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THREE NEW SPECIES OF SOLIFUGAE FROM NORTH AMERICA AND A DESCRIPTION OF THE FEMALE OF *BRANCHIA BREVIS* (ARACHNIDA, SOLIFUGAE)

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ABSTRACT. Three new species of Solifugae are described: *Eremobates paleta* from Mexico, is a member of the *Eremobates scaber* species group; *Eremobates inkopaensis* from California, U.S.A., is a member of the *Eremobates palpisetulosus* group; and *Eremochelis albaventralis* from Mexico is tentatively placed in the *Eremochelis bilobatus* group. The female of *Branchia brevis* Muma from Texas, U.S.A. is described for the first time.

Keywords: Solpugida, species description, taxonomy, camel spider, sun spider, wind scorpion

New species of solifugids are being discovered each year as a result of re-examination of museum material and newly collected material being sent in for identification. These new species are beginning to shed some light on the phylogenetic relationships among species and between species-groups (Brookhart & Cushing 2002, 2004). Herein we describe three new species in the family Eremobatidae and provide a description of the female of *Branchia brevis* Muma 1951 from the family Ammotrechidae.

Using the methods of Muma (1951), Brookhart & Muma (1981, 1987), Muma & Brookhart (1988) and Brookhart & Cushing (2002, 2004) we measured length of palpus, leg I, leg IV, length and width of chelicera and propeltidium, length and width of fondal notch when present, width of base of fixed finger, and length and width of female genital operculum. Abbreviations used to indicate various cheliceral structures are as follows: FF = fixed finger; MF = movable finger; PT = primary tooth; AT = anterior tooth; MT = medial tooth; IT = intermediate tooth; MST = mesal tooth. All measurements are in millimeters.

The number, shape and relative length of ctenidia to succeeding tergite was noted. Counts were made of palpal papillae. Color of palpus, legs I, II, III, IV and general overall color especially that of the propeltidium was recorded. The shape of the female genital operculum especially the medial margin was observed using the terminology of Brookhart & Cushing (2004).

Ratios used previously by Muma (1951, 1970, 1989), Brookhart & Muma (1981, 1987), Muma & Brookhart (1988), and Brookhart & Cushing (2002) were computed. These ratios are as follows: A/CP: the sum of the lengths of palpus, leg I, and leg IV divided by the sum of length of chelicera and propeltidium indicating length of appendages in relation to body size. The larger the number, the longer legged is the species. CL/CW: cheliceral length divided by cheliceral width. FL/FW indicates whether the cheliceral fondal notch is longer or wider. Longer is defined as the anterior to posterior axis and width is defined as the dorsal to ventral axis. PL/PW compares propeltidium length to width. FW/FFW diagnoses the size of fondal notch compared to the thickness of fixed finger. CW/FFW is used to indicate whether the fixed cheliceral finger is thin or robust in relation to the size of the chelicera. This is a useful ratio when there is no fondal notch. GOL/GOW demonstrates the relative size of the female genital operculum in terms of length and width. Abbreviations for collections are as follows: DMNS = Denver Museum of Nature & Science, Denver, Colorado; EMEC = Essig Museum of Entomology, University of California at Berkeley, Berkeley, California; FSCA = Florida State Collection of Arthro-

pods, Gainesville, Florida; SDMC = San Diego Natural History Museum, San Diego, California.

SYSTEMATICS

Family Eremobatidae Kraepelin 1901
Subfamily Eremobatinae Kraepelin 1901
Genus *Eremobates* Banks 1900

Eremobates paleta new species
Figs. 1–5

Material examined.—Holotype male from 2.5 km S. of El Salto (23°28′N, 105°13′W), *Durango Province,* Mexico, 4 August 1986, D.K. Faulkner (SDMC).

Etymology.—From the Spanish for trowel, *paleta,* which refers to the shape of the four ctenidia. To be treated as a noun in apposition.

Diagnosis.—This new species is placed in the *Eremobates scaber* group based on the notch on the posterior aspect of the male fixed finger when viewed dorsally. The four trowel-shaped ctenidia as well as the combination of coloration and ''crimped'' male fixed finger distinguishes it from other members of the *Eremobates scaber* group.

Description.—*Male holotype:* total length 20, chelicera length 2.5, chelicera width 2.5, propeltidium length 3.5, propeltidium width 4.8, palpus length 16, first leg length 17, fourth leg length 20. Ratios: A/CP 8.8, CL/CW 2.24, PL/PW 0.73, FL/FW 1.0, CW/FFW 5.0.

Overall coloration lemon yellow with dusky purplish-brown markings on anterior edge of propeltidium and ocular area (Fig. 1), violet-brown on apical tip of palpal tarsus (Fig. 2). All legs lemon yellow, abdomen dark violet brown dorsally, lighter violet brown ventrally, pleura a light violet. Malleoli white. Cheliceral fixed finger ''crimped'' in mesal view without teeth, movable finger with large PT, smaller AT with no cleft, posterior IT on PT, MST medium in size. ''Crimped'' fixed finger defined in Brookhart & Cushing (2004) and shown as a recurved dorsal edge of fixed finger in Fig. 3. Fondal notch equal in length to width. Fondal teeth graded I, III, II, IV ectally and mesally (Figs. 3 & 4). Mesoventral groove typical of the group, narrow, deep, ending in a cup-like depression beneath the origins of flagellum complex. Flagellum complex typical of *Eremobates* group with apical plumose bristle large, flattened, occupying approximately 90% of mesoventral groove. Palpus with 40 rounded papillae on the apical, ventral region of palpus (Fig. 2). Four short, trowel shaped ctenidia (Fig. 5).

Remarks.—The only valid recorded member of the scaber group from Mexico is *Eremobates legalis* Harvey 2002 which is known from the female type only and has no type locality. Vásquez-Rojas's (1981, 1995) records of *Eremobates zinni* Muma 1951 and *Eremobates ctenidiellus* Muma 1951 appear to be in error based on our recent studies (Brookhart & Cushing 2004). *Eremobates paleta* does not appear to be related to *E. legalis* based on coloration. Gavino (pers. comm.) is also describing a new scaber species from the Baja region of Mexico. The ''crimped'' aspect of the fixed finger is unusual for a species in the southern regions of North America (Brookhart & Cushing 2004).

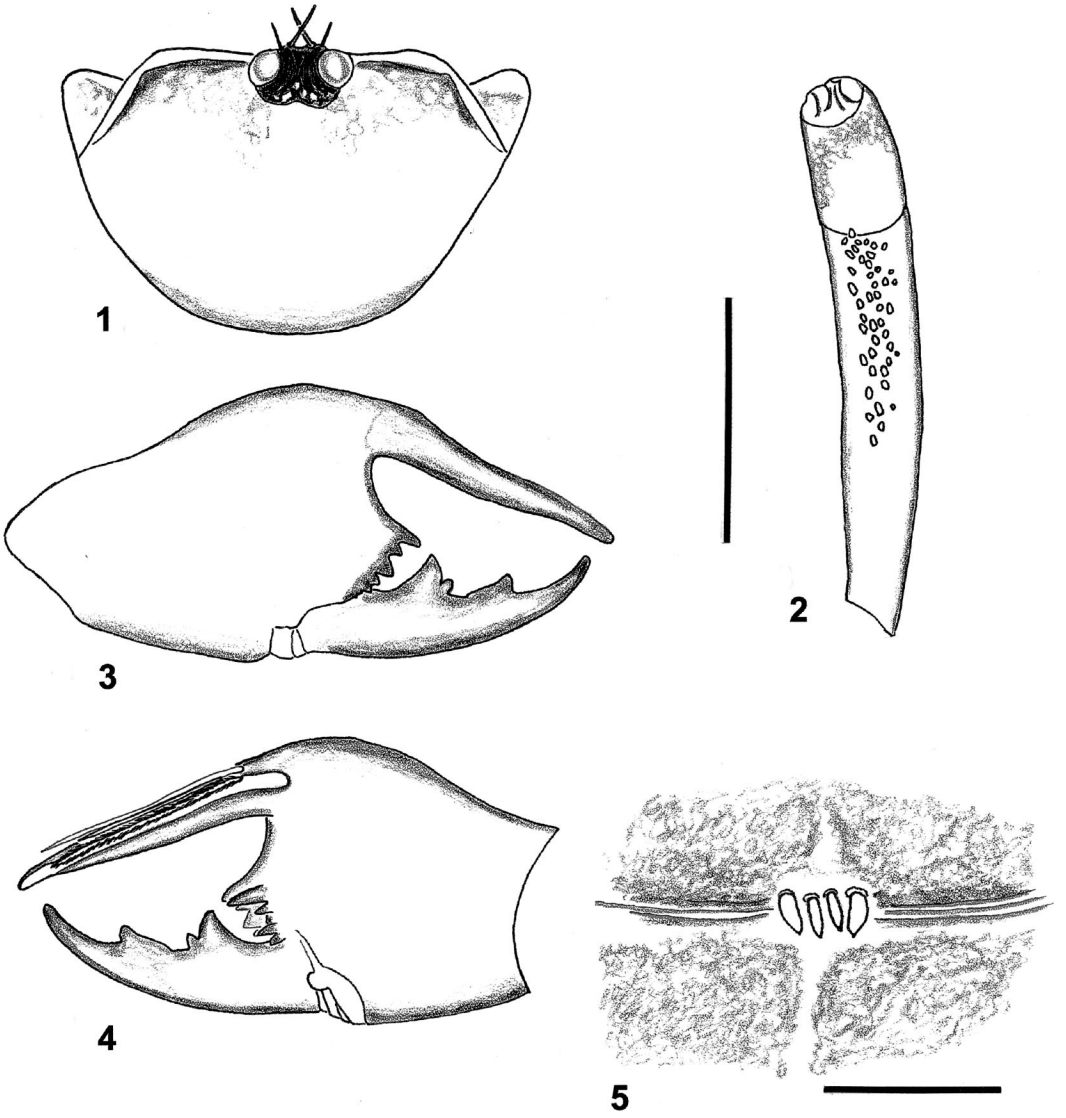
Eremobates inkopaensis new species
Figs. 6–9

Material examined.—Male holotype, In Ko Pah Valley, Meyer Gorge (32°43′N, 116°02′W), Imperial County, *California,* U.S.A., 14 March 1982, pitfall trap, J. Berrian (SDMC). Female allotype from same site, pitfall trap, 17 April 1982, J. Berrian (SDMC). Paratypes: U.S.A.: *California*: 6 males and 1 female from same site locality by same collector between 4 March–17 April 1982 (5 male paratypes in SDMC, 1 male and 1 female in DMNS).

Etymology.—Refers to the type locality, In Ko Pah Valley.

Diagnosis.—This member of the *Eremobates palpisetulosus* group is a member of the kraepelini series as defined by Muma & Brookhart (1988). It is the only member of this group without ctenidia. Most members of this series are pale but have some dusky to dusky purple markings. *Eremobates inkopaensis* is entirely pale in both the male and female.

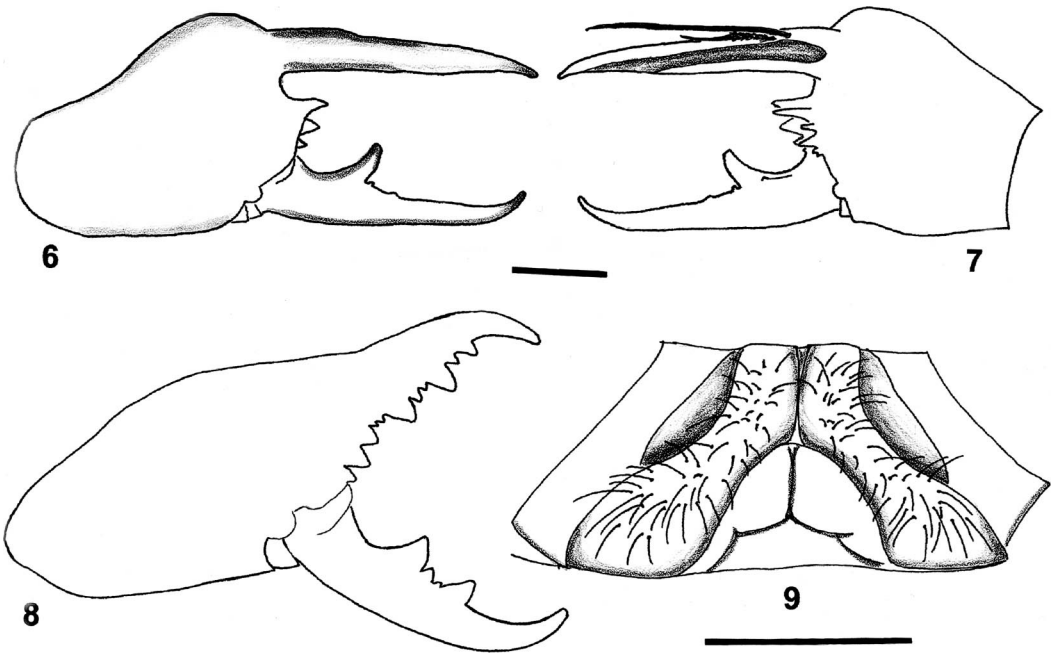
Description.—*Male holotype:* total length 21, cheliceral length 5.4, cheliceral width 2.2, propeltidium length 2.6, propeltidium width 5.2, palpus length 14, first leg length 16, fourth leg length 27. Ratios: A/CP 7.04, CL/CW 2.6, PL/PW 0.5, FL/FW 1.0, CW/FFW 5.2. Coloration cream yellow in all aspects of chelicera, propeltidium and appendages. Malleoli white. Cheliceral FF with low, incon-



Figures 1–5.—*Eremobates paleta* new species. 1–5. Male holotype. 1. Male propeltidium, dorsal view; 2. Male palpus, ventral view; 3. Male right chelicera, ectal view; 4. Male right chelicera, mesal view; 5. Male fourth abdominal segment showing ctenidia, ventral view. Scale bars = 1 mm.

spicuous ridge on basal aspect of FF. No teeth ventrally. MF with large PT but only a low ridge anteriorally, small posterior IT separate from PT, tiny AT, MST absent (some paratypes have tiny MST). Fondal teeth graded I, III, II, IV. Fondal notch equal length to width. Mesoventral groove deep, median in position expanding ventrally near the tip (Figs. 6 & 7). Flagellum complex typical of group, no ctenidia, no palpal papillae. *Male paratypes (6):* total length 20–26, cheliceral length 5.5–6.4, cheliceral width 2.2–2.9, propeltidum length 2.3–3.1, propeltidium width 4.4–4.9, palpus length 17.5–22.0, first leg length 16.0–18.0, fourth leg length 22.0–29.0. Ratios: A/CP 6.5–8.0, CL/CW 2.2–2.9, PL/PW 0.52–0.67, FL/FW 0.7–1.0, CW/FFW 4.2–4.8.

Female allotype: total length 22, cheliceral length 6.2, cheliceral width 2.2, propeltidium length 2.1, propeltidum width 3.9, palpus



Figures 6–9.—*Eremobates inkopaensis* new species. 6–7. Male holotype. 6. Male right chelicera, ectal view; 7. Male right chelicera, mesal view. 8–9. Female allotype. 8. Female right chelicera, ectal view; 9. Female genital operculum, ventral view. Scale bar = 1 mm.

16.5, first leg length 12.5, fourth leg length 21.0. *Ratios*: A/CP 4.3, CL/CW 2.8, PL/PW 0.74 GOL/GOW 0.82. Coloration is the same as the males. Chelicera typical of the group, FF with large PT and MT, smaller AT, two IT between PT and MT, one IT between IT and AT, MF with large PT and medium AT, two smaller IT, MST absent (Fig. 8). Genital opercula with broad anterior arms, recurved medial margin, short, curved wings, posterior margin straight (Fig. 9). The allotype but not the paratype with four tiny, thin ctenidia. *Female paratype (1)*: total length 31, cheliceral length 6.8, cheliceral width 2.2, propeltidium length 3.7, propeltidium width 5.5, palpus length 19.5, first leg length 16.5, fourth leg length 26.0. *Ratios*: A/CP 5.96, CL/CW 2.6, PL/PW 0.65, GOL/GOW 0.76.

Remarks.—The nine specimens of *Eremobates inkopahensis* were collected in mid-March to early April indicating an early maturity. *Eremobates gracilidens* Muma 1951 is also found in southern California in Inyo and San Bernardino counties. The two females are shorter legged then *E. gracilidens* based on the A/CP ratio. The genital opercula are typical of the group although the anterior arms are broader than in other members of this group.

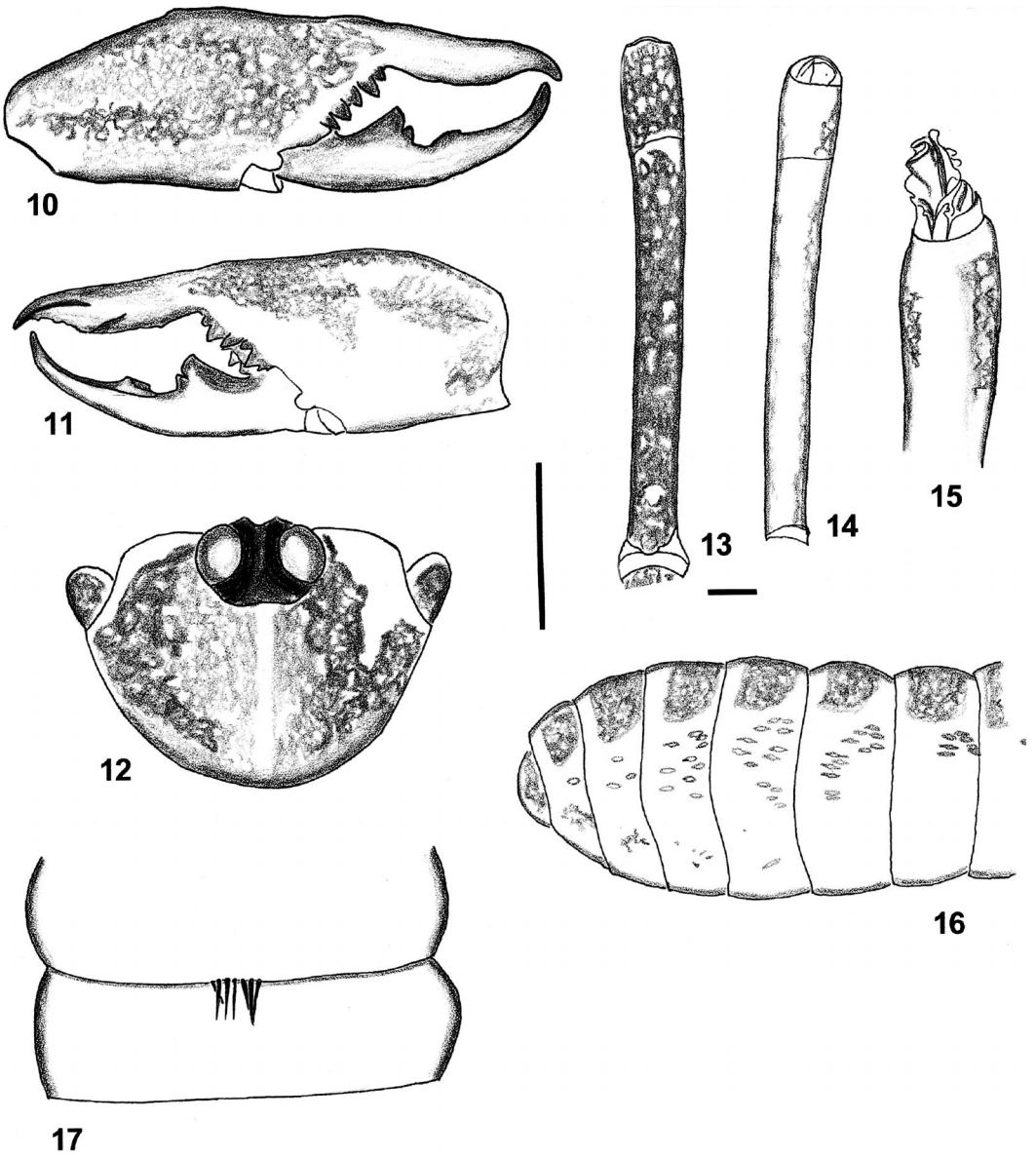
Genus *Eremochelis* Roewer 1934
Eremochelis albaventralis new species
Figs. 10–17

Material examined.—Holotype male, 7 km WSW of Juchitepec (19°06′N, 98°52′W), *Mexico State,* Mexico, 24 August 1987, J. Doyen (CAS). Paratypes: Mexico: *Mexico State*: 1 male, same collection data as holotype (CAS); 1 male, same collection data as holotype (DMNS).

Etymology.—Refers to the contrasting white underside of the species.

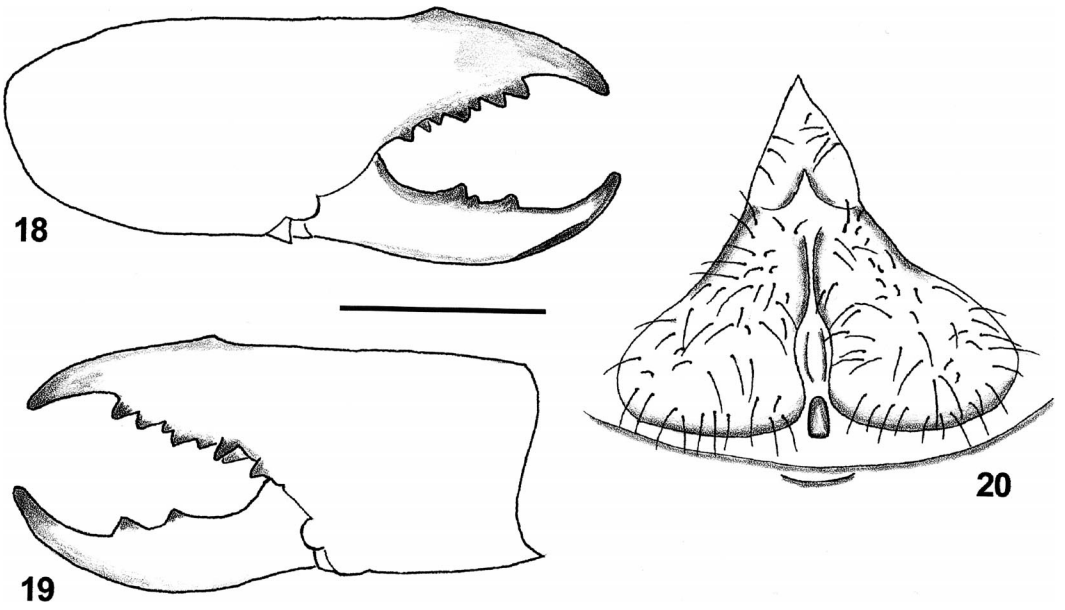
Diagnosis.—This species is distinguished from *Eremochelis rossi* Muma 1987 on the basis of coloration, shape of fixed finger, and ctenidial number and shape.

Description.—*Male holotype:* total length 14, cheliceral length 3.3, cheliceral width 1.3, propeltidium length 1.5, propeltidium width 2.3, palpus length 13.5, first leg length 10.0, fourth leg length 14.0. Ratios: A/CP 7.8, CL/CW 2.5, PL/PW 0.43, no fond, CW/FFW 2.6.



Figures 10–17.—*Eremochelis albaventralis* new species. 10–14. Male holotype. 10. Male right chelicera, ectal view; 11. Male right chelicera, mesal view; 12. Male propeltidium, dorsal view; 13. Male right palpus, dorsal view; 14. Male right palpus, ventral view. 15. Male paratype, ventral view showing everted suctorial organ. 16–17. Male holotype. 16. Male abdomen, ectal view; 17. Male fourth abdominal segment showing ctenidia. Vertical scale line = 1 mm for 10, 11, 12, 16, & 17. Horizontal scale line = 1 mm for 13, 14, & 15.

Metatarsus/tarsus ratio 4.2. *Male paratypes (2):* total length 13–15, cheliceral length 3.4–3.6, cheliceral width 1.3–1.6, propeltidum length 1.9–2.0, propeltidium width 2.3–2.7, palpus length 13.0–16.0, first leg length 10.0–11.0, fourth leg length 14.0–17.0. *Ratios*: A/CP 6.2–7.0, CL/CW 2.25–2.40, PL/PW 0.75–0.80, no fond, CW/FFW 2.6–3.2. Metatarsus/tarsus ratio 4.25–4.50. Coloration in alcohol a blotchy, vibrant violet brown on the dorsal as-



Figures 18–20.—*Branchia brevis* female. 18. Female right chelicera, ectal view; 19. Female right chelicera, mesal view; 20. Female genital operculum, ventral view. Scale line = 1 mm.

pect of most of palpus (Fig. 13), legs I, II, III, IV and most of the propeltidum except for a thin linear area of creamy yellow on the median sector (Fig. 12). Entire ventral aspect white including palpus (Fig. 14). Abdomen more lightly colored with distinct patches on the ectal regions (Fig. 16). Chelicera with 3 lighter stripes ectally of the same color (Fig. 10). Malleoli white. Cheliceral FF with no teeth or denticles, blade shaped with a circular region where you would normally find the fondal notch. Small ventral cup anteriorly extending to a broad, shallow mesoventral groove. MF with large PT and a cusp-like structure for an AT; small IT on the PT; no MST (Figs. 10 & 11). Flagella complex of tubular to slightly striate bristles. No scopula, seven short, needle-like ctenidia (Fig. 17). The everted palpal suctorial organ is shown in Fig. 15.

Remarks.—This species is tentatively placed in the *Eremochelis bilobatus* group but clearly needs to be part of a new group which would include *E. albaventralis*, *E. rossi* Muma 1987, *E. cochiseae* Muma 1989, *E. kerni* Muma 1989 and possibly the two members of the *E. andreasana* group, *E. andreasana* Muma 1962 and *E. larrea* Muma 1962. This distinction is based mainly on the unique shape of the male chelicera.

Family Ammotrechidae Roewer 1934
Subfamily Saronominae Roewer 1934
Genus *Branchia* Muma 1951
Branchia brevis Muma 1951
Figs. 18–20

Branchia brevis Muma 1951: 137–138, figs. 311, 312; Harvey 2003: 208 (full synonymy).

Type specimen.—Holotype male, Edinburgh, Hidalgo County, *Texas*, U.S.A. (26°11′N, 98°06′W), 15 March 1939, S. Mulaik (AMNH).

Material examined.—U.S.A.: *Texas:* Webb County: 19 ♂, 8 ♀, 57.1 km NW of Laredo (27°34′N, 99°30′W), Rt. 83, under cow pies, 21 April 1980, M.H. Muma (FSCA); 2 ♂, 1 ♀, same collection data (DMNS).

Description.—*Females (5):* Length 16.0–18.5, cheliceral length 2.8–3.3, cheliceral width 1.1–1.2, propeltidium length 1.8–2.1, propeltidium width 1.9–2.3, palpus length 5.0–7.0, first leg length 4.0–5.0, fourth leg length 11.5–12.5. Ratios: A/CP 4.45–4.53, PL/PW 0.9, GOL/GOW 0.85–0.92.

Overall coloration in alcohol pale creamy

yellow; ocular area pale; palpus with splotchy brown violet on tarsus and apical two thirds of metatarsus; other appendages creamy yellow; abdomen dusky yellow dorsally and very pale ventrally. Fixed finger typical of the group with equally sized PT, MT and AT; one small IT between PT and MT, MST absent; FT graded II, I ectally and III mesally (Figs. 18 & 19). No ctenidia, no palpal papillae. Genital operculum typical of the group (Fig. 20).

Remarks.—Muma (1951) described the male of *Branchia brevis* from Hidalgo Texas, U.S.A. but did not describe a female allotype (Muma 1951, 1962, 1970, 1989). One of the authors (JOB) has in his personal collection two males and a female from 57.1 km northwest of Laredo, Texas labeled ''*Branchia brevipes*'' with the Muma identifying label. There is no record of this species. The FSCA also has five vials containing nineteen males and eight females of Muma's material from the same site collected on the same day labeled ''*Branchia brevipes*''. Examination of the male holotype as well as the above material determined all these specimens to be *Brancia brevis* Muma. These are included in the material examined.

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