SYSTEMATIC OBSERVATIONS ON THE SCORPION GENUS *SYNTROPIS,* WITH DESCRIPTIONS OF TWO NEW SPECIES (SCORPIONES: VAEJOVIDAE)

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Abstract: Two new species of the vaejovid genus *Syntropis* are described, *Syntropis aalbui* **sp. nov.** and *Syntropis williamsi* **sp. nov.** The discovery of *S. aalbui* extends the known range of *Syntropis* over 350 km northward in Baja California, Mexico. These species are separated from *Syntropis macrura* Kraepelin, 1900 by significant morphometric differences of the metasoma, telson vesicle, and pedipalp, as well as, in part, by overall coloration, its patterns, and pectinal tooth counts. The systematic position of the genus *Syntropis* in the Vaejovidae is discussed and a distribution map of all known records is provided.
Key words: Scorpiones, Vaejovidae, *Syntropis*, **n. sp.**, Mexico.

Observaciones sistemáticas sobre los escorpiones del género *Syntropis*, con la descripción de dos nuevas especies (Scorpiones: Vaejovidae)
Abstract: Se describen dos nuevas especies del género vaejóvido *Syntropis*, *Syntropis aalbui* **sp. nov.** y *Syntropis williamsi* **sp. nov.** El descubrimiento de *S. aalbui* extiende el área de distribución conocida de *Syntropis* más de 350 km hacia el norte en Baja California, México. Estas especies se distinguen de *Syntropis macrura* Kraepelin, 1900 por diferencias morfométricas significativas en el metasoma, vesícula del telson y pedipalpo, así como, en parte, por la coloración general, los dibujos y el número de dientes pectinales. Se discute la posición sistemática del género *Syntropis* en los Vaejovidae, y se aporta un mapa con todos los registros conocidos.
Palabras clave: Scorpiones, Vaejovidae, *Syntropis*, **n. sp.**, México.

Taxonomy/Taxonomía: *Syntropis aalbui* **sp. n.**   *Syntropis williamsi* **sp. n.**

Introduction

We had the opportunity to study six *Syntropis* Kraepelin, 1900, specimens from Baja California, Mexico, five of which originated from two diverse geographic localities representing the most northern and southern records known to date for the genus. The southern locality, Los Aripes, Baja California Sur, matches the most southern record reported by Williams (1980), and the northern locality, Cataviña, Baja California, is a new record, extending the known range of *Syntropis* north by over 350 km. The previous most northern reported locality was San Ignacio, Baja California Sur. All previous records of *Syntropis* are from the Sierra de Guadalupe or Sierra de la Giganta mountain ranges, while the new Cataviña record is considerably outside these ranges, occurring in the inland Sierra Columbia, at the northernmost edge of the Sierra de Calamajué range. The sixth specimen examined originated from Isla del Carmen, Baja California Sur, the only known island record for this genus.

Upon receipt of the specimens from Los Aripes we immediately noticed that they did not exhibit the extreme slenderness of *Syntropis macrura* as shown in the photographs of adult males in Stahnke (1965: fig. 2, the holotype) and Williams (1980: fig. 49). In support of this observation, we see further that Williams (1980: 48) contrasted the most southern populations of *Syntropis* (i.e., in the Los Aripes area) with the other northern and central populations of *Syntropis* as he stated: "… adult males had metasomal segment V 5.2 times longer than wide (instead of 7 times

longer); adult females … 4.0 to 4.3 times longer than wide (instead of 5.2 …) … vesicle was less elongate and more swollen in both sexes …". In addition, he also states "… lighter coloration … pectine teeth of males were 26–28 (not 29–32) … females were 24–26 (not 27–31) …". Our four specimens from Los Aripes comply with all of Williams' observations, having a much stouter metasoma and telson vesicle. Their overall coloration is a light yellow including the chelal fingers, which are darkly pigmented in the other populations, and the pectinal tooth counts are consistent as well, our specimens exhibiting 24–25 in females and 25–26 on the male (which lowers Williams' (1980) observed range of 26–28). These observations were confirmed further after the examination of an adult female *S. macrura* Kraepelin, 1900, from Isla del Carmen, Baja California Sur, Mexico.

The large adult female specimen from Cataviña also demonstrates significant morphometric based differences from *S. macrura*, the metasoma and telson vesicle being much more stocky, exhibiting proportions similar to those seen in the Los Aripes material. In addition, the specimen from Cataviña is considerably out of the reported geographic range of *Syntropis*.

We also discovered that the pedipalpal femur and patella of the Los Aripes specimens are considerably stockier than that found in the northern-central and Cataviña populations, which, in our opinion, represents yet another important diagnostic character. The differences in coloration and its patterns and pectinal tooth counts in the Los Aripes

population are secondary in our opinion, but nonetheless further support a new species status for the Los Aripes population. The specimen from Cataviña differs from the Los Aripes population by exhibiting a much slenderer pedipalp femur and patella, similar to that found in *S. macrura*.

We consider these morphometric differences involving the metasoma, telson vesicle, and pedipalpal femur and patella to be very significant: the new material (adult female) exhibits a 28 to 33 % difference in the slenderness of metasomal segments III to V and a 17 % difference in the slenderness of the telson vesicle from the more slender *S. macrura*. The specimens from Los Aripes exhibit 18 to 36 % difference in the slenderness of the pedipalp femur and patella from the other two populations. Therefore we conclude that the northern Cataviña and southern Los Aripes populations are both different species from that found in the northern-central regions of Baja California Sur, which we establish in this paper to be *S. macrura*.

Taxonomic history
In 1900 Kraepelin described the new genus *Syntropis* and male type species *Syntropis macrura* where he emphasized the single ventromedian (*VM*) carina of metasomal segments I–IV. In addition, to emphasize the importance of this character, Kraepelin (1905) later proposed subfamily Syntropinae in family Vaejovidae, based solely on the presence of a single *VM* carinae on segments I–IV, where he placed into it *Syntropis*, as its only member. Most other workers continued recognition of this subfamily, Birula (1917: 163), Werner (1934: 281), Mello-Leitão (1945: 118). Interestingly, Hoffmann (1931) did not mention subfamily Syntropinae, nor *Syntropis* for that matter, in his monograph on the scorpions of Mexico. Although the main bulk of species addressed by Hoffmann (1931) were from mainland Mexico, references were made to Baja California for species *Hadrurus hirsutus* (now identified as *H. arizonensis* Ewing, 1928), *Anuroctonus phaiodactylus* (now identified as *A. pococki* Soleglad et Fet, 2005), *Uroctonus mordax* Thorell, 1876 (a misidentification, possibly a *Pseudouroctonus* species), *Brotheas allenii* (Wood, 1863) (now identified as *Nullibrotheas allenii*), and *Vaejovis punctipalpi* (Wood, 1863), so the omission of *Syntropis* is strange indeed. Gertsch (1958: 14-15) listed *Syntropis* for Baja California, and discussed its omission in Hoffmann (1931) as well as its subfamily status listed by Werner (1934). In 1969, Williams named a second species of *Syntropis*, *S. longiunguis*, also from Baja California, Mexico, again based on the unusual characteristic of a single *VM* carina on metasomal segments I–IV, but did not mention any subfamily affiliation. Williams (1969: 290–291) commented that the two species were considerably different but considered the differences to be superficial, placing primary emphasis on the single *VM* carina. Stahnke (1974: 113, 120–122) recognized subfamily Syntropinae but assigned *S. longiunguis* to a new genus, *Vejovoidus*, though both genera, *Syntropis* and *Vejovoidus*, remained in Syntropinae based on their single *VM* carina. Williams (1980), in his treatise on the scorpions of Baja California, retained Stahnke's (1974) split into two genera but, again, did not mention subfamily Syntropinae. Stockwell (1989: 195–207), in an unpublished Ph.D thesis, acknowledged Syntropinae in his detailed phylogenetic analysis of scorpions, but its definition was extremely broad

(containing *Syntropis* along with almost all other known vaejovid genera), resembling absolutely nothing of Kraepelin's original narrow diagnosis. More important, Stockwell (1989) recognized that genus *Vejovoidus* was not related at all to *Syntropis*, showing instead a close affinity to the genera *Paruroctonus*, *Smeringurus*, and *Paravaejovis*. Sissom (1990: 107) mentioned subfamily Syntropinae in his combined treatment of families Chactidae and Vaejovidae and made several comments, including the following: "… Although this is not the place to argue for the dissolution of the Syntropinae, the differences between *Syntropis* and *Vejovoidus* are outstanding … not closely related …". Finally, Stockwell (1992: 408–409) synonymized subfamily Syntropinae with Vaejovinae; in doing so, however, he writes "… Distinct groupings within this family are clear enough to recognize subfamilies, but I will defer on this subject until a later time …". Sissom (2000) did not recognize Syntropinae, or any other vaejovid subfamilies. We discuss Stockwell's (1989) cladistic results in more detail elsewhere where we discuss *Syntropis*'s placement in family Vaejovidae (Soleglad et al., in progress).

Stahnke (1965) provided a translation of Kraepelin's (1900) original description of genus *Syntropis* and species *Syntropis macrura*, a full set of measurements of the holotype male, and photographs of the dorsal (full) and ventral (partial) views of the specimen. Very little has been published or illustrated on *Syntropis* since Stahnke's (1965) redescription. Although Williams (1969) reported having collected several dozen specimens of *S. macrura*, a noteworthy event in itself, he concentrated on his description of *Vejovoidus longiunguis* (named *Syntropis longiunguis* at that time), providing no new information or locality data on his *S. macrura* material. Vachon (1974: figs. 140, 148–150), in his monumental treatise on trichobothria, illustrated for the first time the trichobothrial pattern of presumably the male holotype of *S. macrura* (i.e., the type is deposited in Paris at the MNHN). Hjelle (1974) had the opportunity to study the birth behavior of *S. macrura*. In this excellent paper, Hjelle provided photographs of a female with newborn as well as first and second instar juveniles. In his monograph on the scorpions of Baja California, Williams (1980: 47–48, figs. 49, 108B) listed several new localities of *Syntropis macrura*, all primarily from his earlier collecting trips during the late 1960s, a dorsal and ventral photograph of a male, a diagrammatic cross-section of metasomal segment III, plus a general diagnostic characterization of the genus and species. Stockwell (1989: figs. 218–219, 228), in his unpublished Ph.D thesis, illustrated the hemispermatophore of *Syntropis*, and in 1992 (fig. 44) Stockwell illustrated the ventral view of metasomal segments I–IV. Finally, Soleglad & Fet (2003a: fig. 7), in their analysis of the sternum in Recent scorpions, illustrated the sternocoxal area of a female *S. macrura*.

Type specimen locality
As stated above, until the discovery of the specimen from Cataviña, all known records of *Syntropis* were reported from the Sierras Guadalupe and de la Giganta, from the most northern edge (San Ignacio), central area, San Miguel Comondú (and Isla del Carmen in the Sea of Cortez), and to the extreme south, Los Aripes. The type specimen locality is given only as "Lower California" (Kraepelin, 1900). The

collector of the type specimen was Leon Diguet, an engineer and important explorer of Baja California. The famed botanist Ira Wiggins (1963) writes "… A French chemical engineer named Leon Diguet was stationed at Santa Rosalia with the Boleo Company from 1889 to 1892, and collected specimens for the Museum National d'Histoire Naturelle in Paris. These collections were so interesting that the director of the Museum arranged for him to return to Baja California and devote full time to collecting natural history material …". Santa Rosalia is positioned in the Sierra de Guadalupe, roughly 55 km east from San Ignacio where *S. macrura* has been reported (Williams, 1980). Based on this information one can suspect that the type specimen of *S. macrura* may have been collected in the area around San Ignacio and Santa Rosalia. Although, as Wiggins (1963) further writes "…. He spent 17 months on a field expedition from Santa Rosalia to the Cape Region, with many side trips to interesting spots, and visited several islands and Los Angeles Bay. He revisited Baja California in 1900, 1904, and 1913. …", we suspect, based on these dates, it seems probable that the type of *S. macrura* was collected during Diguet's tour with the Boleo Company, 1889 to 1892. The other dates are too late based on Kraepelin's 1900 paper. In addition, traveling in Baja California in the late 1800's would have been a daunting time-consuming endeavor, therefore while stationed in Santa Rosalia, extended field trips would have been unlikely. This conclusion is also in-line with Williams (1980: 48) where he states, in his discussion of northern and central populations of *Syntropis*, that they are consistent with the description of the holotype.

Methods and Material

Terminology and conventions
The systematics adhered to in this paper is current and therefore follows the classification as established in Fet & Soleglad (2005) and as modified by Soleglad & Fet (2006). Terminology describing pedipalp chelal finger dentition follows that described and illustrated in Soleglad & Sissom (2001), the sternum follows that in Soleglad & Fet (2003a), and the metasomal and pedipalp carination, and leg tarsus armature follows that described and illustrated in Soleglad & Fet (2003b). Special chelal finger dentition metrics used in this paper is as defined in Soleglad & Fet (2006) and the laterobasal aculear serrations (LAS) structure is as defined in Fet *et al.* (2006).

Systematics

Order **SCORPIONES** C. L. Koch, 1850

Suborder Neoscorpiones Thorell et Lindström, 1885

Infraorder Orthosterni Pocock, 1911

Parvorder Iurida Soleglad et Fet, 2003

Superfamily Chactoidea Pocock, 1893

Family Vaejovidae Thorell, 1876

Syntropis **Kraepelin, 1900**
Syntropis Kraepelin, 1900: 16–17; type species by monotypy *Syntropis macrura* Kraepelin, 1900.

REFERENCES: see *S. macrura*.

Syntropis macrura **Kraepelin, 1900**
Fig. 1, 24–25, 31–32; Tables I–II.
Syntropis macrura Kraepelin, 1900: 16–17.

HOLOTYPE. Male, Muséum national d'Histoire Naturelle, Paris, France, "Lower California", Mexico (L. Diguet) (not seen; redescribed in detail by Stahnke, 1965).

REFERENCES (selected): *Syntropis macrura*: Kraepelin, 1901: 270; Stahnke, 1965: 257–263, figs. 1, 2; Williams, 1969: 285, 290–291 (in part); Hjelle, 1974: 221–226, figs. 3–5; Stahnke, 1974: 113–120; Stockwell, 1989: figs. 218–219, 228; Vachon, 1974: 914, 916, figs. 140, 148–150; Díaz Nájera, 1975: 6, 12; Williams, 1980: 47–48, fig. 49, 50, 108B (in part); Beutelspacher, 2000: 70, 72, 152 (in part); Sissom, 2000: 526 (in part); Soleglad & Fet, 2003a: 6; 2003b: 8.

DIAGNOSIS. Large sized species, reaching 90 mm in adult females and 100 mm in adult males. Overall coloration is a rusty brown; chelal fingers much darker color than the palm. Pectinal tooth counts 27–31 in female and 29–32 in male. Pedipalpal femur and patella are 5.8 and 5.2 times longer than wide in adult females and 7.3 and 7.1 in males; metasomal segment V is 5.3 times longer than wide in adult females and 7.1 in males; telson vesicle is 2.7 times longer than deep in females and 3.4 in males.

DISTRIBUTION. Sierras Guadalupe and de la Giganta (San Ignacio to San Miguel Comondú, and Isla del Carmen in the Sea of Cortez), Baja California Sur, Mexico (see map in Fig. 37). NOTE: Beutelspacher (2000: 70) incorrectly lists *S. macrura* for USA as well as Mexico.

REPORTED LOCALITIES (after Williams, 1980, and specimens examined). San Ignacio, 26 June 1968 (Williams, Cazier); Isla del Carmen, Puerto Balandra, 23 March 1971 (Lee); Isla del Carmen, Ensenada Marques, 17 May 1982 (Sissom); 13 km SW San Miguel Comondú, 3 July 1968 (Williams, Cazier).

SPECIMENS EXAMINED: Ensenada Marques, Isla del Carmen, Baja California, Mexico, adult ♀, from the personal collection of W. David Sissom.

Syntropis williamsi **Soleglad, Lowe et Fet, sp. nov.**
Fig. 2, 4–15, 28–30, 33–34; Tables I–II.

REFERENCES:
Syntropis macrura: Lourenço, 2002: 140.

HOLOTYPE. Female, N. Los Aripes, Baja California Sur, Mexico, 25 June 1985 (W. Lourenço & G. Polis), deposited in Muséum d'Histoire Naturelle, Genève, Switzerland (MHNG). PARATYPES: male and two females, label same as holotype, deposited in Muséum d'Histoire Naturelle, Genève, Switzerland.

DIAGNOSIS. Medium sized species for its genus, reaching 70 and 80 mm in adult females and males. Overall coloration a pale yellow lacking patterns, chelal fingers not pigmented. Pectinal tooth counts 24–26 in females, 25–28 in males. Pedipalpal femur and patella are 4.5 and 4.4 times longer than wide in adult females, 5 and 4.7 times longer than wide in adult males; metasomal segment V 4 to 4.3 times longer than wide on adult females, 5.2 times longer on adult males; telson vesicle is 2.3 times longer than deep in both females and males.

Table I. Measurements (in *mm*) of *Syntropis williamsi* **sp. nov.** from Los Aripes, Baja California Sur (BCS), Mexico, *Syntropis aalbui* **sp. nov.** from Blue Palm Canyon, 5 km N of Cataviña, Baja California (BC), Mexico, and *Syntropis macrura* Kraepelin, 1900, from Ensenada Marques, Isla del Carmen, Baja California Sur (BCS), Mexico. * Extrapolated estimate, aculeus tip missing.

	Syntropis					
	S. williamsi sp. nov				*S. aalbui* sp. nov.	*S.macrura* Kraepelin
	Female Holotype	Male Paratype	Female Paratype	Female Paratype	Female Holotype	Female
Total Length	64.95	63.75	56.00	53.45	78.35	91.85
Carapace Length	7.60	7.30	7.30	6.35	8.70	9.40
Mesosoma Length	17.65	15.40	13.35	15.90	22.05	23.55
Metasoma Length	32.20	33.85	28.60	25.25	38.35	47.20
Metasomal Segment I						
Length	4.50	4.90	4.00	3.60	5.35	6.15
Width	3.40	3.10	3.25	2.85	4.05	3.95
Metasomal Segment II						
Length	5.40	5.75	4.70	4.10	6.35	7.75
Width	2.90	2.70	2.85	2.45	3.60	3.50
Metasomal Segment III						
Length	5.75	6.05	5.15	4.60	6.95	8.55
Width	2.75	2.60	2.60	2.30	3.35	3.20
Metasomal Segment IV						
Length	7.30	7.40	6.45	5.75	8.95	10.80
Width	2.45	2.35	2.35	2.20	2.95	2.85
Metasomal Segment V						
Length	9.25	9.75	8.30	7.20	10.75	13.95
Width	2.30	2.25	2.15	2.00	2.65	2.60
Telson Length	7.50	7.20	6.75	5.95	9.25	11.70 *
Vesicle Length	5.35	5.00	4.60	4.00	7.00	8.80
Width	2.40	2.25	2.15	1.85	3.20	3.55
Depth	2.35	2.15	2.00	1.65	3.10	3.30
Pedipalp length	30.85	30.00	28.20	25.50	39.30	42.15
Femur Length	8.40	8.20	7.80	7.05	11.40	11.80
Width	1.85	1.65	1.70	1.60	1.85	2.05
Patella Length	9.10	9.10	8.20	7.50	11.90	12.30
Width	2.05	1.95	1.95	1.65	2.05	2.35
Chela Length	13.35	12.70	12.20	10.95	16.00	18.05
Palm Length	4.40	4.20	3.90	3.65	5.50	6.25
Width	2.00	2.00	1.65	1.65	2.20	2.75
Depth	2.40	2.30	2.20	2.05	2.65	3.25
Mov. Fing. Length	9.30	8.80	8.40	7.45	10.95	12.30
Sternum Length	1.65	1.55	1.60	1.65	2.15	1.95
Anterior Width	1.55	1.50	1.40	1.35	1.85	1.85
Posterior Width	1.75	1.75	1.75	1.65	2.05	2.30
Pectinal Teeth	25/25	25/26	24/24	25/25	27/x	28/28
Middle Lamellae	16/17	18/x	16/x	16/17	18/x	21/21

DISTRIBUTION. Extreme southern portion of Sierra de la Giganta, Baja California Sur, Mexico (see in Fig. 37).

ETYMOLOGY. This scorpion species is named in honor of Stanley C. Williams whose studies in the biology of North American scorpions, especially Baja California, Mexico, have contributed significantly to our knowledge of scorpions in these areas. In particular, Williams (1980: 48) provided crucial information which helped us in the identification of this new species.

FEMALE. Description based on holotype female. Locality of holotype is North of Los Aripes, Baja California Sur, Mexico. Measurements of this holotype plus three paratype specimens are presented in Table I and important diagnostic morphometric ratios are provided in Table II. See Figure 2 for a dorsal view of the female holotype.

COLORATION. Basic color pale yellow. Mesosoma slightly darker yellow. No patterns visible, chelal fingers same color as palm. Telson aculeus, eyes and eye tubercles, and articulation condyles of legs reddish brown.

CARAPACE (Fig. 10). Anterior edge essentially straight with very broad subtle indentation, equipped with six setae; interocular area smooth, bisected by a subtle shallow indentation; posterior lateral aspects covered with medium to large granules. Posterior portion with deep medial groove, forming two conspicuous lateral posterior convexed lobes. Lateral eyes number three, decreasing in size posteriorly. Median eye tubercle thin, positioned anteriorly of middle with the following length and width formulas: 280|760 (anterior edge to medium tubercle middle|carapace length) and 97|565 (width of median tubercle including eyes|width of carapace at that point).

MESOSOMA (Fig. 7). Tergites I–IV smooth, V–VI with slight posteromedial granulation; tergite VII covered with coarse granules with two pairs of delicately crenulate carinae. Sternites smooth and lustrous; one pair of ventral lateral carinae present on segment V, rough to crenulate, median pair absent. Stigmata (Fig. 7) are long and slit-like.

METASOMA (Fig. 11, 33). Segments I–IV: dorsal and dorsolateral carinae delicately crenulate, dorsal (I–IV) and dorso-
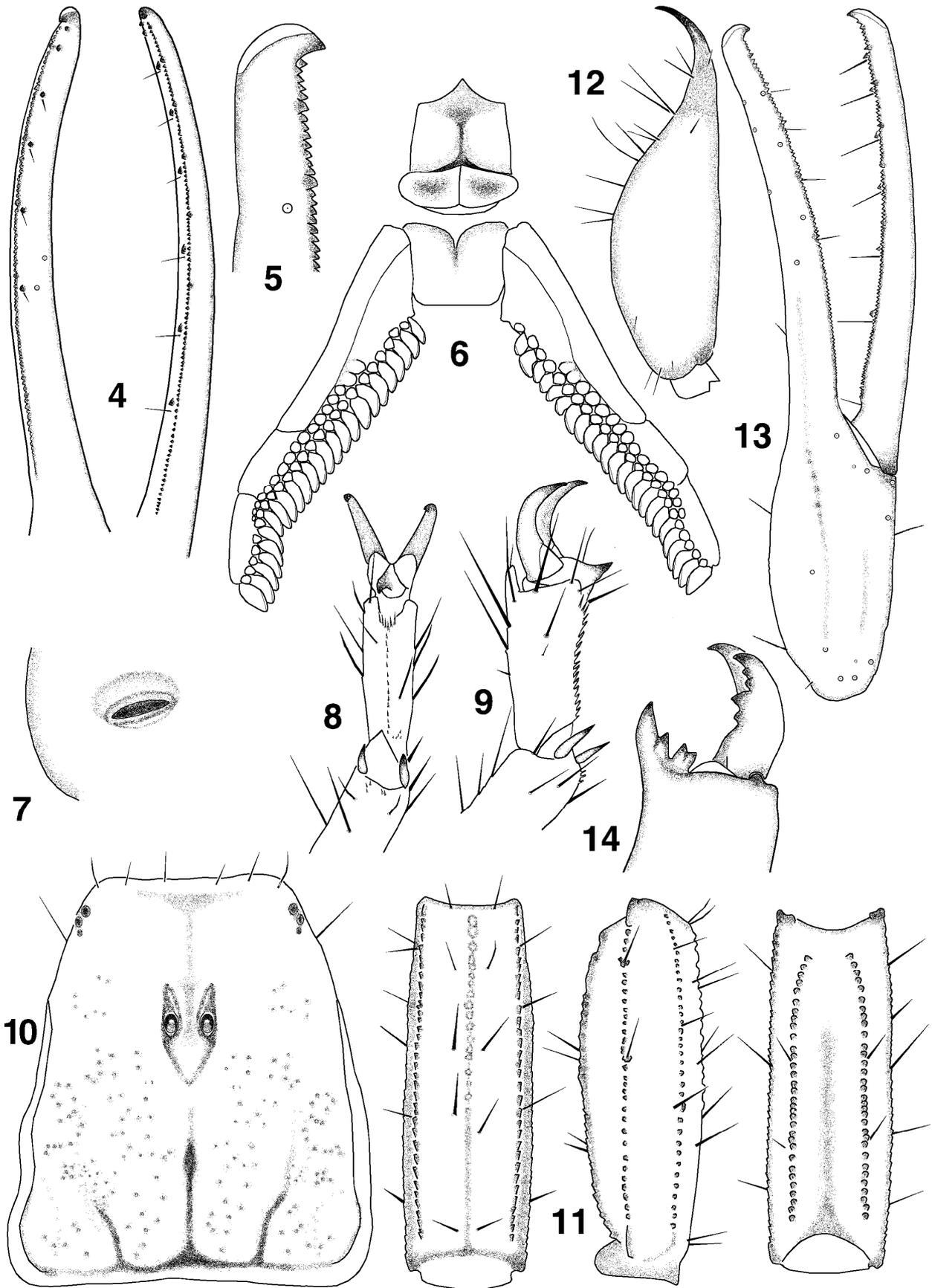
Fig. 4–14. *Syntropis williamsi* **sp. nov. 4–11.** female holotype, **12–14.** male paratype. **4–5.** Chelal finger dentition, fixed (showing position of trichobothria *ib–it*) and movable fingers; fixed finger, external distal aspect, showing "whitish patch" and trichobothrium *et*. **6.** Sternum, genital operculum, and pectines. **7.** Fourth right stigma. **8–9.** Leg tarsus IV, ventral view (showing three distal median spinule pairs), and leg tarsus III, lateral view. **10.** Carapace. **11.** Metasomal segment IV, ventral (showing single ventromedian carina), lateral, and dorsal views (showing flared terminus of dorsolateral carina). **12–14.** Telson, lateral view, chela, lateral view, and chelicera, dorsal view.

Fig. 15. Trichobothrial pattern of *Syntropis williamsi* **sp. nov.**, female holotype.
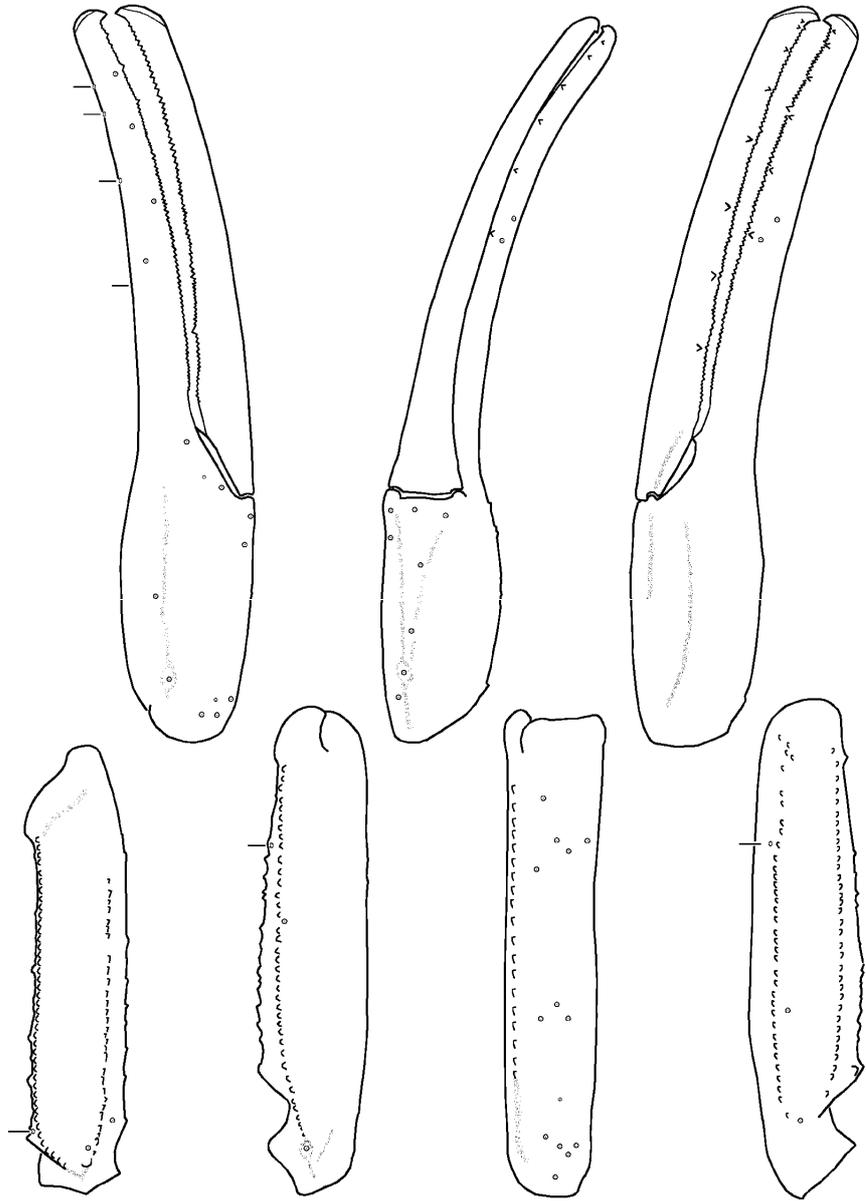
STERNUM (Fig. 6). Type 2, posterior emargination present, well-defined convex lateral lobes, apex visible but not conspicuous; slightly wider than long, length|width formula 165|175; sclerite tapers anteriorly.

CHELICERAE (Fig. 14, paratype male). Movable finger dorsal edge with two subdistal (*sd*) denticles; ventral edge smooth; basal half with setal brush followed by medium developed serrulae with 15/13 contiguous tines, terminating just before distal tip. Ventral distal denticle (*vd*) longer than dorsal (*dd*) counterpart. Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

PEDIPALPS (Figs. 4–5, 15, 28–30; Fig. 13, paratype male). Slender chelate species, no scalloping on chelal fingers, **Femur** (Fig. 28): Dorsointernal, dorsoexternal and ventrointerior carinae delicately crenulate, ventroexternal rounded to obsolete. Dorsal and ventral surfaces smooth, internal and external surfaces with line of large granules. **Patella** (Figs. 29–30): Dorsointernal, dorsoexternal, ventrointernal and ventroexternal carinae delicately crenulate; Dorsal Patellar

Spur (*DPS_c*) carina well developed with line of about 25 granules (Fig. 30); exteromedian carina obsolete. All surfaces smooth; internal surface with remnants of a DPS and Ventral Patellar Spur (VPS), each represented by a small solitary granule accompanied with a seta. **Chelal carinae:** digital (*D1*) carina weak and smooth; subdigital (*D2*) represented basally by one granule; dorsosecondary (*D3*) weak and rounded; dorsomarginal (*D4*) and dorsointernal (*D5*) rounded, irregularly granulose; ventroexternal (*V1*) rough and rounded, terminating at external condyle of movable finger; ventromedian (*V2*) weak and rounded, with subtle granulation on proximal one-half; ventrointernal (*V3*) rounded, irregularly granulated; external (*E*) weak and rounded, essentially obsolete. **Chelal finger dentition** (Figs. 4–5): median denticle (MD) row groups aligned in straight line, numbering 6 and 7 (counting the distal single *MD* denticle as a group on the movable finger); 6/6 and 8/8 internal denticles (*ID*) and 5/5 and 6/6 outer denticles (*OD*) on fixed and movable fingers, respectively. No accessory denticles present. *OD* denticles are situated on the distal half of both fingers. Number of *MD* denticles on movable finger

125

is 101; ratio of *MD* denticle length to fixed finger depth is 1 to 10. Distal tips of both fingers with conspicuous "whitish" patch. **Trichobothrial patterns** (Fig. 15): Type C, orthobothriotaxic. Femur: trichobothrium *d* located next to dorsoexternal carina and proximal to *i*. Patella: ventral trichobothrium v_3 located on external surface, distal of trichobothrium et_3. Chela: trichobothrium *Dt* located at palm midpoint and *Db* positioned on or dorsal of *D1* carina; *ib–it* situated adjacent to inner denticle (*ID*) six of fixed finger, *ib* adjacent to and *it* slightly distal of *ID*–6; spacing between trichobothria V_1 and V_2 approximately same as V_2 and V_3.

LEGS (Figs. 8–9). Both pedal spurs present, tibial spur absent. Tarsus with single median row of spinules on ventral surface, terminating distally with three spinule pairs.

HEMISPERMATOPHORE. Unknown. The large subadult male did not have a hemispermatophore.

MALE PARATYPE (Figs. 12–14). A large subadult specimen. Metasoma, telson (Fig. 12) and pedipalpal femur and patella of male is slightly more slender than that of female type (see morphometric ratios in Table II). No detectable proximal scallop on chelal movable finger (Fig. 13), however, though the male is large, we have declared it as subadult, so possibly the scallop may be present only on fully developed adults. Genital operculum is separated for most of its length, genital papillae visible proximally. Pectinal tooth counts 25–26.

FEMALE PARATYPE COMPARISONS. Two subadult females (16 to 21.5 % smaller than female holotype; carapaces are 4 to 16 % smaller) exhibited slightly heavier metasoma from holotype, segment V in holotype 4.2 to 11.7 % more slender; pedipalpal femur and patella proportions approximately the same as in holotype. Coloration the same as in holotype. Pectinal tooth count range for all three females, including holotype, is 24–25 (24.667) [6].

REPORTED LOCALITIES (after Williams, 1980, and specimens examined). 56.8 km NW Los Aripes, 27 July 1968 (Williams, Bentzien, Bigelow); 24.1 NW Los Aripes, 27 July 1968 (Williams, Bentzien, Bigelow); N Los Aripes, 25 June 1985 (Lourenço, Polis).

SPECIMENS EXAMINED. Adult female holotype, large subadult male paratype, and two subadult female paratypes; N. Los Aripes, Baja California Sur, Mexico, 25 June 1985 (W. R. Lourenço & G. A. Polis), all deposited in Muséum d'Histoire Naturelle, Genève. Note: Lourenço (2002: 140) incorrectly mentions 2 males and 2 females.

Syntropis aalbui **Lowe, Soleglad et Fet, sp. nov.**
Fig. 3, 16–23, 26–27, 35–36; Tables I–II.

HOLOTYPE. Female, Blue Palm Canyon, 5 km N Cataviña, Baja California, Mexico, 13 July 1979 (Rolf L. Aalbu), permanently deposited in Muséum d'Histoire Naturelle, Genève, Switzerland.

DIAGNOSIS (based on female only, male unknown). Large sized species for its genus, approaching 80 mm in adult females. Overall coloration is a rusty brown; carapace with subtle variegated pattern on medio-posterior area; chelal fingers same color as palm. Pectinal tooth counts 27 in female. Pedipalpal femur and patella are 6.2 and 5.8 times

longer than wide in adult females; metasomal segment V is 4.1 times longer than wide in adult females; telson vesicle is 2.3 times longer than deep in adult females.

DISTRIBUTION. Only known from type locality, Cataviña, Baja California, Mexico (see map in Fig. 37).

ETYMOLOGY. This scorpion species is named in honor of Dr. Rolf L. Aalbu, entomologist and student of Baja California. In particular, Dr. Aalbu was the collector of the type specimen.

FEMALE. Description based on holotype female. Locality of holotype is Blue Palm Canyon, 5 km N Cataviña, Baja California, Mexico. Measurements of type specimen is presented in Table I and important diagnostic morphometric ratios are provided in Table II. See Figure 3 for a dorsal view of the female holotype.

COLORATION. Overall color brownish-rust. Carapace with subtle variegated patterns on lateral aspect, from median eyes to posterior edge, but not extending to extreme lateral edges; chelal fingers same color as palm (in preservative, they appear slightly darker). Telson aculeus, eyes and eye tubercles, and articulation condyles of legs dark brown.

CARAPACE (Fig. 17). Anterior edge with very broad indentation, most setae missing; interocular area smooth, bisected by a subtle shallow indentation; posterior lateral aspects covered with medium to large granules in area of variegated pattern, but not extending to extreme lateral areas which are smooth. Posterior portion with deep medial groove, forming two conspicuous lateral posterior convexed lobes. Lateral eyes number three, decreasing in size posteriorly. Median eye tubercle thin, positioned anteriorly of middle with the following length and width formulas: 345|870 and 103|640.

MESOSOMA (Fig. 19). Tergites I–VI smooth, tergite VII with two pairs of crenulate carinae. Sternites smooth and lustrous; one pair of ventral lateral carinae present, irregular, weakly granulate, median pair absent. Stigmata (Fig. 19) are long and slit-like.

METASOMA (Fig. 22). Segments I–IV: dorsal and dorsolateral carinae delicately crenulate, dorsolateral (I–III) carinae terminate with small spine; lateral carinae delicately crenulate on I, crenulate on proximal 17 % of II, and obsolete on III–IV; ventrolateral smooth to granulate on I–III and crenulate on posterior three-quarters of IV; and single ventromedian carina of I widely rounded and smooth, smooth on II, smooth to crenulate on III, and crenulate on most of IV. Dorsolateral carinae of segment IV terminus subtly flared, not terminating at articulation condyle. Segment V: dorsolateral carinae rounded and granulate; lateral carinae granulated for 50% of anterior aspect; ventrolateral and ventromedian carinae crenulate, ventromedian carina not bifurcated, terminating in straight line. Intercarinal areas smooth. Ventral setal formulae (I–V): 4|5|5|6|6 (not all setae present, some missing).

TELSON (Figs. 35–36). Vesicle bulbous with short aculeus; aculeus with 2/3 denticles in the LAS. Vesicle surface smooth, covered ventrally with numerous elongated setae; basal dorsal aspect with vesicular "tabs" terminating in small hooked spine.

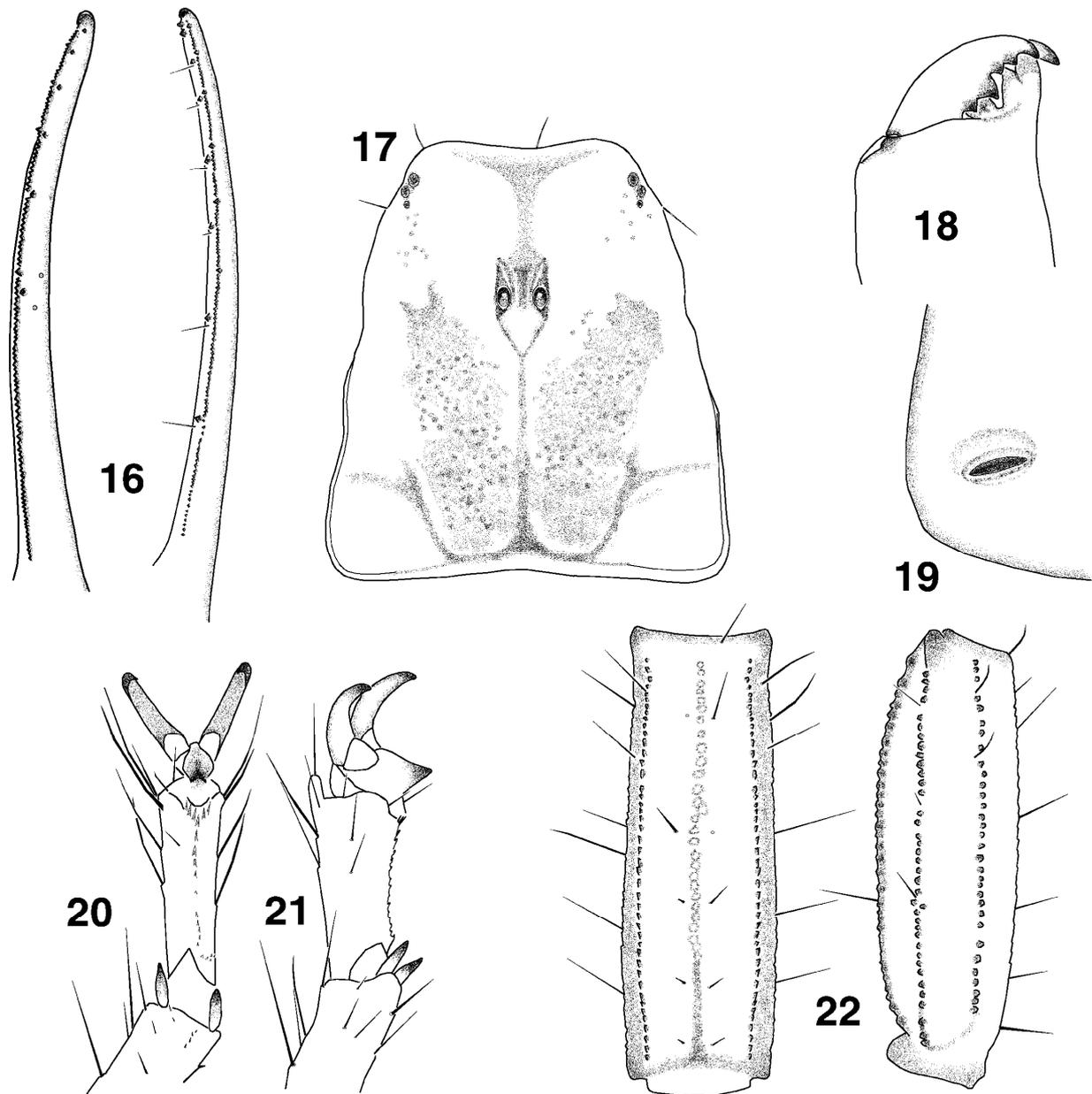**PECTINES.** Well developed elongated segments exhibiting

Fig. 16–22. *Syntropis aalbui* **sp. nov.**, female holotype. **16.** Chelal fixed finger (showing position of trichobothria *ib–it*) and movable finger dentition. **17.** Carapace. **18.** Chelicera, dorsal view. **19.** Fourth right stigma. **20–21.** Leg tarsus IV, ventral view (showing three distal median spinule pairs), and leg tarsus III, lateral view. **22.** Metasomal segment IV, ventral (showing single ventromedian carina) and lateral views (showing flared terminus of dorsolateral carina).

length|width formula 770|185. Three anterior lamellae and 18/x bead-like middle lamellae; fulcra of medium development. Teeth number 27/x (note right pecten is missing). Sensory areas developed along most of tooth inner length on all teeth, including basal tooth. Basal piece quite large, with deep indentation along anterior one-half, length|width formula 195|215.

GENITAL OPERCULUM. Sclerites connected for entire length, operating as a single unit, connection to body at extreme anterior edge, 80 % of sclerites are separated from mesosoma. No genital papillae.

STERNUM. Type 2, posterior emargination present, well-defined convex lateral lobes, apex visible but not conspicuous; slightly wider than long, length|width formula 215|205; sclerite tapers anteriorly.

CHELICERAE (Fig. 18). Movable finger dorsal edge with two subdistal (*sd*) denticles; ventral edge smooth; setal brush and serrula on ventral edge barely discernible due to worn condition of chelicerae. Ventral distal denticle (*vd*) longer than dorsal (*dd*) counterpart. Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

PEDIPALPS (Figs. 16, 23, 26–27). Slender chelate species. **Femur** (Fig. 26): Dorsointernal, dorsoexternal and ventrointerior carinae delicately crenulate, ventroexternal rounded to obsolete. Dorsal and ventral surfaces smooth, internal and external surfaces with line of large granules. **Patella** (Fig. 27): Dorsointernal, dorsoexternal, ventrointernal and ventroexternal carinae delicately crenulate; Dorsal Patellar Spur (*DPS_c*) carina well developed with line of about 33 granules; exteromedian carina obsolete. All surfaces smooth;
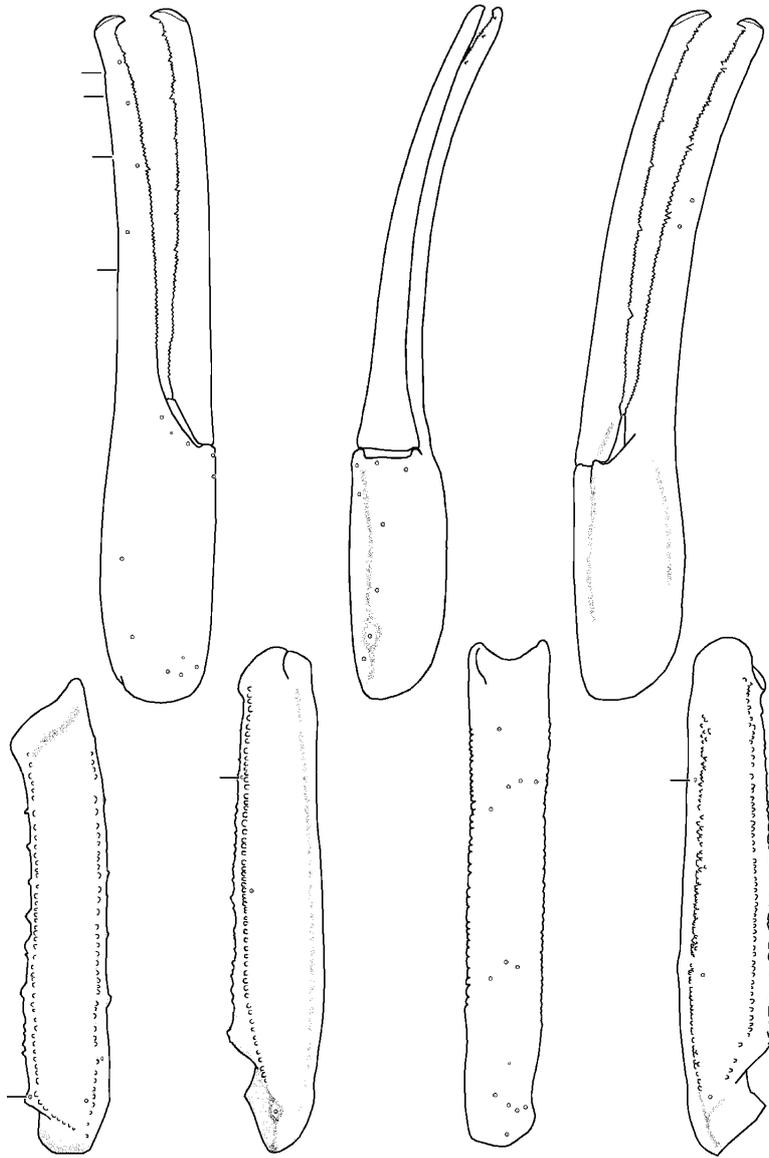
127

internal surface with remnants of a DPS and VPS, each represented by a small solitary granule accompanied with a seta. **Chelal carinae:** digital (*D1*) carina weak and smooth; subdigital (*D2*) represented basally by one granule; dorsosecondary (*D3*) rounded and rough; dorsomarginal (*D4*) and dorsointernal (*D5*) rounded, irregularly granulose; ventroexternal (*V1*) smooth, terminating at external condyle of movable finger; ventromedian (*V2*) irregular and rough; ventrointernal (*V3*) rounded and smooth; external (*E*) obsolete. **Chelal finger dentition** (Fig. 16): median denticle (MD) row groups aligned in straight line, numbering 6 and 7 (counting the distal single *MD* denticle as a group on the movable finger); 6/6 and 8/8 internal denticles (*ID*) and 5/5 and 6/6 outer denticles (*OD*) on fixed and movable fingers, respectively. *OD* denticles are situated on the distal half of both fingers. No accessory denticles present. Number of *MD* denticles on movable finger is 100. Distal tips of both fingers with conspicuous "whitish" patch. **Trichobothrial patterns (**Fig. 23**):** Type C, orthobothriotaxic. Femur: trichobothrium *d* located next to dorsoexternal carina and proximal to *i*. Patella: ventral trichobothrium *v₃* located on external surface, adjacent to trichobothrium *et₃*. Chela: trichobothrium *Dt* located at palm midpoint and *Db* positioned dorsal of *D1* carina; *ib–it* straddle inner denticle (*ID*)

six of fixed finger; spacing between trichobothria V_1 and V_2 approximately same as V_2 and V_3.

LEGS (Figs. 20–21). Both pedal spurs present, tibial spur absent. Tarsus with single median row of spinules on ventral surface, terminating distally with three spinule pairs.

REPORTED LOCALITIES. Blue Palm Canyon, 5 km N Cataviña, Baja California, Mexico, 13 July 1979 (Aalbu).

SPECIMENS EXAMINED: Adult female holotype, Blue Palm Canyon, 5 km N Cataviña, Baja California, Mexico, 13 July 1979 (R. L. Aalbu), deposited in Muséum d'Histoire Naturelle, Genève, Switzerland.

Discussion

Analysis of morphometry in *Syntropis*

Until this study, the only measurements reported for *Syntropis* were those published by Kraepelin (1900) and Stahnke (1965), both of the male type *S. macrura*. Since the primary diagnostic characters of new species *S. williamsi* and *S. aalbui* are based on morphometric differences in the metasoma, telson vesicle and pedipalp (i.e., pectinal tooth counts and overall coloration providing only secondary

diagnostic characters), we believe it is important to establish a foundation for our result. In addition, it is important to note that Williams (1980) reported "… Juveniles appear much different from adults … their metasoma is not as elongate, and their telson is not elongate …". Although none of the material examined in this study are juveniles, two female *S. williamsi* are subadult, so we can determine the degree of morphometric changes with respect to the adult female holotype on those structures where it does or does not occur.

Kraepelin (1900) reported that the *Syntropis macrura* male holotype was 94 mm in length. Stahnke (1965: 261), in his examination of the same type specimen, provided a fairly complete set of measurements and stated its length to be 97.95 mm. In general the measurements provided by both Kraepelin (eight in all) and Stahnke, though exhibiting small differences, were reasonably consistent. This reported size makes *S. macrura* the largest scorpion species found in Baja California, Mexico with the only exception being the large iuroid genus *Hadrurus* which can exceed 120 mm in length. Curiously, Williams (1980: 47), in his monograph on the scorpions of Baja California, Mexico, stated that *S. macrura* adults reached sizes up to 80 mm in length, somewhat smaller than the reported size of the male type and the female examined in this study (92 mm). We suspect this estimate is either a mistake in reporting, or possibly, specimens collected by Williams during his 1968 expeditions to Baja California, which reportedly involved "… several dozen …" (Williams, 1969: 285), did not exhibit the size reported for the type and seen in the adult specimen examined here.

In Table II we present a set of important morphometric ratios that contrast for the three *Syntropis* species relative morphometric differences in the metasoma, telson vesicle, and the pedipalp femur and patella. Although these morphometric differences, which we consider to be diagnostic, are represented numerically in Tab. II, they are also quite apparent as can be seen in Figs. 24–36. These ratios refer to both male and female *S. williamsi* and *S. macrura*, and a female *S. aalbui*. Except for the male *S. williamsi*, which is a large subadult, and two smaller subadult females, all are adult specimens. Actual measurements used for these ratios are from the six specimens examined in this study, Stahnke's (1965) reported measurements of the *S. macrura* male type (with two exceptions noted below), and select gross measurements taken directly of a male shown in the photograph in Williams (1980: fig. 49). This photograph shows the adult male from a direct perspective (perpendicular to specimen), therefore we believe our gross measurements are accurate enough to determine relative proportions. And we must state here, we used Williams' (1980) photograph for the sole purpose of verifying that it is consistent with the male holotype redescribed by Stahnke (1969), thus implying that *S. macrura* was the basis for his description of the northern-central populations of *Syntropis*. Based on several data points shown in Table II, it is clear Williams' (1980) photograph is consistent with Stahnke's (1965) measurements of the male holotype: using the lengths of the carapace and metasomal segments, we see a percentage of difference of only 1.3 to 4.3 %. In addition, Williams (1980) states that the northern-central population male's metasomal segment V is 7 times longer than wide

and we see, using Stahnke's (1965) measurements, a ratio value of 7.17, again showing consistency. However, we used Stahnke's (1965: fig. 2) photograph of the male holotype for two ratios because we discovered his measurements for the pedipalp femur and patella are incorrect. This is based on comparing length/width ratios of the two segments based on his measurements and the measurements taken from his photograph (which, by the way, are consistent with ratios based on Williams' (1980) photograph). Clearly, Stahnke's (1965) femur and patella length measurements are too small. This is particularly obvious when looking at the larger photograph (Stahnke, 1965: fig. 1) where one can see that the femur is considerably longer than metasoma segment I and even longer than segment II; in Stahnke's measurements the femur is only slightly longer than segment I and shorter than segment II. Consequently, in Table II, we show both ratio values for each pedipalp segment from Stahnke's (1965) and Williams' (1980) photographs.

For completeness in Table II, we also compare the large subadult *S. williamsi* male paratype to *S. macrura* holotype. Of course, due to the former's subadult status, the stated ratio differences are considerably larger than they would be if an adult specimen was used. However, we do have Williams' (1980) stated differences in metasomal segment V for adults of these two species, 5.2 times longer than wide versus 7 times longer than wide, showing a considerable difference of 35 %. What is apparent from the ratio data of this subadult male, even though its metasoma is more slender than any of the *S. williamsi* females measured, it is not as slender as that seen in the female *S. macrura*, further emphasizing the difference between these two species.

Adult status of *S. aalbui* and *S. williamsi* holotype females. When the *S. aalbui* female holotype is compared to the adult *S. macrura* female examined in this study, it is clear that the female holotype is most likely an adult. Its carapace size is comparable to both that seen in the *S. macrura* female and male holotype, exhibiting 8 % and 0.5 % differences, respectively. Although the adult *S. macrura* carapace is only 8 % longer than the carapace of *S. aalbui* holotype, its metasoma + telson is 23.7 % longer. The more elongated metasoma in *S. macrura* as compared to *S. aalbui* is demonstrated even further when we see that each metasomal segment of *S. aalbui* is actually wider than those in *S. macrura* (see Table 1). The fact that the *S. aalbui* female is most likely an adult coupled with the significant differences in all metasomal segment proportions with *S. macrura* indicates that it is a different species.

When comparing the two female holotypes of *S. aalbui* and *S. williamsi* we see that they are consistent in relative metasomal and telson proportions, exhibiting negligible differences between the two: for segments I–III, *S. williamsi* is slightly slenderer (average of 2.18 %) and for segments IV–V, *S. aalbui* is slightly more slender (average of 1.35 %). As stated elsewhere, Williams (1980) reported that the northern-central populations of female *Syntropis* has metasomal segment V 5.2 times longer than wide whereas the southern populations have this segment 4 to 4.3 times longer than wide. The *S. williamsi* ratio of metasomal segment V is 4.02, falling into the low end of Williams' stated range, thus indicating an adult. Considering Williams' mor-

Table II. Morphometric ratio comparisons between *Syntropis williamsi* **sp. nov.**, *S. aalbui* **sp. nov.**, and *S. macrura*. Parenthetical numbers state the percentage (%) of difference based on the following comparisons: *S. williamsi* female holotype as compared to *S. aalbui* female holotype (first percentage) and *S. macrura* female (second percentage); *S. williamsi* male paratype male as compared to *S. macrura* male holotype; and *S. aalbui* as compared to *S. macrura* female. Percentages *shaded* indicate significant differences deemed as diagnostic, percentages that are 15 % or more different. In particular, these ratios show the significantly stouter pedipalpal femur and patella in *S. williamsi* as compared to *S. aalbui* and *S. macrura*, and the stouter metasoma and telson vesicle of *S. williamsi* and *S. aalbui* as compared to *S. macrura*. Under *S. williamsi* female holotype we also show ratio values for two subadult female paratypes, which indicates, as compared to the adult type, whether and where morphometric differences exists within these three ontogenetic stages. It must be stressed here the female holotypes of *S. williamsi* and *S. aalbui* and the female *S. macrura* from Isla del Carmen are considered adult while the male paratype is considered to be a large subadult. Therefore, for the latter, the stated ratio percentage differences would most likely be less in an adult as compared to an adult male *S. macrura*. * ratios calculated from data in Stahnke (1965: 261, fig. 2), or as modified by direct inspection of photograph. ** ratios calculated directly from photograph in Williams (1980, fig. 49); *** ratios calculated directly from photograph in Stahnke (1965: fig. 2). L = length, W = width, D = depth.

	Syntropis williamsi sp. nov.		*Syntropis aalbui* sp. nov.	*Syntropis macrura* Kraepelin	
	Female: Holotype, two paratypes (subadult)	Male: Paratype (subadult)	Female: Holotype	Female: Isla del Carmen	Male: Holotype *, Williams **
Metasoma Seg I_L/ Carapace_L	0.59 (3.9 %) (10.5 %) 0.57, 0.55	0.67 (29.5 %)	0.62 (6.3 %)	0.65	0.87 0.83 **
Metasoma Seg II_L/ Carapace_L	0.71 (2.7 %) (15.9 %) 0.65, 0.64	0.79 (33.4 %)	0.73 (12.9 %)	0.82	1.05 1.03 **
Metasoma Seg III_L/ Carapace_L	0.76 (5.7 %) (20.2 %) 0.72, 0.71	0.83 (39.2 %)	0.80 (13.8 %)	0.91	1.15 1.20 **
Metasoma Seg IV_L/ Carapace_L	0.96 (7.1 %) (19.6 %) 0.91, 0.88	1.01 (49.9 %)	1.03 (11.7 %)	1.15	1.52 1.50 **
Metasoma Seg V_L/ Carapace_L	1.22 (1.6 %) (21.9 %) 1.13, 1.14	1.34 (41.2 %)	1.24 (20.1 %)	1.48	1.89 1.93 **
Metasoma_L / Carapace_L	4.24 (4.0 %) (18.5 %) 3.98, 3.92	4.64 (39.7 %)	4.41 (13.9 %)	5.02	6.48 6.50 **
Metasoma Seg I: L/W	1.32 (0.2 %) **(17.6 %)** 1.26, 1.23	1.58 (33.5 %)	1.32 **(17.9 %)**	1.56	2.11 -
Metasoma Seg II: L/W	1.86 (5.5 %) **(18.9 %)** 1.67, 1.65	2.13 (35.0 %)	1.76 **(25.5 %)**	2.21	2.88 -
Metasoma Seg III: L/W	2.09 (0.8 %) **(27.8 %)** 2.00, 1.98	2.33 (44.7 %)	2.08 **(28.8 %)**	2.67	3.37 -
Metasoma Seg IV: L/W	2.98 (1.8 %) **(27.1 %)** 2.61, 2.75	3.15 (56.4 %)	3.03 **(24.9 %)**	3.79	4.93 -
Metasoma Seg V: L/W	4.02 (0.9 %) **(33.4 %)** 3.60, 3.86	4.33 (65.6 %)	4.06 **(32.2 %)**	5.37	7.17 -
Vesicle_L/Vesicle_D	2.28 (0.8 %) **(17.1 %)** 2.30, 2.42	2.33 (47.4 %)	2.26 **(18.1 %)**	2.67	3.43 -
Vesicle_L/Vesicle_W	2.23 (1.9 %) (11.2 %) 2.14, 2.16	2.22 (60.7 %)	2.19 (13.3 %)	2.48	3.57 5.00 **
Femur: L/W	4.54 **(35.7 %) (26.8 %)** 4.41, 4.59	4.97 (57.6 %)	6.16 (7.1 %)	5.76	7.83 *** 7.29 **
Patella: L/W	4.44 **(30.8 %) (17.9 %)** 4.55, 4.21	4.67 (53.1 %)	5.81 (10.9 %)	5.23	7.14 *** 7.50 **

phometric range for the southern population, we can project that some *S. williamsi* females may have a slightly more slender segment V, 7 % slenderer than our holotype (based on 4.02 vs. 4.30). And, we see that the morphometric difference for this segment between the two smaller subadult females of *S. williamsi* and the holotype, the holotype is 4.2 to 11.7 % slenderer. From this we can project the probable maximum size of a female *S. williamsi* to be around 70 mm (the holotype is 65 mm); and, using the same logic, an adult male would be between 75 and 80 mm.

Metasoma and telson vesicle morphometrics. When we compare the metasoma and telson vesicle in the adult females of our three species, we see that the *S. macrura* is considerably more slender, as shown in all five segments, with segment V exhibiting the largest ratio difference (exceeding 32 %). The telson vesicle is also slenderer in *S. macrura*, seen when the length is compared to both its width and depth. For the latter, *S. macrura* ratio difference exceeds 17 % of the other two species. Also quite noticeable in Figs. 31, 33, 35 we see that the dorsal surface of the

vesicle in *S. macrura* is slightly concaved further exaggerating its slenderness. This curious concave condition of the vesicle is even more readily visible in the photographs provided by Stahnke (1965) and Williams (1980) of the adult male *S. macrura*. The vesicle dorsal surface is not concaved in any of the material of *S. williamsi* (Figs. 12, 33) and *S. aalbui* (Fig. 35) examined.

Pedipalp morphometrics. The pedipalp femur and patella of *S. williamsi* are considerably stockier than that found in *S. macrura* and *S. aalbui*. In Table II we see a 36 and 31 % difference between female *S. williamsi* (Figs. 28–29) and *S. aalbui* (Figs. 26–27) for the femur and patella, respectively. *S. macrura* also exhibits a slender femur and patella (Figs. 24–25), though not as slender as in *S. aalbui*, with 27 % and 18 % differences from *S. williamsi*, femur and patella, respectively.

Comparing the femur-patella ratios between male and female *S. williamsi* we see that the male is modestly slenderer, exhibiting 9 and 5 % differences. Based on the comparison of the two subadult paratype females with the holotype, we
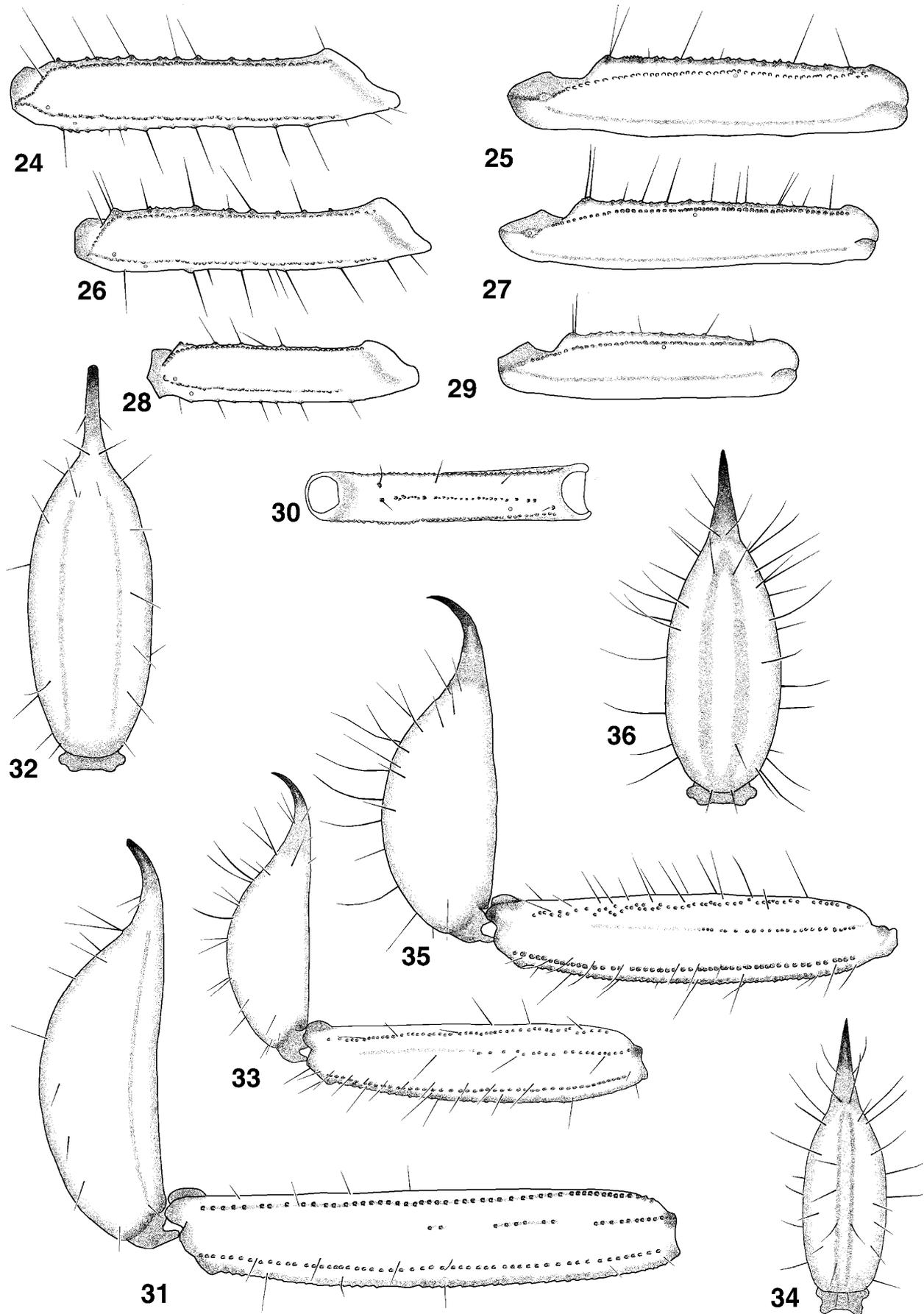
Fig. 24–36. Comparison of key diagnostic structures separating species of *Syntropis*. **24–29.** Pedipalp femur and patella, dorsal view. **30.** Pedipalp patella, internal view, showing DPS_c carina. **31–36.** Metasomal segment V, lateral view, and telson, lateral and ventral views. **24–25, 31–32.** *S. macrura*, female. **28–30, 33–34.** *S. williamsi*, female holotype. **26–27, 35–36.** *S. aalbui*, female holotype.

see very little morphometric differences, implying that these pedipalpal segments do not show significant morphometric changes as they reach adult stages (note that the ratios for the holotype female fall between those of the two female paratypes).

The chela proportions and dentition in *Syntropis* are quite interesting as well. We see considerably elongated fingers, where the lengthening appears to be concentrated at their base. We come to this conclusion because the finger dentition, in particular the outer (*OD*) denticles (Figs. 4 and 16), occur on the distal half of the finger. Even the fixed finger trichobothria *ib–it* are located at midfinger even though they are adjacent to the last outer denticle, *OD*-6. The other fixed finger trichobothria, *eb–et* and *db–dt*, are also located from midfinger to distal tip, unusual in Vaejovidae. On the movable finger, we see eight inner (*ID*) denticles, *ID*-8 somewhat close to the finger base. Eight *ID*s for the movable finger is unusual, seven being typical in the vaejovids. Possibly this additional *ID* denticle is a by-product of this elongation. The median (*MD*) denticles, however, do extend for most of the finger length, considerably beyond the last *OD* denticle.

Kraepelin (1900) reports (after Stahnke, 1965): "… Hand rounded, slender, … Finger with weak lobe …". We can see this lobe, or basal scallop, on the movable finger in the illustration by Vachon (1974: figs. 148, 150) showing the trichobothrial pattern of the chela of *Syntropis*. As stated elsewhere we believe these illustrations are based on the male holotype deposited in MNHN in Paris and therefore it is *S. macrura* (i.e., it is unlikely Vachon borrowed specimens from Williams, the only other known source of this genus at that time). As illustrated in our Fig. 13 of the paratype male of *S. williamsi*, we see no indication of a basal scallop on the movable finger. However, we must keep in mind that this large male is probably not fully matured, as indicated by the smaller morphometric ratio of metasomal segment V as compared to Williams (1980) observation of this population (i.e., 4.33 vs. 5.20). The male of *S. aalbui* is unknown so we have no data as to the presence or absence of a basal scallop. Basal scallops are not present in any of the female material examined.

Other diagnostic characters

Coloration and patterns. Kraepelin (1900) reported (after Stahnke, 1965) "… trunk and cauda are rust colored, ….. pedipalps are yellowish red at the base, then rust red, the fingers are almost brownish red …". Williams (1980) reported "… adults with base color of cuticle rusty brown; pedipalp fingers dark reddish brown …". These two descriptions are consistent furthering implying that the northern-central populations of *Syntropis* studied by Williams are indeed *S. macrura*. As discussed elsewhere, Williams (1980) contrasted the southern populations of *Syntropis* as having a lighter coloration. *S. williamsi* (Fig. 2) is pale yellow in color including the chelal fingers. *S. aalbui* (Fig. 3) is also of a uniformly rusty color as *S. macrura* with a subtle variegated pattern on the medio-posterior half of the carapace. As in *S. williamsi*, its chelal fingers are the same color as the palm. For the female *S. macrura* from Isla del Carmen (Fig. 1), we see the darker chelal fingers, but the overall color is more a dark yellow, not a rusty color.

Pectinal tooth counts. The pectinal tooth count ranges given by Williams (1980) for the northern-central and southern populations of *Syntropis* are disjoint, showing that *S. macrura* counts are 15–16 % larger than in *S. williamsi* (based on comparisons of range midpoints). The smaller pectinal tooth count in *S. williamsi* may also imply that it is a smaller species than *S. macrura*, as is indicated by the holotype female and our projections of its maximum size. For the solitary female *S. aalbui* we have 27 pectinal teeth, within the range of *S. macrura*, as does the *S. macrura* Isla del Carmen female with 28 teeth, Williams (1980) reported 27–31. Kraepelin (1900) and Stahnke (1965) reported 29 teeth for the male holotype, consistent with Williams' (1980) range for the male *S. macrura* (29–32).
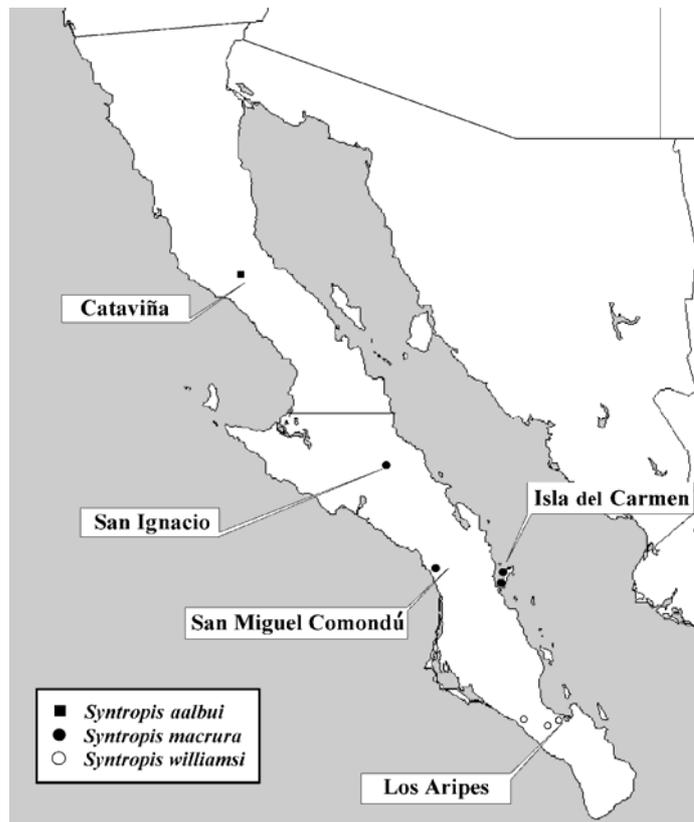
Biogeographical Considerations on *Syntropis*

The length of Baja California is lined on the eastern border along the Sea of Cortez with several essentially contiguous mountain ranges collectively referred to as the Peninsular Ranges, as follows north to south (after Grismer, 2002, in part): Sierra de Juarez (La Rumarosa to San Vicente), Sierra San Pedro Mártir (San Vicente to El Rosario), Sierra de Calmajué (El Rosario to Bahía de Los Angeles), Sierra de San Borja (Bahía de Los Angeles to El Arco), Sierra de San Francisco (El Arco to San Ignacio), Sierra de Guadalupe (San Ignacio to Loreto), Sierra de la Giganta (Loreto to La Paz), and Sierra de la Laguna (La Paz to Cabo San Lucas). In addition, important to this paper, the Sierra Columbia, a smaller westward inland mountain range adjacent to Sierra de Calmajue, is the range where Cataviña is situated, the type locality of *S. aalbui*.

Except for the three *Syntropis* records in the southern end of the Sierra de la Giganta (close to Los Aripes, roughly all within a 57 km area), and the two central populations, San Miguel Comondú and Isla del Carmen (roughly a 87 km area), the other records are quite disjoint: Cataviña to San Ignacio 350 km, San Ignacio to San Miguel Comondú 196 km, and San Miquel Comondú to Los Aripes 280 km, the Cataviña population being the most isolated (see map in Fig. 37).

The "typical" microhabitat for *Syntropis* is described by Williams (1980) "… species is adapted to volcanic habitats where it utilizes the spaces between fractured rocks for shelter. Most specimens found were on more or less vertical cliffs, often high above the ground …". Williams also writes "… species has invaded rock walls built by residents …" for the San Miguel Comondú population. Cataviña and adjacent areas is known for its boulder strewn landscape; Blue Palm canyon, just north of Cataviña, is described by Rolf Aalbu, the collector of the *S. aalbui* holotype (pers. comm. September 2006): "… this is a rocky canyon just north of Cataviña along the main road where a number of the "blue" form of fan palms are found. There is usually some water in this canyon. There are no volcanics in the immediate area which is granitic …". Clearly, the species of this scorpion genus, in certain localities, are ultralithophiles; this is presumably true for *S. macrura*, which would explain, in part, its extreme slenderness, as compared to the other two species. *S. aalbui* and *S. williamsi* appear not to be *ultra*lithophilic, judging from their relatively stouter metasoma, albeit they certainly are lithophiles. We find it curious that the most northern and most southern popula-

Fig. 37. Distribution of genus *Syntropis* showing eight known recorded localities in Baja California, Mexico. Records based on Williams (1980: 47) and specimens examined.

Cataviña

San Ignacio

Isla del Carmen

San Miguel Comondú

■ *Syntropis aalbui*
● *Syntropis macrura*
○ *Syntropis williamsi*

Los Aripes

tions lack the extremely slender metasoma, which only occurs in central populations in the Sierra de Guadalupe and Sierra de la Giganta.

Currently accepted scenarios of historical biogeography for Baja California peninsula based on several animal groups (Riddle et al. 2000) emphasize several vicariant events resulting in late Cenozoic speciation centers due to sea level dynamics. In particular, the well-known Pliocene seaway across the Isthmus of La Paz "La Paz strait" was important in endemic speciation (often cryptic) of southern Baja California ("the Cape region"), the vicariant event being dated 3 to 6 Mya. In addition, vicariance between northern and southern regions of the Baja California Peninsular Desert has been observed probably dating to middle Pleistocene (ca. 1 Mya). These events are quite consistent with our discovery of three *Syntropis* species along Baja California Peninsula, *S. williamsi* representing the southern endemic, *S. macrura*, the mid-peninsular, and *S. aalbui*, the northern one. A similar situation has been observed by Gantenbein et al. (2001) for the scorpion *Centruroides exilicauda* (Wood, 1863) (Buthidae), where molecular markers (16S mtDNA) demonstrated a clear separate clade in southern Baja ("the Cape region", topotypic population) as opposed to the rest of peninsula (probably a different species). Such vicariant speciation also possibly exists in other scorpions (Vaejovidae and Scorpionidae) since a number of species appears to be limited in their distribution only to southern Baja California (Williams, 1980).

Syntropis Placement Within Recent Scorpions

Except for the unique single ventromedian (*VM*) carina on metasomal segments I–IV (also matched in vaejovid genus *Vejovoidus*, see discussion below) and of lesser importance, its extreme slenderness, *Syntropis* is an ordinary vaejovid.

We now briefly discuss the place of *Syntropis*'s among Recent scorpions.

Parvorder, superfamily, and family. __Parvorder:__ This genus complies with Orthobothriotaxy type C (Vachon, 1974), sternum type 2 (Soleglad & Fet, 2003a: fig. 7), and a lamelliform hemispermatophore (Stockwell, 1989: figs. 218–219, 228), exclusive characters of parvorder **Iurida** Soleglad et Fet, 2003b. __Superfamily:__ The ventral edge of the cheliceral movable finger lacks a large solitary denticle (it is smooth), two subdistal denticles are found on the dorsal edge of the cheliceral movable finger, two pedal spurs are found on the legs, the leg tarsus is composed of a single median row of spinules (not clusters or fused clusters of spinules) and irregular lateral setae emanating from small sockets (type 5 armature, Soleglad & Fet, 2003b: 18), and the paraxial organ is without reflection of internobasal sperm duct (after Stockwell, 1989), characters of superfamily **Chactoidea** Pocock, 1893, which, in all or in part, exclude it from superfamilies Iuroidea and Scorpionoidea. __Family:__ The trichobothrial pattern of the chelal fixed finger *est–esb–eb* juncture angles towards the fixed finger edge, *eb* angles towards the dorsal edge; *ib–it* is located on the finger, not on the palm; $V_1–V_4$ extends most of the palm length and $V_1–V_2–V_3$ juncture is straight, not angled towards the internal condyle. The patellar trichobothrium v_3 is located on the external surface. The femoral trichobothrium *d* is located next to the dorsoexternal carina and is proximal of trichobothrium *i*. The LAS structure is present on the base of the telson aculeus. The chelal finger median (*MD*) denticle row groups are aligned in a straight line; inner accessory (*IAD*) and outer accessory (*OAD*) denticles are not present. The genital operculum of the female is not separated its entire length, but instead is completely connected; the pedi-

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palp patellar carina DPS_c is well developed; the terminus of the dorsolateral (*DL*) carina is flared, not coinciding with the articulation condyle; hemispermatophore lamellar flange present with basal hook (two) (after Stockwell, 1989); pectinal tooth count / total length ratio of female is under 3.00, ranging from 2.8 to 2.9, all important characteristics of family **Vaejovidae** Thorell, 1876, which, in all or in part, exclude it from chactoid families Chactidae, Euscorpiidae, and Superstitioniidae.

Vaejovid genera and *Vaejovis* groups. In his important unpublished cladistic analysis of scorpions, Stockwell (1989: 198, fig. 257) suggested the following topology for a tribe in Vaejovidae he called Syntropini: *Serradigitus* (= tribe Stahnkeini) + (*Syntropis* + "eusthenura" group + "punctipalpi" group). We see here that he considered the "eusthenura" and "punctipalpi" groups of *Vaejovis* to be the closest relatives of genus *Syntropis*. Based on our preliminary analysis we tend to agree with Stockwell for the following reasons: *Syntropis* and these two *Vaejovis* groups share the following important diagnostic characters. Sclerites of female genital operculum are connected their entire length, both plates operating as a single unit (only shared by tribe Stahnkeini); ventral surface of leg tarsus with multiple (2–4) pairs of distal spinules (only shared by genera *Pseudouroctonus* and *Uroctonites*, and some presumably "mexicanus" group species); chelal palm trichobothria *Dt* is located distally, at least midpalm, and *Db* is positioned on or above the digital (*D1*) carina (the former only shared by tribe Stahnkeini and genus *Paravaejovis*; and the latter shared only by genera *Pseudouroctonus* and *Uroctonites*); chelal fixed finger trichobothria *ib–it* positioned adjacent to outer (*OD*) denticle-6; and distal aspect of hemispermatophore sperm (= mating) plug toothed (after Stockwell, 1989) (only shared by related genera *Paruroctonus*, *Smeringurus*, *Vejovoidus*, and *Paravaejovis*).

"eusthenura" and "punctipalpi" groups. Of the two related *Vaejovis* groups, *Syntropis* appears to be more closely related to the "eusthenura" group as follows: the subdigital (*D2*) carina in *Syntropis* is vestigially developed, comprised of one small denticle, whereas in the "punctipalpi" group, *D2* is well developed, crenulate to serrulate, sometimes extending one-third the palm's length; inline with this, the other chelal carinae are quite reduced in *Syntropis* whereas in the "punctipalpi" group they are well developed and usually granulate to crenulate; the carapace anterior edge in *Syntropis* is essentially straight or with a wide rounded indentation, not exhibiting a well developed emargination and narrow indentation as seen in most "punctipalpi" group species. Although the metasomal carinae in *Syntropis* are more delicately structured as those found in the "punctipalpi" group, not widely flared dorsally as seen in most "eusthenura" group species, this may be caused, in part, by the extensive morphometric lengthening of the metasoma seen in *Syntropis*. Similarly, in line with the slender metasoma, we see the telson vesicle in *Syntropis* to be more elongated as seen in some "punctipalpi" group species, not exhibiting the highly basal to terminal tapering as exhibited in the "eusthenura" group. Again this may be attributed to the unusual morphometric slendering of *Syntropis* appendages.

We calculated the chelal finger denticle metrics defined by Soleglad & Fet (2006), in their analysis of the tribe Stahnkeini, and compared them to other vaejovid groups discussed by these authors (see their tables 2–3): $MD + OD$ density quotient (= 81–87) and the MD_length/Fixed finger_Depth ratio (= 0.10, only for species *S. williamsi*). For the first metric we see *Syntropis* is outside the range of both the "eusthenura" and "punctipalpi" groups, falling into ranges comparable to those found in *Franckeus* and the "nigrescens" and "mexicanus" groups. For the second metric, *Syntropis* is within range of the "eusthenura" group, and outside that of the "punctipalpi" group. [See Soleglad & Fet, 2006, for a list of the 73 vaejovid species used in these comparisons.] This further emphasizes the unique finger dentition found in tribe Stahnkeini. Although they and *Syntropis* are lithophiles and in general have slender fingers, the highly derived finger dentition seen in the former is not present in *Syntropis*. In addition, this further supports the thesis that the "whitish" patch found on the finger tips in Stahnkeini, and as well *Syntropis*, *Franckeus*, "nigrescens" group, plus others, is independent of the serrated condition found in Stahnkeini. It is becoming clear that the predominant association with lithophilic friendly microhabitats and the "whitish" patch is not a coincidence.

Other vaejovid genera and *Vaejovis* groups. Important structural differences between *Syntropis* and the other more distant vaejovid assemblages are as follows, ordered from, presumably, its next closest relative and so on:

tribe Stahnkeini (= *Serradigitus* + *Stahnkeus*): differs from *Syntropis* by its unique flat, elongated, serrated chelal finger denticles; the lack of sensorial areas on the basal pectinal teeth of the female; the variable position of chelal trichobothria *ib–it*; the single pair of ventral median distal spinules on leg tarsus; and the smooth terminus of the hemispermatophore sperm plug;

−genera *Pseudouroctonus* and *Uroctonites*: differ from *Syntropis* by the posterior separation of genital operculum of the female; chelal palm trichobothrium *Dt* is located proximal of palm midpoint; chelal fixed finger trichobothria *ib–it* are basal on finger, considerably proximal of last *OD* denticle; chelae is somewhat flat with a reduced or obsolete ventromedian (*V2*) carina; pectinal tooth count is considerably reduced as compared to the size of the adult scorpion; and the smooth terminus of the hemispermatophore sperm plug;

−genus *Franckeus* and *Vaejovis* "nigrescens" and "mexicanus" groups: differ from *Syntropis* by the posterior separation of genital operculum of the female; chelal palm trichobothrium *Dt* is located proximal of palm midpoint; chelal fixed finger trichobothria *ib–it* are basal on finger considerably proximal of last *OD* denticle; the single pair of ventral median distal spinules on leg tarsus; and the smooth terminus of the hemispermatophore sperm plug;

−genera *Paruroctonus*, *Smeringurus*, *Vejovoidus*, and *Paravaejovis*: differ from *Syntropis* by the independent movement of the genital operculum sclerites of the female which are separated posteriorly; chelal palm trichobothrium *Dt* is located considerably proximal of palm midpoint (*Paravaejovis* is an exception); chelal fixed finger trichobothria *ib–it* are proximal of *OD*-6; chelal fixed finger trichobothrium *dst* is located proximal of *est*; the spacing

between chelal palm trichobothria V_2–V_3 is considerably larger than that of V_1–V_2; the presence of "setal combs" on the dorsal surface of the leg basitarsus and tarsus (after Stockwell, 1989); the presence of a single pair of ventral median distal spinules on leg tarsus; the presence of dentition on the cheliceral movable finger ventral edge (*Paravaejovis* is an exception); and the lack or near lack of a flared terminus on the dorsolateral (DL) carinae of metasomal segment IV.

Derived characters. Finally, based on the suggested topology of Stockwell (1989) and the discussion of diagnostic characters presented above, which supports Stockwell's result in our opinion, we believe the presence of a single ventromedian (VM) carina on metasomal segments I–IV is clearly a derived condition and can be considered a nonhomoplasious synapomorphy for genus *Syntropis*. We classify it as nonhomoplasious (i.e., reflecting congruency) because we believe it is *only* analogous to that same condition seen in genus *Vejovoidus*. We suggest here that this condition derived separately in the two genera and, in all probability, is a byproduct of the drastic adaptation exhibited in both genera to their specialized microhabitats, lithophilic for *Syntropis* and ultrapsammophilic for *Vejovoidus*. We also consider the *midfinger* placement of the basal *OD* denticles of the chelal fixed and movable fingers and the *ID* denticle of the fixed finger to be a derived character as well, being quite unusual in vaejovid scorpions in general. This derivation is further supported by the mid- to distal placement of trichobothrial series *ib–it*, *eb–et*, and *db–dt* (basal *db* is slightly proximal of midfinger). As with the single ventromedian carina, we suggest this character may be a product of the extreme lengthening of *Syntropis* appendages, in this case, as discussed elsewhere, a lengthening of the finger bases.

In summary our analysis, in general, agrees with that of Stockwell (1989) where we see strong support for the clade "Stahnkeini + ((*Syntropis* + "eusthenura" group) + "punctipalpi" group)".

Acknowledgments

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Catálogo de los Carabidae (Coleoptera) de la Península Ibérica /
Catalogue of the Carabidae (Coleoptera) of the Iberian Peninsula

José Serrano

Monografías SEA, vol. 9, Septiembre, 2003, 130 pp.

La obra consta del **catálogo** propiamente dicho, la **bibliografía**, una propuesta formal de **cambio nomenclaturial**, el **índice taxonómico**, la relación de **novedades** para la fauna ibérica con respecto al catálogo de Zaballos & Jeanne (1994), la **relación sintética de la Sistemática** empleada junto con las **estadísticas** del catálogo y dos **mapas** de la Península Ibérica.

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