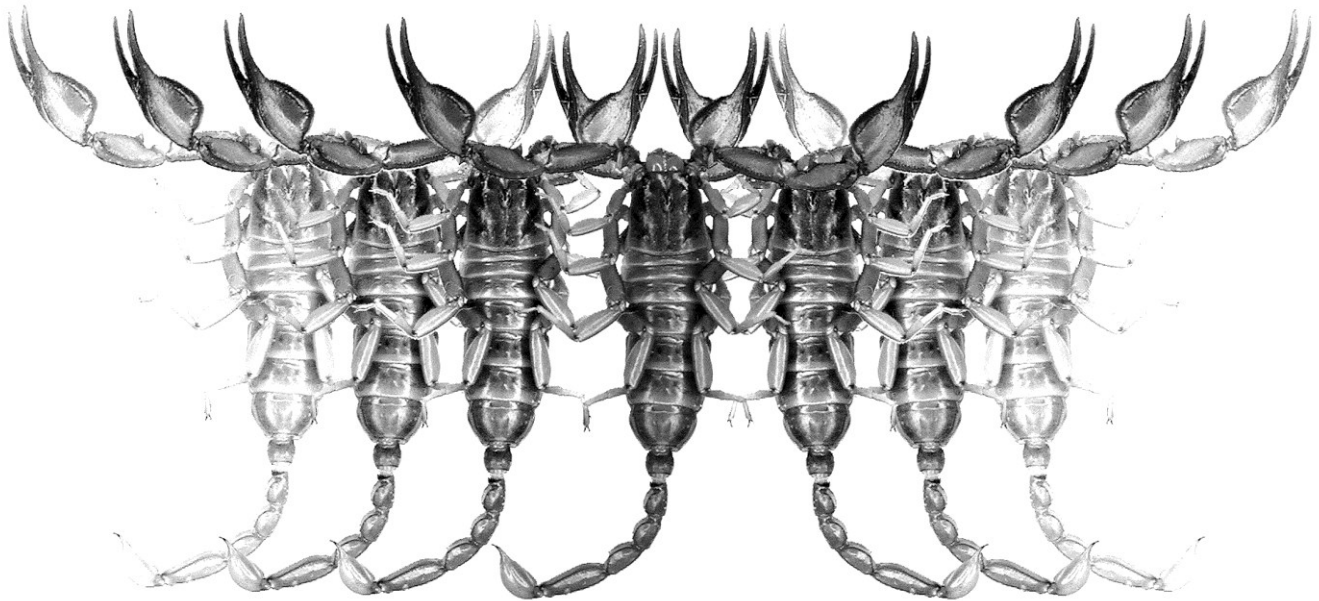


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**Occurrence of a Telson Gland in the Genus *Superstitionia*
Stahnke, 1940 (Scorpiones: Superstitioniidae)**

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

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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.

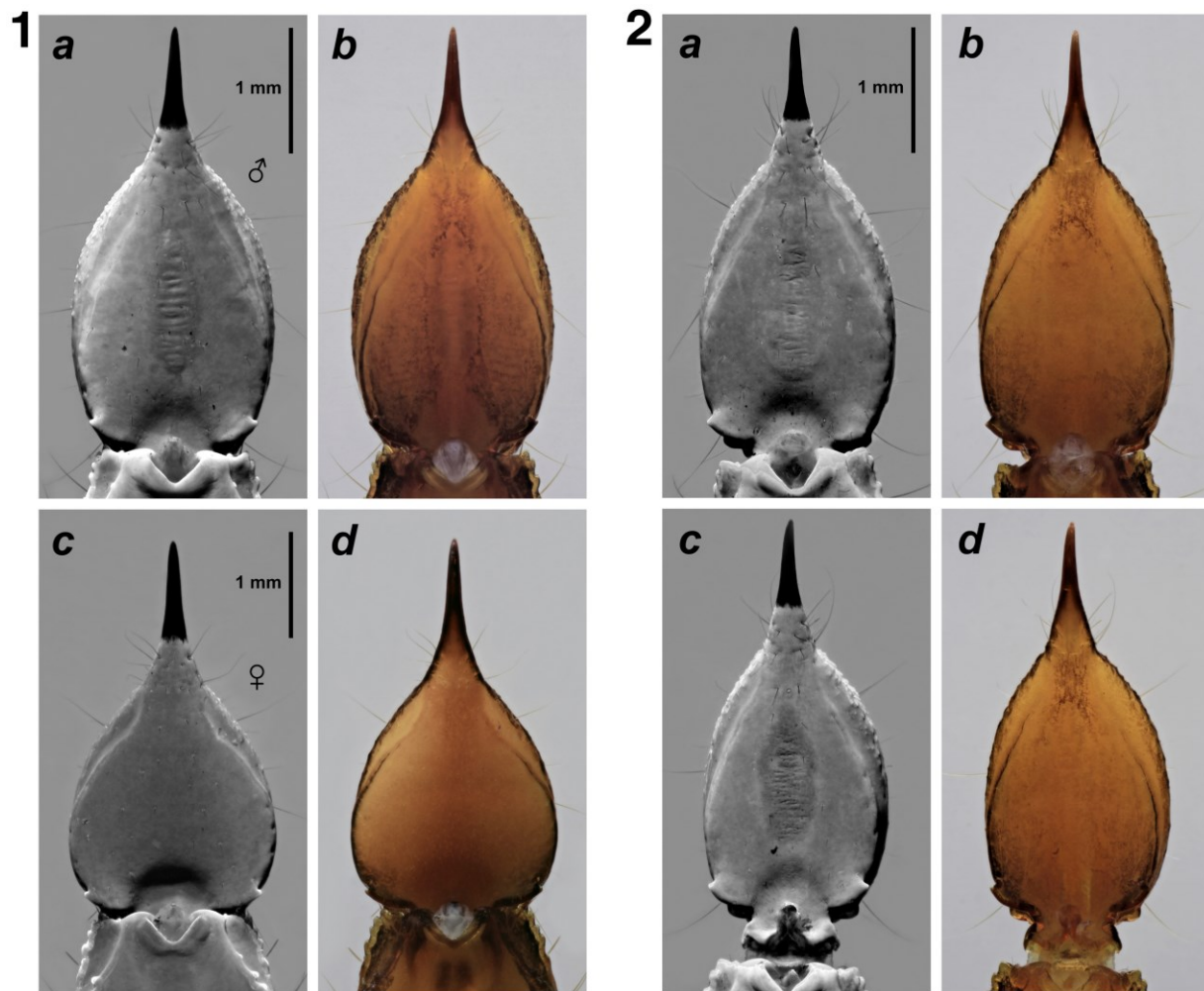
Introduction

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 vaejovoid 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 *Euscorpium flavicaudis* (Euscorpidae). 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

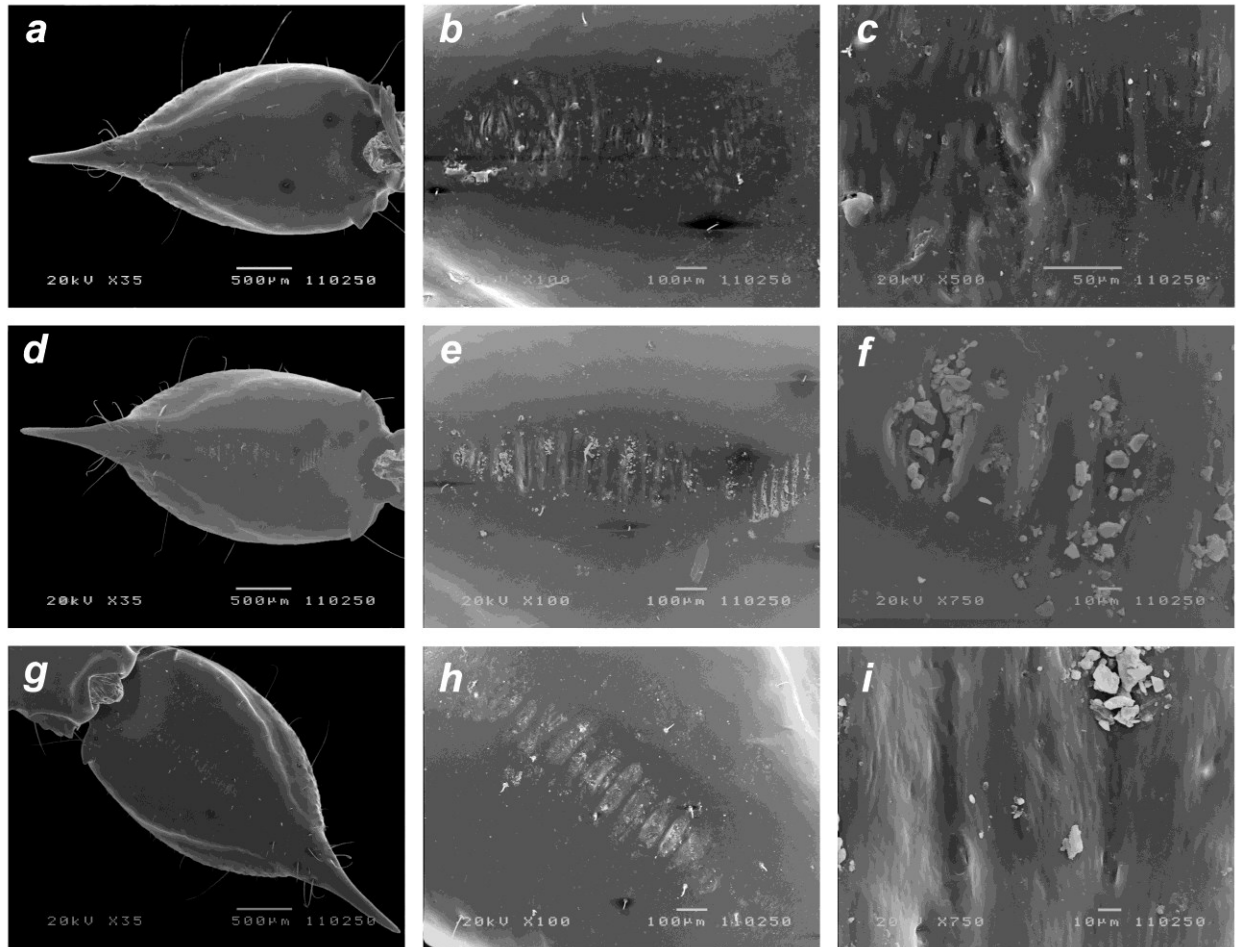


Figure 3: Dorsal telson surfaces of 3 males of *Superstitionia donensis* visualized under SEM, showing ultrastructure of glandular folds under various magnifications. **a – c:** specimen from Banner Canyon, Riverside Co., California; **d – f, i:** specimen from Mt Emma Rd, Los Angeles Co., California; **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, N35°18.87' W118°5.29', 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, N34°9.64' W 117°50.51', 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, N34°9.97' W 117°50.51', 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, N33°4.93' W116°34.42', 1 September 1992, leg. G. Lowe & B. Hébert (GL) (**Figs. 1a–b, 3a–c**); 1 ♀, Route S2, Vallecito Valley, N32°58.29' W116°24.01', 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)

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