Karyotype. Unknown.

Recognition. Description indicates large body size and absence of styli on subgenital plate. The stridulatory file tooth density places this species at the upper end of variation for the Sequoia Group. The tooth density of the single known specimen is less than the closest geographic relative, *N. inversa* (density 64–68 teeth/mm). The single specimen is the only Sequoia Group individual collected in the Central Valley west of the Sierra Nevada.

Notes. This species is one of four extinct North American Orthoptera species (Hoekstra 1998) and that status has not changed; David Rentz and DBW have searched for this species at the type locality on several occasions over the last few decades, visiting during summer months when *Neduba* are active and using a bat detector. On no occasion were individuals found. The lack of molecular, bioacoustical, and cytogenetic characters make this species difficult to place in context of this revision, but the stridulatory file tooth density is consistent with the Sequoia Group. Minimally destructive molecular work may be undertaken in the future to place *N. extincta* into phylogenetic context. Among the extant Sequoia Group species, *N. inversa* is distributed near the San Joaquin River watershed and is therefore a possible relative, and this lineage could have colonized the western edge of the Central Valley across riparian corridors. The description of *N. arborea* in this work reports the only other Sierranus or Sequoia Group members known west of the Sierra Nevada. Many *Neduba* populations were no doubt extirpated as the eastern slope of the Coast Ranges became more arid and as humans modified the Central Valley for agriculture. In the case of the Antioch dunes, sand mining and commercial development drove extinction of this species. Thorough collecting efforts are needed in the eastern slopes of the Coast Ranges to search for possible unknown populations.

Neduba inversa Cole, Weissman, & Lightfoot, sp. n.

Fig. 19 (distribution), Fig. 27 (male and female habitus, calling song, male and female terminalia, karyotype), Plate 3C (live habitus), Plate 5G (male calling song), Plate 8D (male ventral sclerite), Plate 10G (male titillators), Plate 12E (female subgenital plate).

Common name. Kings Canyon Shieldback.

History of recognition. Likely confused with *N. sierranus*.

Type material. HOLOTYPE MALE:, **USA, CA, Fresno Co.,** Bretz Mill Campground, Sierra National Forest, 24 mi. NE Trimmer on Big Creek Rd., 37.03775N, 119.24040W, 871 m, 13-VIII-2015, JA Cole, JCT15-15 [karyotype], 150820_01 [recording], 206 [teeth], 3.3 [mm file count], tegmen in gel capsule and genitalia in vial below insect deposited in CAS, Entomology type #19710. PARATYPES (n = 19): **Fresno Co.,** 1♂, same data as holotype, CAS; 2♂, same data as holotype, LACM; 3♂, 1♀, Bretz Mill Campground, Sierra National Forest, 24 mi. NE Trimmer on Big Creek Rd., 37.0375N, 119.2388W, 1006 m, 29-30-VII-2012, JA Cole, LACM; 3♂, Princess Campground, Sequoia National Forest, 36.80456N, 118.94154W, 1797 m, 25-27-VII-2017, JA Cole, CAS; 7♂, 1♀, same data except LACM; 1♂, same data except JAC.

Measurements. (mm, ♂n = 17,♀n = 2) Hind femur ♂20.22–24.12, ♀23.15–23.40, pronotum total length ♂8.17–10.54,♀8.48–9.42, prozona length ♂3.57–5.11, ♀4.06–4.98, metazona dorsal length ♂4.29–5.95, ♀3.50–5.36, pronotum constriction width ♂2.22–2.95, ♀2.43–2.94, metazona dorsal width ♂5.68–6.63, ♀6.25–6.42, head width ♂4.84–5.47, ♀5.24–5.59, ovipositor length ♀15.81–16.78.

Distribution. West slope of the Sierra Nevada, between the San Joaquin and Kings River watersheds in the vicinity of Kings Canyon National Park.

Habitat. Understory of mixed conifer forests.

Seasonal occurrence. Available records are midsummer from July (1-VII-1935, EE Honeycutt, CAS) through mid-August (13-VIII-2015, JA Cole, LACM).

Stridulatory file. (n = 7) length 3.0–4.0 mm, 206–266 teeth, tooth density 66.3 ± 6.9 (55.5–78.3) teeth/mm.

Song. (n = 24) Qualitatively like Sierranus Group taxa, high frequency (PTF 15.9 ± 1.2 kHz) with a fluttering quality caused by multiple OPT (PTN 9.2 ± 3.4). PTR is significantly slower (1.3 ± 0.3 s^{-1}) than *N. sierranus* and faster than *N. radocantans* (ANCOVA, $P = 3.96 \times 10^{-9}$) but is indistinguishable from that of *N. arborea*.

Karyotype. (n = 5) 2n♂= 21 (2m + 16t + XtXtYm). JCT15-15, paratopotype.

Recognition. Males have a high stridulatory file tooth density (64–68 teeth/mm) like *N. sierranus* and *N. radocantans*. A weakly constricted pronotum separates *N. sierranus* from this species. *N. radocantans* is morphologically separable only by its slightly higher stridulatory file tooth density (68–75 teeth/mm). This species belongs to

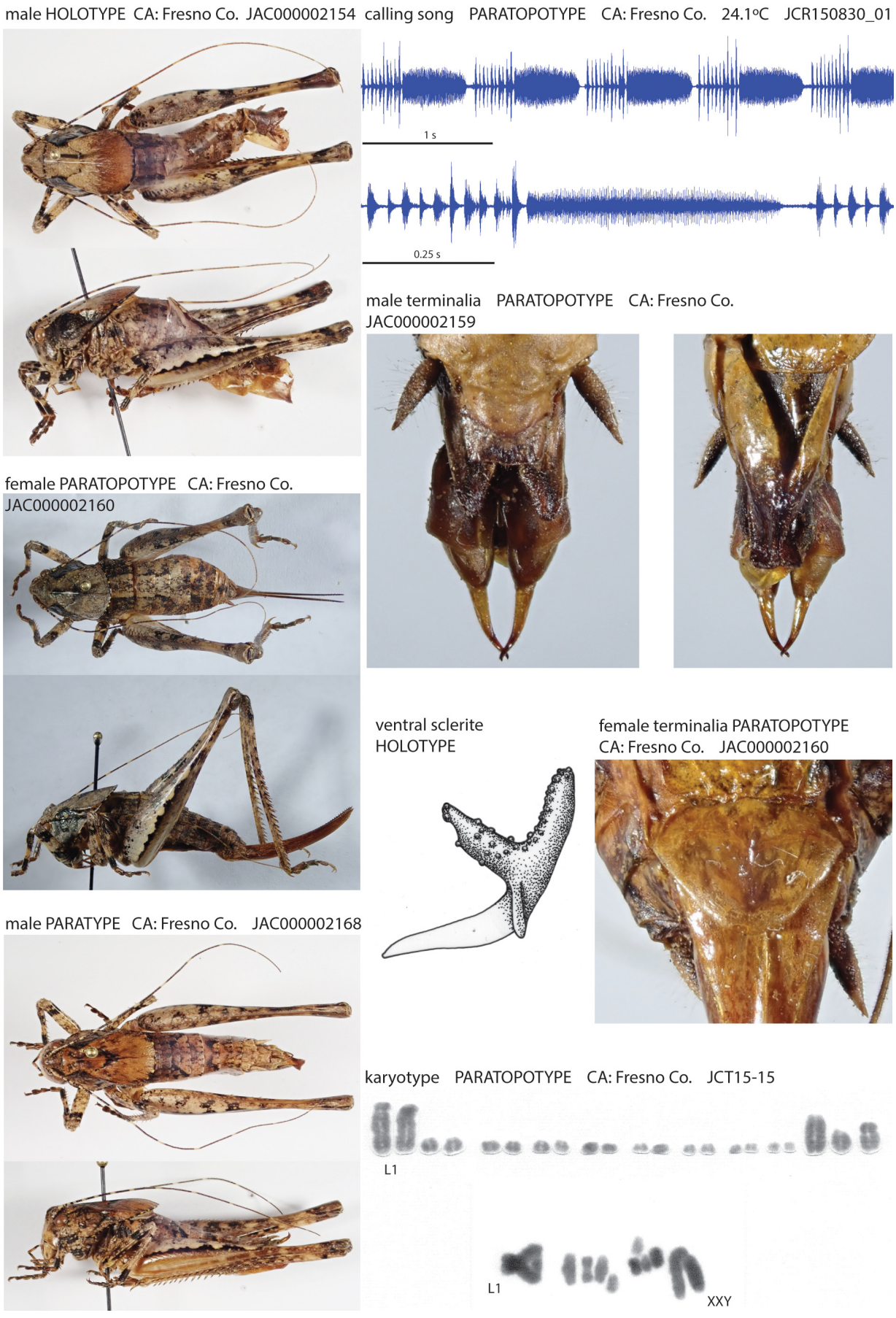

FIGURE 27. *N. inversa* male and female habitus, calling song, male and female terminalia, karyotype.

the Sequoia Group lineage but has a Sierranus Group song with multiple OPT. The high PTN of *N. radocantans* will separate that otherwise cryptic species from *N. inversa*. Males of the neighboring species to the north, *N. sierranus*, have songs with a faster PTR than those of *N. inversa*. Songs from all population of the Sequoia Group to the south have only one OPT. Karyotypes also separate *N. inversa* from the geographically proximal species mentioned above. The distribution of this species lies between the San Joaquin and Kings River drainages in the vicinity of Kings Canyon National Park.

Etymology. *l. inversa* "to change, to pervert, to turn upside down," in reference to the mosaic of characters possessed by this species, with the song of one clade but the genetics of another.

Notes. At the type locality the species was common, but the quiet male songs were drowned out by the incessant loud calls of the shield-back katydid *Cyrtophyllicus chlorum* Hebard. The distribution of *N. inversa* lies where the Sierranus and Sequoia Groups meet in the central Sierra Nevada (Figs. 8, 19). This species combines characters from the two lineages and gene flow between neighboring lineages has occurred during its evolutionary history (Fig. 4). The stridulatory file and the calling song with a fluttering sound, caused by numerous OPT, is similar to *N. sierranus* in the Sierranus Group, which is distributed to the north in the Yosemite Valley region. DNA places this species with Sequoia Group species to the south, however, and this species shares a karyotype with *N. prorocantans*. The remaining Sequoia Group species have simple songs with one OPT between any pair of MPT. Song alleles may have introgressed across species boundaries in this contact zone region (e.g. Cole 2016).

Material examined. Type series only, see Type material above.

Neduba prorocantans Cole, Weissman, & Lightfoot, sp. n.

Fig. 19 (distribution), Fig. 28 (male and female habitus, calling song, male and female terminalia, karyotype), Plate 3D–E (live habitus), Plate 5H (male calling song), Plate 8E (male ventral sclerite), Plate 10H (male titillators), Plate 12F (female subgenital plate).

Common name. Incessant Shieldback

History of recognition. Records from Dougherty Creek, Kern River Canyon, CA (Rentz & Birchim 1968) were confused with *N. sierranus*.

Type material. HOLOTYPE MALE: **USA, CA, Kern Co.,** Tehachapi, Water Canyon Rd., 0.15 mi. S of intersection with Highline Rd., 35.307739N, 118.021738W, elev. 1463 m, 28-VIII-1983, DB Weissman, S83-115, R83-295 [recording], T83-46 [karyotype], 150 [teeth], 3.3 [mm file count], tegmen in gelcap and genitalia in vial below specimen, deposited at CAS, Entomology type #19681.

PARATYPES (n = 30): **USA, CA, Kern Co.,** 3♂, 1♀, same data as holotype; 6♂, Hobo Campground overflow area, 3 miles west of Bodfish on Kern River Canyon Road, 35.5752N, 118.5305W, 700 m, 23-VI-2003, JA Cole, LACM; 1♂, horse trough spot, Tejon Ranch Conservancy, 34.97927N, 118.69159W, 1223 m, 3-VI-2017, L Pavliscak, LACM; 1♂, Kern River Rd. 1.1 mi. from jct. Caliente-Bodfish Rd., 35.59429N, 118.5141W, 1470 m, 21-VII-2015, JA Cole, DB Weissman, LACM; 1♂, Kernville, 37 Sierra Way, 35.7561N, 118.4203W, 828 m, 26-28-VII-2002, JA Cole, JAC; 2♂, same data except LACM; 2♂, same data except 27-VII-2004, JA Cole, LACM; 1♂, same data except 28-VII-2004, JA Cole, JAC; 1♀, Lopez Flat, Tejon Ranch Conservancy, 34.94264N, 118.63381W, 816 m, 3-VI-2017, JA Cole, K Halsey, LACM; 3♂, 1♀, Paradise Valley, Tehachapi Mountains, 34.91664N, 118.66759W, 7-VIII-1931, ER Tinkham, CAS; 1♂, Tehachapi Mountain Park, 35.06861N, 118.4825W, 1470 m, 20-VII-2015, JA Cole, DB Weissman, LACM; 2♂, Tehachapi Mountain Park, 35.06861N, 118.4825W, 1707 m, 28-VIII-1983, DB Weissman, CAS; 1♀, Tejon Ranch Conservancy, Indian Schoolhouse, Tejon Creek, 35.04512N, 118.67052W, 647 m, 1-IV-2018, K Moore, LACM; 4♂, Water Canyon Rd., 1.4 mi. below entrance to Tehachapi Mountain Park, 35.08258N, 118.49486W, 1571 m, 20-VII-2015, JA Cole, DB Weissman, LACM.

Measurements. (mm, ♂n = 14,♀n = 2) Hind femur ♂19.60–22.59, ♀22.55–23.50, pronotum total length ♂8.25–10.15, ♀9.25–9.65, prozona length ♂3.83–5.09, ♀4.54–5.65, metazona dorsal length ♂4.07–5.35 ♀4.00–4.71, pronotum constriction width ♂2.44–3.50, ♀3.24–3.29, metazona dorsal width ♂4.99–6.80, ♀5.60–5.89, head width ♂4.70–5.57, ♀5.47–5.60, ovipositor length ♀8.75–9.41.

Distribution. West slope of the southern Sierra Nevada south of the Tule River watershed, south to the north slope of the Tehachapi Mountains.