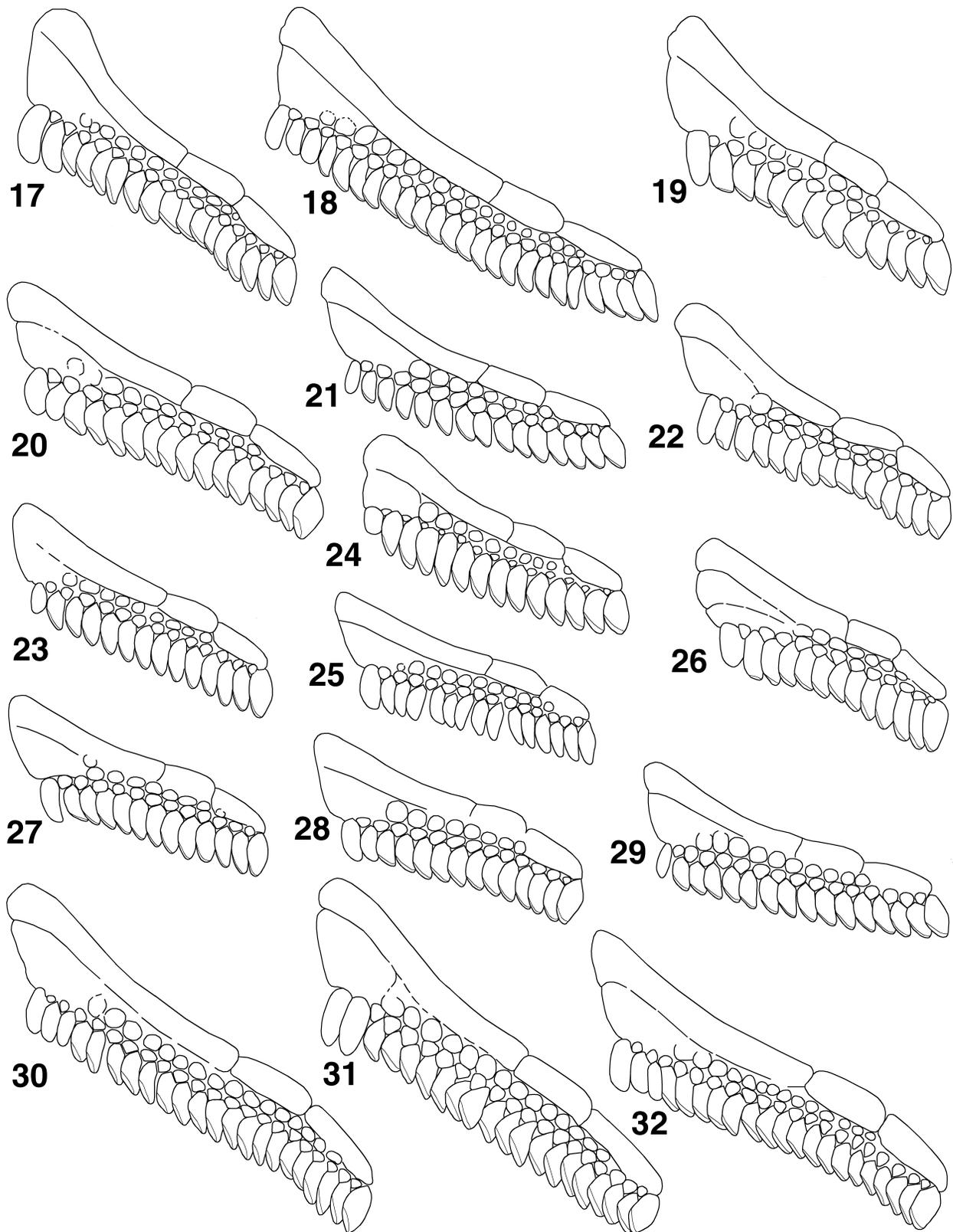


Figures 13–16: Basal pectinal teeth of female showing the characteristic smooth (i.e., lacking sensorial area), elongated and non-angled teeth of tribe Stahnkeini. **13 & 14** *Serradigitus g. gertschi*, San Diego, California. **15 & 16** *Stahnkeus subtilimanus*, Borrego Springs, California.



Figures 17–32: Examples of the female pecten of genera *Serradigitus* and *Stahnkeus* showing the varied configurations of the basal teeth. 17. *Serradigitus wupatkiensis*. 18. *S. adcocki*. 19. *S. torridus*. 20. *S. calidus*. 21. *S. bechteli*. 22. *S. g. gertschi*. 23. *S. minutis*. 24. *S. littoralis*. 25. *S. hearnei*. 26. *S. joshuaensis*. 27. *S. haradoni*. 28. *S. gramenestris*. 29. *S. pacificus*. 30. *Stahnkeus harbisoni*. 31. *S. subtilimanus*. 32. *S. deserticola*. Figs. 20, 22, 26, 30–32 after Soleglad (1974, in part).

♀	Left Pecten		Right Pecten	
	Total Teeth	Basal Teeth	Total Teeth	Basal Teeth
<i>Stahnkeus allredi</i>	14–16	2	14–16	2
<i>Stahnkeus deserticola</i>	20–21 (20.333) [3]	3* (3.000) [3]	20–21 (20.500) [2]	3* (3.000) [2]
<i>Stahnkeus harbisoni</i>	22–24 (23.167) [6]	2–3 (2.833) [6]	22–24 (22.667) [6]	2–3* (2.833) [6]
<i>Stahnkeus polisi</i>	15–21	2	15–21	2
<i>Stahnkeus subtilimanus</i>	19–23 (21.880) [25]	2–4* (2.782) [23]	21–24 (21.954) [22]	2–3* (2.730) [23]
<i>Serradigitus adcocki</i>	23 (23.000) [1]	2 (2.000) [1]	24 (24.000) [1]	3* (3.000) [1]
<i>Serradigitus agilis</i>	14–15	2	14–15	2
<i>Serradigitus bechteli</i>	15 [1]	2* [1]	15 [1]	1 [1]
<i>Serradigitus calidus</i>	16–17 (16.500) [2]	2 (2.000) [2]	15–16 (15.500) [2]	1 (1.000) [2]
<i>Serradigitus g. gertschi</i>	15–16 (15.500) [8]	2* (2.000) [9]	15–16 (15.571) [7]	1–3 (2.000) [7]
<i>Serradigitus gramenestris</i>	13–14 (13.800) [10]	1–2* (1.889) [9]	13–14 (13.667) [9]	1–2* (1.750) [8]
<i>Serradigitus haradoni</i>	13–14 (13.500) [2]	1 (1.000) [2]	13 (13.000) [2]	1–2* (1.500) [2]
<i>Serradigitus hearnei</i>	15–16 (15.500) [2]	1 [1]	15 (15.000) [2]	1 (1.000) [3]
<i>Serradigitus joshuaensis</i>	12–14 (12.895) [19]	1–2* (1.263) [19]	12–15 (12.944) [18]	1–2* (1.056) [18]
<i>Serradigitus littoralis</i>	13–14 (13.500) [4]	1 (1.000) [3]	13–14 (13.750) [4]	1 (1.000) [3]
<i>Serradigitus minutis</i>	13–15 (13.875) [7]	1–2* (1.375) [8]	13–14 (13.571) [7]	1–2* (1.143) [7]
<i>Serradigitus pacificus</i>	16 [1]	1 [1]	15 [1]	1* [1]
<i>Serradigitus torridus</i>	13–15 (14.333) [6]	1–2 (1.667) [6]	13–15 (14.333) [6]	1–3* (2.000) [6]
<i>Serradigitus wupatkiensis</i>	16–17 (16.500) [2]	2 (2.000) [2]	16–17 (16.500) [2]	2 (2.000) [2]
<i>Serradigitus yaqui</i>	13–15	1–2*	13–15	1–2*

Table 4: Pectinal tooth data of *female* for genera *Stahnkeus* and *Serradigitus*. *Basal teeth* refer to elongated or shortened, non-angled teeth lacking peg sensilla. Minimum–maximum (mean) [number of samples]. Data based on material examined and Soleglad (1974) for *Serradigitus calidus* (in part), and Sissom & Stockwell (1991) for *Stahnkeus allredi*, *S. polisi*, *Serradigitus agilis* and *S. yaqui*; for the latter species the number of samples or left/right distribution are not available. * indicates that most distal tooth in basal range only partially exhibits tooth modifications.

position the sensorial area parallel to the substrate. In males, whose sensorial area is considerably larger than that of the female, we see a more exaggerated angling to accommodate the larger group of peg sensilla. Finally, one may also argue that the lack of this angling might be the cause of this tooth being more elongated or ovoid in shape, thus symmetric laterally. In summary, without a sensorial area, the tooth need not be positioned parallel to the substrate, thus it is not angled, and therefore essentially symmetric laterally.

This character presents itself in many various configurations. Figures 12–16 depict: a short non-angled, smooth basal tooth (*Serradigitus joshuaensis* and *S. minutis*), one elongated non-angled smooth tooth (*S. g. gertschi*), and three conspicuously elongated non-angled smooth teeth (*Stahnkeus subtilimanus*). The smoothness exhibited on these basal teeth is due to the complete lack of a sensorial area on the distal aspect of

the tooth. It is also important to note in these figures that the second, and with the case of *S. subtilimanus*, fourth tooth, respectively, exhibit a partial modification: in these cases there is a slightly developed sensorial area containing peg sensilla and slight exeterodistal angling. The more distal teeth in these four species are normally developed, exhibiting the typical size of sensorial area. On the teeth that have a reduced sensorial area, the peg sensilla show the same density as that of the normally developed tooth, only the area is reduced.

Figures 17–32 illustrate the wide spectrum of configurations of this curious character as it exists in sixteen species of tribe Stahnkeini. These figures show the shortened, rounded basal tooth of species *Serradigitus minutis*, *S. littoralis*, and *S. joshuaensis* (Figs. 23, 24 and 26); a shorter and thinner basal tooth of species *S. bechteli* and *S. pacificus* (Figs. 21 and 29); the two exaggerated elongated basal teeth of *S. wupatkiensis*

(Fig. 17); and three modified basal teeth in *S. adcocki* (Fig. 18), one of the largest *Serradigitus* species. In genus *Stahnkeus*, its three largest species, *S. harbisoni*, *S. subtilimanus* and *S. deserticola*, exhibit two to three modified basal teeth (Figs. 30–32), the average being three.

It is important to note here, as first reported by Soleglad (1974: 108), that these pectinal modifications show variability within the species and even within a specimen, where sometimes one pecten is formed differently than the other with respect to these modifications. For example, a pecten may exhibit a partially modified tooth (as seen in Figs. 12–16) whereas the other pecten may have this tooth completely modified, or, presented as a normally formed tooth lacking any modifications. Table 4 presents statistics of the pectines of a large representative set of *Stahnkeini* species, where we see asymmetry across the pectines. It is also clear from these data, as well as in Figs. 17–32, that the larger species, thus those exhibiting the overall largest pectinal tooth counts, have a tendency for two or sometimes three modified basal teeth. The smaller species such as *S. minutis*, *S. haradoni*, *S. hearnei*, *S. littoralis* and *S. joshuaensis* exhibiting on an average only a single modified basal tooth. Table 4 also shows, where multiple specimens were available for examination, the occurrence of partially modified basal teeth is somewhat common, as that shown in Figs. 12–16.

History of the character. It is interesting to point out that this character was defined quite accurately as far back as 1940 when Herbert Stahnke (1940a: 102), in his unpublished Ph.D. thesis, described new species *Vejoavis wupatkiensis* (now *Serradigitus wupatkiensis*): "... first two teeth on the female are larger, rounder, and smoother looking than the others ...". Stahnke essentially observed the three modifications attributed to this character. This was the most accurate description of this character until Soleglad (1974: 102, figs. 1–6) described and illustrated it in detail for several species of *Stahnkeini*. Of special interest, when Stahnke (1940b) published an official abstract of the new species described in his unpublished thesis, only a small paragraph was devoted to *S. wupatkiensis* and nothing was mentioned concerning this character. Stahnke (1974), when he officially established the genus *Serradigitus*, described this character as follows: "... female pectines with teeth number one to three more paddle-like and somewhat larger than the others ...". Curiously, he does not mention the smoothness of the teeth, i.e., the lack of a sensorial area. It is interesting to note that this character was sometimes completely ignored by other workers in their descriptions of species of this tribe, including the first author of this paper: Gertsch & Allred (1965), for species now called *Serradigitus wupatkiensis*; Williams (1968), for *S. g.*

gertschi; Williams (1970b, in part), for *S. minutis*; Hjelle (1972), for *S. gertschi striatus*; Soleglad (1972), for *S. joshuaensis* and *Stahnkeus subtilimanus*; Johnson & Allred (1972), for *Serradigitus wupatkiensis*; and Williams (1980), for all Baja California species associated with the "wupatkiensis" group of *Vaejoavis*. Williams (1970a) mentioned this character, in part, for two new species (now *Serradigitus gramenestrus* and *Stahnkeus deserticola*), only referring to the "elongated" aspect of the character. Williams (1970b) mentioned this character for *Vejoavis harbisoni* (now *Stahnkeus harbisoni*) but ignored it for *V. minutis* (now *Serradigitus minutis*). Presumably, only the "elongated" aspect of the character was recognized, not the loss of the sensorial area or its lack of external angling (the basal tooth of *S. minutis* is small and round (Figs. 12, 23)). As discussed elsewhere, Williams (1980) analyzed this character in his argument for synonymizing *Serradigitus* with *Vaejoavis* but limited his depiction of the character only to its shape and decided, because it is found on one, or sometimes two teeth, that it is too variable to be a legitimate character. In his analysis, Williams (1980) completely ignored Soleglad's (1974) detailed description of the character which encompassed the variability of these modifications. This somewhat limited analysis of the character plus the confusion with non-*Stahnkeini* species, such as *Vaejoavis peninsularis* (now placed in *Franckeus*) and *V. janssi*, caused Williams (1980), in part, to synonymize genus *Serradigitus*. However, in 1986, Williams & Berke reconsidered the position of *Serradigitus* and reestablished it as a legitimate genus, but still did not completely describe this character: "... females with proximal teeth 1–3 often more elongate or more swollen than more distal ones ...". Sissom & Stockwell (1991: figs. 1, 14, 27, 36) illustrated this character for four new species. In their depiction of this character they did mention the lack of peg sensilla. Finally, Stockwell (1992: 416, fig. 42) illustrated and described this character in his key "... females with one or more pairs of proximal pectinal teeth ovoid and lacking sensillae ...". Stockwell's description succinctly defines female pectines of the *Stahnkeini*.

The similar character found in Buthidae. It seems relevant to mention here that the modified basal pectinal teeth in scorpion females are known also in some Old World Buthidae. Such modifications are, to a variable degree, present in all species of the endemic Madagascan genus *Grosphus* Simon, 1880 (e.g. Lourenço, 1996: figs. 3–9) as well as in Afrotropical genus *Uroplectes* Peters, 1861 (e.g. Lamoral, 1979: figs. 229, 230, 268, 284, 291). In some buthids, a single, most basal pectinal tooth can be elongated in a bizarre, saberlike shape (e.g. *Grosphus grandidieri* Kraepelin, 1900; see Lourenço, 1996: fig. 7). Our preliminary SEM data (V. Fet & P. H. Brownell, in progress) show that the

	$(ib^1/\text{Fixed Finger Length}) = A \mid A/\text{Carapace Length}$	<i>it</i> Position Relative to Inner Denticles (<i>ID</i>)	<i>ib</i> Position Relative to Inner Denticles (<i>ID</i>)
<i>Stahnkeus allredi</i>	0.282 0.091	not determinable	not determinable
<i>Stahnkeus deserticola</i>	0.471 0.091	not determinable	not determinable
<i>Stahnkeus harbisoni</i>	0.471 0.079	not determinable	not determinable
<i>Stahnkeus polisi</i>	0.353 0.075	not determinable	not determinable
<i>Stahnkeus subtilimanus</i>	0.462 0.084	not determinable	not determinable
<i>Serradigitus adcocki</i>	0.500 0.106	between <i>ID</i> -4 & <i>ID</i> -5	between <i>ID</i> -4 & <i>ID</i> -5
<i>Serradigitus agilis</i>	0.216 0.068	adjacent to <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus armadentis</i>	0.297 0.082	between <i>ID</i> -5 & <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus baueri</i> ³	0.161 0.047	adjacent to <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus bechteli</i>	0.313 0.089	between <i>ID</i> -5 & <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus calidus</i>	0.375 0.114	between <i>ID</i> -4 & <i>ID</i> -5	between <i>ID</i> -5 & <i>ID</i> -6
<i>Serradigitus dwyeri</i>	0.255 0.093	between <i>ID</i> -5 & <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus g. gertschi</i>	0.222 0.072	between <i>ID</i> -5 & <i>ID</i> -6	adjacent to <i>ID</i> -6
<i>Serradigitus gigantaensis</i>	0.215 0.081	between <i>ID</i> -5 & <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus gramenestris</i>	0.262 0.071	between <i>ID</i> -5 & <i>ID</i> -6	adjacent to <i>ID</i> -6
<i>Serradigitus haradoni</i>	0.253 0.086	between <i>ID</i> -5 & <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus hearnei</i>	0.327 0.113	adjacent to <i>ID</i> -5	between <i>ID</i> -5 & <i>ID</i> -6
<i>Serradigitus joshuaensis</i> ²	0.208 0.069	proximal to <i>ID</i> -4 ²	proximal to <i>ID</i> -4 ²
<i>Serradigitus littoralis</i> ³	0.152 0.042	proximal to <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus minutis</i>	0.316 0.105	adjacent to <i>ID</i> -5	between <i>ID</i> -5 & <i>ID</i> -6
<i>Serradigitus pacificus</i> ³	0.214 0.055	adjacent to <i>ID</i> -6	proximal to <i>ID</i> -6
<i>Serradigitus torridus</i>	0.292 0.077	between <i>ID</i> -5 & <i>ID</i> -6	between <i>ID</i> -5 & <i>ID</i> -6
<i>Serradigitus wupatkiensis</i>	0.311 0.074	between <i>ID</i> -5 & <i>ID</i> -6	between <i>ID</i> -5 & <i>ID</i> -6
<i>Serradigitus yaqui</i>	0.313 0.098	between <i>ID</i> -5 & <i>ID</i> -6	between <i>ID</i> -5 & <i>ID</i> -6

Table 5: Chelal trichobothrial series *ib*–*it* relative positioning on fixed finger in relationship to the inner denticles (*ID*) for genera *Stahnkeus* and *Serradigitus*. The two morphometric ratios illustrate that the relative position of the *ib*–*it* trichobothrial series is a function of the species adult size; the larger species exhibit a more midfinger position of these trichobothria and, similarly, smaller species have these trichobothria more proximally on the finger. This is shown by the first ratio (= *A*). The second ratio normalizes the first ratio by dividing it by the carapace length. Note that “not determinable” refers to the presence of inner accessory denticles (*IAD*) that obscure the identity of individual *ID*. Data based on specimens examined and from Sissom & Stockwell (1991). ¹ *ib* position measured from base of fixed finger. ² *S. joshuaensis* exhibits a reduced number of inner (*ID*) denticles, *ID*-4 is the most proximal denticle. ³ Indicates species with unusually basal *ib*–*it* trichobothria.

reduction of the sensorial area and number of peg sensilla takes place on the modified basal tooth in *Uroplectes* in the same fashion as in *Stahnkeini*. In addition, a similar lobe-producing enlargement is known for the proximal median lamella of the pecten, rather than a pectinal tooth, in the African genus *Parabuthus* Pocock, 1890 (e.g. Lamoral, 1979: fig. 108), and in the New World buthid genera *Tityus* C.L. Koch, 1836 and *Tityopsis* Armas, 1974, also in the females. The function of modified basal pectinal teeth or lamellae is not known, but their presence only in females and, moreover, in close proximity to the genital opening

allows to hypothesize this feature as a reproductive adaptation, either for mating or for parturition.

Chelal finger trichobothria *ib* and *it*. The “mid-finger” position of chelal internal trichobothria *ib*–*it* in *Stahnkeini* was first discussed by Gertsch & Soleglad (1972: 564, figs. 76–79) where they for the first time illustrated the chelal trichobothrial pattern of a member of this tribe (*Vejovis wupatkiensis*, now *Serradigitus wupatkiensis*). In their discussion, they contrasted the midfinger *ib*–*it* position of *V. wupatkiensis* with that of *V. gracilis* Gertsch et Soleglad, 1972, whose trichobothria are positioned basally on the finger. The

relatively basal position of chela trichobothrial *ib-it* on the fixed finger was also used by Soleglad (1973: 360) in his definition of the “mexicanus” group of genus *Vaejovis*. Williams (1980: fig. 53A–Q) used this character as well in his monograph on scorpions of Baja California, Mexico, and improved on Soleglad’s (1973) depiction, based solely on finger position (i.e., a ratio), by associating the position of these trichobothria in respect to the *ID* denticles of the finger. Sissom & Francke (1985) also used the position of *ib-it* in their definition of the “nitidulus” group of *Vaejovis* (now genus *Franckeus* + *Vaejovis* “nigrescens” group; Soleglad & Fet, 2005).

Soleglad & Fet (2003: figs. 67–78) illustrated the relative position of trichobothria *ib-it* for 41 scorpion species representing all major genera and *Vaejovis* groups in family Vaejovidae. In this case, the authors were emphasizing the *finger* placement of these trichobothria in Vaejovidae in contrast to the *palm* placement found in families Chactidae and Euscorpiidae. In fig. 67, Soleglad & Fet (2003b) illustrated the position of *ib-it* for five species now placed in tribe Stahnkeini. From this figure, it is clear that the relative position varied within these species. In contrast, other illustrated vaejovid genera and *Vaejovis* groups exhibited the essentially consistent placement of *ib-it* in respect to *ID* locations. This is also verified in the additional species examined during the present study. Soleglad & Fet (2005: 6) commented on this variability of *ib-it* position in the taxa now placed in Stahnkeini suggesting that the position was based, in part, on the adult size of a species: trichobothria *ib-it* are located more mid-finger on larger species of Stahnkeini and likewise, are positioned more basally on smaller species. This observation in general is correct. Table 5 presents data documenting both the *ib-it* position on the fixed finger in respect to their alignment with specific *ID* denticles as well as a ratio based on trichobothrium *ib* position and fixed finger length. The smaller species of Stahnkeini, such as *Serradigitus joshuaensis*, *S. minutis*, *S. gigantaensis*, and *S. gertschi*, exhibit a more proximal placement of *ib-it*, whereas in larger species *S. adcocki*, *Stahnkeus harbisoni*, *S. deserticola* and *S. subtilimanus*, *ib-it* placement is more midfinger, their *ib*/fixed finger length ratio ranging 0.462–0.500 (Table 5). In order to demonstrate that the position of *ib-it* is roughly related to the species adult size, Table 5 employs a second ratio based on the carapace length: (*ib*_position/fixed finger length)/carapace length. The carapace length is used as an indicator of adult size. Our hypothesis here is that if a species is twice the adult size of another species, then the relative distance from trichobothrium *ib* to the fixed finger base would also be twice as large. Using this ratio, we do see overall consistency in tribe Stahnkeini, i.e., the hypothesis is generally correct, except for three species, *Serradigitus littoralis*, *S. baueri*, and *S.*

pacificus. In these species, trichobothria *ib-it* are placed considerably more basally on the fixed finger (as indicated by the somewhat lower second ratio stated in Table 5; 0.042–0.055) considering the reported adult size of the species. We also see in *S. littoralis* that both *ib* and *it* are positioned proximal to the basal *ID* (= *ID-6*); in *S. baueri* and *S. pacificus*, which appear to be closely related (see discussion elsewhere), these trichobothria are positioned closer to *ID-6*.

Relatively large pectinal tooth numbers. Soleglad & Fet (2003: 61–65, figs. 110–113) discussed the number of pectinal teeth as it related to the mature size of the scorpion species, in particular, contrasting the four chactoid families, Chactidae, Euscorpiidae, Superstitioniidae, and Vaejovidae. In is interesting to point out here that this analysis by Soleglad & Fet (2003) was based on the original observation of Soleglad (1973: figs. 13–14) that within closely related species sets (e.g., a genus) the number of pectinal teeth is proportional to the scorpion species adult size; that is, larger species in a related species set will exhibit a larger pectinal tooth count than a smaller species in that same set. And, important to taxonomic analysis, the ratios derived from these comparisons differ across different species sets, thus providing a gross diagnostic indicator. In their analysis, based primarily on published data, Soleglad & Fet (2003) demonstrated that pectinal tooth count in the family Vaejovidae is considerably larger than that found in the other three chactoid families, exhibiting, on an average, an increase well exceeding 100 % (i.e., as it relates to the species mature size). Consequently, a character was established in their cladistic analysis (character 103), where the more developed pectines was shown to be a synapomorphy for family Vaejovidae. See Soleglad & Fet (2003: appendix D) for details and assumptions used in their analysis.

In their analysis, Soleglad & Fet (2003) considered 91 species of the family Vaejovidae, including 16 species now placed in tribe Stahnkeini, the subject of this paper. As originally reported by Soleglad (1973) based on a smaller species set, Soleglad & Fet (2003: fig. D–6) also demonstrated that the assemblage of taxa now placed in Stahnkeini has relatively the largest pectinal tooth counts in the family Vaejovidae, only approached by the genus *Franckeus* and the *Vaejovis* “nigrescens” and “mexicanus” groups, where there is some standard error overlap. In stark contrast, genera *Pseudouroctonus* and *Uroctonites* clearly have the most reduced pectinal tooth numbers in the family.

In this analysis, factoring in the entire species set in tribe Stahnkeini, the Total Length (TL)/Pectinal Tooth Count (PTC) ratio for the *female* is the following: *Serradigitus* = 1.429–2.484 (1.915) [16], *Stahnkeus* = 1.667–2.217 (2.041) [5], and tribe Stahnkeini = 1.429–2.484 (1.945) [21].

Additional comments. Of particular interest for the present study was the examination of species *Serradigitus pacificus*, *S. baueri*, *S. littoralis*, and *S. bechteli*. This interest was precipitated, in part, by several events: (1) these species were considered members of the “wupatkiensis” group by Williams (1980); (2) then they were removed from *Serradigitus* by Williams & Berke (1986); (3) then they were returned (again) to *Serradigitus* by Sissom & Stockwell (1991); and (4) Sissom & Stockwell’s (1991: 198–199) curious statement: “... should be noted that *Vaejovis pacificus* and *V. baueri* [note that they were listed under *Vaejovis* by Williams & Berke, 1986] do not have modified proximal pectinal teeth in females ... *Vaejovis littoralis* has one proximal tooth on each pecten that is elliptical ... and the condition of the female pectinal teeth in *V. bechteli* is not known to us ...”. Taking this statement at its face value, the instability of genus placement of the species, and Williams’s (1980: 95) diagnostic comparisons between *Vaejovis baueri* and *V. pacificus*, which even included *Pseudouroctonus minimus thompsoni* (i.e., presumably implying a close relationship), we suspected that these species could represent a separate, closely related group distinct from *Serradigitus*. Adding to this suspicion was the fact that three of these species shared the same unusual, distally widening metasoma (i.e., segments III and IV sometimes as wide as, or wider than long; see Gertsch & Soleglad, 1972: figs. 141, 144), had elongated curved chelal fingers, and geographically, were isolated on islands off the west coast of southern California and Baja California, Mexico. *Serradigitus baueri* and *S. pacificus* in particular are situated quite close geographically. However, suspicions aside, based on very limited material, and contrary to Sissom & Stockwell’s (1991) comment, we *did observe* modified pectinal basal teeth in species *S. pacificus* (Fig. 29) and *S. bechteli* (Fig. 21, only known from female type specimen). Since only a solitary male of *S. baueri* was available for examination, we were not able to confirm one way or the other Sissom & Stockwell’s (1991) observation as to the female basal pectinal teeth lacking modifications. We suspect, based on this discrepancy with *S. pacificus*, and the qualified description of pectines of *S. littoralis*, that Sissom & Stockwell’s (1991) definition of this character is somewhat restricted, as was the case in Williams & Berke (1986). This probably explains why Sissom & Stockwell (1991) did not consider the modified pectinal base in females to be a mandatory diagnostic character for genus *Serradigitus*. While Sissom & Stockwell (1991) did not have the opportunity to examine *S. bechteli* (i.e., only known from female holotype), we do see that its modified pecten base is quite similar to that seen in *S. pacificus* (Figs. 21 and 29). In addition, with respect to other diagnostic characters, *Serradigitus baueri* and *S. pacificus* exhibited the serrated chelal

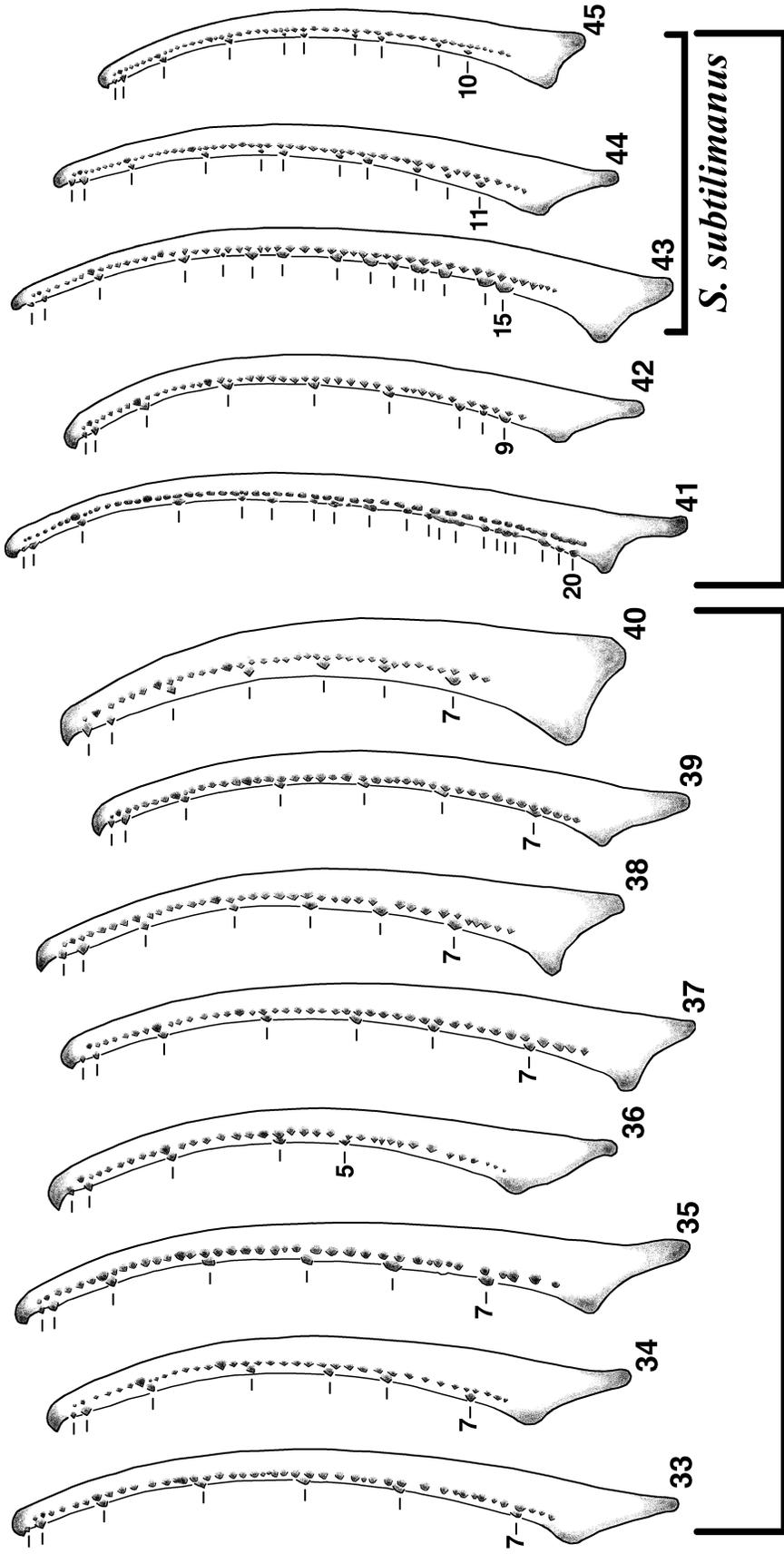
finger denticles as defined in this current study (i.e., low *MD + OD* density, *MD* denticles somewhat elongated, *OD* denticles not discernable proximally), plus they exhibited other characters consistent with tribe Stahnkeini. Interestingly, *S. baueri* and *S. pacificus*, along with *S. littoralis*, do exhibit an unusually basal position of chelal trichobothria *ib–it* in contrast to the other species of Stahnkeini (see Table 5). This is discussed further elsewhere in this paper.

To complete this analysis we even checked species *Pseudouroctonus minimus thompsoni* and concluded, predictively, that it is not related at all to members of tribe Stahnkeini, being more consistent with other members of *Pseudouroctonus*: genital operculum of the female is separated on the posterior one-fifth (it is fused in Stahnkeini), the leg tarsus terminus is equipped with multiple distal spinule pairs (*DSP*) (a single pair is found in Stahnkeini); chelal ventrointernal (*V2*) carina is essentially obsolete (it is present in Stahnkeini); chelal palm trichobothrium *Dt* is located proximally of palm’s midpoint (it is situated at, or distally to midpalm in Stahnkeini); chelal palm trichobothrium *ib* is located at the extreme base of the fixed finger (it is variable in Stahnkeini but never found on the extreme finger base); chelal finger dentition not overly serrated nor reduced in number, exhibiting a *MD + OD* density of 66; pectinal tooth counts are quite low in comparison to length of adult specimens, 10–11 teeth (the pectinal tooth counts are relatively high in Stahnkeini, the highest in Vaejovidae).

As a final comment, it must be noted that species *Serradigitus armadentis*, *S. dwyeri*, and *S. gigantaensis* are based on single male holotypes only, and their females are unknown. Therefore, the state of the basal teeth of the female pectines is not known in these species. Other diagnostic characters discussed in this paper, however, were verified from the single male type specimens to be consistent with *Serradigitus*.

Character analysis: genus *Stahnkeus*

Inner accessory (*IAD*) denticles. Stahnke (1974: 130), in his formal description of genus *Serradigitus*, stated a range of 6–16 for the number of inner (*ID*) denticles found on the movable finger of the chela. This range is unusual for vaejovids in general, since they typically exhibit six and seven *ID* on the fixed and movable fingers, respectively. Of course, there are exceptions to these counts, there are species with six *ID* on the movable finger (e.g., *Uroctonites huachuca*, *Vaejovis vorhiesi*), species with four and five *ID* on fixed and movable fingers (e.g., *Serradigitus joshuaensis*), etc., and, in contrast, genus *Vejovoidus* exhibits eight *ID* on the fixed finger. However, these exceptions as well as the typical counts of six and seven are in general consistent within the species, reflecting



Serradigitus

Stahnkeus

Figures 33–45: Denticle edge of chelal movable finger showing arrangement of inner (*ID*) and inner accessory (*IAD*) denticles of genera *Serradigitus* and *Stahnkeus*. Horizontal lines indicate *ID* and *IAD*; number specifies the total count of these denticles. **41–45** *Stahnkeus ID* and *IAD* denticles. **33.** *Serradigitus wupatkiensis*, female, Wupatki National Monument, Arizona. **34.** *S. calidus*, female, Cuatro Ciénegas, Coahuila, Mexico. **35.** *S. adcocki*, female, Isla Cerralvo, Baja California Sur, Mexico. **36.** *S. joshuaensis*, female, Indian Gorge, ABDSP, California. **37.** *S. torridus*, male, Nine Mile Rd., Kern Co., California. **38.** *S. minutis*, male, Cabo San Lucas, Baja California Sur, Mexico. **39.** *S. g. gertschi*, female, Chariot Canyon, ABDSP, California. **40.** *S. littoralis*, female, Isla Danzante, Baja California Sur, Mexico. **41.** *Stahnkeus harbisoni*, female adult, Oakies Landing, Baja California, Mexico. **42.** *S. deserticola*, female adult, Saratoga Springs, Death Valley, California. **43–45.** *S. subtilimanus*, Split Mountain, ABDSP, California. **43.** Male adult. **44.** Male subadult. **45.** Female juvenile.

	Adult		Subadult		Juvenile	
	MF	FF	MF	FF	MF	FF
<i>Stahnkeus harbisoni</i>	14–20 (16.83) [6]	12–18 (14.45) [6]	12–20 (15.50) [4]	11–14 (12.25) [4]	11–13 (12) [4]	9–11 (10) [4]
<i>Stahnkeus subtilimanus</i>	13–18 (15.31) [35]	12–17 (14.06) [36]	10–16 (12.69) [29]	9–16 (12.07) [29]	8–12 (10.08) [12]	7–10 (8.64) [11]
<i>Stahnkeus deserticola</i>	9–12 (10) [4]	6–10 (7.25) [4]	8	6	-	-

Table 6: Numbers of chelal inner (*ID*) and inner accessory (*IAD*) denticles for select species of *Stahnkeus* partitioned into general ontogenetic stages. The denticle numbers are the *sum* of *ID* and *IAD*. Note the increase in *IAD* number as specimens reach maturity. Based on the general stability of the inner (*ID*) denticle counts in the genus *Serradigitus*, we hypothesize here that they most likely equal six and seven in *Stahnkeus* for the fixed and movable fingers, respectively. Minimum–maximum (mean) [number of samples]; MF = movable finger, FF = fixed finger.

little variability. Soleglad (1972: 186) reported 9–15 internal denticles on both fingers of *Vejoavis subtilimanus* (now placed in *Stahnkeus*). This is noteworthy for two reasons; first, the counts are considerably higher than the normal number of *ID* found in Vaejovidae, and second, the counts are variable within the species. Clearly, some of the reported *ID* were inner accessory denticles (*IAD*), which makes Soleglad (1972) the first report of *IAD* denticles in the family Vaejovidae. We consider these accessory denticles for two reasons: first, they are variable in number, their number and overall development increasing with respect to the specimen's ontogenetic development; second, except for *Stahnkeus*, they are not known in any other vaejovid species where in general the number of *ID* is consistent within a species.

These *IAD* denticles occur in no less than five species previously included in the genus *Serradigitus*, now forming the new genus *Stahnkeus*: *Stahnkeus harbisoni*, *S. deserticola*, *S. subtilimanus*, *S. allredi*, and *S. polisi*. The presence of *IAD* in *Stahnkeus* is considered a synapomorphy for the genus. Note that, except for the distal aspect of the finger, *ID* cannot reliably be distinguished from *IAD* denticles, therefore our statistics in Table 6 depict the sum of these inner denticles, *ID* + *IAD*. As stated above, the overall size and number of *IAD* increase as the *Stahnkeus* specimen advances to an adult stage. Figure 7 illustrates a closeup of the movable finger of *S. subtilimanus* showing the somewhat irregular and enlarged *IAD* occurring most frequently on the base of the chelal fingers of adults. Also of interest in this figure are two small granule-like denticles which presumably are *IAD* in the process of developing. In addition, as shown in Table 6 for three *Stahnkeus* species, and supported by the presence of small denticles in Fig. 7, the number of *ID* + *IAD* increases in the specimens developmental stages. We suggest here that the initial *IAD* found in a juvenile increases in size during successive molts as newer small denticles are developed. This is one possible explanation for the larger numbers and somewhat larger irregularly developed *IAD* found on adult specimens (Fig. 7). *S.*

harbisoni, the largest species in genus *Stahnkeus*, averages 17 *ID* + *IAD* on adults for the movable finger, this number decreasing in subadults, showing counts of 16, and in juveniles, showing counts of 12. Similar trends are seen in *S. subtilimanus* and *S. deserticola* (the latter based on limited data), but reflecting smaller *ID* + *IAD* numbers. For species *S. subtilimanus*, where a larger number of specimens were available, the average number of *ID* + *IAD* denticles for adults, subadults and juveniles are 15, 13, and 10, respectively.

Figures 33–45 illustrate the denticle edge of the movable finger of 11 species of *Serradigitus* and *Stahnkeus*, showing the configuration of *ID* and *ID* + *IAD*, respectively. Three developmental stages of *Stahnkeus subtilimanus* (Figs. 43–45) exhibit the number of *ID* + *IAD* as 15, 11, and 10 for adult, subadult and juvenile, respectively. In contrast, for genus *Serradigitus* (Figs. 33–40), we see the typical vaejovid configuration of six and seven *ID* denticles on fixed and movable fingers, respectively. In *Serradigitus joshuaensis* (Fig. 35), however, these fingers have four and five *ID*.

History of *IAD* recognition in Stahnkeini. In the earliest descriptions of species now placed in *Stahnkeus* as *S. deserticola* and *S. harbisoni*, Williams (1970a, 1970b) did not discuss internal denticles of the chelal fingers, accessory or otherwise. Soleglad (1972: 186) was the first to report *IAD* in *Stahnkeus* in his description of *Vejoavis subtilimanus*: "... Teeth serrate, flanked by irregular row of supernumerary teeth, numbering 9–15 on both fingers ...". Stahnke (1974) also recognized the occurrence of *IAD* by providing a range when he formally described genus *Serradigitus* "...interior lateral, large flanking denticles vary in position and number from six on the type-species up to 16 on other species ...". Williams (1980: 103, fig. 541) described and illustrated the internal denticle arrangement of species *S. harbisoni* in his monograph on the scorpions of Baja California, Mexico. Sissom & Stockwell (1991: figs. 9, 22) discussed and illustrated the occurrence of multiple inner accessory granules in their descriptions of *Stahnkeus allredi* and *S. polisi*. Sissom & Stockwell (1991) did not distinguish between

inner and inner accessory denticles *sensu* Soleglad & Sissom (2001), but collectively referred to them as “accessory” (= “supernumerary” of Soleglad (1972)). For example, in an important aside, Yahia & Sissom (1996: 86) mentioned that “In all vaejovids except *Serradigitus* Stahnke, pedipalp chela finger dentition has been accepted as a very stable character. Much of the variation in the number of denticle sub-rows and inner accessory denticles appears to be due either to developmental anomalies or to injuries that were improperly repaired during molting. Only in *Serradigitus* spp., is significant ‘normal’ intraspecific variation in these characters observed”. It is important to note here, that Sissom & Stockwell (1991: 202) did suggest the relationship officially established in this paper (i.e., our new genus *Stahnkeus*) in their discussion of species *Serradigitus polisi*: “... is related to *S. harbisoni* (Williams), *S. subtilimanus* (Soleglad), and *S. allredi* ...”. The species *S. deserticola* was not included in their discussion because, until as reported herein, the presence of *IAD* on this species was not known. Soleglad & Sissom (2001: 39, fig. 28) also alluded to this taxonomic group by referring to three of its species as the “harbisoni” group in genus *Serradigitus*.

Inner accessory (*IAD*) denticles in parvorder Iurida. Soleglad & Sissom (2001: 33–41) were the first to differentiate inner (*ID*) denticles from inner accessory (*IAD*) denticles in their revision of chactoid family Euscorpiidae. This distinction was necessary in order to quantify the complex chelal finger dentition arrangements found throughout the euscorpiids. Euscorpiidae is the only known Recent scorpion family where all species exhibit *IAD*, a major synapomorphy for the family. Other than in Euscorpiidae, the presence of *IAD* is quite rare in Iurida. In family Caraboctonidae (superfamily Iuroidea), genus *Hadruroides* exhibits both *IAD* and outer accessory (*OAD*) denticles, most prevalent on mature specimens. This is the primary character separating *Hadruroides* from its sister genus *Caraboctonus* (see key in Fet et al., 2004b: 23). This distinction between these two genera, using accessory denticles, is analogous to that established in the present paper using *IAD* to separate genera *Serradigitus* and *Stahnkeus*. In the family Bothriuridae (superfamily Scorpionoidea), *IAD* are present in two species of *Lisposoma* (subfamily Lisposominae), *L. josehermana* Lamoral, 1979, and *L. haringtoni* (Prendini, 2003). The occurrence of *IAD* separates these closely related species from their sister species, *L. elegans*, which lacks *IAD* (see Fet et al., 2004a, for a detailed discussion and illustrations concerning this character).

Taxonomy & nomenclature

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

Stahnkeini Soleglad et Fet, **trib. nov.**

Type genus. *Stahnkeus* Soleglad et Fet, **gen. nov.**

Composition. This tribe contains two genera, *Stahnkeus* with five species, and *Serradigitus* with 20 species and subspecies.

Distribution. Mexico (Baja California, Baja California Sur, Coahuila, Sonora) and United States (Arizona, California, Nevada, New Mexico, Texas, Utah). See map in Fig. 46.

Diagnosis (*Synapomorphies*). Median (*MD*) and outer (*OD*) denticles of the chelal fingers are flattened and elongated, forming a serrated denticle edge, *OD* 1–3, which are situated directly inline with the *MD*, usually visible, other more basal *OD* denticles indistinguishable; basal pectinal teeth 1, 2, and/or 3 of female with missing or highly reduced sensorial area, exerodistal angling not present or reduced, shape usually elongate and symmetric laterally, but sometimes shorter and fatter; chelal finger trichobothria *ib–it* position on fixed finger is variable, not aligned with a specific inner (*ID*) denticle, located more midfinger in large species and basally in smaller species.

Important characteristics. Sclerites of female genital operculum are completely fused and hinge widely as a single unit; ventral median spinule row of leg tarsus equipped distally with a single pair of spinules; leg basitarsus and tarsus lacking “setal combs”; dorsolateral (*DL*) carinae terminus on metasomal segment IV flared, not coinciding with articulation condyle; ventromedian (*VM*) carinae of metasoma paired on segments I–IV; chelal trichobothrium *Db* positioned ventrally from digital (*DI*) carina; chelal trichobothrium *Dt* positioned at or distally of midpalm; distal ventral edge of cheliceral movable finger equipped with well developed serrula; chelal ventrointernal carina (*V2*) well developed, subdigital carina (*D2*) vestigial; dorsal patellar spur carina (*DPS_c*) well developed, exhibiting many serrated granules; median (*MD*) and outer (*OD*) denticle density quotient of chelal movable finger is low, ranging from 30–42 (36.7); distal margin of sperm plug of hemispermatophore is smooth (after Stockwell, 1989); pectinal tooth numbers large with respect to adult size, TL/PTC ratio for female usually ≤ 2.00 .

Other general characteristics. Carapace exhibits well developed anterior emargination, anteriorly with a subtle median indentation, never straight or convex; chelal fingers elongate, usually as long or longer than carapace, and terminate in an exaggerated distal hook equipped with a conspicuous “whitish patch”; cheliceral dorsal edge of movable finger with two subdistal (*sd*) denticles; cheliceral ventral edge of movable finger



Figure 46: Reported distribution of tribe Stahnkeini. ● = *Serradigitus* (species identified); ○ = *Stahnkeus* (see Map in Fig. 47 for species identifications). Localities based on specimens examined and from the following sources: Stahnke (1940a, 1940b), Gertsch & Allred (1965), Williams (1968, 1970a, 1970b, 1980), Hjelle (1972), Soleglad (1972, 1974), Johnson & Allred (1972), Williams & Berke (1986), Berke (1987, in part) and Sissom & Stockwell (1991).

smooth; vesicular tabs of telson equipped with small “hooked” granule; carinae of leg patellae developed and usually delicately crenulate; most species are lithophilic.

Discussion. From a cladistic point of view, the tribe Stahnkeini clearly forms a solid clade among the generic groups and “*Vaejovis* groups” currently defined in family Vaejovidae, exhibiting multiple unambiguous synapomorphies as detailed in this paper. Based on extensive preliminary cladistic analysis in progress, the choice of tribe level at this time seems the most prudent for this assemblage within the Vaejovidae. The rationale for this choice of taxonomic level will be demonstrated in an upcoming contribution.

Tribe Stahnkeini shares symplesiomorphies with the “punctipalpi” and “eusthenura” groups of *Vaejovis* such as the genital operculum of the female which distinctly operates as a single unit, showing no separation on the proximal edge, the non-basal positioning of chelal trichobothria *ib-it*, and the midpalm to distal position of chelal trichobothrium *Dt*. It differs from these two groups, in addition to the stated synapomorphies discussed above, primarily in exhibiting a single distal spinule pair on the leg tarsus ventral surface, whereas the other two groups have 2–4 pairs, and the smooth edge of the distal aspect of the hemispermatophore sperm plug, not toothed as in the other two groups (after Stockwell, 1989). Other vaejovid assemblages, such as *Pseudouroctonus* + *Uroctonites*, *Vaejovis* “mexicanus” group, *Franckeus* + *Vaejovis* “nigrescens” group, *Paravaejovis*, and *Paruroctonus* + *Smeringurus* + *Vejovoidus*, are proving to be less related to Stahnkeini, especially the last two aggregates, which are quite isolated and distinct in Vaejovidae. These issues will be the subject of other upcoming contributions in the near future.

Serradigitus Stahnke, 1974

Serradigitus Stahnke, 1974: 130–132, fig. 6C, 6D (in part).

Type species. *Vaejovis wupatkiensis* Stahnke, 1940 [= *Serradigitus wupatkiensis* (Stahnke, 1940)].

Diagnosis. Closely related to sister genus *Stahnkeus*, from which it can be distinguished by the following: pedipalp chelal fingers lack inner (*IAD*) accessory denticles, only a fixed number of inner (*ID*) denticles are present, usually six and seven *ID* are found on the fixed and movable fingers, respectively. Otherwise, genus *Serradigitus* exhibits characters of the tribe.

References. *Serradigitus*: Williams & Berke, 1986: 350–351 (in part); Sissom, 1990a: 114; Sissom & Stockwell, 1991: 197–199 (in part); Stockwell, 1992: 409, 416, 419, fig. 40, 42 (in part); Yahia & Sissom, 1996: 86 (in part); Kovařík, 1998: 145 (in part);

Lourenço & Sissom, 2000: 119 (in part); Sissom, 2000: 518–524 (in part); Soleglad & Sissom, 2001: 32, 39 (in part), fig. 28; Soleglad & Fet, 2003: 8, 37, 88, fig. 67 (in part); Sissom & Hendrixson, 2005: 127–128 (in part).

Distribution. Mexico (Baja California, Baja California Sur, Coahuila, Sonora) and United States (Arizona, California, Nevada, New Mexico, Texas, Utah). See Map in Fig. 46.

Species list. The following 20 species and subspecies comprise this genus; general locality data based on specimens examined, Gertsch & Allred (1965), Williams (1968, 1970a, 1970b, 1980), Hjelle (1970), Johnson & Allred (1972), Soleglad (1972, 1974), Williams & Berke (1986), Berke (1987), Sissom & Stockwell (1991), Sissom (2000).

S. adcocki (Williams, 1980), Baja California Sur, Mexico (Figs. 18, 35).

S. agilis Sissom et Stockwell, 1991, southern Arizona, southwestern New Mexico, USA; northeastern Sonora, Mexico.

S. armadentis (Williams, 1980), Baja California Sur, Mexico.

S. baueri (Gertsch, 1958), Baja California, Mexico.

S. bechteli (Williams, 1980), Baja California Sur, Mexico (Fig. 21).

S. calidus (Soleglad, 1974), Coahuila, Mexico (Figs. 20, 34).

S. dwyeri (Williams, 1980), Baja California Sur, Mexico.

S. gertschi gertschi (Williams, 1968), Southern California, USA; Baja California, Mexico (Figs. 1, 5, 13, 14, 22, 39).

S. gertschi striatus (Hjelle, 1970), Central California, USA.

S. gigantaensis (Williams, 1980), Baja California Sur, Mexico.

S. gramenestris (Williams, 1970), Southern California, USA (Fig. 28).

S. haradoni (Williams, 1980), Baja California Sur, Mexico (Fig. 27).

S. hearnei (Williams, 1980), Baja California Sur, Mexico (Fig. 25).

S. joshuaensis (Soleglad, 1972), Southern California, southwestern Arizona, USA (Figs. 2–4, 12, 26, 36).

S. littoralis (Williams, 1980), Baja California, Baja California Sur, Mexico (Figs. 24, 40).

S. minutis (Williams, 1970), Baja California Sur, Mexico (Figs. 12, 23, 38).

S. pacificus (Williams, 1980), Baja California, Mexico (Fig. 29).

S. torridus (Williams et Berke, 1986), Southern California, USA (Figs. 19, 37).

S. wupatkiensis (Stahnke, 1940), Arizona, California, Idaho, Nevada, New Mexico, Utah, USA (Figs. 17, 33).

S. yaqui Sissom et Stockwell, 1991, Sonora, Mexico.

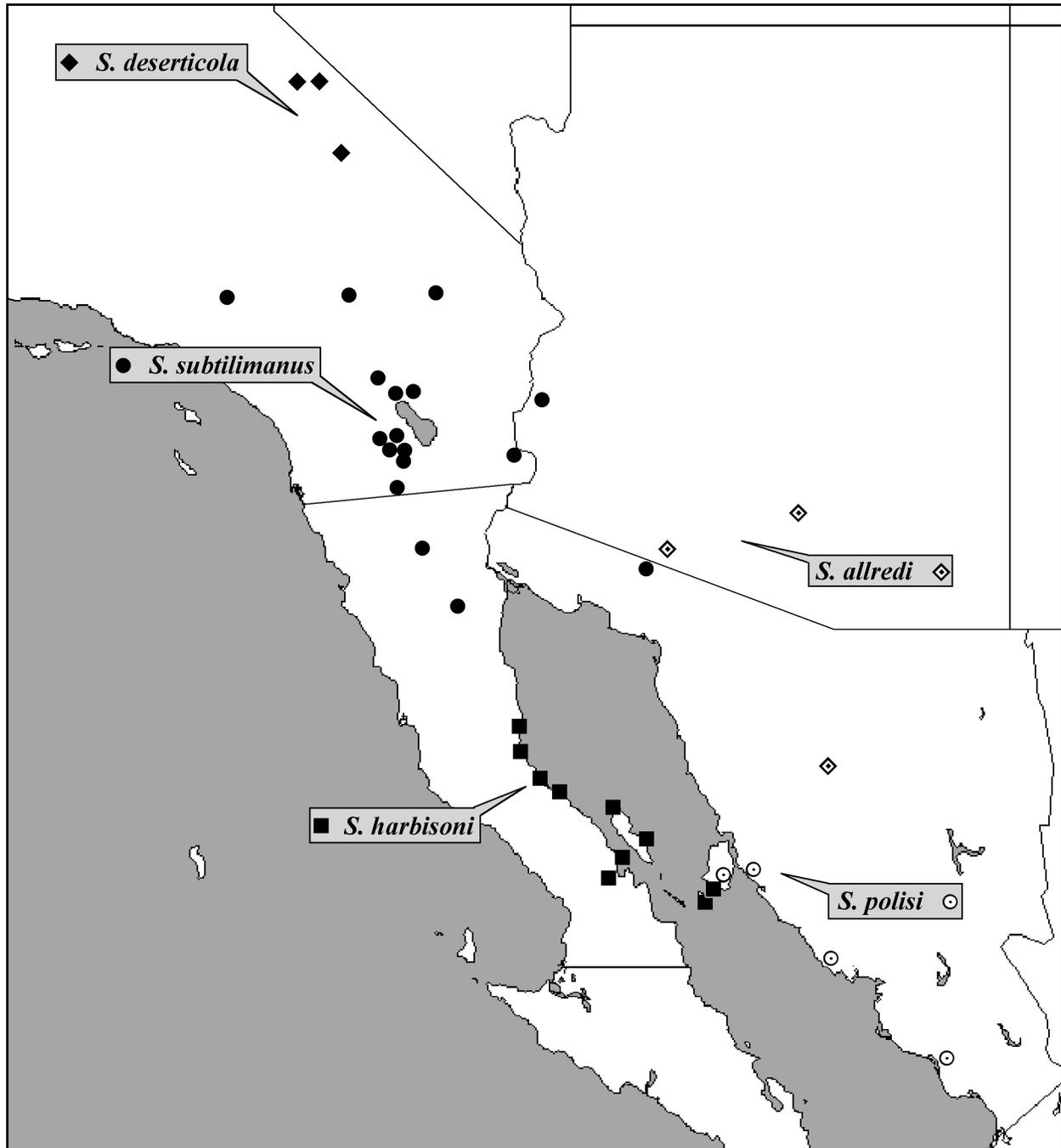


Figure 47: Map showing distribution of genus *Stahnkeus*. Individual localities based on specimens examined, Williams (1970a, 1980: fig. 98, in part), Berke (1987, in part) and Sissom & Stockwell (1991).

Discussion. *Serradigitus* ranges in size from 40 mm (*S. wupatkiensis* and *S. adcocki*) to 23 mm (*S. joshuaensis*), one of the smallest vaejovids known. Its species are found in the southwestern United States and in Mexico (Coahuila, Sonora, Baja California, Baja California Sur) (Fig. 46). In California, *Serradigitus* ranges as far north as Mendocino County (*S. gertschi striatus*), south to San Diego County (*S. g. gertschi*), and

east to Inyo County (*S. gramenestris* and *S. wupatkiensis*). It is found in southern Nevada (*S. wupatkiensis*), northern Arizona (*S. wupatkiensis*), and southeastern Utah (*S. wupatkiensis*). In his paper on scorpions of Idaho, Anderson (1975) did not report *S. wupatkiensis*, but Sissom (2000: 524) reports this species from Idaho as well as New Mexico. The species of *Serradigitus* have been reported as far east as Cuatro



Figure 48: *Stahnkeus subtilimanus*, male, dorsal view, Split Mountain, ABDSP, California, USA.

		<i>S. harbisoni</i>	<i>S. subtilimanus</i>	<i>S. deserticola</i>	<i>S. polisi</i>	<i>S. allredi</i>
Inner Denticles (<i>ID</i> + <i>IAD</i>) (adults)	M	14–20 (17)	13–18 (15)	9–12 (10)	8–11	9–11
	F	12–18 (14)	12–17 (14)	6–10 (7)	7–9	6–11
Carapace length		5.4–6.8	4.8–5.5	5.2	3.7–4.7	3.0–3.1
Pectinal Tooth Counts	♂	25–27	24–26	21–22	18	15–17
	♀	21–24	19–23	20	15–21	14–16
Carapace Interocular Area		smooth	granular	granular	granular	granular
Chelal Digital (<i>DI</i>) Carina		smooth to marbled	granular to marbled	delicately crenulate	weak and smooth	strong and smooth
Metasomal Segments Ventral Median (<i>VM</i>) Carinae (♀)	I	smooth	smooth	smooth to crenulate	smooth to crenulate	weak to granulate
	II	smooth	smooth, weak to crenulate 1/3	crenulate	crenulate to serrate	weak to granulate
	III	smooth, weak to crenulate 1/5	crenulate	crenulate	crenulate to serrate	crenulate
	IV	smooth, weak to crenulate 1/3	crenulate	crenulate	crenulate to serrate	crenulate
Metasomal Segments (W/L) (♀)	I	1.03	1.13	1.18	1.29	1.46
	II	0.83	1.00	1.03	1.03	1.13
	III	0.84	0.89	0.97	0.95	1.06
	IV	0.66	0.68	0.70	0.65	0.77
Carapace Length/Movable Finger Length (♀)		0.95	0.75	0.79	0.89	1.03
Trichobothrium <i>ib</i> / Fixed Finger Length *		0.471	0.462	0.471	0.353	0.282
Geographic Distribution (see Fig. 47)		central-east Baja California, Mexico	Colorado Desert, southern California, USA; northern Baja California, Mexico	Mojave Desert, southern California, USA	northern Sonora, Mexico	southern Arizona, USA; northern Sonora, Mexico
General Coloration (adults)		dark orange-brown, no variegated patterns on carapace	dark orange-brown, no variegated patterns on carapace	dark orange-brown, no variegated patterns on carapace	yellow-brown, with dusky patterns on carapace	yellow-brown, with dusky patterns on carapace
Adult Size (♂/♀)		43/51	40/48	43/45	28/36	20/18

Table 7: Diagnostic characters for species of genus *Stahnkeus*, **gen. nov.** Data for *Stahnkeus allredi* and *S. polisi* after Sissom & Stockwell (1991). * *ib* position measured from base of fixed finger. MF = movable finger, FF = fixed finger.

Cienegas, Coahuila, Mexico (*S. calidus*) and as far south as Cabo San Lucas, Baja California Sur, Mexico (*S. minutis*). In addition, isolated endemic species are only known from small islands off the coast of Baja California, Mexico (*S. armadentis*, *S. baueri*, *S. dwyeri*, and *S. bechteli*). As seen in the map (Fig. 46), there are gaps in the range of this genus; however, we suspect that the interjoining areas are probably inhabited by these specialized scorpions in the microhabitats hospitable to lithophiles. For example, a *Serradigitus* sp. has been reported from the Big Bend National Park in Texas (Sissom & Stockwell, 1991: 197), which bridges considerably the geographical gap as reflected in the map (Fig. 46). Lourenço & Sissom (2000: 119) projected that “a number of new species should be found in northwestern Mexico, especially in the Sierra Madre Occidental”.

Stahnkeus Soleglad et Fet, **gen. nov.**

Type species. *Vaejovis harbisoni* Williams, 1970 [= *Stahnkeus harbisoni* (Williams, 1970)].

Diagnosis. Closely related to sister genus *Serradigitus*, from which it can be distinguished by the following synapomorphic (derived) character: pedipalp chelal fingers exhibit an irregular number of inner (*IAD*) accessory denticles, the number increasing during ontogenetic development; number of *ID* + *IAD* is species-dependent and ranges from 6 to 18 and from 8 to 20 for the fixed and movable fingers, respectively. Otherwise, genus *Stahnkeus* exhibits characters of the tribe.

Etymology. This genus is named after Herbert L. Stahnke for his contributions to scorpion systematics and for being the first to describe a species of *Serradigitus* in 1940 and establishing the genus *Serradigitus* in 1974.

Distribution. Mexico (Baja California, northern Sonora) and United States (Arizona, California). See map in Fig. 47.

Species list. The following five species comprise this genus; general locality data based on specimens examined, Williams (1970a, 1980, in part); Soleglad (1972), Berke (1987, in part), Sissom & Stockwell (1991), Sissom (2000).

- S. allredi* (Sissom et Stockwell, 1991), **comb. nov.** Southern Arizona, USA; northern Sonora, Mexico.
- S. deserticola* (Williams, 1970), **comb. nov.** Death Valley, California, USA (Figs. 32, 42).
- S. harbisoni* (Williams, 1970), **comb. nov.** Central Baja California, Mexico (Figs. 30, 41).
- S. polisi* (Sissom et Stockwell, 1991), **comb. nov.** Sonora, Mexico.
- S. subtilimanus* (Soleglad, 1972), **comb. nov.** Southern California, southwestern Arizona, USA; northern Baja California, northern Sonora, Mexico (Figs. 6, 7, 15, 16, 31, 43–45, 46).

Discussion. In comparison with the broader distribution of *Serradigitus* (Fig. 46), the genus *Stahnkeus* forms roughly a contiguous “horseshoe” pattern around the Sea of Cortez, extending northward to Death Valley, California and southward to central Baja California state in the west and Sonora, Mexico, in the east. In the map (Fig. 47) two northern localities originally reported for species *S. harbisoni* by Williams (1980) have been changed to *S. subtilimanus*, this based on the somewhat disjunct ranges of the specialized microhabitat required by this genus (i.e., they are lithophilic). In addition, the report of *S. harbisoni* from extreme southern Baja California Sur, Isla Cerralvo (Williams, 1980: 103), is unlikely in our opinion, therefore we consider this a locality misidentification.

The five species of *Stahnkeus* can be separated by the characters provided in Table 7. Genus *Stahnkeus* contains the largest species in tribe Stahnkeini, *S. harbisoni*, which reaches lengths of 50 mm. Three species, *S. deserticola*, *S. subtilimanus* and *S. harbisoni*, are closely related, their disjunct distribution forming a north to south pattern from Death Valley, California through the Colorado Desert in southern California, to central-east Baja California state (see map in Fig. 47). All adults of these three species share an attractive yellow-orange coloration of the metasoma, legs and pedipalps with dark mahogany highlights on the pedipalp and metasomal carinae; dusky patterns of the carapace are absent in these species (see Fig. 48 of an adult male *S. subtilimanus*). As typical of large species of tribe Stahnkeini, the trichobothrial series *ib-it* in these three species is located roughly midfinger (Tab. 5). The other two species, *S. allredi* and *S. polisi* from southern Arizona, USA, and Sonora, Mexico, are smaller in size, exhibit dusky patterns on their carapaces, and tricho-

bothria *ib-it* are located more proximally on the fixed finger (after Sissom & Stockwell, 1991).

Acknowledgments

We thank Charles Griswold, Graeme Lowe, and Darrell Ubick for the loan of specimens, and Matt Graham for a specimen used for SEM study. Special thanks are also due to Michael Brewer and David Neff who provided their expert skills with SEM micrography at Marshall University. Finally, we extend our gratitude to Luis F. de Armas and František Kovařík who reviewed this paper.

References

- ANDERSON, R. C. 1975. Scorpions of Idaho. *Tebiwa, The Journal of the Idaho State University Museum*, 18 (1): 1–17.
- BERKE, B. T. 1987. *The scorpion genus Serradigitus in California (Scorpiones: Vaejovidae)*. (M.S. thesis, unpublished). San Francisco State University, 116 pp.
- FET, V., M. E. SOLEGLAD & F. KOVAŘÍK. 2004a. Subfamily Lisposominae revisited (Scorpiones: Bothriuridae). *Revista Ibérica de Aracnología*, 10: 195–209.
- FET, V., M. E. SOLEGLAD, D. P. A. NEFF & I. STATHI. 2004b. Tarsal armature in the superfamily Iuroidea (Scorpiones: Iurida). *Revista Ibérica de Aracnología*, 10: 17–40.
- FRANCKE, O. F. 1977. Two emendations to Stahnke's (1974) Vaejovidae revision (Scorpionida, Vaejovidae). *Journal of Arachnology*, 4: 125–135.
- GERTSCH, W. J. 1958. Results of the Puritan-American Museum Expedition to Western Mexico 4. The scorpions. *American Museum Novitates*, 1903: 1–20.
- GERTSCH, W. J. & D. M. ALLRED. 1965. Scorpions of the Nevada Test Site. *Brigham Young University Science Bulletin*, 6(4): 1–15.
- GERTSCH, W. J. & M. E. SOLEGLAD. 1972. Studies of North American scorpions of the genera *Uroctonus* and *Vejois* (Scorpionida, Vaejovidae). *Bulletin of the American Museum of Natural History*, 148 (4): 549–608.

- HJELLE, J. T. 1972. Scorpions of the northern California coast ranges (Arachnida: Scorpionida). *Occasional Papers of the California Academy of Sciences*, 92: 1–59.
- HOFFMANN, C. C. 1931. Monografías para la entomología médica de México. Monografía Num. 2, Los escorpiones de México. Primera parte: Diplocentridae, Chactidae, Vejovidae. *Anales del Instituto de Biología Universidad Nacional Autónoma de México*, 2(4): 291–408.
- JOHNSON, J. D. & D. M. ALLRED. 1972. Scorpions of Utah. *Great Basin Naturalist*, 32(3): 154–170.
- KOVAŘÍK, F. 1998. *Štíři* [Scorpiones]. Jihlava (Czech Republic): Publishing House "Madagaskar", 176 pp. (in Czech).
- LAMORAL, B. H. 1979. The scorpions of Namibia (Arachnida: Scorpionida). *Annals of the Natal Museum*, 23(3): 497–784.
- LOURENÇO, W. R. 1996. *Faune de Madagascar. 87. Scorpions (Chelicerata, Scorpiones)*. Paris: Muséum National d'Histoire Naturelle, 102 pp.
- LOURENÇO, W. R. & W. D. SISSOM. 2000. Scorpiones. Pp. 115–135 in: Llorente Bousquets, J., E. González Soriano & N. Papavero (eds.). *Biodiversidad, taxonomía y biogeografía de artrópodos de México*. Universidad Nacional Autónoma de México, 2.
- SISSOM, W. D. 1985. *Systematics of the nitidulus group of the genus Vaejovis, with comments on phylogenetic relationships within the family Vaejovidae (Arachnida: Scorpiones)*. Ph.D. Thesis, Vanderbilt University, Nashville, Tennessee. 292 pp. (unpublished).
- SISSOM, W. D. 2000. Family Vaejovidae Thorell, 1876. Pp. 503–552 in: Fet, V., W. D. Sissom, G. Lowe & M. E. Braunwalder. *Catalog of the Scorpions of the World (1758–1998)*. New York, NY: New York Entomological Society, 690 pp.
- SISSOM, W. D. & O. F. FRANCKE. 1985. Redescriptions of some poorly known species of the *nitidulus* group of the genus *Vaejovis* (Scorpiones, Vaejovidae). *Journal of Arachnology*, 13(2): 243–266.
- SISSOM, W. D. & B. E. HENDRIXSON. 2005. Scorpion biodiversity and patterns of endemism in northern Mexico. Pp. 122–137 in: J.-L. E. Cartron, G. Ceballos & R. S. Felger (eds.), *Biodiversity, Ecosystems, and Conservation in Northern Mexico*. Oxford, UK: Oxford University Press.
- SISSOM, W. D. & S. A. STOCKWELL. 1991. The genus *Serradigitus* in Sonora, Mexico, with descriptions of four new species (Scorpiones, Vaejovidae). *Insecta Mundi*, 5(3–4): 197–214.
- SOLEGLAD, M. E. 1972. Two new scorpions of the *wupatkiensis* group of the genus *Vejovis* (Scorpionida: Vejovidae). *The Wasmann Journal of Biology*, 30 (1, 2): 179–195.
- SOLEGLAD, M. E. 1973. Scorpions of the Mexicanus group of the genus *Vejovis* (Scorpionida, Vejovidae). *The Wasmann Journal of Biology*, 31 (1, 2): 107–120.
- SOLEGLAD, M. E. 1974. *Vejovis calidus*, a new species of scorpion from Coahuila, Mexico (Scorpionida: Vejovidae). *Entomological News*, 85: 109–115.
- SOLEGLAD, M. E. & V. FET. 2003. High-level systematics and phylogeny of the extant scorpions (Scorpiones: Orthosterni). *Euscorpius*, 11: 1–175.
- SOLEGLAD, M. E. & V. FET. 2004. The systematics of the scorpion subfamily Uroctoninae (Scorpiones: Chactidae). *Revista Ibérica de Aracnología*, 10: 81–128.
- SOLEGLAD, M. E. & V. FET. 2005. A new scorpion genus (Scorpiones: Vaejovidae) from Mexico. *Euscorpius*, 24: 1–13.
- SOLEGLAD, M. E. & W. D. SISSOM. 2001. Phylogeny of the family Euscorpiidae Laurie, 1896: a major revision. Pp. 25–111 in Fet, V. & P. A. Selden (eds.). *Scorpions 2001. In memoriam Gary A. Polis*. Burnham Beeches, Bucks: British Arachnological Society.
- STAHNKE, H. L. 1940a. *The scorpions of Arizona* (Ph.D. Thesis, unpublished). Iowa State College, 184 pp.
- STAHNKE, H. L. 1940b. The scorpions of Arizona. *Iowa State College Journal of Science*, 15: 101–103.
- STAHNKE, H. L. 1965. Observations on the type specimen of the scorpion *Syntropis macrura* Kraepelin. *Proceedings of the California Academy of Sciences*, 30 (13): 257–263.

- STAHNKE, H. L. 1974. Revision and keys to the higher categories of Vejovidae (Scorpionida). *Journal of Arachnology*, 1: 107–141.
- STOCKWELL, S. A. 1989. *Revision of the Phylogeny and Higher Classification of Scorpions (Chelicerata)*. Ph.D. Thesis, University of Berkeley, Berkeley, California. 319 pp. (unpublished). University Microfilms International, Ann Arbor, Michigan.
- STOCKWELL, S. A. 1992. Systematic observations of North American Scorpionida with a key and checklist of the families and genera. *Journal of Medical Entomology*, 29 (3): 407–422.
- WILLIAMS, S. C. 1968. Two new scorpions from western North America. *The Pan-Pacific Entomologist*, 44 (4): 313–321.
- WILLIAMS, S. C. 1970a. Three new species of *Vejovis* from Death Valley, California. *The Pan-Pacific Entomologist*, 46 (1): 1–11.
- WILLIAMS, S. C. 1970b. Scorpion fauna of Baja California, Mexico: eleven new species of *Vejovis* (Scorpionida: Vejovidae). *Proceedings of the California Academy of Sciences*, 37 (8): 275–332.
- WILLIAMS, S. C. 1980. Scorpions of Baja California, Mexico and adjacent islands. *Occasional Papers of the California Academy of Sciences*, 135: 1–127.
- WILLIAMS, S. C. & B. T. BERKE. 1986. A new species of *Serradigitus* from central California (Scorpiones: Vaejovidae). *Pan-Pacific Entomologist*, 62(4): 350–354.
- YAHIA, N. & W. D. SISSOM. 1996. Studies on the systematics and distribution of the scorpion *Vaejovis bilineatus* Pocock (Vaejovidae). *Journal of Arachnology*, 24: 81–88.