co*., Aguila, 2100', 23-vii-1990 (S90-71). **Texas:** *Hudspeth Co.,* Cornudas, 4420', 13-vii-2001 (S01-65).

Derivation of name. Named in appreciation of David C. Lightfoot, who first recognized this taxon during field work at the type locality, and who has helped the senior author with companionship, counsel, and comradery for over 40 years. Plus, for all of those times at 4 AM, when asked to help collect just 2 more crickets (and for which he naively continued to believe that I was serious about only collecting just 2 more!).

Geographic range. (Fig. 212). Ranges from the deserts of southeastern CA through central and southern Arizona and New Mexico, into western Texas.

Habitat. From 73m (Algodones Dunes, S11-91) to 1963m (Goat Draw, S93-69), but usually below 1680m and away from dense tree canopy. Vegetation at the Chihuahuan Desert grassland/scrubland type locality includes soaptree yucca (*Yucca elata*), honey mesquite (*Prosopis glandulosa*), tarbush (*Flourensia cernua*), and burrow grass (*Scleropogon brevifolia*). Elsewhere associated with Arizona interior chaparral, dry, rocky streambed bottoms, and at base of vegetation in California sand dune habitats such as Kelso Dunes (S85-28) and Algodones Dunes (S11-91). When driving lower from the sky island, oak covered localities in Madera Canyon (S90-80) and Hualapai Mt Park (near S07-66 and S12-32), where *G. montis* exists, at both sites, in good numbers, one enters more open interior chaparral/grassland habitat. Once around 1676m, faster chirping (when compared with *G. montis) G. lightfooti* are first heard and females, with their distinctive tegminal bar, can be seen wandering on the road. Males frequently daytime sing from pack rat nests, where they occur with females and nymphs, and can be difficult to collect because of cholla jumping cactus sections sequestered by the pack rats.

At Willcox Playa (S15-104), we collected *G. lightfooti* and 2 adult *G. staccato* males singing during afternoon hours from the same dead skirt of a *Yucca elata.* The only other similarly arboreal western *Gryllus* taxon is *G. sotol* at Aguirre Springs, NM (S15-77), where singing *G. sotol* were collected along with one non-singing *G. longicercus* male, in sotol (*Dasylirion wheeleri*), during late afternoon.

Life cycle & seasonal occurrence. One generation/year. No egg diapause: Las Cruces (S86-40 & S88-58); Jornada type locality (S87-82); Mt. Graham (S15-100); and Cima, CA (S16-24). D.C. Lightfoot reports (pers. comm. to DBW, October, 2015) the following for the type locality: "They have one generation a year; that year's eggs hatch late summer (August) with the monsoon rains, slowly grow as nymphs through the winter, probably mostly inactive with cold temps, but active with warm temps, and mature in the late spring (May) and are present as adults

through most of the summer. Their life cycle is very similar to *G. veletis*, except they mature about a month later (May/June vs. April/May) and persist as adults through the summer for a month longer (May/June vs. August/Sept." This information agrees with our oatmeal trail, collecting efforts for *G. lightfooti*: 95% of hundreds of individuals seen 31-v-2013 at Agua Fria National Monument, AZ (S13-13); all 10 individuals collected 2-vi-2013 at Apache Pass, AZ (S13-20); 21 of 22 collected 2-vi-2013 from Ft. Bowie, AZ (S13-19); and 5 of 6 collected 5-vi-1989 from Essex, CA (S89-29), were penultimate or late instars when collected.

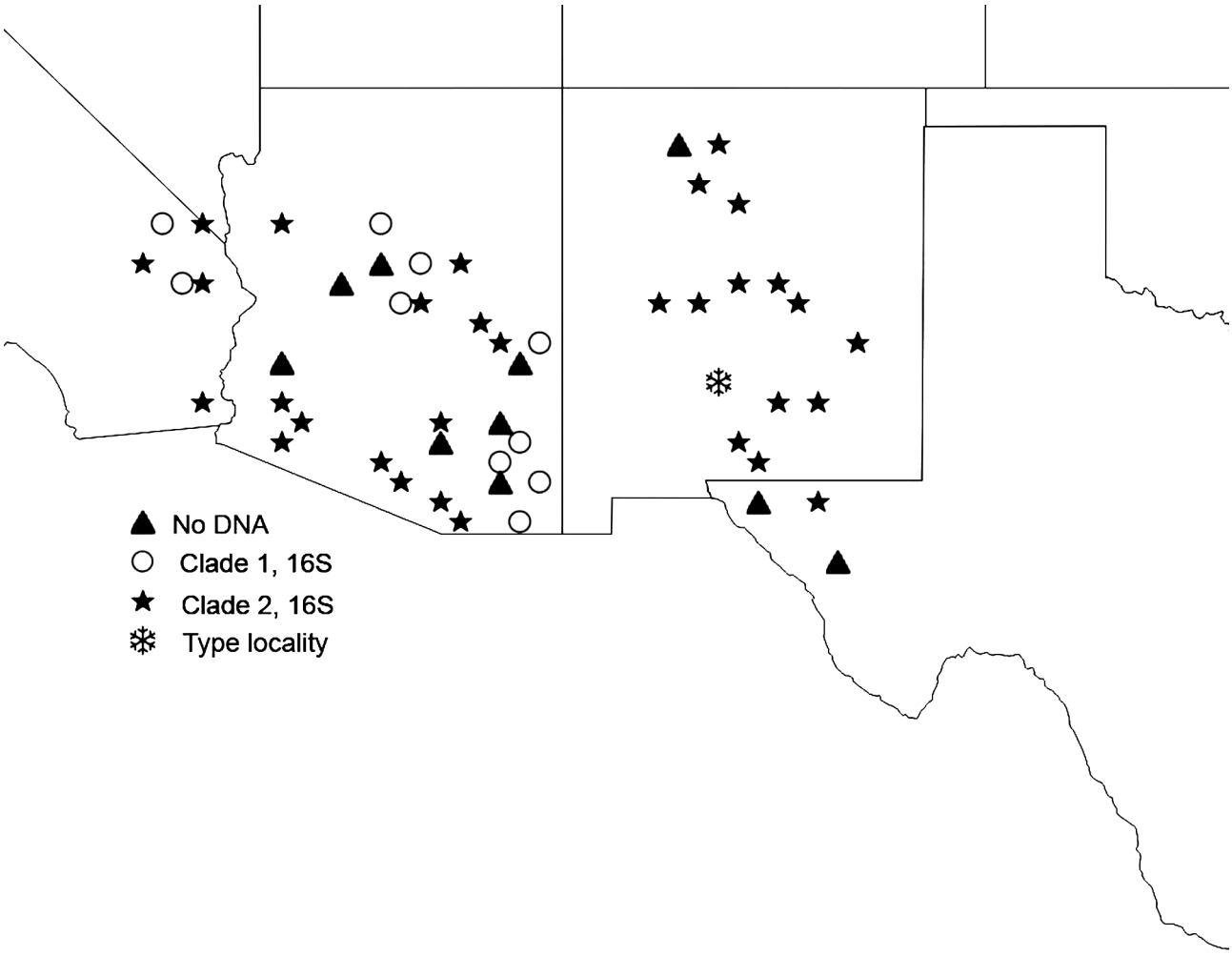

FIGURE 212. Known US distribution of *G. lightfooti* showing distribution of two16S DNA Clades. See discussion of DNA in Barcoding section (p. 16) of this paper.

In the laboratory, all eggs from one female hatch synchronously, when the substrate is kept moist, although nymphs from the same female grow slowly and at different rates from each other, even at temperatures > 25°C. There is no obvious nymphal diapause. On the other hand, when the egg laying substrate is initially not kept moist, and then subsequently moistened, we suspect that eggs may hatch over an extended period of time. In a regime where constant damp sand is provided and nighttime temperatures are kept above 18°C year around, D.C. Lightfoot gets continuous generations and year-round egg laying.

Variation. **Body length:** Adults living within *Y. elata* plants generally smaller than those living elsewhere. **Cerci length vs. ovipositor length:** In females with at least one intact cercus, some 32% have that cercus longer than the tip of the ovipositor in situ. **Color**: Adult specimens generally with dark bodies and lightly tinged, reddish insides of hind femur. Tegminal color varies from black to light brown, with female tegminal bars most noticeable in the former. Occasional males also with tegminal bars. **Hind wing length**: Out of some 485 field-collected individuals, only 6 with long hind wings, as follows: CA: Essex (S90-69, 1♂), Cima (S16-24, 1♂); AZ: Ajo (S98-74, 1♂ 1♀),

Kofa (S88-87, 2♀). Laboratory-hatched nymphs raised to adult can yield 50-100% long hind winged individuals of both sexes (D.C. Lightfoot, pers. comm., December, 2015).

DNA. multilocus 2016-038, Jornada type locality. Closest relatives are *G. sotol* and *G. transpecos* (Gray *et al.* 2019).

Discussion. This is one of our most difficult field crickets to identify when away from *Yucca elata. G. lightfooti* is most easily separated from similar sounding and appearing *Gryllus* species by habitat—there is little else common in open, desert Southwest grassland/scrublands. Difficulty arises where it occurs in mixed habitats with grasses, sparse tree cover and rocks. For instance, on Hualapai Mt. Road, Arizona (S90-56), 1524m, 8.4 km NW of Hualapai Park, we collected *G. lightfooti* microsympatric along with *G. montis* and *G. longicercus,* although we could distinguish their songs in the field, mostly by a combination of differing pulse and chirp rates. At Goat Draw, New Mexico, (S93-69), we found *G. lightfooti* microsympatric with *G. longicercus* in a rocky canyon area of pinyon pine—juniper, *Opuntia* cactus and some grasslands.

In such Southwest US mixed-habitats, one has to also consider the widespread slow chirpers *G. veletis* and *G. transpecos.* Using a combination of distribution maps, song analysis, especially PR and CR, file tooth number, arboreal or not, and presence or absence of a female (and sometimes male) tegminal bar should enable identification of most specimens. But probably not all specimens with certainty. DNA analysis may be required in some cases.

This is our most arboreal western field cricket, with the possible exception of the geographically restricted *G. sotol.* Where *G. lightfooti* occurs with *Yucca elata*, the two seem to be intimately associated with male crickets frequently heard chirping, from within plants*,* during the hottest part of the day when air temperatures exceed 35°C. They prefer the lower dead-portion skirts of living plants as well as those dead plants on the ground. When dead *Yucca* plants not present to search, we have (rarely) broken off a living *Yucca* stalk at ground level*,* moved the plant into a dirt clearing or onto a nearby road, and by pounding it on the surface, dislodged the crickets, which can then be gathered. We have collected over 15 individuals from one small plant using this technique although they are quick to hop and try to reenter the same *Yucca*. They obviously see well, even at night with just the light from our headlamps. After sunset, they apparently climb down from *Y. elata* and walk around, mostly silently on the ground, as seen on Mt. Graham (S15-100), and observed by D.C. Lightfoot in his laboratory cultures (pers. comm. to DBW, 6/2017).

We wonder if this arboreal behavior provides some or all of the following benefits: relief from hot daytime temperatures when compared with ground dwelling field crickets; protection from nocturnally-active, parasitic tachinid flies; and access to a possible food (and water?) source of the plant itself, including preying on other small arthropods living within the skirt. We suspect that females oviposit into the substrate as in other field crickets. Interestingly, *G. lightfooti* is found in areas of western and northwestern Arizona, southeastern California, and western New Mexico where *Yucca elata* doesn't occur. Conversely, perfectly suitable-looking habitat in western Texas has *Y. elata* but no Arboreal Desert Field Crickets.

Where *G. lightfooti* occurs away from *Y. elata,* males can still be found singing from elevated perches at night: Alamo Lake (S11-86), 1 male 1m up in *Larrea*. When we attempted to capture him, he retreated to base of *Larrea* into a pack rat nest. Town of Van Horn (S91-48), 1 male singing 4m up in a building. Hualapai Mt. Road (S07-67), 1 male 1.5m up in Palo Verde. Open Mohave Desert near Providence Mts. State Rec. area (S16-31), 1 male 0.5m up in shrub. In towns like Las Cruces and Albuquerque, NM, they are common in suburban neighborhoods, and live in bushes and will enter houses and sing from under roof tiles. Also heard in commercial areas of Socorro, NM (S15-54).

D.C. Lightfoot notes the following (pers. comm. to DBW, 6/2017) about his 5th generation, type locality laboratory culture: "They live and sing and mate almost exclusively above the sandy soil bottom of the terrarium, especially during the day. Females wander on the sand floor at night and lay eggs in damp sand. They are highly gregarious, and hang out together, females, males, and nymphs; singing males fight and chase each other a lot but still hang out together. Also, they exhibit a "jerking motion walking behavior" like many camouflaged insects do when they walk (like stick insects and mantises) and they blend in very well with the wood that they live on (tan and brown color). In these aspects, they are totally different from *G. veletis* which I have also kept in the same terrarium. *G. veletis* stay on the ground, are not gregarious, and do not 'jerk walk.'"

Lightfoot reports that juveniles, from the type locality, are distinctly pale tan with mottling. Early instars have black markings on the head, many late instars have dorsum of head black, and all nymphal stages look very similar to *Acheta domesticus* nymphs. They become dark brown/black as adults, but some still retain the black markings

on the head adjacent to the eyes. These color patterns are also seen in *G. lightfooti* from Southern CA (S16-31). We have not explicitly compared nymphal color patterns between different *Gryllus* species (but see discussion of striped nymphs under the Longicercus Group, p. 229), although such information might prove phylogenetically relevant.

We have documented parasitoid tachinids *Ormia ochracea* at the following Arizona localities: near Alamo Lake (S11-86), Mt. Graham (S15-100), Willcox Playa (S15-104), Brown Canyon (S15-105), and Painted Rock Petroglyph Site. We believe that the distorted adult sex ratios (e.g. Brown Canyon, S15-105; W of Sells, S15-108) seen later in the season, where adult females greatly outnumber adult males, may be related to the high incidence of tachinid-killed males (Sakaguchi & Gray 2011). Also, not singing at night, when gravid tachinid female flies are most active and acoustically searching for singing male *Gryllus*, should help protect adult males that can still find adult females due to high population densities. DC Lightfoot (pers. comm. to DBW, 6/2017) also reports laboratory males singing more in afternoon and early evening than later at night.

***Gryllus sotol* Weissman & Gray, n. sp.**
Organ Mountains Field Cricket
Figs 207–209, 213–215, Table 1

FIGURE 213. Holotype male of *G. sotol.* Female also from type locality (S17-4).

Distribution. Known only from the sky island Organ Mountains of south central New Mexico, above 1520m.

Recognition characters and song. A medium to large, always short hind winged, generally black (except for inside of hind femur) cricket, whose cerci are always shorter than tip of ovipositor in situ (Fig. 213). Intimately associated with sotol, *Dasylirion wheeleri*, from which it frequently sings during the daytime. *Song* (Fig. 214) a slow chirp, usually 3–5 p/c (range 3–6), with a chirp rate of 120–160 (range 82–170) and a PR of 16.5–22.7 at 25°C. Dominant frequency 3463–4746 Hz. Distinguished from other Southwestern slow chirping *Gryllus* as follows: from microsympatric *G. longicercus*, which it greatly outnumbers, by (generally) having non-overlapping and lower file teeth number (Table 1, p. 18), higher PR, and shorter cerci never longer than ovipositor tip in situ (almost always longer in *G. longicercus*). Separated from more eastern, allopatric sister species *G. transpecos* (although some