

***Neduba lucubrata* Cole, Weissman, & Lightfoot, sp. n.**

Fig. 19 (distribution), Fig. 23 (male and female habitus, calling song, drumming, male and female terminalia, karyotype), Plate 2E (live habitus), Plate 5C (male calling song), Plate 7G–H (male ventral sclerites), Plate 10D (male titillators), Plate 12A (female subgenital plate).

Common name. Midnight Shieldback.

History of recognition. None.

Type material. HOLOTYPE MALE, USA, CA, Monterey Co., Miller's Lodge, 0.6 miles west jct. Arroyo Seco Road and G16, 36.25466N, 121.43208W, 192 m, 22-VII-2015, JA Cole, DB Weissman, JAC000002197 [specimen barcode], DNA161 [tissue], SING0503 [DNA extraction], JCT15-08 [karyotype], genitalia in vial under specimen, deposited in CAS, Entomology type #19712.

PARATYPES (n = 32): All USA, CA, Monterey Co., 4♂, 1♀, same data as holotype, LACM; 2♂, 1♀, Arroyo Seco Rd., 0.6 mi. W of intersection with G16, 36.235139N, 121.473392W, 274 m, 29-VII-1983, DB Weissman, CAS; 3♂, Bottcher's Gap, Los Padres National Forest, 19 miles north of Big Sur off SR1 on Palo Colorado Road, 36.355N, 121.8138W, 652 m, 20-21-VIII-2012, JA Cole, LACM; 1♂, same data except 7-8-IX-2002, JA Cole, LACM; 7♂, Nacimiento-Ferguson Rd., at bridge of Nacimiento River, 8.4 miles east of SR1, 36.0135N, 121.4216W, 587 m, 19-20-VIII-2012, JA Cole, LACM; San Benito Co., 9♂, Short Fence Trailhead, Coalinga Road, Laguna Mountain Recreation Area, BLM, 36.36403N, 120.8784W, 670 m, 10-11-VIII-2017, JA Cole, LACM; 2♂, same data except 10-11-VIII-2017, JA Cole, JAC; 2♂, Upper Sweetwater Campground, Coalinga Road, Laguna Mountain Recreation Area, BLM, 36.36067N, 120.85256W, 848 m, 10-11-VIII-2017, JA Cole, LACM.

Measurements. (mm, ♂n = 24, ♀n = 2) Hind femur ♂16.35–20.74, ♀21.61–22.90, pronotum total length ♂7.04–9.03, ♀8.95–9.17, prozona length ♂2.65–4.78, ♀4.02–4.18, metazona dorsal length ♂3.85–5.10, ♀4.77–5.15, pronotum constriction width ♂1.85–2.66, ♀2.70–3.35, metazona dorsal width ♂5.36–6.25, ♀5.76–6.35, head width ♂3.90–4.70, ♀5.11–5.46, ovipositor length ♀16.50–16.60.

Distribution. Santa Lucia and Diablo Ranges in the South Coast Range, California.

Habitat. Mixed woodland and chaparral. Taken from twigs in tangles, poison oak, and California sage (*Artemisia californica* Less.). Males call approximately 1 m above ground level in thick tangles. At dusk two males and one female emerged for nocturnal activity from a pack rat nest, suggesting that this structure served as a daytime shelter for an aggregation of individuals. These individuals retreated into the nest when disturbed.

Seasonal occurrence. Adults from late July (22-VII-2015, JA Cole and DB Weissman, LACM) through early September (8-IX-2002, JA Cole, LACM).

Stridulatory file. (n = 7) length 3.2–3.8 mm, 121–186 teeth, tooth density 45.9 ± 4.2 (38.4–50.0) teeth/mm.

Song. (n = 31) Brief bouts separated by long intervals between bouts. PTR is 4.0 ± 0.5 s⁻¹. Males may add one PT to each successive bout, for example three successive bouts may consist of 3 PT, 4 PT, then 5 PT, and then the cycle recommences at 3 PT. PTF is 14.9 ± 0.8 kHz. Males may accompany stridulation with audible drumming, which is generated by the abdomen striking the substrate (Weissman 2001; JAC pers. obs.). Drumming coincides with partial PT at the beginning of a bout (Fig. 23). Drumming does not occur frequently and may not occur in all populations. Drumming was observed at the Monterey County localities of Arroyo Seco (one of two males, DBW, JAC, pers. obs.) and Bottcher's Gap (JAC, pers. obs.), but not at any San Benito County localities.

Karyotype. (n = 8) Unique. $2n♂ = 24$ (2m + 20t + XtYt). T83-37, S83-107, paratopotype.

Recognition. With a single apical protibial spine, dark apical tegminal spots and prosternal spines, this species may be confused only with *N. propsti*, a larger species that does not occur on the California mainland. The female subgenital plate length and width are subequal, in contrast with the elongated subgenital plate of *N. propsti*. The song, which consists of short stridulation bouts accompanied by drumming, is unique.

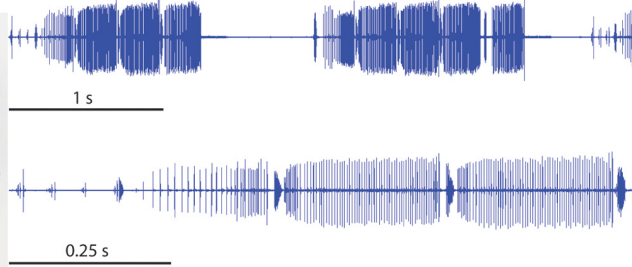
Etymology. *l. lucubrata* burning the midnight oil, descriptive of male acoustic activity continuing throughout the night.

Notes. This species shares morphological and genitalic characteristics with *N. propsti* as well as with the species of the Sierranus and Castanea Groups. Santa Lucia Range and Diablo Range populations are genetically distinct (Figs. 3–5) but are separable neither morphologically nor bioacoustically. The chirping song structure combined with abdominal drumming makes *N. lucubrata* the most acoustically distinct species of *Neduba*. Selection for mate recognition may have driven the evolution of distinctive song phrasing in *N. lucubrata*, as within its distribution are found two sympatric nedubines: *N. carinata* and a small *Aglaothorax* species. Females may require silent periods

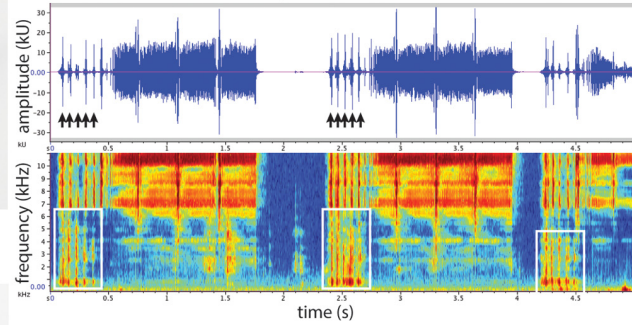
male HOLOTYPE CA: Monterey Co.
JAC000002197



calling song PARATOPOTYPE CA: Monterey Co. 24.5°C JCR150802_04



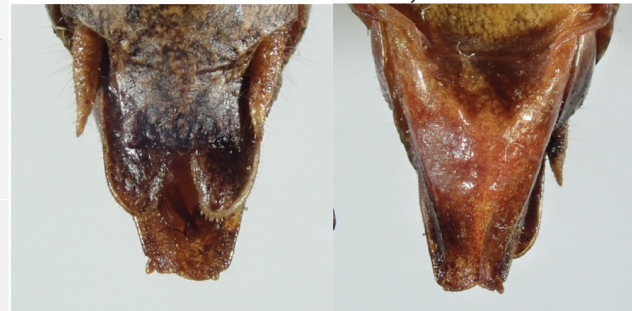
calling song with drumming (arrows and white boxes)
PARATOPOTYPE CA: Monterey Co. 24.5°C JCR150802_04



female PARATOPOTYPE CA: Monterey Co.
JAC000002198



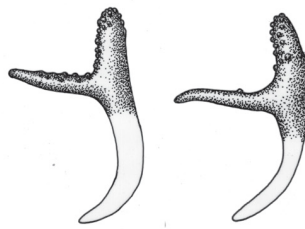
male terminalia PARATOPOTYPE CA: Monterey Co. JAC000002195



ventral sclerite
HOLOTYPE
JAC000002197

PARATYPE
Monterey Co.
JAC000002199

female terminalia PARATOPOTYPE
CA: Monterey Co. JAC000002198



male PARATYPE CA: San Benito Co.
JAC000002216



karyotype PARATOPOTYPE CA: Monterey Co. S83-107 T83-37

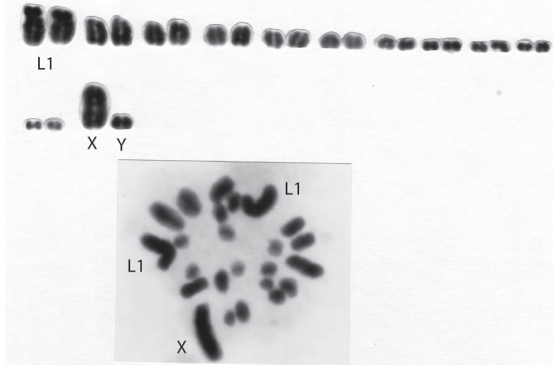


FIGURE 23. *N. lucubrata* male and female habitus, calling song, male and female terminalia, karyotype.

of an appropriate intermediate length between bouts to recognize a conspecific male signal (Cole 2016): intermediate length gaps between PT bouts will contrast with the continuous PT production of sympatric *N. carinata* as well and the long periods of silence between pulse production in *Aglaothorax*.

Material examined. Type series only. See Type material above.

Sierranus Group

The Sierranus Group is composed of 3 species (*sierranus*, *arborea*, and *radocantans*). Like the Sequoia Group, all Sierranus Group species have a single spine on the posterior margin of the forefemur, a pair of prosternal spines, and the entire male tegmen ivory or white. The male subgenital plate has lateral carinae that converge to the apex, which is devoid of styli, petal-like and often reflexed. The stridulatory file tooth density is the highest of all *Neduba* species groups (59–77 teeth/mm), and this character alone separates it from all Sequoia Group species except *N. inversa*. The Sierranus Group is distributed in the central and northern Sierra Nevada while the Sequoia Group occupies the southern portions of that mountain range (Figs. 8, 19). Within this Group are morphologically cryptic species defined by song and/or karyotype. Body part measurements and stridulatory files offer the only means to identify males that lack song data. Females may also be identified by body part measurements and sometimes the shape of the subgenital plate. Species are parapatric in the Sierra Nevada (Fig. 19) and thus geography will serve to narrow species possibilities. Molecular data show hybridization (Fig. 4) between species with adjacent ranges.

Neduba sierranus (Rehn & Hebard, 1910)

Fig. 19 (distribution), Fig. 24 (male and female habitus, calling song, male and female terminalia, karyotype), Plate 2F–G (live habitus), Plate 5D (male calling song), Plate 8A (male ventral sclerite), Plate 10E (male titillators), Plate 12B (female subgenital plate).

Common name. Yosemite Shieldback.

History of recognition. Described in *Aglaothorax* from Yosemite Valley (Rehn & Hebard 1910) and transferred to *Neduba* (Rehn & Hebard 1912). The Tulare and Kern County records in Rentz and Birchim (1968) belong to Sequoia Group species that are described in this work (*N. sequoia* and *N. prorocantans*).

Type material. The holotype male is in ANSP. Images of the holotype are available at OSFO (Cigliano *et al.* 2020). **TOPOTYPES:** All USA, CA, Mariposa Co., 2♂, Carl Inn, Yosemite, 12-VIII-1938, ER Tinkham, CAS; 4♂, Yosemite National Park, Wawona, 37.53694N, 119.65528W, 1223 m, 27-VIII-1982, DB & BI Weissman, CAS; 4♂, 4♀, Yosemite National Park, Wawona Area, Redwood Estates, 37.53694N, 119.65528W, 1250 m, 23-25-VI-1989, DB Weissman, CAS.

Measurements. (mm, ♂_n = 14, ♀_n = 5) Hind femur ♂18.11–22.25, ♀21.92–23.60, pronotum total length ♂7.87–9.90, ♀8.54–9.00, prozona length ♂3.80–4.99, ♀4.35–4.91, metazona dorsal length ♂4.01–5.45, ♀3.83–4.50, pronotum constriction width ♂2.60–3.23, ♀2.85–3.20, metazona dorsal width ♂5.47–6.67, ♀5.64–6.05, head width ♂4.50–5.40, ♀5.20–5.65, ovipositor length ♀13.75–14.84.

Distribution. Western slope of the Central Sierra Nevada of California, distributed between the Merced and Mokelumne River watersheds in the vicinity of Yosemite National Park.

Habitat. Mixed conifer forests. Males call from dense understory vegetation and from pine needle litter, most commonly 15 cm or less from the ground but occasionally as high as 3 m above the ground in conifers. This species is associated with mountain misery (*Chamaebatia foliosa* Benth.), incense cedar (*Calocedrus decurrens* (Torr.) Florin), western bracken fern (*Pteridium aquilinum* (L.) Kuhn), and white fir (*Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.).

Seasonal occurrence. Adults have been taken from early July (9-VII-1968, TR Haig, CSCA) into mid-September (12-IX-2015, JA Cole, LACM). Last instar nymphs from late June into early July.

Stridulatory file. (n = 7) length 2.9–3.6 mm, 196–234 teeth, tooth density 66.1 ± 5.9 (58.8–75.5) teeth/mm.

Song. (n = 14) The calling song of this species was published in Morris *et al.* (1975). The song of *N. sierranus*, like all other species in the Sierranus Group, has a complex pattern of several OPT between MPT, and gives the song a “fluttering” quality as perceived by a human listener. The PTF is 16.2 ± 1.2 kHz, and at this high carrier