

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. sotal* 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. sotal*); 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.

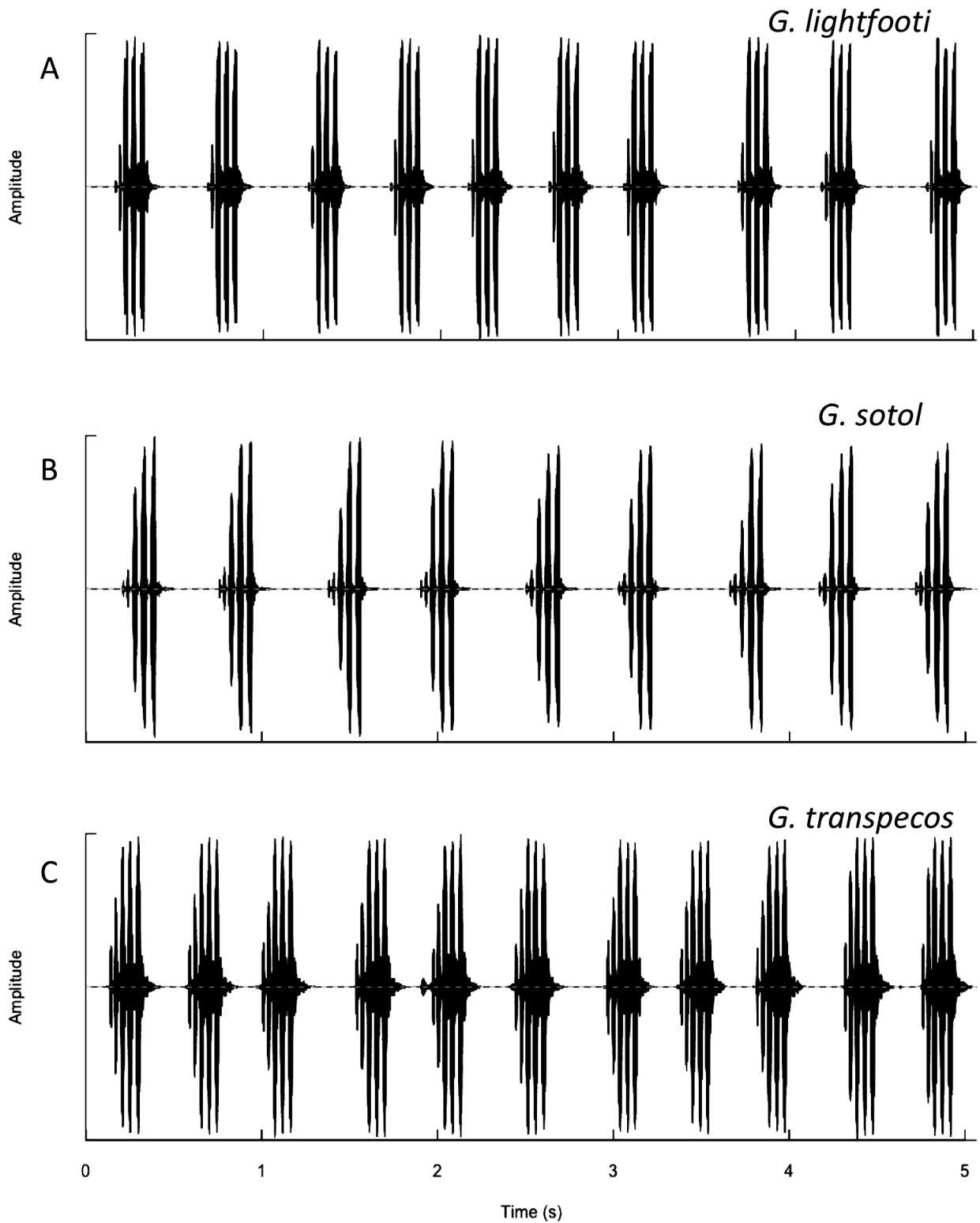
Arboreal Desert Field Cricket

Figs 205, 207–212, Table 1

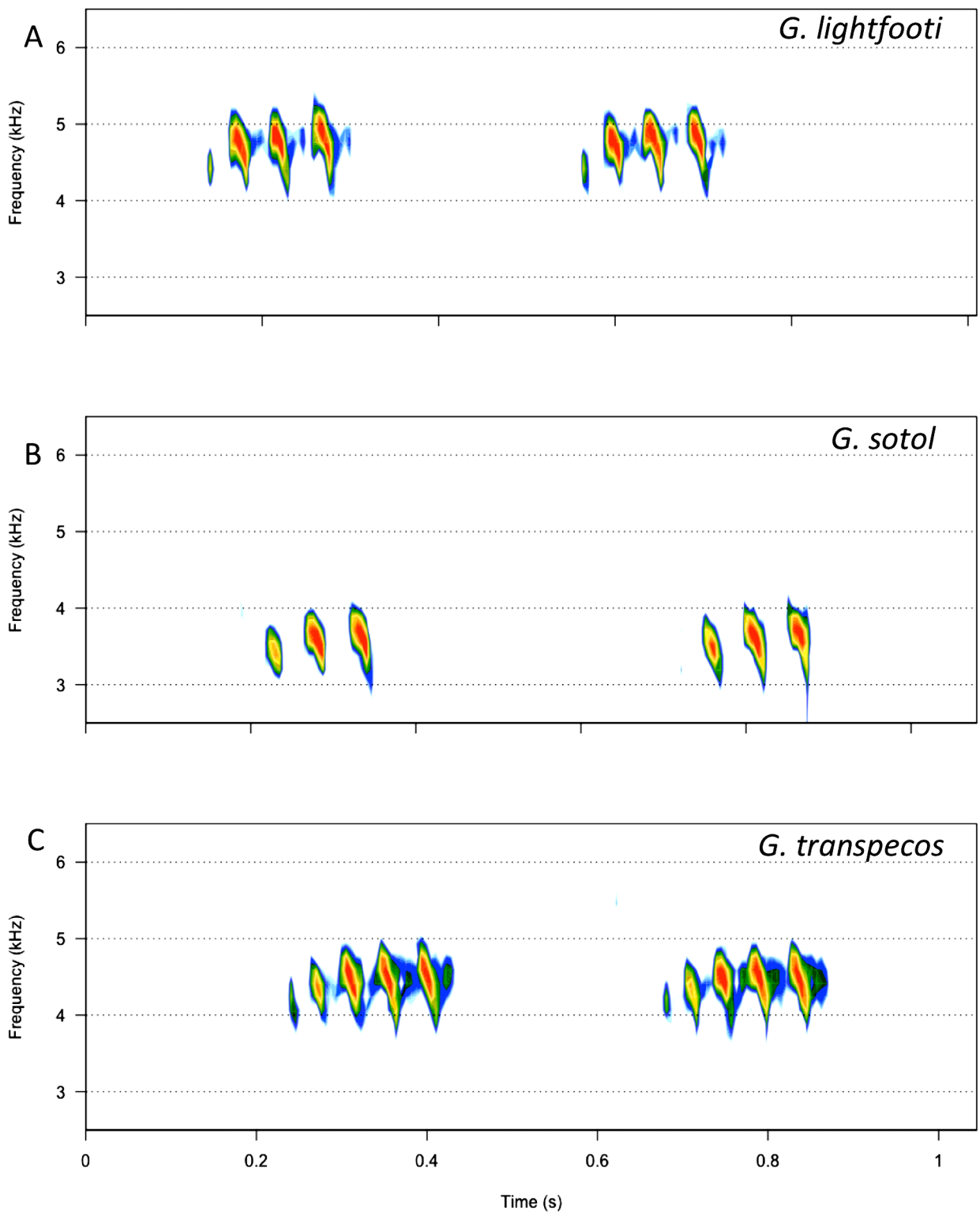
‘G. #23’, ‘yucca *Gryllus*’ in DBW notebooks.

*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

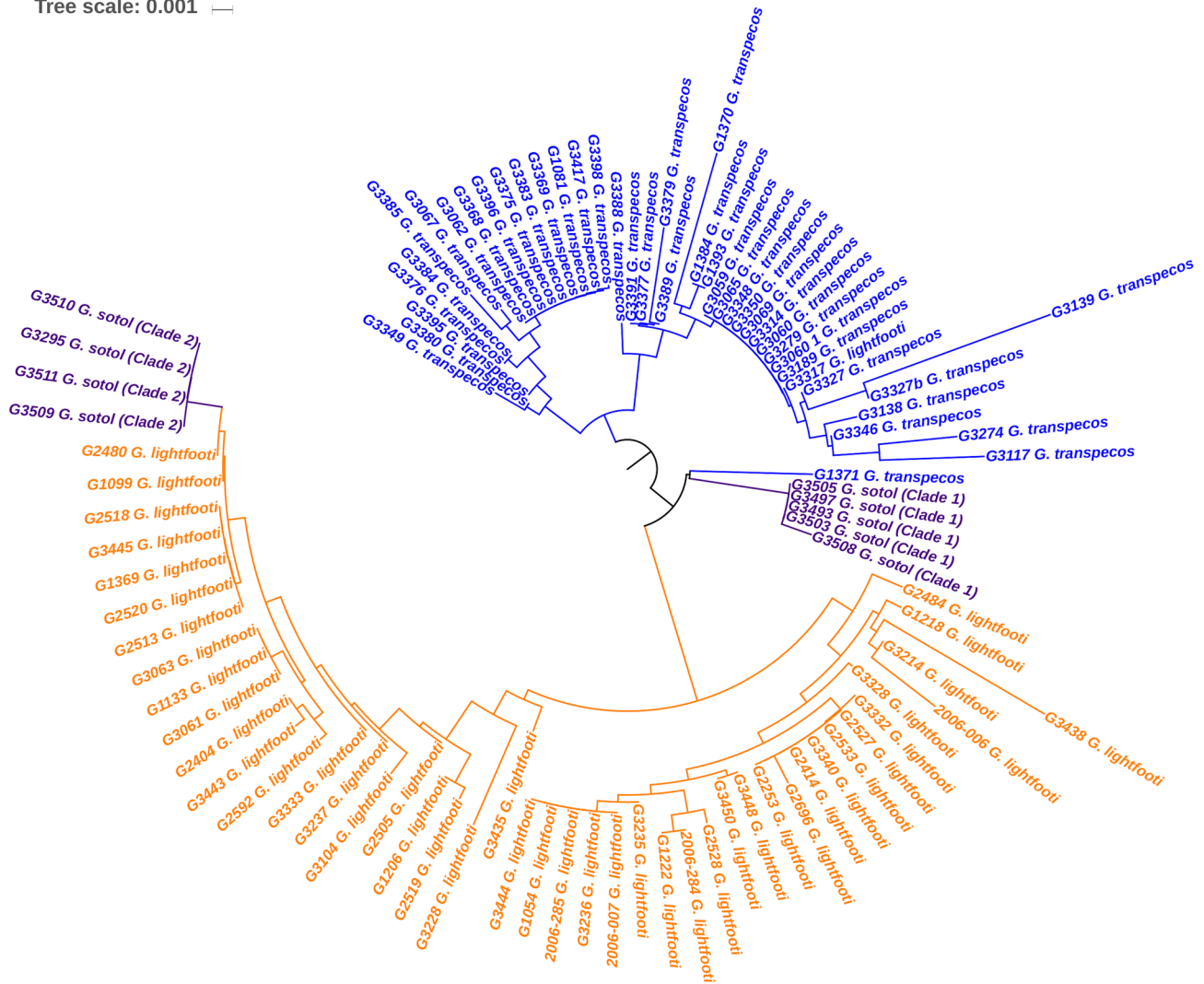


**FIGURE 207.** Five second waveforms of typical calling songs of (A) *G. lightfooti*, (B) *G. sotoi*, and (C) *G. transpecos*. (A) *G. lightfooti*: (R09-69) Cochise Co., AZ (S09-55), at 24°C; (B) *G. sotoi*: (R17-44) from type locality (S17-4), at 24.1°C; (C) *G. transpecos*: (R09-93) Culberson Co.,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

Tree scale: 0.001



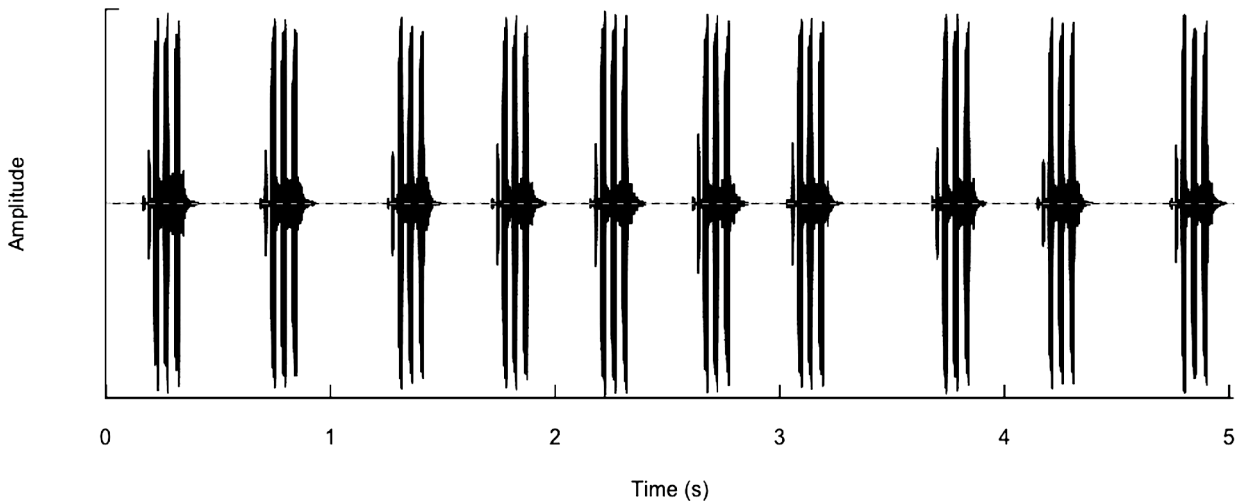
**FIGURE 209.** ITS2 gene tree. Collection stop numbers for *G. lightfooti* samples (orange): S07-61 (G1099, G1206); S07-66 (G1218); S07-67 (G1222); S07-68 (G1133); S09-55 (G1369); S12-19 (G2253); S12-102 (G2404); S12-103 (G2414); S13-13 (G2518, G2528); S13-16 (G2480, G2513, G2519, G2520); S13-18 (G2484, 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. sotal* 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. sotal*.

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 “tegmina 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!).

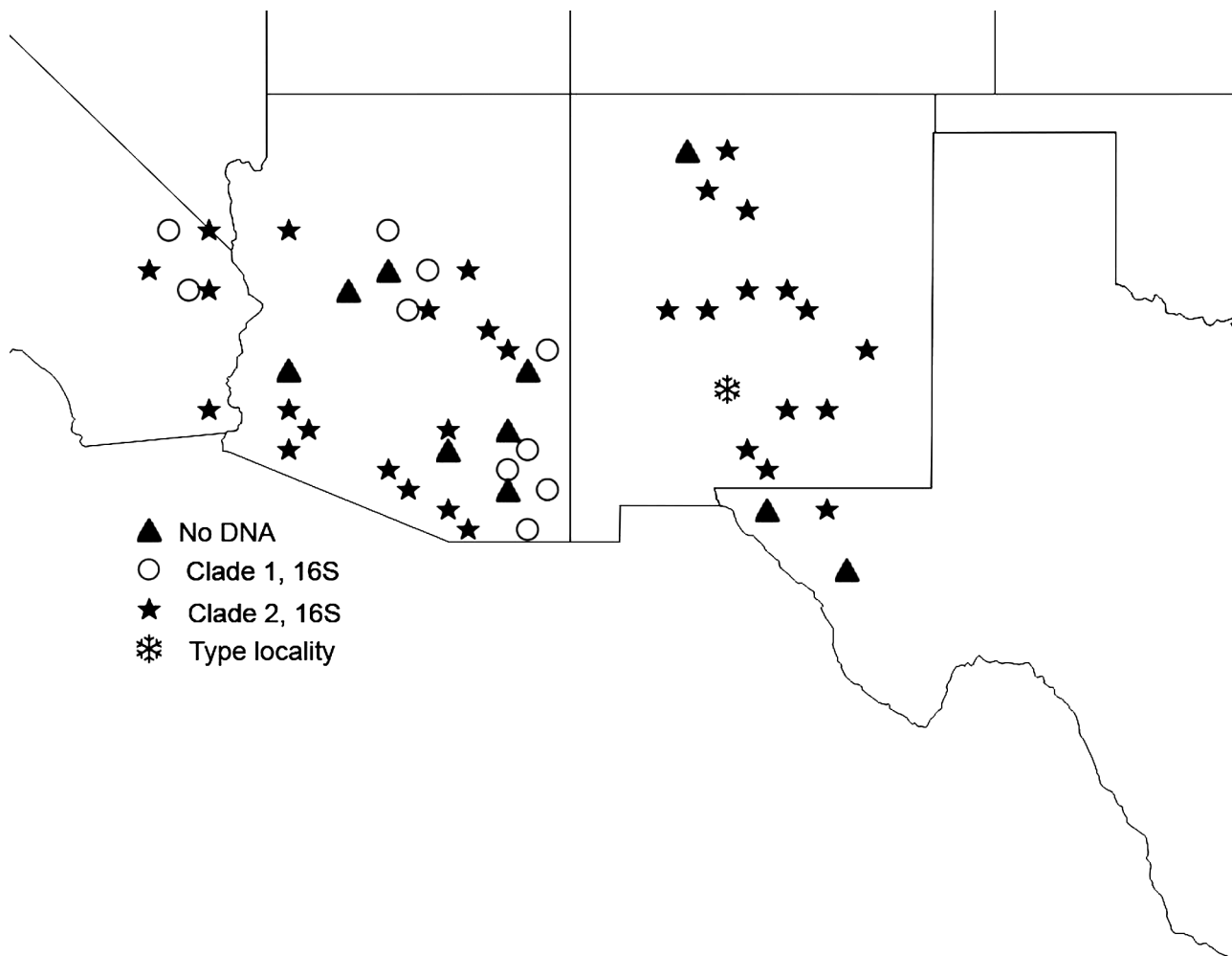
*Geographic range.* (Fig. 212). Ranges from the deserts of southeastern CA through central and southern Arizona and New Mexico, into western Texas.

*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. sotal* at Aguirre Springs, NM (S15-77), where singing *G. sotal* were collected along with one non-singing *G. longicercus* male, in sotal (*Dasyllirion 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 two 16S 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 5<sup>th</sup> 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

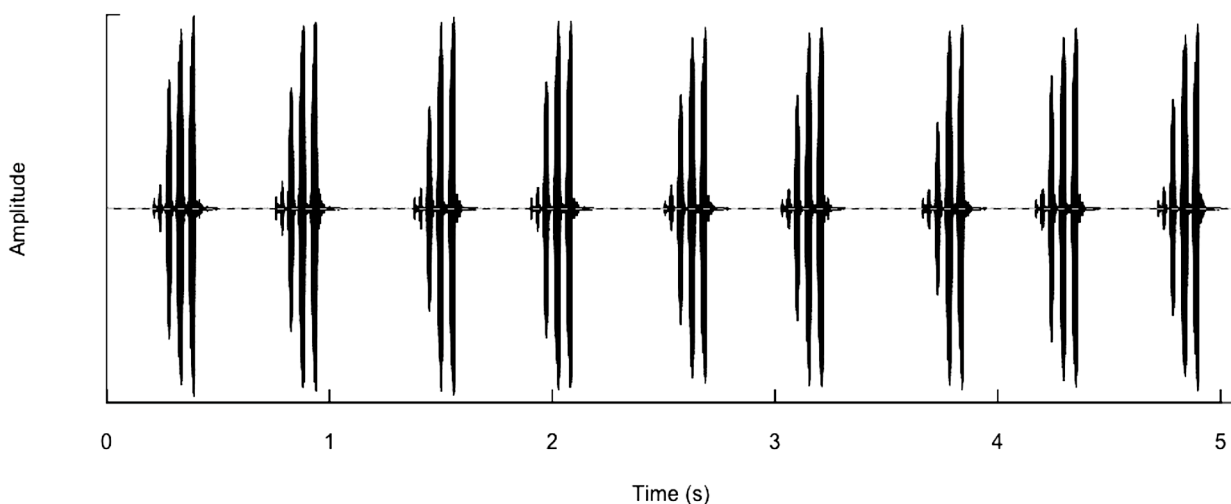


**FIGURE 213.** Holotype male of *G. sotol*. Female also from type locality (S17-4).

*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*, *Dasyllirion 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

individuals [those in Clade 1—see below] with similar ITS2 DNA [see Fig. 209]), *G. sotol* has more teeth, higher tooth density, shorter cerci never as long as ovipositor tip (almost always longer in *G. transpecos*), slower PR, and habitat: open, lower elevation, drier, rocky Chihuahuan Desert for *G. transpecos* versus higher, cooler, low mountain bajadas and woodlands, with sotol, for *G. sotol*. Additionally, *G. sotol* frequently climbs into sotol while *G. transpecos* is only found on the ground, although sometimes on rocky cliff faces in road cut areas. Separated from lower elevation, also arboreal, later maturing (despite lower elevations and warmer habitat), more open Chihuahuan and Sonoran Desert grassland sister species *G. lightfooti*, although some individuals (those in Clade 2—see below) with similar ITS2 DNA (see Fig. 209), *G. lightfooti*, often associated with *Yucca elata*, have longer cerci usually as long as ovipositor tip in situ, and females usually with light tegminal bar (of 21 *G. sotol* females collected in 2017, only 2 have slight indications of tegminal bars despite their bodies being solid black, which would accentuate any overlying tegmina bar). Additionally, late instar *G. sotol* abdomens frequently with circular, dorsal stripes while those of *G. lightfooti* are usually tan and blotched. Separated from sky island *G. planeta* from the Davis Mts., in western Texas, by the latter's shorter cerci and oak-forested habitat and distinct multilocus DNA (Gray *et al.* 2019). Separated from allopatric, earlier maturing (despite higher, cooler elevation), more western *G. montis* by multilocus DNA (Gray *et al.* 2019), more teeth/mm in *G. sotol*, and habitat, with *G. montis* occurring under mountain-top trees and *G. sotol* occurring in more open Chihuahuan Desert. Separated from more western *G. saxatilis* by the latter's longer cerci, habitat (likes rocks and almost never up in plants) and DNA. Separated from more western *G. vulcanus* by lower, non-overlapping PR in the latter and differences in habitat (sotol obligate vs. lava bed obligate) and multilocus DNA (Gray *et al.* 2019). Separated from *G. leei* by habitat (sotol obligate vs. lava bed obligate) and multilocus DNA.



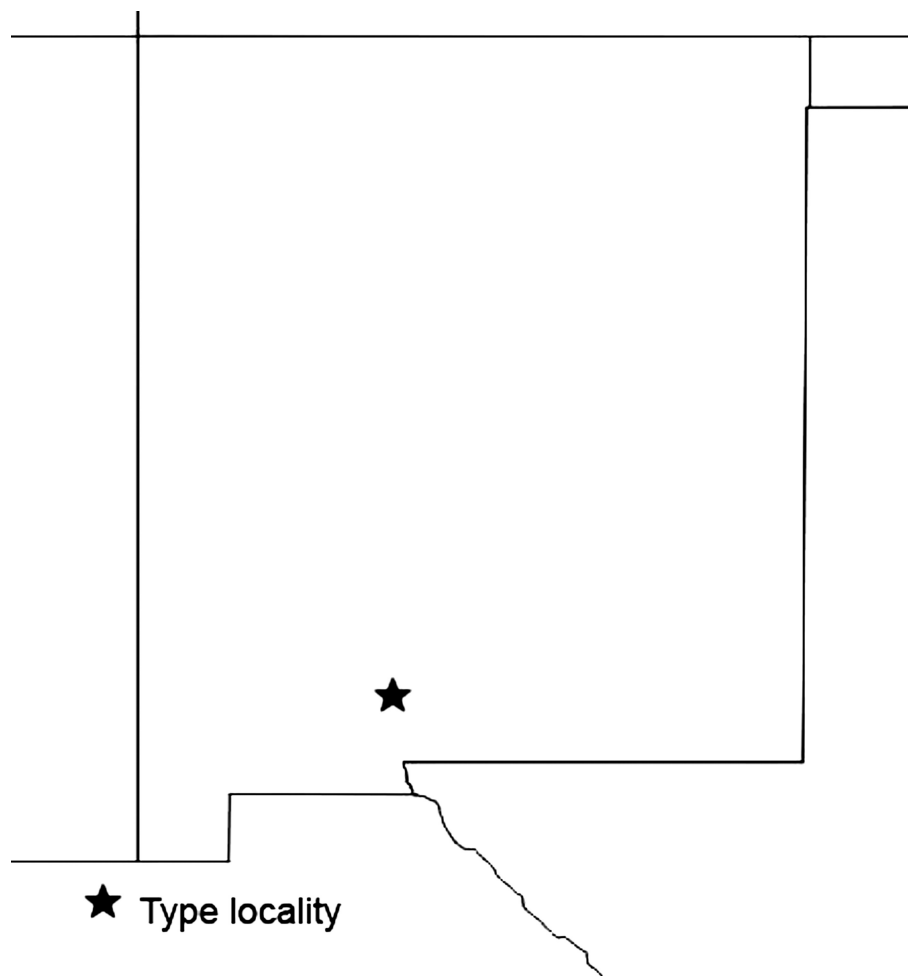
**FIGURE 214.** Calling song (R17-44) of *G. sotol* from type locality (S17-4), recorded at 24.1°C.

*Holotype.* Male (Fig. 213): USA, New Mexico, Dona Ana Co., Organ Mountains-Desert Peaks National Monument, Aguirre Springs Campground, 3-vii-2017, 5807', 32° 22' 12.72" -106° 33' 41.18". D.B. Weissman, D.W. Weissman. S17-4, R17-26, DNA (ITS2 and multilocus) sample G3493. GenBank accession # ITS2: MN136862. BL 20.66, HF 11.89, right cercus 12.63. Right tegmen removed: 152 teeth, file length 3.3, TL 10.9, TW 4.3. Type deposited in CAS, Entomology Type #19279.

*Paratypes.* (total 33♂ 36♀) Type locality, 24-vi-1985 (S85-93), D.C. Lightfoot, 2♂ 3♀; early June, 1994 (S94-29), D.C. Lightfoot, 9♂ 6♀; 3-vii-2015 (S15-77), 4♂ 4♀; 19-v-2017 (S17-4) 17♂ (including holotype) 23♀, most raised from late instars.

*Derivation of name.* Named for its association with sotol, *Dasyilirion wheeleri*, in the Organ Mts. Sotol is a distilled spirit made by a process similar to that for mescal.

*Geographical range.* Currently known only from the Organ Mts. (Fig. 215), however the Transmountain Road through the Franklin Mountains to the south of the Organ Mountains, should be checked for *G. sotol* in the appropriate habitat. Highest peak there is almost 2194m.



**FIGURE 215.** Known distribution of *G. sotol*; known only from the type locality in NM despite extensive sampling of nearby regions.

*Habitat.* Type locality with short oaks and other trees, various shrubs, sotol, and some cactus. The site is at the transition of two Level IV, Chihuahuan Desert ecoregion zones: 24c (Low Mountains and Bajadas) and 24d (Chihuahuan Montane Woodlands). See <https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-state>.

*Life cycle and seasonal occurrence.* No egg diapause (S17-4). Apparently one generation/year in the field, based on our observations of them overwintering as mid-late instars with first adults appearing mid-May. Few adult males heard singing during spring stops in 1994 (early June) and 2017 (May 19th) but oatmeal laid on dirt trails in campground area, during both visits, resulted in many late instars being collected. No singing males were heard during mid to late-summer nighttime visits on 17-viii-1993 (S93-70) and DC Lightfoot visit on 16-ix-2018, consistent with one generation/year. And, most importantly, no nymphs and only 1 adult female came to 7 kg of oatmeal on 16-ix-2018.

Interpretation of this apparently straightforward field situation is complicated by laboratory data: Nymphs collected May 19-2017, were raised to adult under ambient light conditions, at fluctuating temperatures between 18-30°C, and allowed to mate. Adult females were then isolated in cartons with moist sand, for oviposition, starting on June 13 and June 24. Very good egg hatch commenced on July 8 and July 13, respectively, indicating the absence of an obligate egg diapause. Many, but not all, nymphs in both cultures grew rapidly with the first adults appearing around September 12th in both containers, confirming the possibility of 2 generations/year. Males were heard singing starting on September 16. Still, a fair number of nymphs were only mid-instar in mid-September. So, while this species could have 2 field generations/year, on-site observations are necessary to confirm if those results from 1993 and 2018 are representative of most seasons.

We believe the following could explain this puzzling situation: *Gryllus* eggs need to absorb liquid water, from the substrate, to grow (Hinton 1981). Oviposition into constantly moist sand satisfies this requirement and can re-

sult in the rapid hatching of such eggs and the appearance of second generation adults in late summer. But for eggs laid in the field, where Southwestern US monsoon rains typically first arrive in July and August, there may not be adequate time for second generation adults to appear before the arrival of cool fall temperatures, if egg development only first starts with the arrival of moisture. We suspect that if the first rains arrive in July, there will be enough time for some second-generation adults, although their contribution to the following year's population is unknown. What is apparent from the laboratory data is that since many nymphs from first-generation adults grow slowly, there will still be many individuals overwintering as late instars even in years with early July monsoon rainfall. Such a range of maturation dates results in flexibility, depending on rainfall and temperatures, within the population: early hatching would give the nymphs a chance to mature the same summer rather than overwintering as late instars and becoming adults the following spring. We would also like to see research into how long *Gryllus* eggs can remain viable in dry soil, since one predicted result of climate change is increased droughts in certain areas. This information may be particularly relevant in the Southwestern US since Hinton (1981, p. 177) notes that among insects "there are no kinds of eggs that will enter a state of cryptobiosis (i.e. reversible standstill of metabolism) by dehydration at physiological temperatures." Also, do crickets in areas with monsoon rains have more variable instar development than those in California with its predictable summer drought periods and a Mediterranean climate—rainfall regime?

**Variation. Color:** Three 2017, laboratory maturing adult females with a light colored, central, longitudinal belly strip that darkened post-mortem. **Tegmina:** One 1994, laboratory maturing female with tan tegmina.

**DNA.** Eight males and one female of *G. sotal* were sequenced for ITS2, and yielded 2 clades at the type locality (S15-77 & S17-4) (Fig. 209): 4 males and 1 female (G3493, G3497, G3503, G3505, G3508) were in Clade 1, more similar to *G. transpecos*; and 4 males (G3295, G3509, G3510, G3511) were in Clade 2, more similar to *G. lightfooti*. We suspect that this may be an artifact of poor alignment of ITS2 data (see general DNA discussions, pp 14 & 16). Multilocus sequence data (Gray *et al.* 2019), including individuals from each *G. sotal* ITS2 clade, suggests that *G. sotal* is genetically cohesive and most closely related to frequently arboreal *G. lightfooti* and terrestrial *G. transpecos*.

**Discussion.** On arrival, between 17:00 and 17:30, at the type locality in 2015 and 2017, males heard singing from sotal plants despite bright, sunny, warm weather. The plants with the most singers were those with live blades near the top but with dead flower stalks and dead skirts on lower three to four feet. Breaking off such plants at ground level and pounding the main stalk on open ground resulted in individuals being thrown onto the ground. Displaced individuals quickly attempted, many times successfully, to jump back into the plant being beaten.

We heard probable *G. sotal* males singing some 90m lower (32° 23' 14.05" -106° 33' 4.83") off Aguirre Springs Road but none could be collected, despite repeated attempts, with oatmeal trails, over several years. Once into more open and dryer Chihuahuan Desert at 1536m, where we found *Yucca elata*, no *Gryllus* crickets, including *G. lightfooti*, were heard. The time was 22:25 and the air temperature was 15.6°C, so the locality should be rechecked later in the season since mid-May, 2017, may be too early for singing *G. lightfooti*.

Oatmeal trail most productive where sotal plants occurred. In fact, this technique was much more successful than collecting later in summer when most of population is adult because, during the latter period, adult males seldom wander and infrequently come to oatmeal trails. Much greater success comes from collecting late instars and raising them to adult, especially at this site where collecting of singing adult males is extremely difficult due to their calling from impenetrable locations under, and within sharp, succulent sotal plants.

This is one of only 2 *Gryllus* commonly associated with an arboreal habitat, and both it and *G. lightfooti* are sister species [Note: several other species do occasionally climb vegetation, and that occurrence is noted under each respective taxon.]

### ***Gryllus transpecos* Weissman & Gray, n. sp.**

Texas Trans-Pecos Field Cricket

Figs 207–209, 216–221, Table 1

'G. #16' and 'G. #24' of DBW notebooks.

**Distribution.** Only known from western Texas between the Rio Grande River and the Pecos River.

*Recognition characters and song.* Medium to large sized, wide head and pronotum, always short hind winged, female tegmina only cover  $\frac{1}{2}$  to  $\frac{3}{4}$  of abdomen, cerci in situ typically extend beyond tip of ovipositor. Overall color black (Fig. 216) except for inside of hind femur which is reddish. *Song* (Fig. 217, R09-93) a slow chirp of 4–5 (range 3–7) p/c, CR usually 80–150, PR 20–30 at 25°C. Closely related and similar to both *G. lightfooti* and *G. sotol*. Separated from *G. lightfooti* by, in *G. transpecos*, cerci in situ typically longer than ovipositor tip, female tegminal bars usually absent (Fig. 216), associated with rocks (vs. open grasslands), small but consistent ITS2 DNA differences (Fig. 209), and not known to climb into vegetation to sing. The two taxa could overlap in far western Texas, although no such locality presently known. From Van Horn Pass, where *G. transpecos* is common, to the town of Van Horn (S91-48), where *G. lightfooti* occurs, is some 4 miles distance. The allopatric, Organ Mts., NM, endemic and closely related, *G. sotol* (Table 1, p. 18) has more file teeth, higher tooth density, shorter cerci never as long as ovipositor tip (typically longer in *G. transpecos*), slower PR, and different habitat: open, lower elevation, drier, rocky Chihuahuan Desert for *G. transpecos* versus higher, cooler, low mountain bajadas and woodlands, with sotol (*Dasyilirion wheeleri*), for *G. sotol*. Additionally, *G. sotol* frequently climbs into sotol while *G. transpecos* is found on the ground, or sometimes on rocky cliff faces in road cut areas.



**FIGURE 216.** Holotype male (left) of *G. transpecos*. Female (right) also from Big Bend National Park (S07-37) near type locality.

There are four other slow chirping, frequently rock-associated *Gryllus* species in the Trans-Pecos area that *G. transpecos* must be distinguished from. These four are not closely related to *G. transpecos* and can be separated by DNA (16S, ITS2, and multilocus data). Combinations of morphological, ecological and song characters are also diagnostic, as follows. From sometimes sympatric (at Van Horn Pass and Davis Mts.) *G. longicercus*: *G. transpecos* is distinguished by its larger head, broader pronotum, shorter cerci, lower tooth count and higher pulse rate. From almost sympatric (Davis Mts.) *G. veletis*: *G. transpecos* with longer cerci and different habitat (never in grassland). From sometimes sympatric (Davis Mts., S15-61) *G. planeta*, separated by 5 mostly non-overlapping physical characters (Table 1, p. 18): *G. planeta* has fewer number of teeth and shorter file length, cerci length, tegminal length and tegminal width, and faster chirp rate. From sometimes sympatric (at Big Bend, S85-55) *G. chisosensis*, they are separated by no overlap in number of teeth and PR and minor overlap in teeth/mm and cerci length. The two taxa are

also separated by microhabitat in that *G. chisosensis* prefers rocky areas of many rock layers (e.g. talus slopes) while *G. transpecos*, while preferring rocky habitats like rocky road cuts, is not associated with extensive piles of rocks.

From other allopatric, widespread, more western and unrelated, slow chirping US *Gryllus*, *G. transpecos* is separated from *G. montis* which has shorter cerci, narrower head and pronotum, earlier appearance of adults, different habitats (latter almost always with an overhead tree canopy), and longer ovipositor (Fig. 218).

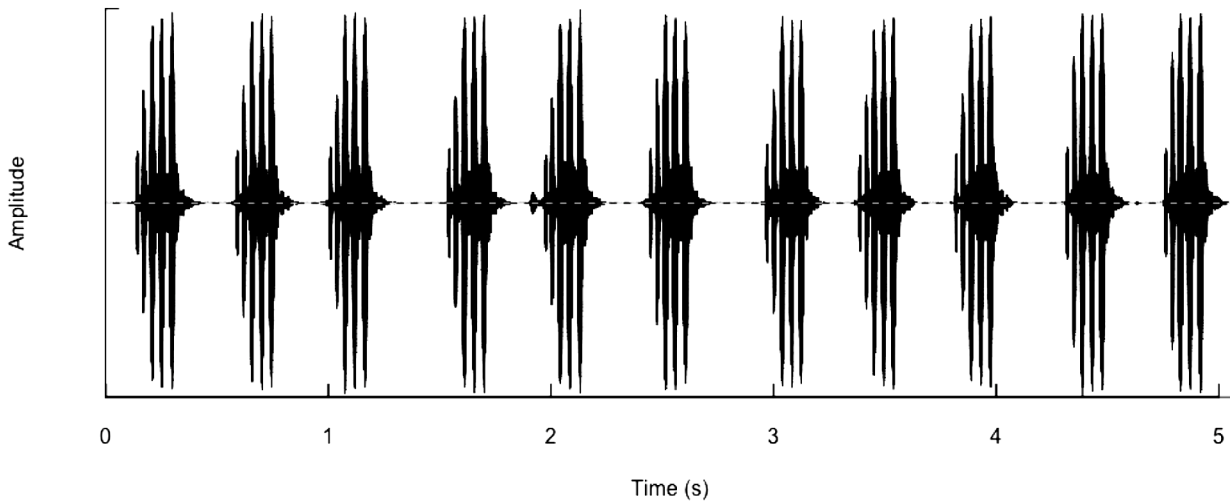


FIGURE 217. Calling song (R09-93) of *G. transpecos* from Culberson Co., TX (S09-64), recorded at 25°C.

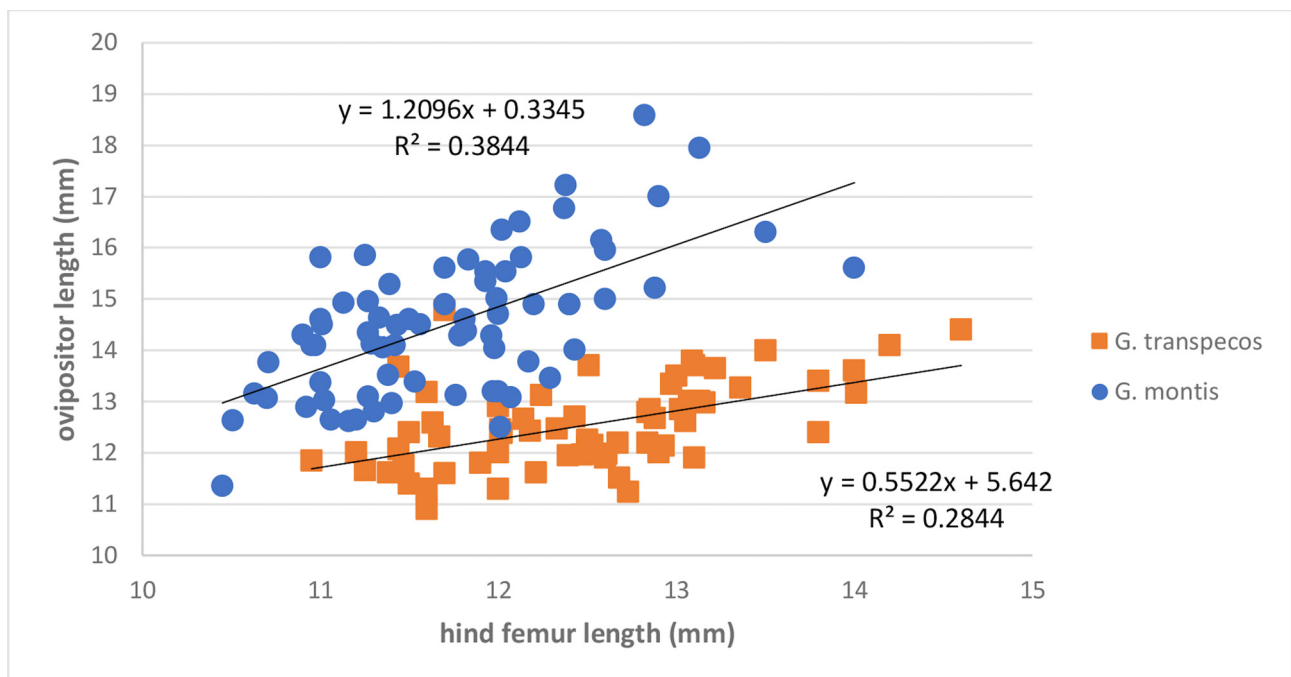


FIGURE 218. Regression hind femur length vs. ovipositor length in *G. transpecos* vs. *G. montis*.

Separated by 800 km from more western *G. saxatilis* which has longer tegmina and longer ovipositor, different multilocus (Gray *et al.* 2019), 16S, and ITS2 (Fig. 209) DNA.

*Holotype*. Male (Fig. 216). USA, Texas, Brewster Co., Chisos Mts., Big Bend National Park, Grande Village Road to Ranger Station near Lost Mine Trail parking lot, 1.5 m NW ranger station, 12-vi-2007. 5500', 29° 16.471' -103° 17.211'. D.B. Weissman & D.C. Lightfoot. S07-36, R07-95, G1175. 16S ribosomal RNA GenBank accession # MN136663. BL 19.49, HF 12.13, LC 12.36. Right tegmen removed: 142 teeth, file length 3.8, TL 11.9, TW 5.2. Deposited CAS, Entomology type #19273.

*Paratypes*. (Total: 105♂ 76♀). **Texas**, Brewster Co., Chisos Mts., Big Bend National Park, 5500', type locality, 8-

vi-1985 (S85-55) 13♂ 6♀; 5-vi-1991 (S91-41) 11♂ 7♀; 12-vi-2007 (S07-36) 2♂ 1♀; Panther Junction, 3734', 12-vi-2007 (S07-38), 2-vii-2015 (S15-68) 3♂ 3♀; 18.7 m SE Panther Junction, 9-vi-1985 (S85-57) 1♂; 5-vi-1991 (S91-42) 1♂; Maverick Rd., 3756', 2-vii-2015 (S15-69) 2♂; Rio Grande Village, 2100', 9-vi-1985 (S85-56) 4♂ 1♀; 5-vi-1991 (S91-43) 2♂; Grande Village Road 4.5 m NW ranger station, 4340', 12-vi-2007 (S07-37) 1♂ 3♀; 28-v-2016 (S16-12) 1♂. Hwy 118 24 m S Alpine, 4434', 2-vii-2015 (S15-72) 7♂ 10♀. Hwy 170 8 m W Terlingua, 3000', 27-v-2016 (S16-10) 1♂. Hwy 385 3.3 m S Marathon, 4050', 28-v-2016 (S16-14) 2♂ 1♀. *Culberson Co.*, Van Horn Pass area, 4880', 31° 03' 17.0" -104° 57' 04.4", 12-vi-1985 (S85-65) 6♂ 4♀; 6-vi-1991 (S91-47) 11♂ 11♀; 29-vi-2009 (S09-64) 10♂ 3♀. *Jeff Davis Co.*, Davis Mts., Observatory, 6747', 1-vii-2015 (S15-61) 4♂ 1♀; 2.9 road m below Observatory, 6010', 1-vii-2015 (S15-64) 1♂ 2♀; 3.2 road m below Observatory, 5935', 1-vii-2015 (S15-65) 5♂ 5♀. *Presidio Co.*, Chianti Mts., Hwy 67 Shafter, 3880', 27-v-2016 (S16-3) 4♂; 0.5 m N Shafter, 3856', 27-v-2016 (S16-2) 7♂ 15♀; 2.3 m S Shafter, 26-vi-1986, 3900' (S86-45) 3♂ 2♀. Hwy 170 E. Presidio, 2680', 27-v-2016 (S16-7) 1♂ 1♀. Hwy 170 39 m W Terlingua, 2660' 27-v-2016 (S16-8) 1♂; 30 m W Terlingua, 2600', 27-v-2016 (S16-9) 1♂.

*Derivation of name.* Trans-Pecos was originally defined, in 1887, by Texas geologist Robert T. Hill, as that portion of Texas west of the Pecos River, which perfectly describes the distribution of this species.

*Geographical range.* (Fig. 219). Apparently absent from ecologically similar areas of the Guadalupe Mts., Culberson Co., Texas, where we found (S01-63, 64, 65) slow chirpers *G. longicercus* and *G. lightfooti* at lower, dryer elevations, and *G. veletis* at higher (1920m), more mesic Dog Canyon.

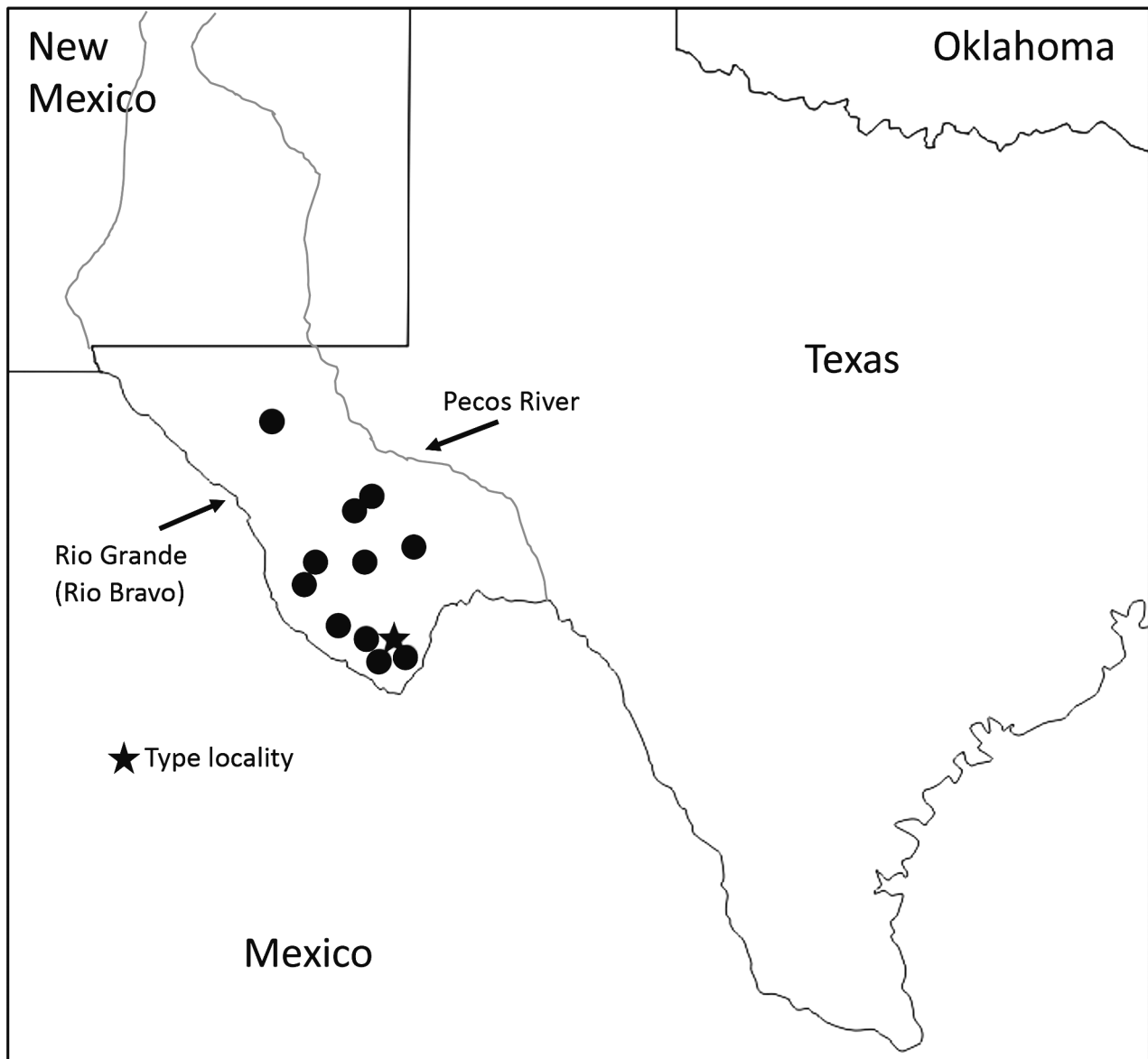


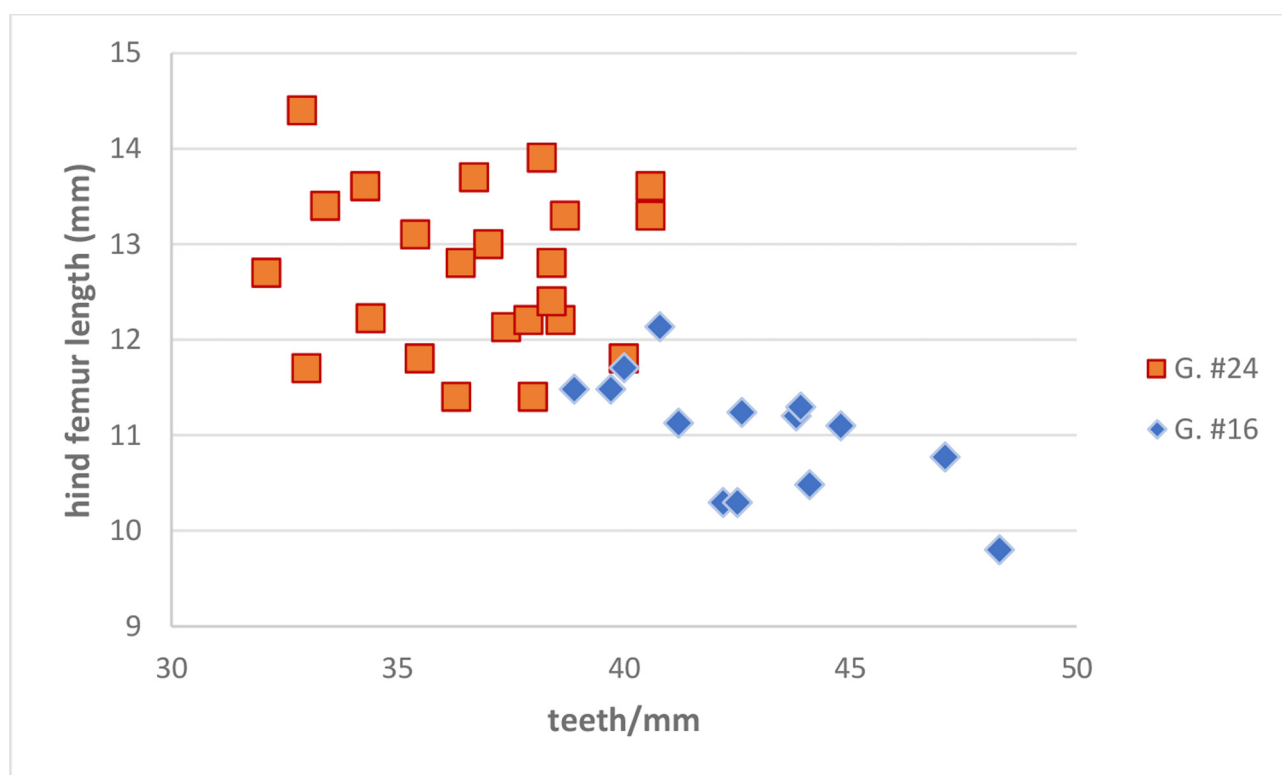
FIGURE 219. Known distribution of *G. transpecos*.



*Habitat.* Rocky road cuts (S16-2, 16-4); Piñon-juniper-oak woodland (S07-36); Chihuahuan Desert (S07-37) with *Acacia*, sotol, and *Yucca*; and natural, rocky slopes in and around towns (S16-3). Males sing from crevices, holes, under small plants, and under and around rocks. Not known from within any town, where *G. lightfooti* can frequently occur. *G. transpecos* appears to be the ecological equivalent of more western *G. saxatilis*.

*Life cycle and seasonal occurrence.* No egg diapause: Big Bend (S85-55 and S85-56), Van Horn (S85-65). Probably one generation/year. No nymphs seen at any Brewster Co. locality but most of population south of Shafter (Presidio Co., S86-45) penultimate or last instar when collected on 26-vi-1986.

*Variation.* Specimens from Big Bend National Park (our ‘G. #24’) are larger than those from Van Horn Pass (our ‘G. #16’) (see Table 1, p. 18) and this caused us some initial confusion. Individuals from these two localities differed in temperature corrected pulse rate, with #16 slower than #24 ( $21 \pm 0.4$  p/s versus  $24 \pm 0.4$  p/s;  $F_{2,22} = 12.02$ ,  $P < 0.001$ ); males differed in teeth/mm vs. hind femur length (Fig. 220;  $F_{2,30} = 5.5$ ,  $P < 0.01$ ) and tegmina width vs. hind femur length (Fig. 221;  $F_{2,30} = 7.4$ ,  $P < 0.01$ ). There was no difference in chirp rates, pulses/chirp, or dominant frequency. However, with the addition of individuals from areas other than these two localities, these significant differences disappeared, and we currently attribute this variation mostly to differences in body size, which is consistent with the linear relationships seen in both regressions—i.e. larger crickets have larger body proportions.

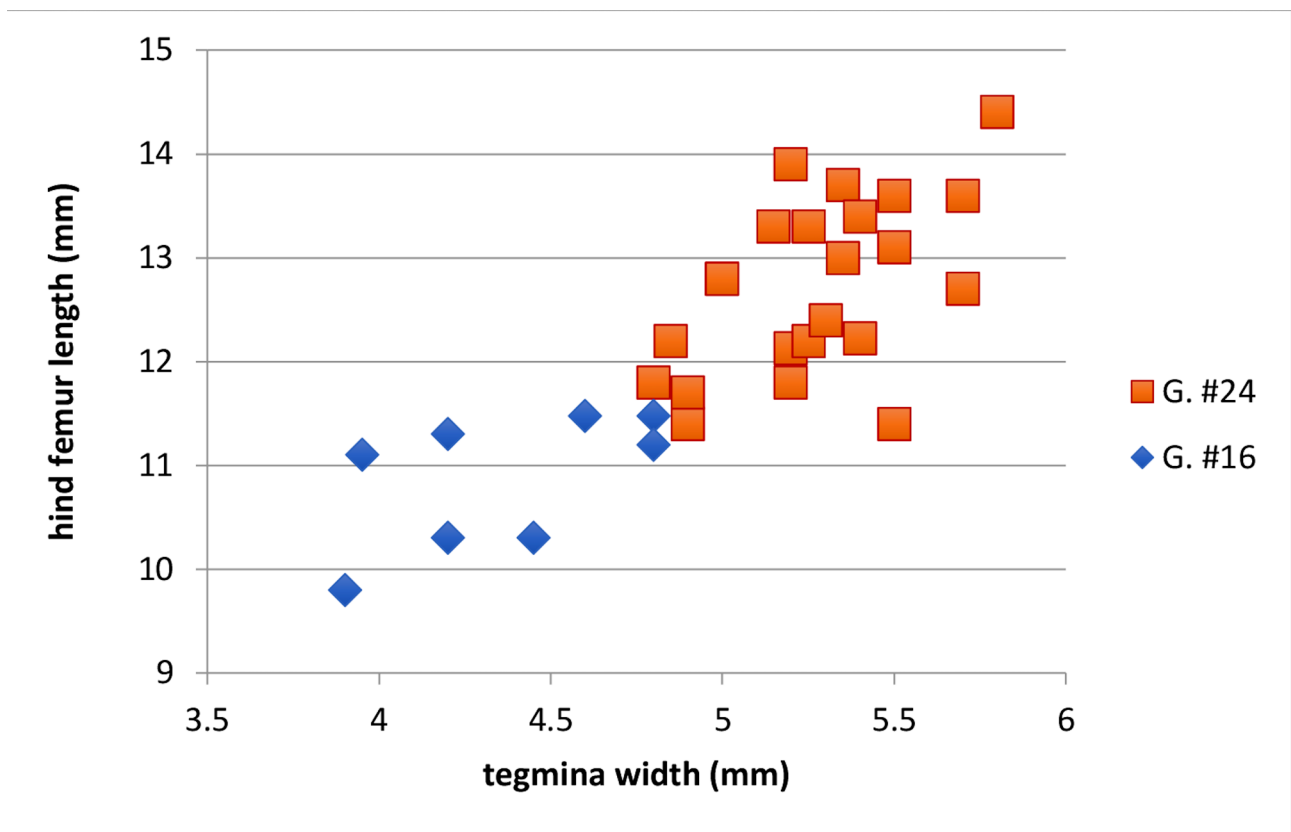


**FIGURE 220.** Regression of teeth/mm vs. hind femur length in *G. transpecos* populations from Big Bend National Park (‘G. #24’) vs. Van Horn Pass (‘G. #16’).

*DNA.* Multilocus G3062 Big Bend National Park (S15-68) and G3083 Davis Mts. (S15-61) sister species of *G. sotol* and *G. lightfooti* (Gray *et al.* 2019). We note that our confusion re. G. #16 and G. #24 (see above) was compounded by the fact that early 16S sequencing of *G. transpecos* yielded 3 separate clades comprised of individuals from 5.3 km south Marathon (S16-14), individuals from 38.6 km south of Alpine (S15-72), and individuals from Van Horn Pass (S09-64). Subsequent ITS2 sequencing showed these same individuals, from all three sites, to cluster together (Fig. 209, p. 207), hence our combining them together under *G. transpecos*.

*Discussion.* Can be a relatively common field cricket where found. Singing males easy to approach but stop singing once turning over rocks near them, as opposed to many males of *G. longicercus* that continue to sing while “their” rocks being turned over. Can sing all night and into early morning in Big Bend (S85-55, at 08:30).

Tinkham (1948) discussed the Orthopteran and faunistic zones of the Big Bend Region.



**FIGURE 221.** Regression tegmina width vs. hind femur length in *G. transpecos* populations from Big Bend National Park ('G. #24') vs. Van Horn Pass ('G. #16').

### The Longicercus Group

*G. longicercus* Weissman & Gray, n. sp. and *G. vulcanus* Weissman & Gray, n. sp.

Sister species of field crickets with exceptionally slow pulse rates within chirped song (Figs 222, 223). *G. longicercus* is widespread in the Southwestern US hotter desert regions; *G. vulcanus* is a morphologically similar, but smaller, cricket restricted to two lava flows in New Mexico. ITS2 does not separate the taxa (Fig. 224); whether or not this is due to incomplete lineage sorting, given a recent derivation of the lava-endemic *G. vulcanus* from *G. longicercus*, or because *G. vulcanus* is simply *G. longicercus* as found on lava, is not entirely clear.

#### *Gryllus longicercus* Weissman & Gray, n. sp.

Long Cercus Field Cricket

Figs 206, 222–229, 232, 233, Table 1

'Gryllus #13' of DBW notebooks.

'*G. longicercus*' of Gray *et al.* (2016a).

**Distribution.** Southwestern states of Arizona, New Mexico, and Texas, with minor extensions into California, Utah, and Colorado.

**Recognition characters and song.** A medium to large, usually short hind winged cricket with the longest known cerci in the genus, sometimes exceeding the body length of pinned specimens (male from Kofa [S88-88, R88-172]). Intact cerci always considerably longer than ovipositor in situ (except for individuals from Tijeras Canyon, NM, S19-35). File teeth from ~170–220 (range 155–231). Almost always associated with rocks. **Song** (Fig. 225, R15-159) a slow to medium fast chirp with 4–5 (range 3–6) p/c, PR usually from 9–12 with individual pulses distinguishable