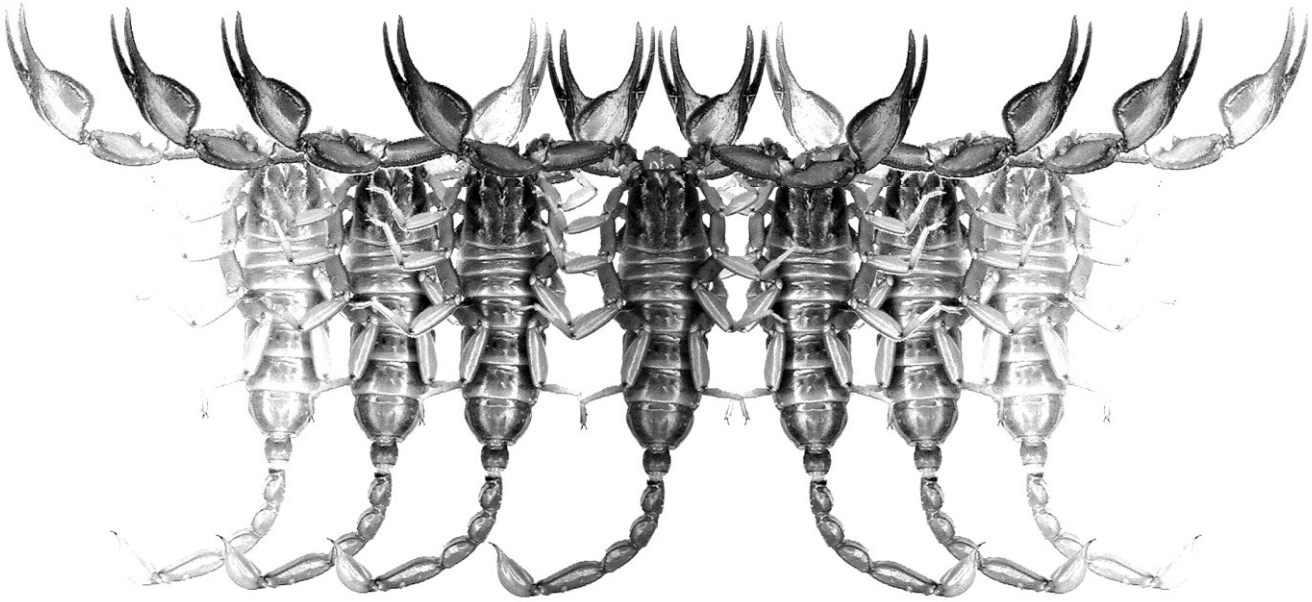
Euscorpius

Occasional Publications in Scorpiology



Occurrence of a Telson Gland in the Genus *Superstitionia* Stahnke, 1940 (Scorpiones: Superstitioniidae)

Rolando Teruel, Graeme Lowe, Victor Fet & Kelly Anne Daniel

August 2015 — No. 204

Euscorpius

Occasional Publications in Scorpiology

EDITOR: Victor Fet, Marshall University, 'fet@marshall.edu'
ASSOCIATE EDITOR: Michael E. Soleglad, 'soleglad@znet.com'

Euscorpius is the first research publication completely devoted to scorpions (Arachnida: Scorpiones). ***Euscorpius*** takes advantage of the rapidly evolving medium of quick online publication, at the same time maintaining high research standards for the burgeoning field of scorpion science (scorpiology). ***Euscorpius*** is an expedient and viable medium for the publication of serious papers in scorpiology, including (but not limited to): systematics, evolution, ecology, biogeography, and general biology of scorpions. Review papers, descriptions of new taxa, faunistic surveys, lists of museum collections, and book reviews are welcome.

DERIVATIO NOMINIS

The name ***Euscorpius*** Thorell, 1876 refers to the most common genus of scorpions in the Mediterranean region and southern Europe (family Euscorpiidae).

Euscorpius is located at: **http://www.science.marshall.edu/fet/Euscorpius**

(Marshall University, Huntington, West Virginia 25755-2510, USA)

ICZN COMPLIANCE OF ELECTRONIC PUBLICATIONS:

Electronic ("e-only") publications are fully compliant with ICZN (*International Code of Zoological Nomenclature*) (i.e. for the purposes of new names and new nomenclatural acts) when properly archived and registered. All ***Euscorpius*** issues starting from No. 156 (2013) are archived in two electronic archives:

- **Biotaxa,** http://biotaxa.org/Euscorpius (ICZN-approved and ZooBank-enabled)
- **Marshall Digital Scholar**, http://mds.marshall.edu/euscorpius/. (This website also archives all *Euscorpius* issues previously published on CD-ROMs.)

Between 2000 and 2013, ICZN did not accept online texts as "published work" (Article 9.8). At this time, *Euscorpius* was produced in two identical versions: online (*ISSN 1536-9307*) and CD-ROM (*ISSN 1536-9293*) (laser disk) in archive-quality, read-only format. Both versions had the identical date of publication, as well as identical page and figure numbers. Only copies distributed on a CD-ROM from ***Euscorpius*** in 2001-2012 represent published work in compliance with the ICZN, i.e. for the purposes of new names and new nomenclatural acts.

In September 2012, ICZN Article 8. *What constitutes published work*, has been amended and allowed for electronic publications, disallowing publication on optical discs. From January 2013, ***Euscorpius*** discontinued CD-ROM production; only online electronic version (*ISSN 1536-9307*) is published. For further details on the new ICZN amendment, see http://www.pensoft.net/journals/zookeys/article/3944/.

Publication date: 20 August 2015
http://zoobank.org/urn:lsid:zoobank.org:pub:D3949273-6963-4F0E-8E1A-38B6FAE4477E

Euscorpius — Occasional Publications in Scorpiology. 2015, No. 204

Occurrence of a telson gland in the genus *Superstitionia* Stahnke, 1940 (Scorpiones: Superstitioniidae)

Rolando Teruel [1], Graeme Lowe [2], Victor Fet [3] & Kelly Anne Daniel [4]

[1] Centro Oriental de Ecosistemas y Biodiversidad (BIOECO), Museo de Historia Natural "Tomás Romay", José A. Saco # 601 esquina a Barnada, Santiago de Cuba 90100, Cuba; email: rteruel@bioeco.cu

[2] Monell Chemical Senses Center, 3500 Market St., Philadelphia, PA 19104, USA; email: loweg@monell.org

[3] Department of Biological Sciences, Marshall University, Huntington, WV 25755-2510, USA; email: fet@marshall.edu

[4] Forensic Science Center, Marshall University, Huntington, WV 25755-3628, USA.

http://zoobank.org/urn:lsid:zoobank.org:pub:D3949273-6963-4F0E-8E1A-38B6FAE4477E

Summary

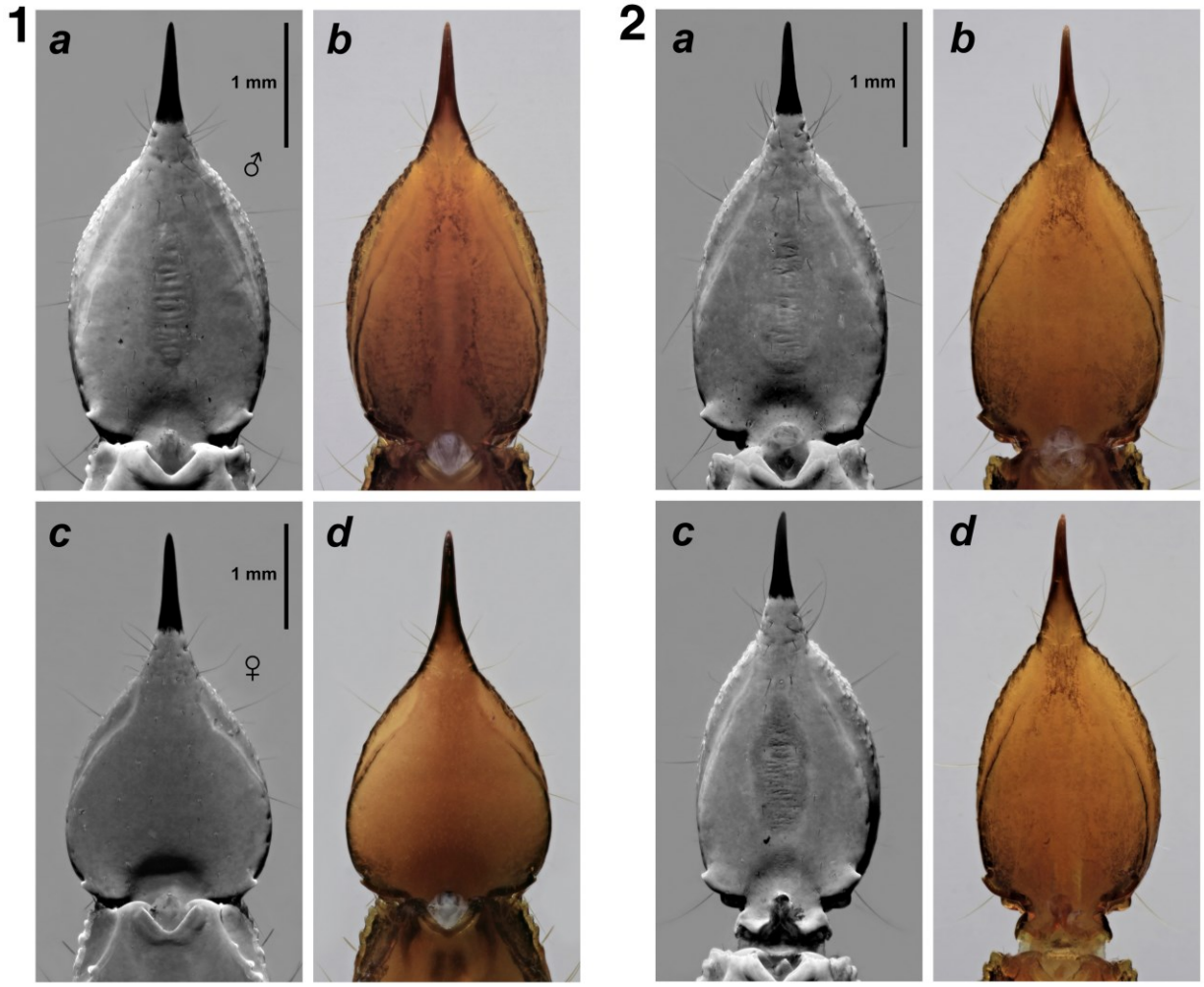
In this note, we record for the first time the occurrence of a telson gland in the monotypic genus *Superstitionia* Stahnke 1940 (Scorpiones: Superstitioniidae). The putative gland is marked by an elongated patch of wrinkled cuticle restricted to the dorso-apical surface of the telson vesicle of adult males, and is absent from females and immatures. Similar presumed glandular structures have been observed in a number of other scorpions, including many South American Bothriuridae, and the recently defined vaejovid genera *Chihuahuanus* González-Santillán et Prendini, 2013 and *Maaykuyak* González-Santillán et Prendini, 2013.

Introduction

The metasoma is perhaps the best known part of scorpion anatomy, wielding the venom-injecting telson, a conspicuous and important defensive and offensive organ. The metasoma and telson include diverse structures that have long been used by specialists for diagnosing species, genera and even families, e.g., the presence, absence, shape and development of various tubercles, granules, carinae, punctuations, and setae.

A unique feature that has received scant attention are patches of modified cuticle appearing either as local swellings or depressions, on the dorsal surface of the fifth metasomal segment and/or telson in males of a number of scorpion taxa. These have been termed "telson glands" and presumed to have an exocrine function (Sissom, 1990; Farley, 1999; Acosta & Maury, 1998; Ojanguren Affilastro, 2002, 2005; Kovařík & Ojanguren Affilastro, 2013). Further, the term "androvestigia" has been applied to those occurring on metasomal segment V. A glandular function was first suggested by Pavlovsky (1918, 1924) based on his pioneering histological studies of the male telson of *Bothriurus bonariensis* (referred to as *B. vittatus*) (Bothriuridae). Underlying a median dorsal cuticular depression he observed an extensive zone of specialized epithelium composed of enlarged cuboidal cells arranged in deep longitudinal folds. He named this organ *glandula plicata* and speculated about its possible sexual role. Cekalovic (1973) reported the presence of elongated, bilateral patches of modified cuticle on the dorsal side of metasoma V in some males of the bothriurid genus, *Brachistosternus*. Maury (1975) described similar paired dorsal structures on both metasoma V and telson of another bothriurid, *Timogenes mapuche*, and termed them "glándulas caudales" (caudal glands). In this species, the underlying tissue is arranged differently, as a layer of thickened unfolded epithelium with superficial ovoid and deeper elongated cells housed in a shallow dome scooped out of the endocuticle (De La Serna de Esteban, 1977). Scanning electron microscopy (SEM) revealed numerous pores on the external cuticle, with each pore being peppered by finer nano-perforations visible at higher magnification. De La Serna de Esteban (1978) conducted a more extensive survey comparing the fine structure of metasoma V and telson glands of nine species of Bothriuridae belonging to three genera, *Bothriurus*, *Urophonius* and *Brachistosternus*. He documented varying complexity in their cytological organization, ranging from simpler rippled layers of columnar cells to more elaborate, lobate structures with cuboidal cells arranged in deep folds. The cuticle overlying these glands may be excavated internally, and may be traversed by dense concentrations of pore canals which could conduct secretions to the surface.

The metasoma V and telson glands have only been found in male scorpions. Their dorsal location at the posterior end of the metasoma suggests that they could secrete contact pheromones applied to females during pre-mating courtship (promenade à deux) (Polis & Sis-



Figures 1-2: Fig. 1. Male telson gland in *Superstitionia donensis*. **a, b**. Dorsal surface of adult male telson, visualized by UV fluorescence (***a***), and white light (***b***). Specimen from Banner Canyon, San Diego Co., California. **c, d.** Dorsal surface of adult female telson, visualized by UV fluorescence (***c***), and white light (***d***). Specimen from Ortega Highway, Riverside Co., California. **Fig. 2.** Variation in telson gland structure in *Superstitionia donensis*. Dorsal surface of telson of two additional adult males, visualized by UV fluorescence (***a***, ***c***), and white light (***b***, ***d***). Mil Potrero Rd, Ventura Co., California.

som, 1990). Peretti (1997) described such courtship behavior in *Bothriurus bonariensis* and other members of the genus. During courtship, males brush female bodies with their telsons, apparently dabbing a waxy exudate to make her more receptive. Courted females were less receptive if the telson glands of the males were sealed with paraffin.

Although they are best known in the bothriurids, gland-like specializations of the telson have also been reported in male scorpions from several other families. Some species of the caraboctonid genus *Hadrurus* Thorell, 1876, have bilateral paired swellings near the dorsal base of their aculeus (Williams, 1970a, 1970b). The recently defined vaejovid genera *Chihuahuanus* and *Maaykuyak* also appear to have median glandular patches on the dorsal surfaces of their telson vesicle (González-Santillán & Prendini, 2013). Most enigmatic is the chactoid genus *Anuroctonus*, whose males have a single prominent swelling incorporated into the aculeus itself (Williams, 1980; Soleglad & Fet, 2004). Foelix et al. (2014) used SEM to study the ultrastructure of the aculeus of *Euscorpius flavicaudis* (Euscorpiidae). They observed large, ducted pores which they presumed to be glandular and speculated about their sexual function. However, they did not specify if these pores occurred in males or females.

Recently, while examining samples of the small North American scorpion *Superstitionia donensis* Stahnke, 1940, we noticed a gland-like structure on the telson. Under white light illumination, a narrow, median elliptical patch is visible on the dorsal surface as an area that excludes dark cuticular pigmentation (Figs. 1b, 2b, 2d). Viewed under UV epifluorescence, this patch is distinguishable from the surrounding smooth cuticle as a

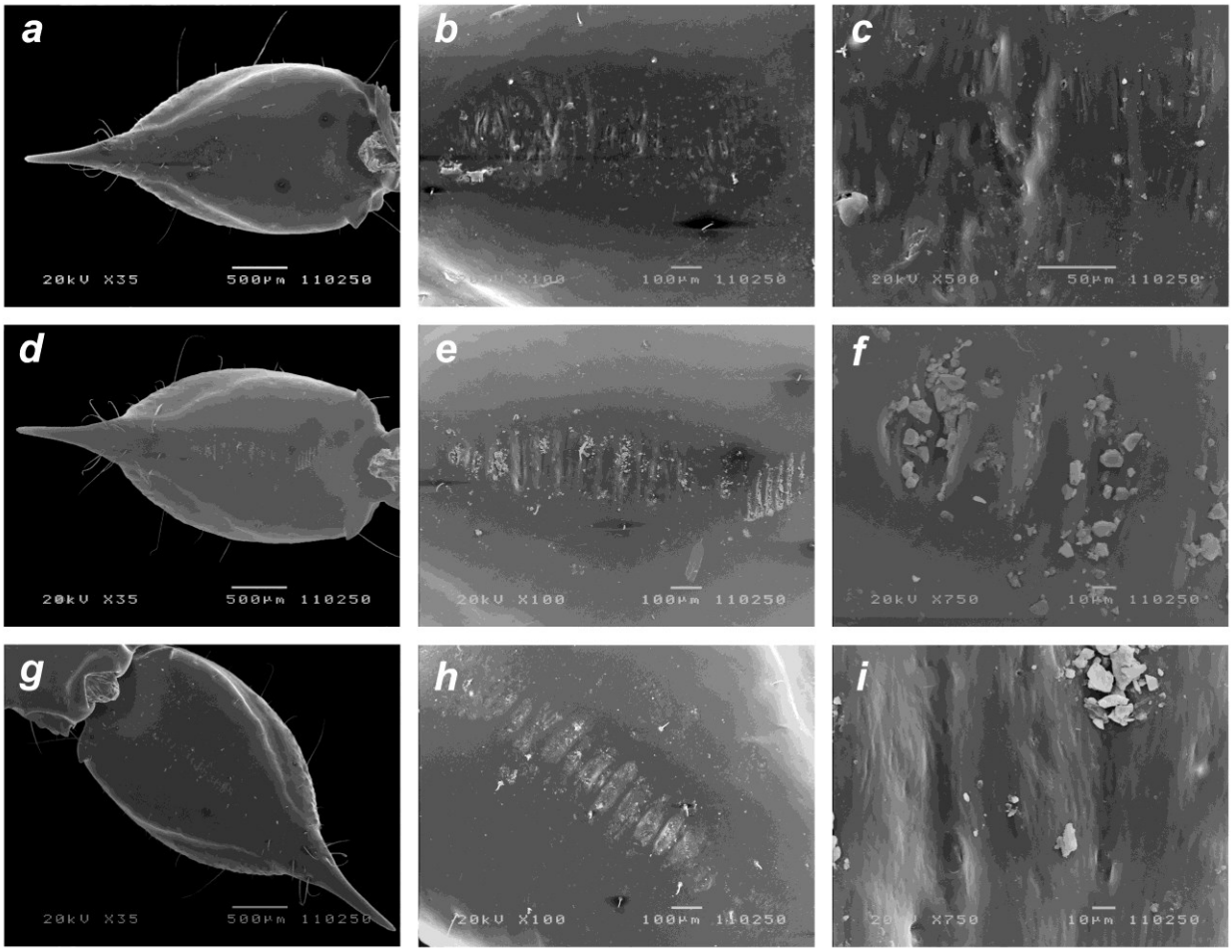


Figure 3: Dorsal telson surfaces of 3 males of *Superstitionia donensis* visualized under SEM, showing ultrastructure of glandular folds under various magnifications. ***a – c***: specimen from Banner Canyon, Riverside Co., California; ***d – f, i***: specimen from Mt Emma Rd, Los Angeles Co., California; ***f***, ***i***: higher magnification views of posterior and median-posterior folds; ***g***, ***h***: specimen from Carmel Mt Rd, San Diego Co., California. Magnifications and scales indicated in each panel.

zone of reduced fluorescence, marked by variable, closely spaced, transverse corrugations or striations (Figs. 1a, 2a, 2c). These surface features are also visible under SEM (Fig. 3). Under higher magnification, SEM did not reveal any dense pore canals or nano-pores seen in bothriurids (De La Serna de Esteban, 1977). However, such ultrastructure might have been obscured by residual wax that was not removed by our relatively mild solvent wash in chloroform used to prepare specimens for SEM (Hadley & Filshie, 1979). We have only observed the telson gland in adult male *Superstitionia* (N = 20), not in adult females (N = 9) (Figs. 1c, 1d). Its general morphology is consistent with telson glands seen in some other scorpions, and the sexual dimorphism suggests that it may also be used in courtship. A telson gland has not been mentioned in any previously published descriptions of *Superstitionia donensis* (Stahnke, 1940; Mulaik & Higgins, 1944; Gertsch & Allred, 1965; Williams, 1980). Our finding thus extends the occurrence of telson glands to the family Superstitioniidae. We suspect that telson glands have evolved independently for sexual functions in divergent scorpion lineages, and further investigation may reveal their existence in other families as well.

Material examined. USA. *Arizona*: Maricopa County: 1 ♂, 2 ♀, 3.5 mi. E. of Mesa, 1959, leg. M. E. Soleglad (MES). ***California*: Kern County:** 1 ♀, Jawbone Canyon Road, N35º18.87' W118º5.29', 883 m a.s.l., 2 August 1997, leg. G. Lowe & B. Hébert (GL); **Los Angeles County:** 1 ♂, Mt. Emma Rd., 1 mi. E Cheseboro Rd., 12 October 1985, leg. G. Lowe (VFPC) (**Fig. 3d–f, i**); 1 ♀, Glendora Mt Road, above Little Dalton Canyon, Angeles National Forest, N34º9.64′ W 117º50.51′ , ca. 500 m a.s.l., 13 November 1998, leg. G. Lowe & B. Hébert; 1 ♀, Glendora Mt Road, above Little Dalton Canyon, Angeles National Forest, N34º9.97′ W 117º50.51′ , ca. 500 m a.s.l., 13 November 1998, leg. G.

Lowe & B. Hébert. **Riverside County:** 1 ♀, Riverside Co., dirt road to Blue Jay, 2.3 mi. off Route 74 (Ortega Highway), under rock pile, 23 March 1983, leg. G. Lowe & C.P. Kristensen (GL) (**Fig. 1c–d**); 5 ♂, 1 ♀, Anza-Borrego Desert State Park, Chariot Canyon, 30 August 1997, leg. M. E. Soleglad & K. Pinion (MES); 8 ♂, 1 subadult ♂, Anza-Borrego Desert State Park, Coyote Creek (near Anza), 9 September 1997, leg. M. E. Soleglad & K. Pinion (MES). **San Diego County:** 1 ♂, 1 ♀, San Diego, 1975, leg. S.C. Johnson (RTO: Sco-0221); 1 ♂, I-78, W of junction with Route S2, 3.2 km NW of Banner, above Banner Canyon, N33º4.93' W116º34.42', 1 September 1992, leg. G. Lowe & B. Hébert (GL) (**Figs. 1*a–b*, 3a–c**); 1 ♀, Route S2, Vallecito Valley, N32º58.29' W116º24.01', 1700' a.s.l., 2 September 1992, leg. G. Lowe & B. Hébert (GL); 1 ♂, Peñasquitos, Carmel Mt. Rd, 5 August 1999, leg. M. E. Soleglad (VFPC) (**Figs. 3g–h**). **Ventura County:** 2 ♂, Mil Potrero Rd, opposite Valle Vista campground, leg. G. Lowe, 9 October 1982 (GL) (**Fig. 2**).

(*Abbreviations*: GL, Personal collection of Graeme Lowe, Philadelphia, Pennsylvania, USA; MES, Personal collection of Michael E. Soleglad, Winchester, California, USA; RTO, Personal collection of Rolando Teruel, Santiago de Cuba, Cuba; VFPC, Personal collection of Victor Fet, Huntington, West Virginia, USA)

Acknowledgments

We express our great thanks to all those friends and colleagues who have provided for years the pertinent literature: Oscar F. Francke (Colección Nacional de Arácnidos, Universidad Nacional Autónoma de México, Mexico D.F.), František Kovařík (Prague, Czech Republic), and Luis F. de Armas (Instituto de Ecología y Sistemática, Havana, Cuba). GL thanks Blaine Hébert, and Chuck Kristensen for joint field trips that collected *Superstitionia* used in this study, and Wendell R. Icenogle for donating additional materials. Further, we thank two anonymous reviewers for their valuable comments to the manuscript of this research note.

References

ACOSTA, L. E. & E. A. MAURY. 1998. Scorpiones. Pp. 545–559 in: Morrone, J. J. & S. Coscarrón (eds.) *Biodiversidad de artrópodos argentines*. La Plata: Ediciones Sur.

CEKALOVIC, T. 1973. Nuevo carácter sexual secundario en los machos de *Brachistosternus* (Scorpiones, Bothriuridae). *Boletín de la Sociedad Biológica de Concepción*, 46: 99–102.

De LA SERNA DE ESTEBAN, C. J. 1977. Las glandulas tegumentarias del metasoma y vesicula de *Timogenes* (*Latigenes*) *mapuche* Maury, 1975 (Bothriuridae, Scorpionida). *Neotropica*, 23(69): 55–63.

De LA SERNA DE ESTEBAN, C. J. 1978. Las glandulas tegumentarias del metasoma en algunas especies argentinas de la familia Bothriuridae (Scorpiones). *Physis*, C, 38 (94): 121–132.

FARLEY, R. D. 1999. Scorpiones. Pp. 117–222 in: Harrisson, F.W. & R.F. Foelix (eds.) *Microscopic anatomy of Invertebrates*. *Vol. 8A. Chelicerate Arthropoda*. New York: Wiley-Liss.

FOELIX, R., B. ERB & M. E. BRAUNWALDER. 2014. Fine structure of the stinger (aculeus) in *Euscorpius*. *Journal of Arachnology*, 42: 119–122.

GERTSCH, W. J. & D. M. ALLRED. 1965. Scorpions of the Nevada Test Site. *Brigham Young University Science Bulletin, Biological Series*, 6(4): 1–15.

GONZÁLEZ-SANTILLÁN, E. & L. PRENDINI. 2013. Redefinition and generic revision of the North American vaejovid scorpion subfamily Syntropinae Kraepelin, 1905, with descriptions of six new genera. *Bulletin of the American Museum of Natural History*, 382: 1–71.

HADLEY, N. F. & B. K. FILSHIE. 1979. Fine structure of the epicuticle of the desert scorpion *Hadrurus arizonensis* with reference to location of lipids. *Tissue and Cell*, 11 (2): 263–275.

KOVAŘÍK, F. & A. A. OJANGUREN AFFILASTRO. 2013. *Illustrated catalogue of scorpions. Part II. Bothriuridae; Chaerilidae; Buthidae I, genera* Compsobuthus, Hottentotta, Isometrus, Lychas *and* Sassanidotus. Prague: Clairon Production, 400 pp.

MAURY, E. A. 1975. Escorpiofauna Patagonica. I. Sobre una nueva especie del genero *Timogenes* Simon 1880 (Bothriuridae). *Physis*, C, 34 (88): 65–74.

MULAIK, S. & H. G. HIGGINS. 1944. A new genus of scorpions in the Southwest. *Entomological News*, 4(9): 237–240.

OJANGUREN AFFILASTRO, A. A. 2002. Nuevos aportes al conocimiento del género *Urophonius* Pocock, 1893. *Revista Ibérica de Aracnología*, 6: 181–186.

OJANGUREN AFFILASTRO, A. A. 2005. Estudio monográfico de los escorpiones de la República Argentina. *Revista Ibérica de Aracnología*, 11: 75–241.

PAVLOVSKY, E. N. 1918. Glandula plicata, nouvel organe chez le mâle de *Bothriurus vittatus*. *Bulletin du Muséum d'Histoire Naturelle* (*Paris*), 24: 19–21.

PAVLOVSKY, E. N. 1924. Studies on the organization and development of scorpions. *Quarterly Journal of Microscopical Science*, 68: 615–640.

PERETTI, A. V. 1997. Relación de las glándulas caudales de machos de escorpiones Bothriuridae con el comportamiento sexual (Scorpiones). *Revue Arachnologique*, 12(3): 31–41.

POLIS, G. A. & W. D. SISSOM. 1990. Chapter 4. Life history. Pp. 161–223 in: Polis, G. A. (ed.). *The Biology of Scorpions*. Stanford, CA: Stanford University Press.

SISSOM, W. D. 1990. Chapter 3. Systematics, biogeography and paleontology. Pp. 64–160 in: Polis, G. A. (ed.). *The Biology of Scorpions*. Stanford, CA: Stanford University Press.

SOLEGLAD, M.E. & V. FET. 2004. The systematics of the scorpion subfamily Uroctoninae (Scorpiones: Chactidae). *Revista Ibérica de Aracnología*, 10: 81–128.

STAHNKE, H. L. 1940. The scorpions of Arizona. *Iowa State College Journal of Science*, 15(1): 101–103.

WILLIAMS, S. C. 1970a. A systematic revision of the giant hairy scorpion genus *Hadrurus*. *Occasional Papers of the California Academy of Sciences*, 87: 1–62.

WILLIAMS, S. C. 1970b. A redescription of *Hadrurus pinteri* Stahnke based on the adult (Scorpionida: Vejovidae). *The Wasmann Journal of Biology*, 28(1): 169–174.

WILLIAMS, S. C. 1980. Scorpions of Baja California, Mexico and adjacent islands. *Occasional Papers of the California Academy of Sciences*, 135: 1–127.