

## Description of *Schistocerca cohni* n. sp. and redescription of *S. socorro* (Dirsh) (Orthoptera: Acrididae: Cyrtacanthacridinae) from Mexico

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### Abstract

*Schistocerca cohni* n. sp. is described from central Mexico and a Socorro Island endemic species, *S. socorro*, is redescribed with status change and justified emendation. Male external and internal genitalia are described and illustrated. Biology of the endemic species briefly described.

**Key words:** Orthoptera, Acrididae, Cyrtacanthacridinae, *Schistocerca*, taxonomy, new species, Mexico, Socorro Island

### Introduction

*Schistocerca* Stål is the largest and the most diverse locust genus within a subfamily Cyrtacanthacridinae, containing about 50 species, widely distributed throughout the New World (Dirsh 1974; Song 2004a). Four species in the genus are known to swarm through density-dependent phase polyphenism (Harvey 1981). The most well-known is the desert locust, *S. gregaria* (Forskål), which produces severe pest problems throughout North Africa and the Middle East. A majority of the species are, however, non-swarming, sedentary grasshoppers (Song 2004b). These sedentary species have radiated into many habitats, but they are generally arboreal and prefer to feed on herbaceous plants (Dirsh 1974). Except for the agriculturally important species and a few sedentary species, not much is known about their biology.

In a synonymic catalogue, Kirby (1910) listed 19 species from Mexico. Since then, Rehn (1913) described a subspecies from Clarion Island, and Hebard (1932) added another species from Jalisco. In his revision, Dirsh (1974) reduced these to six species and ten subspecies from Mexico, but some of his distribution records came from erroneous identification and unreliable species concept. The genus has gone through two partial revisions

since Dirsh (1974), and currently at least nine *Schistocerca* species are recognized from Mexico (Harvey 1981, Song 2004b): *S. piceifrons*, *S. pallens*, *S. nitens*, *S. centralis*, *S. camerata*, *S. damnifica*, *S. brevis*, *S. albolineata* and *S. obscura*. Several synonymized concepts need to be revisited, and the actual number of species in Mexico is likely to increase.

Here I describe a new species from central Mexico and redescribe an endemic species from Socorro Island in the Pacific, bringing the known fauna of *Schistocerca* in Mexico to eleven.

### Material and methods

This work is based on the study of specimens from the following institutions: University of Michigan Museum of Zoology, Ann Arbor, MI (UMMZ); National Museum of Natural History, Washington, D.C. (USNM); British Museum of Natural History (BMNH); Universidad Nacional Autónoma de México, México City, México (UNAM); the authors personal collection (SONG). Genital structures were dissected and prepared using techniques described by Hubbell (1932) and Song (2004b). Photographs for the representative specimens were taken using a Nikon Coolpix 990 digital camera. Illustrations were initially made using a camera lucida mounted on a Wild stereomicroscope and they were then traced in Adobe Illustrator CS using an optical pen mouse.

GPS coordinates for the collecting localities were estimated using GeoNet Names Server (<http://gnswww.nga.mil/geonames/GNS/>). Maps were generated using Online Map Creation (<http://www.aquarius.geomar.de/>), and modified in Adobe Illustrator CS.

The holotype and paratypes of the new species are deposited in UMMZ. The holotype male of the redescribed species is deposited in USNM. Paratypes are deposited in USNM and BMNH.

### Descriptive Taxonomy

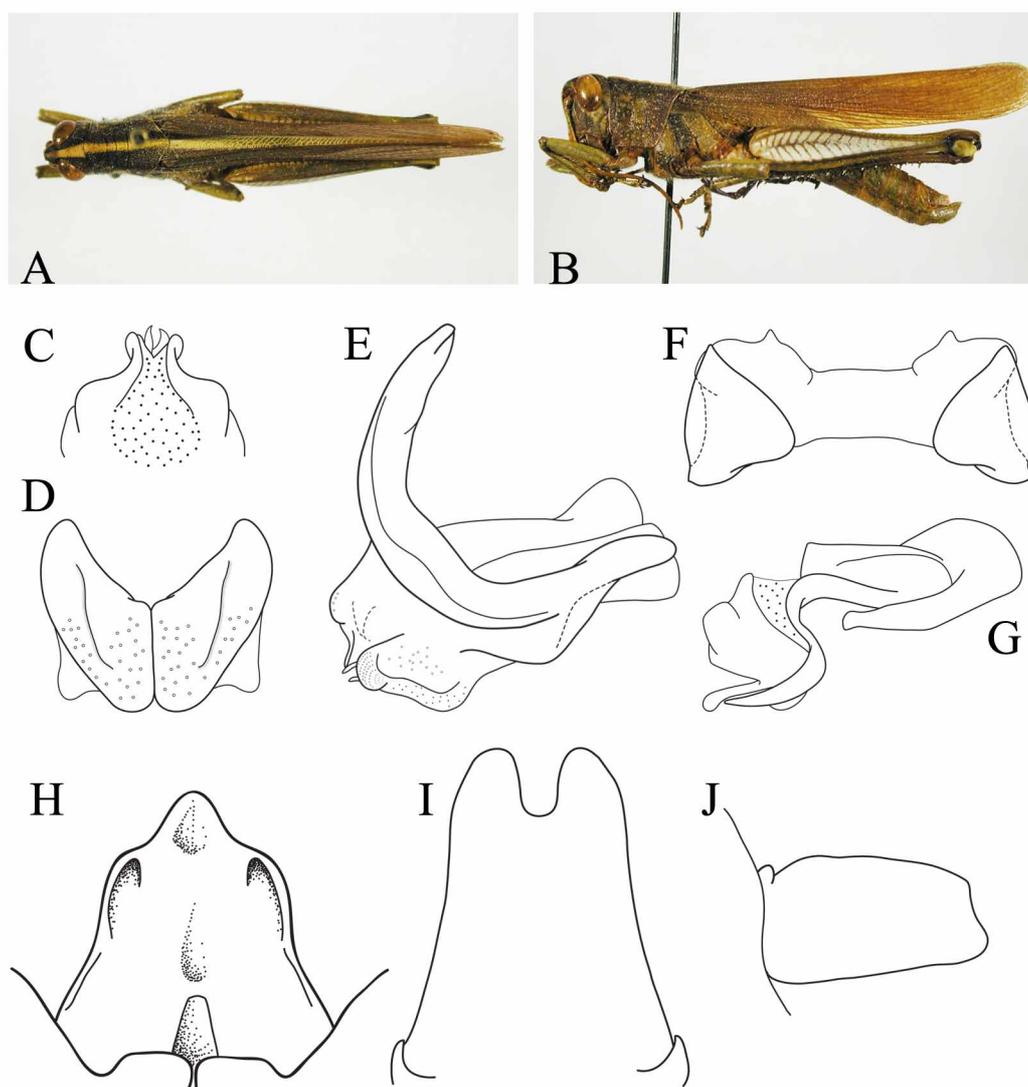
#### *Schistocerca cohni* Song n. sp.

(Figs. 1A–1J, 3A)

**Male.** Medium size (total length =  $39.2 \pm 3.15$  mm; hind femur length =  $20.13 \pm 1.87$  mm; pronotum length =  $6.97 \pm 0.6$  mm ( $n = 6$ )).

Antennae much longer than the combined length of head and pronotum. Integument highly setose. Setae on pronotum, sternum, abdomen and femora long. Median carina of pronotum distinct and slightly raised, but not constricted. Sulci distinct, but not deep. Sculpting pattern of dorsal surface of prozona papillulate. Lateral lobes of prozona slightly wrinkled. Hind angle of pronotum slightly obtuse-angular. Small granules present on pronotum and thorax. Anterior and posterior portion of pronotum similar width. Tegmina

slightly extending beyond the tip of abdomen. Cerci quadrate, with length twice longer than width (Fig. 1J). Apical tip of cercus slightly bilobed, with lower part extruding more than upper. Furcula small and rectangular. Epiproct with a pair of tubercle absent (Fig. 1H). Subgenital plate with round apex (Fig. 1I). Apical lobes of subgenital plate not outwardly flared, with U-shaped notch.



**FIGURE 1.** *Schistocerca cohni* n. sp. holotype dorsal view (A), holotype lateral view (B), “basal eminence” of zygoma (C), ectophallic sclerite (D), cingulum (E), epiphallus (F), endophallus (G), male epiproct (H), male subgenital plate (I), and male cercus (J).

*Color:* Rusty brown to slightly deep olive green. Head rusty brown to deep olive green with faint to strongly dark subocular stripes. A pair of dark brown stripes between eyes

from upper half of frontal ridge to occiput, often extending to pronotum. Head, pronotum and tegmina with a bright yellow dorsal longitudinal stripe. Lateral lobes of pronotum without marking. Metazona with granules. Epimeron without marking. Tegmina uniformly brown. Tegminal veins brown. Hind wings with slightly yellow tinge. Posterior margin of abdominal tergites with a row of black dots. Dorsal and ventral surface of hind femora light brown to olive green. Hind femora mostly without dorsal bands, but sometimes with a trace. Medial area white. Carinula with a row of very small black dots. Upper and lower carina without dots. Hind tibiae dark reddish brown to black, with tibial spines yellow with a black tip.

**Phallus:** Cingulum, surfaces of rami slightly infolded in the middle and somewhat convex, thus making “basal eminence” appear slightly bilobate and somewhat constricted in the middle (Figs. 1C & 1E). Endophallus, basal valves ventral angle protruding more than dorsal, valves of cingulum club-shaped and curved downward, protruding more than apical valves of aedeagus (Fig. 1G). Epiphallus, distance between lophi longer than the length of base of a lophus (Fig. 1F). Lophi lamelliform.

**Female.** Much larger than male (total length =  $59.37 \pm 3.27$  mm; hind femur length =  $29 \pm 1.91$  mm; pronotum length =  $10.83 \pm 0.6$  mm ( $n = 3$ )). Median carina of pronotum more raised. Otherwise same as male.

**Type.** Holotype male (Fig. 3A). Mexico: Guerrero: 9 rd. mi. NE. Taxco (1.7 rd. mi. SW. Acuitlapan) 5700 ft. 17 Sep 1959, I.J.Cantrall & T.J.Cohn, #137 (deposited at University of Michigan Museum of Zoology).

**Collecting Localities.** Eight paratypes ( $\sigma^7$ : 5,  $\text{♀}$ : 3) from UMMZ. **Mexico: Guerrero:** 9 rd. mi. NE. Taxco (1.7 rd. mi. SW. Acuitlapan) 5700 ft. 17 Sep 1959, I.J.Cantrall & T.J.Cohn, #137 (2  $\sigma^7$  + 1  $\text{♀}$ ); **Jalisco:** 12.4 mi. N. Barra de Navidad (on Hwy 80) 5 Oct 1970, T.J.Cohn & J.W.Cohn, #43 (2  $\sigma^7$ ); **Oaxaca:** 2.5 mi. E. La Ventosa (12 mi. NE Juchitán) 150 ft. 13 Sep 1959, I.J.Cantrall & T.J.Cohn, #107 (1  $\sigma^7$ ); **Puebla:** 3 mi. SE. Petalcingo 4900ft. 15 Sep 1959, I.J.Cantrall & T.J.Cohn, #126 (1  $\sigma^7$ ); **San Luis Potosi:** El Pujal. 100 ft. 18 Jul 1939, R.Haag (1  $\text{♀}$ ).

**Diagnostic Characters.** *Schistocerca cohni* has a bright yellow dorsal stripe from head to tegmina. Antennae are much longer than the combined length of head and pronotum, especially in males. It can be easily distinguished from the species in the Alutacea Group on the basis of male epiproct (Fig. 1H), which lacks a pair of tubercles and the male subgenital plate (Fig. 1I) which is not flared outwardly.

**Biology.** Not much is known about *S. cohni*. The specimens were collected from open woodlands with a thick growth of medium-height weeds. Nothing is known about its feeding preferences, but the overall ecology and behavior are likely to be similar to other species in the Alutacea Group.

**Taxonomic Discussion.** This species was initially discovered during a morphological phylogenetic analysis of *Schistocerca* (Song 2004a). The specimens were identified by Dirsh as *S. obscura* (Fabricius), but they clearly lacked a characteristic subgenital plate of

*S. obscura*. Further examinations on both internal and external morphological structures revealed that it was a new species overlooked by previous taxonomists. The collecting localities (Figure 3A) indicate that this species is widespread in various habitats. Song (2004a) found that *S. cohni* (*S. new sp.* in Figure 2) is phylogenetically closely related to the species in the Alutacea Group. In fact, this species possesses all the synapomorphies uniting the Alutacea Group, namely, round subgenital plate, quadrate cerci, pronotal granules, and constricted zygoxa (Song 2004b). *Schistocerca cohni* is superficially similar to *S. lineata*, but has a distinctly different epiproct where a pair of tubercles is absent. This loss character is also found in *S. albolineata* and *S. obscura*, but *S. cohni* is distinct from these two species because the apical lobes of subgenital plate are not flared outwardly.

**Etymology.** Named in honor of the eminent orthopterist, Dr. Theodore J. Cohn, who collected the type series.

***Schistocerca socorro* (Dirsh, 1974) n. stat. and just. emend.**

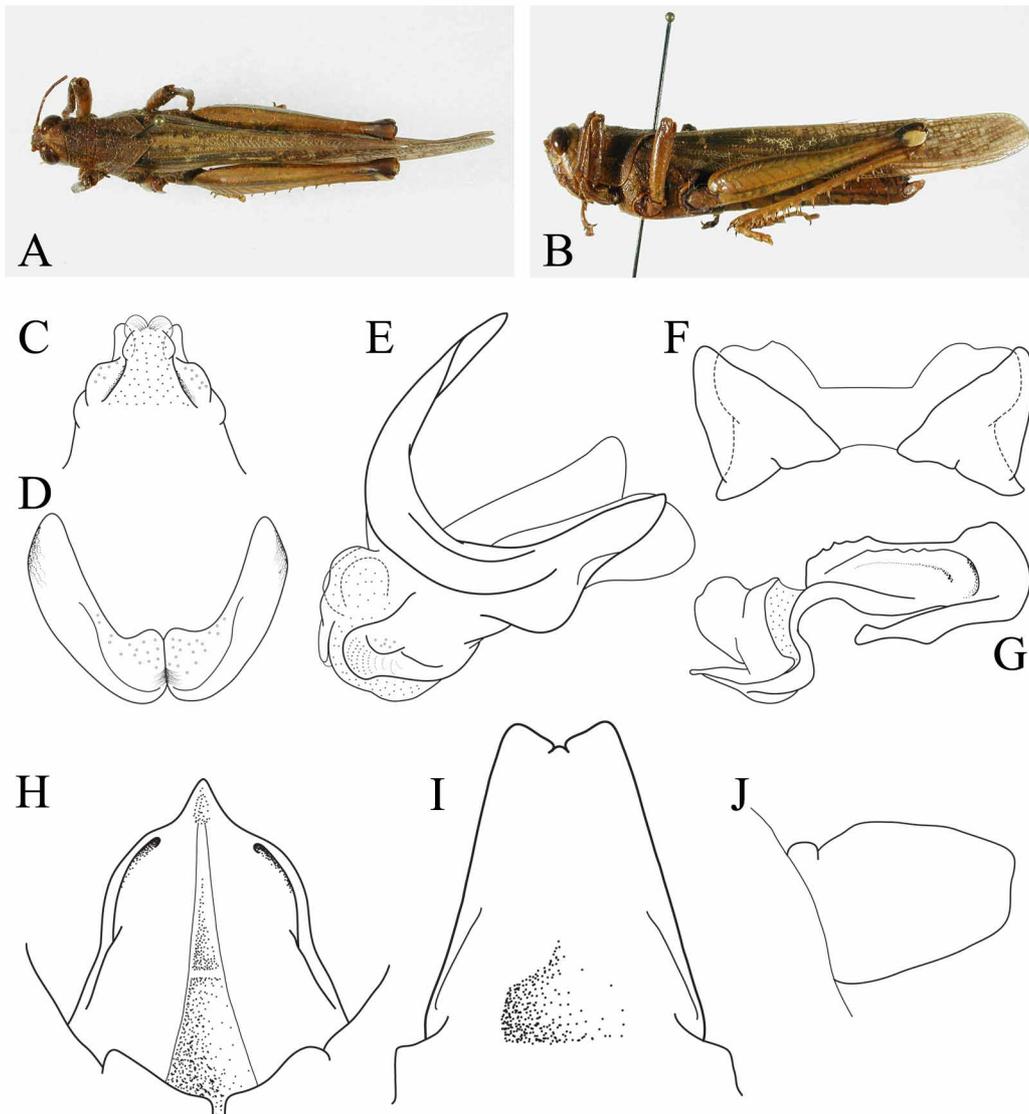
(Figs. 2A–2J, 3B)

*Schistocerca americana socoro* Dirsh, 1974: 59

**Male.** Medium size (total length =  $49.95 \pm 3.03$  mm; hind femur length =  $21.98 \pm 1.80$  mm; pronotum length =  $8.83 \pm 0.41$  mm ( $n = 10$ )).

Antennae slightly longer than the combined length of head and pronotum. Integument highly setose. Setae on pronotum, sternum, abdomen and femora short. Median carina of pronotum distinct and slightly raised, and slightly constricted. Sulci distinct, but not deep. Dorsal surface of prozona sculpting pattern very finely granulous with faint ridges. Lateral lobes of prozona faintly papillulate and wrinkled. Hind angle of pronotum slightly obtuse-angular. Granules absent. Pronotum width narrowing anteriorly. Tegmina extending beyond the tip of abdomen. Cerci slightly narrowing toward apex, with length about the same as width (Fig. 2J). Apical tip of cercus almost round, sometimes faintly bilobed, with upper and lower part forming elongated “3” shape. Furcula broad and sinuate, narrowing at the base. Epiproct with a pair of tubercle absent (Fig. 2H). Subgenital plate with smoothly angular and broad apex (Fig. 2I). Subgenital plate notch V-shaped.

**Color:** Overall dark brown. Dorsal stripe absent. Head brown with two subocular stripes, white anterior to dark brown. Two dark brown stripes converging on dorsal portion of head from behind eyes to occiput. Lateral lobes of pronotum with a faintly white horizontal streak. Marginal ridge of pronotum cream color. Epimeron brown without distinct marking. Tegmina semitransparent with distinct dark patches. Tegminal veins dark brown. Hind wings smoky. Posterior margin of abdominal tergites with a row of black dots. Dorsal and ventral surface of hind femora light brown. Hind femora without dorsal bands. Bottom half of medial area white. Dark stripe along upper carinula. Upper and lower carina without dots. Hind tibiae light brown, with tibial spines brown with black tip.



**FIGURE 2.** *Schistocerca socorro*. paratype male dorsal view (A), paratype male lateral view (B), “basal eminence” of zygoma (C), ectophallic sclerite (D), cingulum (E), epiphallus (F), endophallus (G), male epiproct (H), male subgenital plate (I), and male cercus (J).

*Phallus*: Cingulum, surfaces of rami not infolded in the middle and sinuate, thus making “basal eminence” appear hourglass-shaped and broad in the middle (Figs. 2C & 2E). Endophallus, basal valves ventral angle protruding slightly more than dorsal, overall semi-circular (Fig. 2G). Valves of cingulum pointed, protruding more than apical valves of aedeagus. Epiphallus, distance between lophi shorter than the length of base of a lophus (Fig. 2F). Lophi right-triangular.

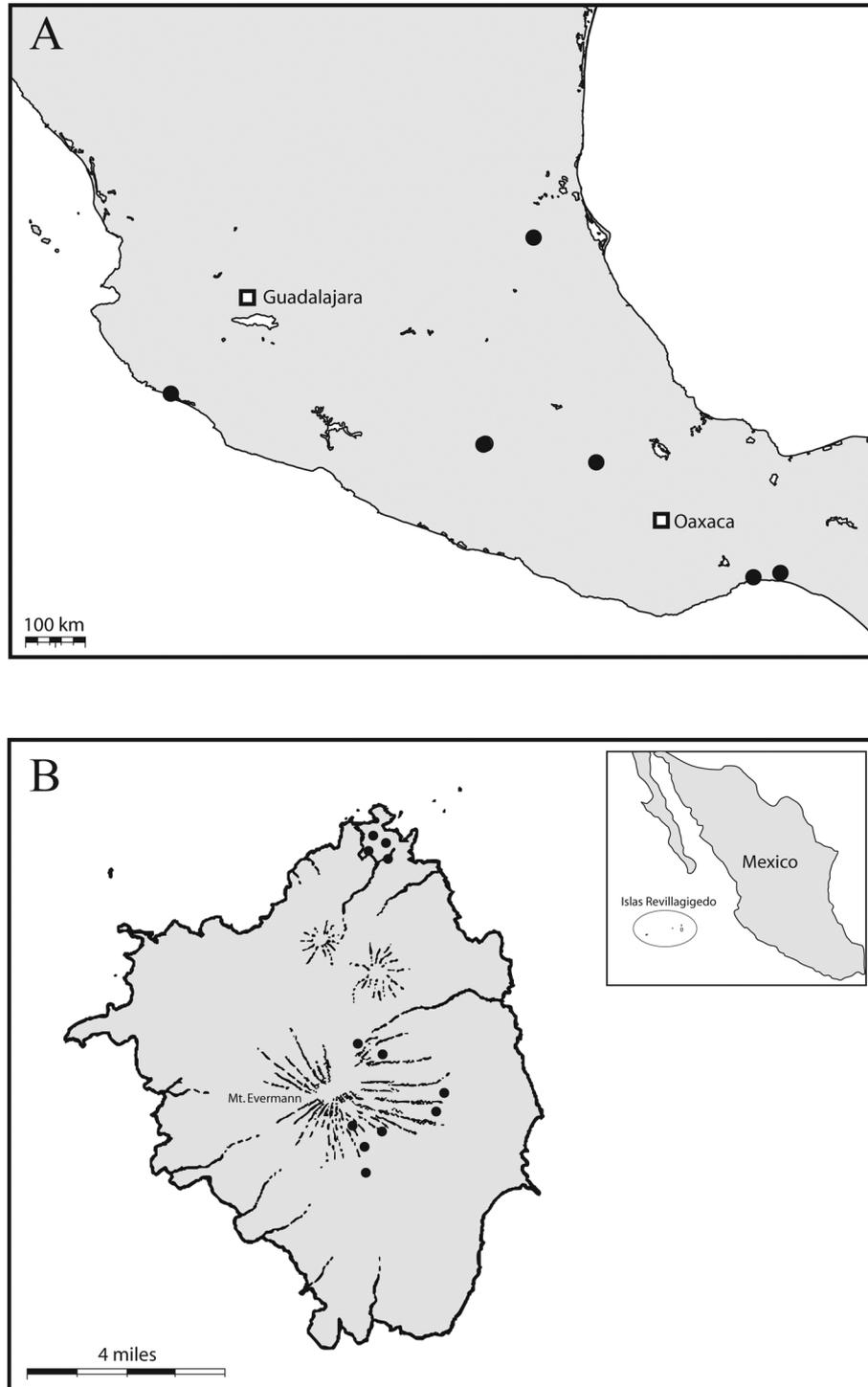
**Female.** Much larger than male (total length =  $67.5 \pm 4.58$  mm; hind femur length =  $30 \pm 2.60$  mm; pronotum length =  $15.83 \pm 3.75$  mm ( $n = 3$ )). Similar to male.

**Type Material.** 1. PARATYPE ♀ [BMNH] with labels, "Socorro I. / RevillaGigedo Is. / III-27-32," "M Willows Jr. / Collector," "Templeton / Crocker / Exped. 1932," "Para- / type," "From Collection / Calif Acad Sci," "USNM," "Brit. Mus. / 1981-203," "Ph," "32," "Schistocerca am. / socoro Dirsh ♀ / V.M.Dirsh det., 1974." 2. PARATYPE ♂ [BMNH] with labels, "Socorro Id. / Brthwte Bay / May 7, 1925," "H.H.Keifer / Collector," "Para- / type," "From Collection / Calif Acad Sci," "USNM," "Brit. Mus. / 1981-203," "Ph," "Schistocerca am. / socoro Dirsh ♂ / V.M.Dirsh det., 1974." 3. PARATYPE ♀ [USNM] with labels, "Socorro Id. / Brthwte Bay / May 7, 1925," "H.H.Keifer / Collector," "Para- / type," "USNM," "31," "SCHISTOCERCA / AMERICANA / SOCORO DIRSH / V.M. Dirsh det., 1971." 4. PARATYPE ♂ [USNM] with labels, "Socorro Id. / Brthwte Bay / May 7, 1925," "H.H.Keifer / Collector," "Para- / type," "From Collection / Calif Acad Sci," "USNM," "22," "SCHISTOCERCA / AMERICANA / SOCORO DIRSH / V.M. Dirsh det., 1971."

**Additional Material.** 13 specimens (10 ♂, 3 ♀) collected during CONABIO-sponsored trip to Socorro Island (October 17-November 5, 2004). **Mexico: Colima:** Islas Revillagigedo, Isla Socorro. Road to al Volcan in the forest N18°45.494' W110° 57.557' 618 m, 20-X-2004; 40 min. hike up from *Senna* field (El Paradero) N18°46.331' W110° 57.402' 1716 ft, 25-X-2004; Playa Norte N18°51.527' W110° 59.249' 153 ft, 27-X-2004; Road to Playa Norte N18°46.283' W110° 55.595' 345 m, 26-X-2004; Road to Playa Norte N18°47.172' W110° 56.031' 361 m, 26-X-2004; Road to Playa Norte N18°48.011' W110° 56.269' 360 m, 29-X-2004.

**Diagnostic Characters.** *Schistocerca socorro* is overall dark brown with no dorsal stripe. This species is only found on Socorro Island and seems to prefer a forest habitat. Two migrant *Schistocerca* species, *S. piceifrons* and *S. nitens*, co-occur on the island, and an angular hind margin of pronotum of the endemic species is a useful character to distinguish it from *S. piceifrons*, which has a round hind margin of pronotum. Dark patches on tegmina can be used to distinguish the endemic species from *S. nitens* which has a mottled pattern on tegmina.

**Distribution.** This species is endemic to Socorro Island, Mexico (Fig. 3B). Socorro Island is the largest of four islands comprising the Islas Revillagigedo, located about 480 kilometers southwest of Baja California, México. The type series of *S. socorro* was collected from Braithwaite Bay, a mixed habitat located at lower elevations of the island. However, a migrant locust species, *S. piceifrons*, currently inhabits at Braithwaite Bay in large numbers. Recently collected material of *S. socorro* is all from higher elevations, in the forest in Mt. Evermann and in Playa Norte. This could indicate that the endemic species is limited to higher elevations perhaps due to competitive exclusion (Song *et al.* accepted).



**FIGURE 3.** Collecting localities of *Schistocerca cohni* n. sp. (A), and collecting localities of *Schistocerca socorro* on Socorro Island (B).

**Biology.** *Schistocerca socorro* is an arboreal species that prefers to feed on native herbaceous plants. It is behaviorally sedentary and is a strong flyer. In early 2003, a group of Mexican officials and researchers working on Socorro Island reported a significant locust outbreak. The locust species was later identified as *S. piceifrons*, which apparently colonized the island from the mainland Mexico at unknown time. Because of the voracity of the locusts, especially to the native flora, CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad) issued a year-long ecological study of the impact of *S. piceifrons* to the island biota. CONABIO was particularly concerned with the negative impact of the locusts to the endemic *Schistocerca* species, then known as *S. americana socoro*. This endemic species had not been collected since 1925. In October 2004, a group of researchers from Universidad Nacional Autónoma de México (UNAM) and I visited Socorro Island and found several sustainable populations of the endemic species. We also identified several ecological differences between *S. socorro* and *S. piceifrons*. Although there are areas where two species co-occur, we found that the endemic species is mostly confined to the forested areas in higher elevations, whereas the locust species occur in disturbed areas in lower elevations. We do not know how the endemic species interacts with the locust species, and a continuous monitoring of the population dynamics is desperately needed.

**Taxonomic Discussion.** Dirsh (1974) originally described *Schistocerca americana socoro* based on a series collected in 1925 by Hartford H. Keifer and in the California Academy of Sciences. He described it as a subspecies of *S. americana*, because he reasoned that patterns on hind femora and tegmina were indicative of an affinity to the nominal species, but these characters have since shown to be highly variable and taxonomically unreliable (Song 2004a). In a phylogenetic analysis, Song (2004a) showed that all the species in the Americana Complex (*sensu* Harvey 1981) are grouped by a round hind margin of pronotum, which *S. socorro* lacks. Thus, here I argue for a taxonomic status change from a subspecies to a valid species. Dirsh (1974) also used a subspecific epithet *socoro* despite the fact that the type label clearly states the correct spelling of the island. *Schistocerca socorro* is the only endemic grasshopper species on Socorro Island, and I feel it is important for it to reflect the correct name of the island. Thus, I propose a justified emendation of the species epithet from *socoro* to *socorro*.

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