

# The genus *Bothriurus* (Scorpiones, Bothriuridae) in Patagonia

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Historically, the identity and distribution of some *Bothriurus* species from Patagonia have not been clear. The previous concepts of the *Bothriurus patagonicus* species group may comprise more than one species. Two new species, *Bothriurus huincul* sp. n. and *B. sanctaecrucis* sp. n., are described, and additional morphological and distributional data of *B. patagonicus*, and *B. burmeisteri* are provided. An identification key and a map with all the records of Patagonian *Bothriurus* species are provided. Phylogenetic and biogeographic aspects of Patagonian *Bothriurus*, reflecting ancient connections of Patagonia with the center and north of Chile, are discussed.

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## Introduction

Patagonia is a vast cool semi-desert of southern South America that occupies southern Argentina and small areas of southern Chile, covering ca. 500,000 km<sup>2</sup>. In Argentina, Patagonia extends south from the Colorado River, reaching north of Tierra del Fuego Island, between the Andes and the Atlantic Ocean. In Chile, it is only present in small sectors near east border of Aisén (XI) and Magallanes (XII) Regions (Cabrera & Willink 1973; Gajardo 1995). Patagonia is ecologically diverse, encompassing a wide spectrum of vegetation types, from true deserts to shrub and grass steppes. Opinions about the number and definition of the patagonian biotopes vary (Cabrera & Willink 1973; Soriano 1983; Morrone 2001; Morrone et al. 2002).

The presence of several species of scorpions in the extreme south of South America is well known (Pocock 1898; Mello-Leitão 1931; Maury 1968, 1978; Ojanguren Affilastro 2005). The genus *Urophonius* Pocock 1893 has at least three species inhabiting Patagonia: *U. granulatus* Pocok 1898, *U. eugenicus* Mello-Leitão 1931 and *U. somuncura*

Acosta 2003 (Ojanguren Affilastro 2005). The same number of species has been reported from *Brachistosternus* Pocock 1893: *B. (Leptosternus) alienus* Lönnberg 1898, *B. (L.) paulae* Ojanguren Affilastro 2003 and *B. (L.) angustimanus* Ojanguren Affilastro and Roig Alsina 2001 (Ojanguren Affilastro 2005). Contrary to the previous genera, Patagonian species of *Bothriurus* Simon 1880 remain poorly studied.

Maury (1968) listed three species of *Bothriurus* from Argentinean Patagonia: *Bothriurus burmeisteri* Kraepelin 1894, *Bothriurus dorbignyi* (Guérin-Méneville 1843) (currently in the genus *Timogenes* Simon 1880) and *Bothriurus patagonicus* Maury 1968. He also reported and mapped several records of two “species (related to) [...] (or) possible subspecies” of *B. patagonicus*, located north and south of the range of *B. patagonicus* (both indicated as *Bothriurus* sp. on his map). Maury (1968: 159) suggested that they could both be new species, based on their morphological and ecological differences. However, as a result of the scarcity of material and of certain morphological gradation with *B. patagonicus*, he decided not to

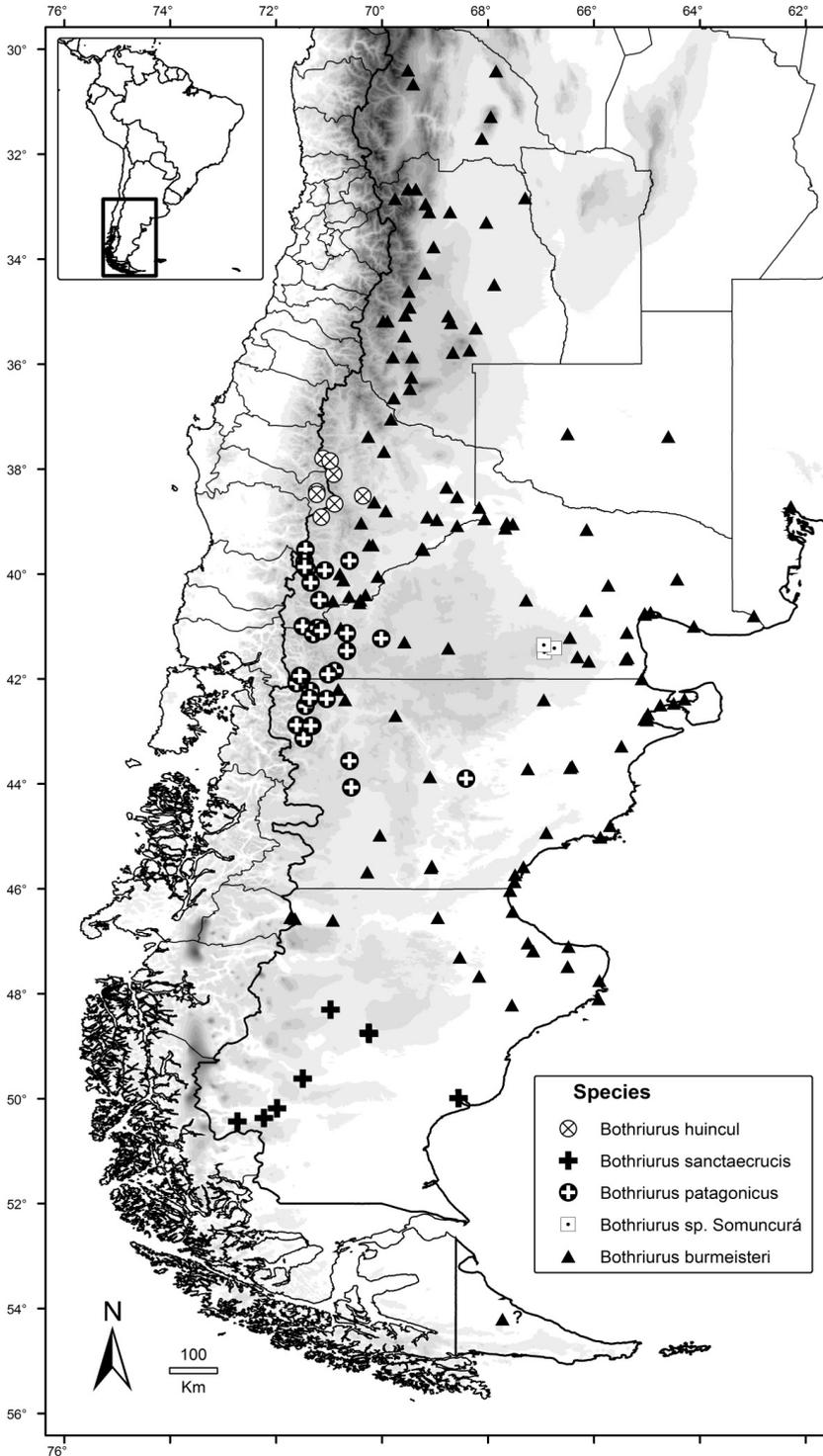


Fig. 1. Map showing the distribution of *Bothriurus patagonicus* Maury, *Bothriurus sanctaerucis* sp. n., *Bothriurus huincul* sp. n., *Bothriurus* sp. from Meseta Somuncurá and *Bothriurus burmeisteri* Kraepelin. Thick line: country limits; thin line: province limits; contour interval, 500 m.

consider them taxonomically until having new decisive elements that allow a categorical definition. These forms, and another from the Meseta Somuncurá (a basaltic plateau in northern Patagonia), were later referred to as members of the “patagonicus species group”, although without elucidating the status for the different forms (Maury 1979) or only recognizing those coming from Meseta Somuncurá as distinct (Acosta & Maury 1998; Acosta 2003). In the recent catalog of the Argentinean scorpions, Ojanguren Affilastro (2005) mentioned again the presence of these three undescribed species, but without further details.

I have had the opportunity to study some of the material seen by Maury, in addition to more and better preserved specimens, including some recently collected in Argentinean Patagonia and Chile. Based on this material, I confirm that the different observed forms (Maury 1968; Acosta & Maury 1998; Acosta 2003) correspond to three new species. The three share the presence of one subdistal tooth on the chelicerae with *B. patagonicus*; this is an autapomorphy of the *patagonicus* species group (Mattoni 2003). The main goal of this contribution is to describe two new species, and to add to the knowledge of *Bothriurus patagonicus* and *Bothriurus burmeisteri* (from *burmeisteri* species group, Mattoni 2003; Ojanguren Affilastro 2005).

**Materials and methods**

Terminology for general morphology follows Stahnke (1970) and Prendini (2000, 2003a, 2003b), except for the terminology for pedipalp carinae (Francke 1977), and trichobothrial nomenclature (Vachon 1974). The nomenclature of the hemispermatophore structures follows San Martín (1965) and Acosta (1998); I maintained the abbreviations derived from the names in Spanish, since they were widely used in the literature.

*Abbreviations of studied collections.* – AMNH: American Museum of Natural History, New York, USA; UCCC: Universidad de Concepción Colecciones Científicas, Chile; MACN-Ar: Arachnids collection, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina; CDA: Cátedra de Diversidad Animal I, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Argentina; MNHS: Museo Nacional de Historia Natural,

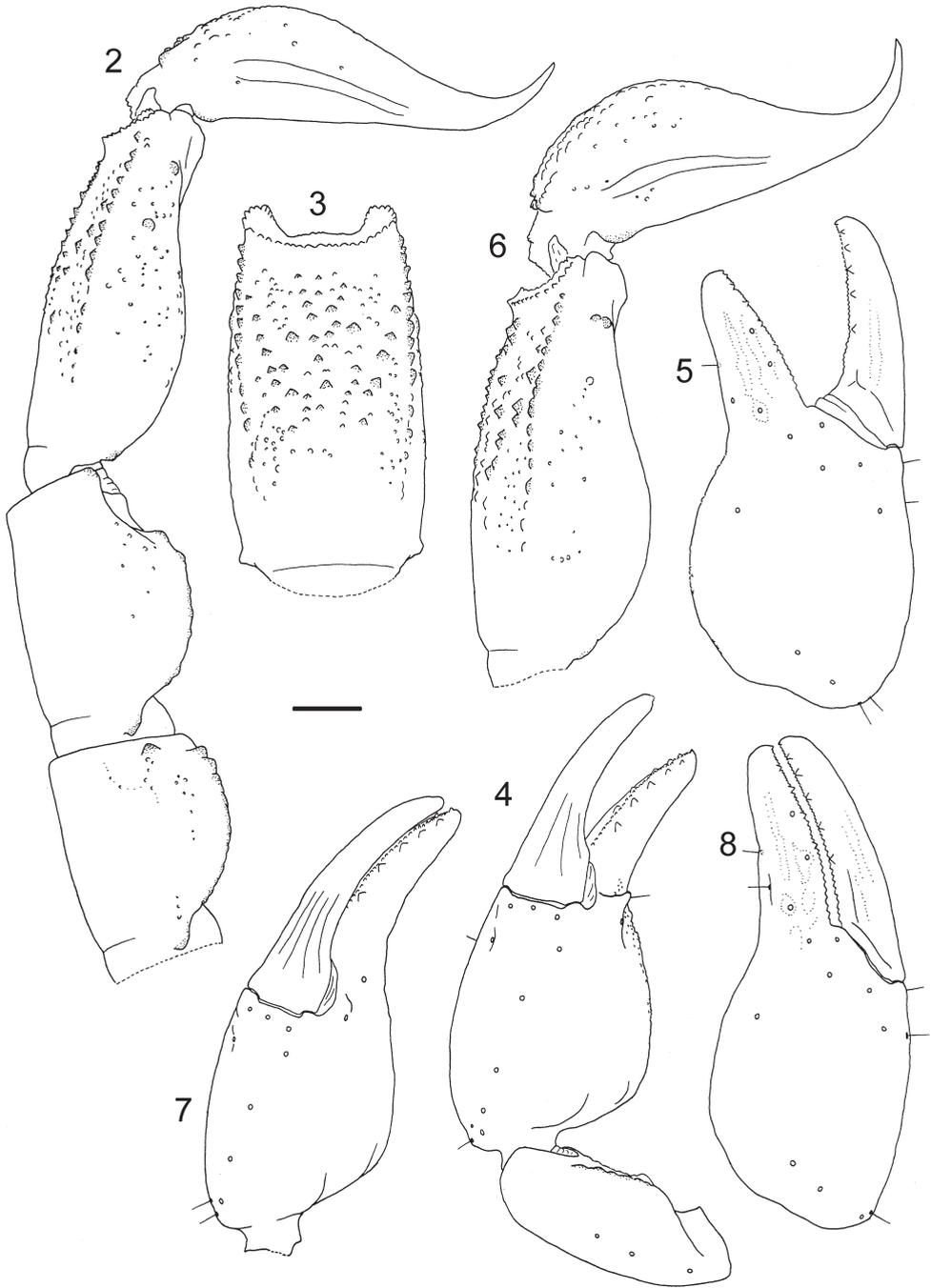
Santiago, Chile; IADIZA: Instituto Argentino de Investigaciones de las Zonas Áridas, Mendoza, Argentina. Tissue samples of all the species are stored (in the vapor phase of liquid nitrogen at -150°C) in the Ambrose Monell Collection for Molecular and Microbial Research (AMCC) at the AMNH.

*Abbreviations of descriptive terms.* – Carinae on metasomal segments: DSM = dorsosubmedian; DL = dorsolateral; ML = median lateral; VL = ventrolateral; VSM = ventrosubmedian; VM = ventromedian. Hemispermatophore: L = distal lamina; c.d. = distal crest of lamina; r.d.p. = posterodistal fold; l.i. = internal lobe of capsule; l.b. = basal lobe of capsule; l.e. = external lobe of capsule.

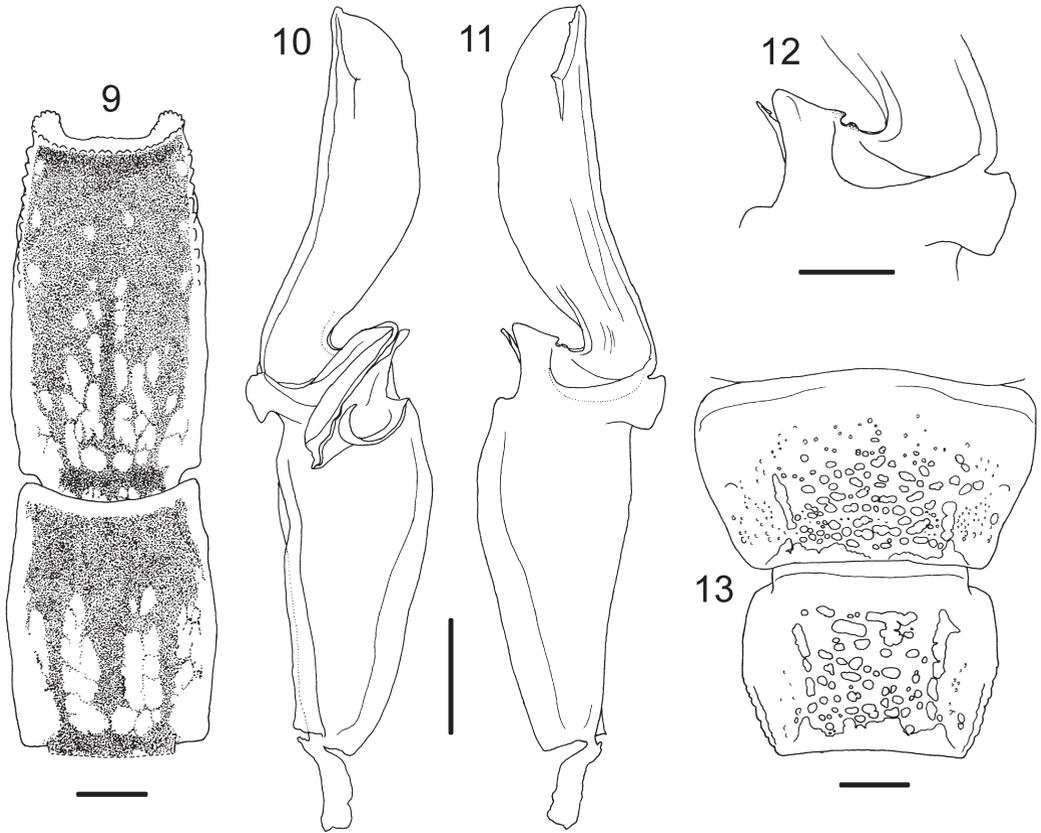
Illustrations were produced using a Leica MS5 stereomicroscope and camera lucida. All measurements are in mm and were taken using an ocular micrometer. The variability values are expressed as follows: extremes, median ± standard deviation. Hemispermatophores were dissected from surrounding tissues and observed in 80% ethanol. The distribution map was generated using ArcMap 9.0 (Environmental Systems Research Institute [ESRI], Redlands, California). The topographic coverage was generated from a digital elevation model file (1 arc degree resolution) from the United States Geological Survey (USGS) website (<http://edc-daac.usgs.gov:80/gtopo30/gtopo30.asp>). The records were georeferenced using a GPS (Garmin® Etrex), with the GeoNet Names Server (GNS, <http://gnswww.nga.mil/geonames/GNS/index.jsp>), or through satellite images using Google Earth® v 3.0762 (available at <http://earth.google.com>).

**Key to the identification of Patagonian species of *Bothriurus***

1. Chelicerae movable finger with two subdistal teeth; metasomal carinae strongly developed, with big acute granules (Figs 32, 33)..... *B. burmeisteri*
- Chelicerae movable finger with one subdistal tooth (as in Fig. 27); metasomal carinae medium developed, with small blunt granules (Figs 2, 16, 29)..... 2
2. Hemispermatophore with two apophyses on the external face of l.i., base of L. narrower than the distal portion (Figs 10-11); surface of sternite VII and metasomal segment I extremely granulous, with VL and VSM carinae irregular and discontinued (Fig. 13)..... *B. huincul* sp. n.
- Hemispermatophore with one apophysis on the



Figs 2–8. *Bothriurus huincul* sp. n. 2–5. Male holotype; 2. Metasomal segments III–V and telson, lateral view; 3. Metasomal segment V, ventral view; 4. Right pedipalp chela and patella, ventromedial view; 5. Right pedipalp chela, external view; 6–8. Female paratype (MACN-Ar); 6. Metasomal segment V and telson, lateral view; 7. Right pedipalp chela, ventromedial view; 8. Right pedipalp chela, external view. Scale bar = 1 mm.



Figs 9–13. *Bothriurus huincul* sp. n. 9–12. Male holotype (MACN-Ar); 9. Pigmentation pattern of metasomal segments IV–V, ventral view (carinae omitted); 10–12. Left hemispermatophore; 10. Internal view; 11. External view; 12. Detail of lobes area, external view; 13. Female paratype (MACN-Ar), sternite VII and metasomal segment I, ventral view. Scale bars, 9–11 and 13 = 1 mm; 12 = 0.5mm.

- external face of l.i. , base of L. as wide as the distal portion (as in Figs 24, 25); ventral surface of sternite VII and metasomal segment I smooth or with only a few small granules, with VL and VSM carinae (if present) straight and continuous (Figs 23, 31) ..... 3
- 3. VL and VSM carinae on metasomal segment I and sternite VII absent on males and females; the three metasomal ventral stripes of pigment not fused in any segment ..... *Bothriurus* sp. from Meseta Somuncurá
- VL and VSM carinae on metasomal segment I and sternite VII present (at least on females) (Figs 23, 31); the three metasomal ventral stripes of pigment fused on distal of segments II–V (as in Fig. 26)..... 4
- 4. VSM carinae on sternite VII absent in males and females, VL carinae absent on males, present on females; VSM carinae on metasomal

- segment I absent on males, present on females, poorly developed (Fig. 31); metasomal DSM carinae complete on segments I–IV, well developed (Fig. 29); telson of males, length/height ratio 3.16–3.72, dorsal surface with a wide, rounded glandular depression; metasomal segment V with three pairs of VL setae ..... *B. patagonicus*
- Males and females with VL and VSM carinae on metasomal segment I and sternite V, females with VL and VSM carinae on anterior third of metasomal segment II (Fig. 23); metasomal DSM carinae incomplete or poorly developed on segments I–IV (Fig. 16); telson of males, length/height ratio 2.87–3.11, dorsal surface with a small, oval glandular depression; metasomal segment V with three or four pairs of VL setae (Fig. 28)... *B. sanctaerucis* sp. n.

***Bothriurus huincul* sp. n.**

(Figs 1-15)

*Bothriurus* sp.: Maury 1968: 150 (map, localities 50, 51 and 52), 159 ("group ... from Pehuén district").*Bothriurus* from *patagonicus* group: Maury 1979: 707, 715 (map 5-G, part); Ojanguren Affilastro 2005: 211 (part).*Bothriurus patagonicus*: Acosta & Maury 1998: 554 (part).

*Type material.* – ARGENTINA: Neuquén Province: Holotype ♀ (MACN-Ar 11089), Pino Hachado, 38°40'S 70°54'W, 1884m, 7.i.1987, E. Maury. Paratypes: 1 ♀, 2 ♂ (MACN-Ar 11090), 1 ♀ (CDA 000.095), 1 ♀ and 1 ♂ (CDA 000.096), same data as holotype; 1 ♂ (CDA 000.097), Las Lajas, 38°31'S 70°22'W, i.1973, A. Romanelli. CHILE: IX Region (La Araucanía): Malleco Province: 1 ♀, 1 ♂ (AMNH), Lonquimay, 38°26'S 71°14'W, 18.ii.1980, L. Peña; 5 ♀, 2 ♂, 16 km E of Lonquimay, 38°29'6.756"S 71°14'4.416"W, 936 m, u.v. on Patagonian steppe, with sandy volcanic soil, 17.i.2006, C. Mattoni, M. Vivanco.

*Additional material.* – ARGENTINA: Neuquén Province: Copahue, Paso de Copahue, 37°48'S 71°07'W, 2013m, i.1963, S. Coscarón, 2 juv. (MACN-Ar); Cavihue, 37°51'S 70°59'W, 12.ii.1967, 2 ♀, 2 ♂, 15 juv. (MACN-Ar); Chenque Pehuén, 38°06'S 70°55'W, 1800m, 15.ii.1974, M. Gentili, 1 ♀ (MACN-Ar); 1 juv. (MACN-Ar), Las Lajas, 38°31'S 70°22'W, i.1973, A. Romanelli; same data as holotype, 5 juv. (MACN-Ar); 2 ♀ (MACN-Ar), Lago Aluminé, 38°55'S 71°09'W, ii.1982, L. Gallardo. CHILE: Region IX (La Araucanía): Malleco Province: Lonquimay, 38°26'S 71°14'W, 18.ii.1980, L. Peña, 2 ♂, 2 juv. (AMNH); 16 km E of Lonquimay, 38°29'6.756"S 71°14'4.416"W, 936 m, u.v. on Patagonian steppe, 17.i.2006, C. Mattoni, M. Vivanco, 5 ♀, 2 ♂, 6 juv. (AMNH), 1 ♀, 1 subad. ♂, 3 juv. (AMCC 163245).

*Etymology.* – The specific epithet means 'mountain' in Mapuche, an indigenous language from Southern South America, and is used as a noun in apposition.

*Diagnosis.* – *Bothriurus huincul* shares the presence of one subdistal tooth on the chelicera with the species of the *patagonicus* group, and possibly some minor characteristics including the habitus and the general pigmentation pattern. The hemispermatophore morphology, with two apophyses on the external face of I.i. (Figs 10–12), and the general arrangement of the ventral carinae of metasomal segment V (Fig. 3) are very similar to the *Bothriurus* of the *vittatus* group (Mattoni 2002a, 2002b, 2002c), but all species of this group have two subdistal teeth on the chelicera, and a different pigmentation pattern on tergites: the pigment reaches the posterior edge of each tergite on the species from *vittatus* group, and *B. huincul* lacks pigment on the posterior half to third of each ter-

gite. The particular morphology of the sternite VII and metasomal segment I of *B. huincul* possess discontinuous and irregular carinae, and abundant blunt granulation (Fig. 13). This clearly separates them from the remaining species of *Bothriurus* of the *patagonicus* and *vittatus* groups, which have continuous carinae and are less granulated or have a smooth ventral surface.

*Description.* – *Coloration.* The general colour is yellow-reddish, with markings of dark brown and black pigments. Yellow legs with diffuse markings on the prolateral side of trochanter, femur and tibia; pectines light yellow; spotted pedipalps with diffuse dark markings on dorsal and external face. Pigmentation of carapace: large pentagonal central spot on the anterior half connected to a lateral pair of, irregular spots, ocular prominence darker, with connecting pigment bands toward the lateral eyes; posterior area with irregular pigmentation mostly concentrated near the postero-lateral margins. Tergites: completely spotted pretergites; the pigment almost covers the whole tergites I and II, being diffused a lot in the posterior third to fourth of III to VI, VII with pigment only in anterior forth; the center of the tergites decreases in quantity of pigment from II to VII, showing a thin clear central band. Sternites yellowish, immaculate. Metasoma: on ventral side three stripes of pigment that join at distal half of segments II–V (Fig. 9), segment I only have two thin and diffuse lateral stripes; lateral and dorsal faces with only a weak stripe of pigment following the dorsal carinae, or without pigment. Telson ventrally blackish, with bright bands: two thin and ventral, one lateral; dorsal immaculate, with wide yellow area in males (it almost occupies the whole dorsal surface).

*Carapace.* Tegument without carinae, finely granular in males, smooth in females. Anterior margin straight, with only lateral ocular, central median and posterior median furrows (with deep fissure among the last ones), and posterior lateral furrows; posterior margin straight. Three pairs of lateral ocelli; median ocelli larger than lateral ocelli, situated medially, separated 1.3–1.4 diameters from each other. Ocular tubercle protruding slightly above median ocelli.

*Tergites.* Tegument finely granular in males, smooth in females. I–VI without carinae; VII with four short carinae in the posterior half, two lateral and two paramedian.

*Sternites.* III–VI finely granular, with the most

pronounced grains toward the sternite VI (a little more developed in males); sternite VII (Fig. 13) with abundant low grains that increase in quantity and development distally (more pronounced in females) and form two lateral carinae in the distal half of the segment. Stigmata small, oval, slightly oblique, almost parallel to the distal margin of sternites.

Sternum. Slitlike, represented by a narrow transversal plate, slightly V shaped. Medial longitudinal furrow weak.

Genital operculum. Loosely joined along the anterior one-fourth of their length in males; completely joined in females. Each plate isosceles triangle-shaped in males, with the more acute angle towards posterior; equilateral triangle-shaped in females. Genital papillae absent.

Metasomal segments I–IV. DSM carinae complete, weak, with blunt granules, the posterior ones in each segment more developed (Fig. 2); DL carinae present only on distal third of segments, area between DSM and DL carinae with some small sparse granules in segments I–III; ML carinae vestigial on distal fourth of segments I–III, absent on IV; ventral area of segments II–IV smooth, without carinae; ventral area of segment I with many low granules (more developed in females), VL carinae strong, VSM carinae difficult to distinguish, interrupted.

Metasomal segment V and telson. DL carinae of segment V represented by large granules in the end, and some small scattered granules among (Figs 2, 6); ML carinae represented as sparse granulation and a big granule in distal third (in the base of a ML setae); VL carinae developed on distal three quarters of segment (Fig. 3); VSM and VM carinae from near segment half to the distal end, VSM slightly oblique, finishing before the end of the segment, VM bifurcated posteriorly, area between ventral carinae with small granules; three pairs of VL setae. Telson of male elongated and low (Fig. 2), ventral surface granular on proximal third, dorsal surface smooth, with soft glandular depression on the whole surface of the vesicle; telson of female larger than that of male (Fig. 6), without dorsal glandular depression.

Chelicerae. With one subdistal tooth on movable finger (or two, see variability below). Dorsally with a single macroseta in the base of fixed finger; ventral aspect of movable finger and manus with abundant macrosetae.

Pedipalp. Femur tricarinate, dorsoexternal, dor-

sointernal and ventrointernal carinae, present in the proximal half with small blunt granules, prolateral and dorsal side with scattered granules; patella with two carinae (Fig. 4), dorsointernal and ventrointernal carinae feeble; chela without carinae, only a few vestiges in the fingers; chela of male very dilated (Figs 4, 5), with a strong conical apophysis on prolateral side near movable finger and with soft depression above the apophysis, tegument with very fine granulation (more remarkable granules in the prolateral depression and in dorsal edge); chela of female less inflated (Figs 7, 8), with fingers proportionally longer than males, with small blunt granule in the position of the apophysis of the male, tegument smooth. Trichobothrial pattern type C, neobothriotaxic major, with the following segment totals: femur 3 (1 *d*; 1 *i*; 1 *e*), patella 19 (2 *d*; 1 *i*; 13 *e*; 3 *v*) and chela 27 (21 manus, 5 *V*; 10 fixed finger); chela: *Esb* near to *Eb*<sub>1</sub> and *Eb*<sub>2</sub>.

Legs. Without carinae or granules. Tibial spur absent, prolateral and retrolateral pedal spurs well developed. Basitarsi with spiniform macrosetae on prolateral and retrolateral margins, and on ventral surface; leg I with 2 macrosetae, II and III with 6, IV with 5; basitarsi I with 3 ventral longitudinal rows (one median, one ventroprolateral, one ventroretrolateral) of short hyaline setae, basitarsi II with one row (ventroretrolateral). Telotarsi I–IV with paired ventrosubmedian rows of macrosetae (setiform on telotarsi I and the distal pair of II, spiniform on the remaining) and a ventromedian row of hyaline setae; counts of macrosetae in the pro- and retrolateral rows: telotarsi I with 1/1, II with 2/2, III with 3/3, IV with 3/3. Telotarsal ungues short (around one third of tarsus length), distinctly curved, and of equal length.

Pectines. With a single row of median lamellae, 13 lamellae in males, 12 in females. Pectinal teeth: males 17–19 (holotype 17/18), females 12–16 (see variability in Table 2); males with larger teeth, beginning in proximal third of the basal median lamella, females with smaller teeth, beginning at distal end of the basal median lamella.

Hemispermaphore. Distal lamina slender (much more near the base), slightly curved (Figs 10, 11); c.d. parallel to L. edge, partitioned, distal portion curved, proximal straight; l.b. laminar, bifid; l.i. with two apophyses on the external face (the exterior spiniform, the internal comb-like) (Fig. 12); l.e. with semilunar shelf; r.d.p. well developed.

Table 1. Measurements on mm of the holotypes males and paratypes females of *Bothriurus huincul* sp. n. and *Bothriurus sanctaecrucis* sp. n. Hol. = holotype, Par. = paratype.

Type and sex		<i>B. huincul</i>		<i>B. sanctaecrucis</i>	
		Hol. ♀	Par. ♂	Hol. ♀	Par. ♂
Total length		34.66	39.74	32.51	31.59
Carapace	length	4.67	5.34	4.20	4.54
	anterior width	2.87	3.27	2.60	2.80
Mesosoma	total length	8.25	10.46	8.50	9.05
Metasoma	total length	21.74	23.94	19.81	18.00
Metasomal segment I	length	2.13	2.47	2.00	2.00
	width	3.40	3.87	2.87	2.87
Metasomal segment II	length	2.53	3.00	2.47	2.33
	width	3.27	3.54	2.67	2.67
Metasomal segment III	length	2.87	3.33	2.67	2.47
	width	3.20	3.47	2.67	2.60
Metasomal segment IV	length	3.20	3.60	3.13	2.80
	width	3.00	3.40	2.53	2.47
Metasomal segment V	length	4.74	5.14	4.07	3.60
	width	2.93	3.34	2.40	2.40
	height	2.20	2.67	1.80	1.87
Telson	length	6.27	6.40	5.47	4.80
	width	2.47	2.93	2.27	2.27
	height	1.73	2.20	1.80	1.90
Aculeus	length	1.60	1.67	1.13	1.07
Pedipalp	total length	13.45	14.70	12.60	12.60
Femur	length	3.27	3.67	3.13	3.00
	width	1.33	1.53	1.27	1.33
Patella	length	3.60	3.93	3.27	3.27
	width	1.53	1.60	1.40	1.40
Chela	length	6.58	7.10	6.20	6.33
	width	2.67	2.33	2.33	2.00
	height	3.27	2.93	3.00	2.47
Movable finger	length	3.60	4.00	3.13	3.60

*Variability.* – Total length (mm): males 29.29–37.27,  $32.82 \pm 2.81$  (n=10); females up to 39.74. Length/height telson ratio: males: 3.45–3.96,  $3.67 \pm 0.16$  (n=9); females: 3.01–3.15,  $23.01 \pm 0.08$  (n = 6). Left hemispermatophore total length: 5.14–6.71,  $5.93 \pm 0.68$  (n=5). Number of subdistal teeth on chelicera (left/right): 1/1 (22 specimens), 2/1 (3), 1/2 (3), 2/2 (1). Measurements of holotype ♀ and paratype ♂ are presented in Table 1.

*Remarks.* – Only the scarcity of materials (3 vials with 3 ♀, 2 ♂, and 17 juveniles) seen by Maury (1968) could explain being unsure about the identity of this new species, since it presents great quantity of characteristics that easily separate it

from the other species in Patagonia. The morphology of the hemispermatophore is different, being nearest to species of the *vittatus* group (Mattoni 2002a, 2002b, 2002c).

*Distribution and natural history.* – The species appears to be restricted to high altitude valleys of the Andean chain (up to 2000m), in the Northwest of Neuquén Province (Argentina) and eastern Malleco Province (Chile) (Fig. 1). Remarkably, *B. huincul*, which shares characteristics with both the *patagonicus* and *vittatus* groups, is also geographically intermediate between them: the *vittatus* group is distributed from the center of Chile to the north of the Malleco Province in Chile (Mattoni



Figs 14–15. 14. Collection locality of *Bothriurus huincul* sp. n., Lonquimay valley, Chile. 15. *Bothriurus huincul* sp. n., couple mating upside down on a branch of a small bush (female on the left, male on the right).

2002a, 2002b, 2002c), *B. huincul* in the east of Malleco and in the Northeast of the Neuquén Province in Argentina, and the other species from the *patagonicus* group is present toward the south and west, in Argentinean Patagonia (Fig. 1). The author collected this species with U.V. light during the night in a valley near Lonquimay, Chile, with a Patagonian habitat (steppe with some grass and bushes), over sandy volcanic soil (Fig. 14). The moon was almost full, and all the scorpions were waiting in the shadows of the bushes or grass, and a couple was mating upside down on a branch of a small bush, a behavior never reported in scorpions (Fig. 15).

### *Bothriurus sanctaerucis* sp. n.

(Figs 16–28)

*Bothriurus* sp.: Maury 1968: 150 (map, loc. 57), 159 (part. of the "... group [...] from West of Chubut and Santa Cruz...").

*Bothriurus* from *patagonicus* group: Maury 1979: 707, 715 (map 5–G) (part); Ojanguren Affilastro 2005: 211 (part.).

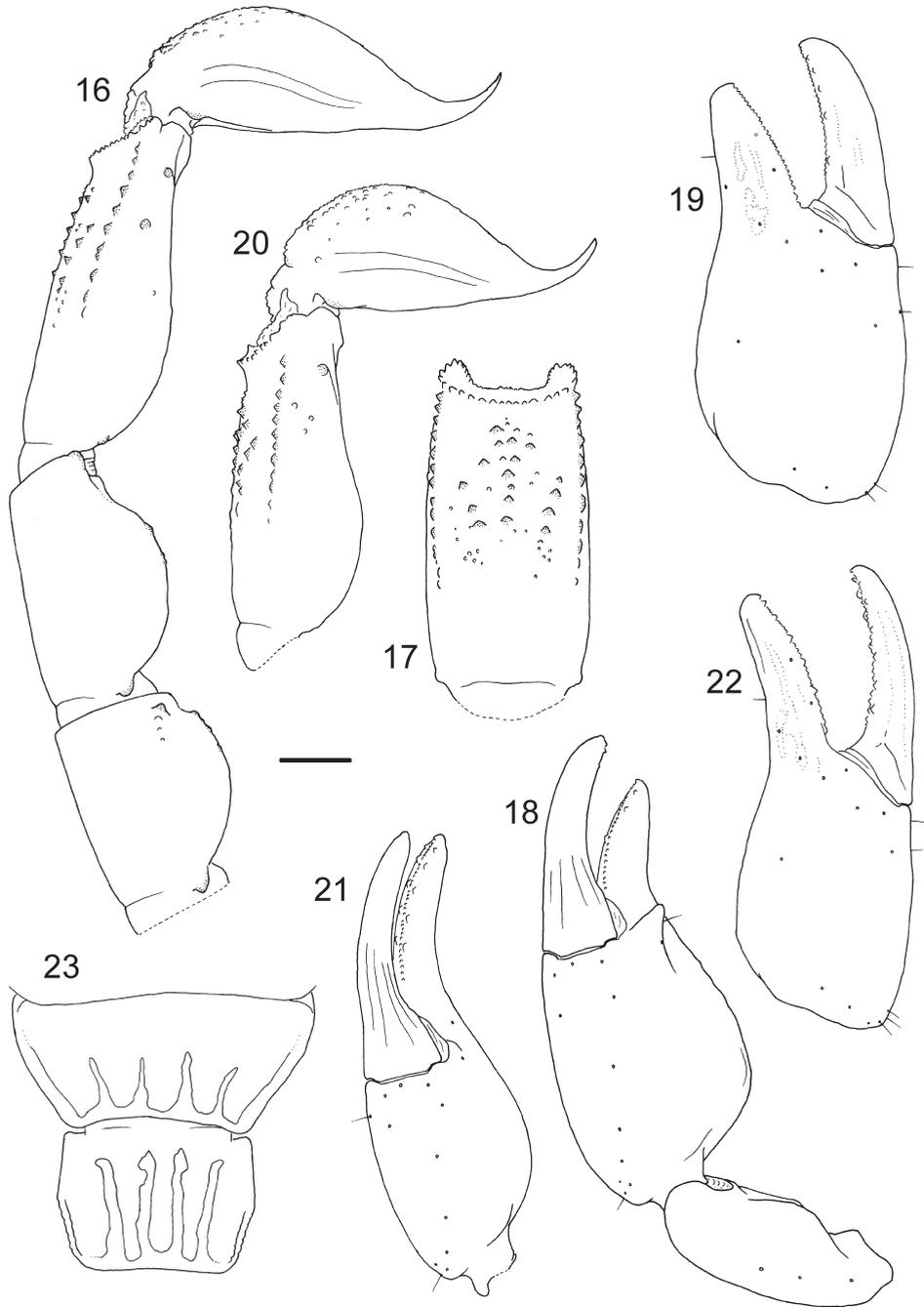
*Bothriurus patagonicus*: Acosta & Maury 1998: 554 (part.).

*Type material.* – ARGENTINA: Santa Cruz Province: Holotype ♀ (MACN-Ar 11091), Cañadón Misioneros, 49°59'24"W 68°33'30"S, Puerto Santa Cruz, 31.i.1978, E. Maury, B. Petricek. Paratypes: 1 ♀, 1 ♂ (CDA 000.094), 1 ♂ paratype (MACN-Ar 11091), same data as holotype; 2 ♀, 1 ♂ (MACN-Ar 11093), 1 ♀, 1 ♂ (CDA 000.093), Piedra Clavada, 49°37'W 71°30'S, 19.i.1978, E. Maury; 5 ♀, 5 ♂ (AMNH), Gobernador Gregores, 48°44'31.2"S 70°15'20.2" W, 287 m, 17.i.2005, M. Magnanelli, E.G. López.

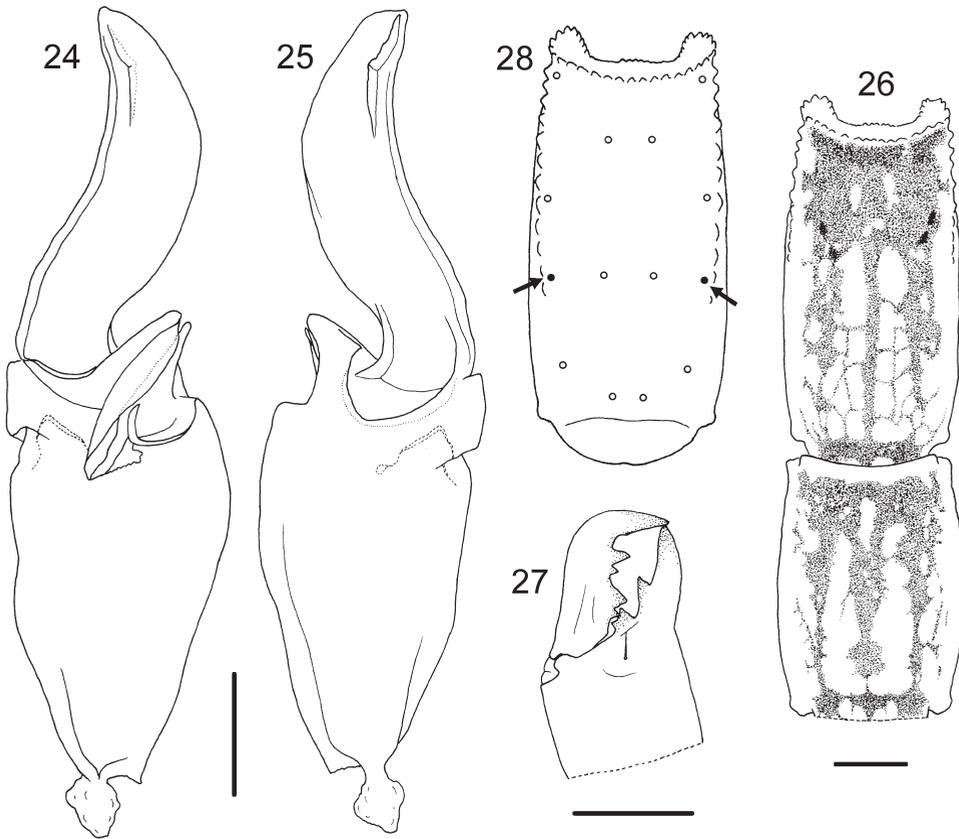
*Additional material.* – ARGENTINA: Santa Cruz Province: Gobernador Gregores, 48°46'W 70°15'S, i.1963, Guiles, 1 ♀ (UCCC 260); but 48°44'31.2"S 70°15'20.2"W, 287 m, 17.i.2005, M. Magnanelli, E.G. López, 13 ♀, 5 subad. ♀, 18 ♂, 10 juv. (AMNH), 2 ♂, 2 subad. ♀, 2 subad. ♂, 2 juv. ♂, 2 juv. (AMCC 163246), 1 ♂, 1 juv. ♂ (AMCC 163248); Tamel Aike, 48°18'8.1" S 70°58'29.6" W, 545 m, 17.i.2005, M. Magnanelli, E.G. López, 2 juv. (AMCC 163247), 1 ♂, 1 juv. ♂ (AMCC 163249); Piedra Clavada, 49°37'S 71°30'W, 19.i.1978, E. Maury, 1 ♀, 4 juvs. (MACN-Ar); Península Magallanes (Lago Argentino), on 11 Route, on Río Mitre, 50°26'W 72°44'S, 20.i.1993, 1 ♀ (MACN-Ar); El Calafate, Cerro Calafate, 50°22'W 72°14'S, Río Santa Cruz, Río La Leona, 50°11'S 71°59'W, E. Maury, 2 ♀, 3 ♂, 2 juv. (MACN-Ar); same data as holotype, 6 juv. (MACN-Ar).

*Etymology.* – The specific epithet is Latin genitive referring to the type locality (Puerto Santa Cruz).

*Diagnosis.* – *Bothriurus sanctaerucis* is closely related to the species of the *patagonicus* group, because of the presence of one subdistal tooth on the chelicera, and a similar ventral carinae morphology on metasomal segment V, in common with *B. patagonicus* and *Bothriurus* sp. from Meseta Somuncurá. Also, the three species share similar hemispermatophore morphology (Figs 24, 25). *Bothriurus sanctaerucis* is probably the sister species of *B. patagonicus*, since both have VL and VSM carinae on metasomal segment I of the females, and VL carinae on the sternite VII of males and females (*Bothriurus* sp. from Meseta Somuncurá do not have any ventral carina on sternite VII and metasomal segment I in both sexes). The both species are easily separated by the presence of VSM carinae on sternite VII on *B. sanc-*



Figures 16–23. *Bothriurus sanctaecrucis* sp. n. 16–19. Male holotype (MACN-Ar); 16. Metasomal segments III–V and telson, lateral view; 17. Metasomal segment V, ventral view; 18. Right pedipalp chela and patella, ventromedial view; 19. Right pedipalp chela, external view; 20–23. Female paratype (MACN-Ar); 20. Metasomal segment V and telson, lateral view; 21. Right pedipalp chela, ventromedial view; 22. Right pedipalp chela, external view; 23. Sternite VII and metasomal segment I, ventral view. Scale bar = 1 mm.



Figs 24–28. *Bothriurus sanctaerucis* sp. n.; 24–26. Male holotype (MACN-Ar); 24–25. Left hemispermatophore; 24. Internal view; 25. External view; 26. Pigmentation pattern of metasomal segments IV–V, ventral view (carinae omitted); 27. Male paratype (Piedra Clavada, MACN-Ar), left chelicer, dorsal view; 28. Schematic representation of the disposition of the ventral setae in the metasomal segment V (arrows indicate the variable setae, carinae omitted, not to scale). Scale bar = 1 mm.

*taerucis* (Fig. 23), absent on *B. patagonicus* (Fig. 31); and by the absence of VSM carinae on metasomal segment I in the males of *B. patagonicus*, present in both sexes on *B. sanctaerucis*. The females of *B. sanctaerucis* also have a vestigial VL on metasomal segment II, which is absent on *B. patagonicus*. On the other hand, all the metasomal carinae (except VL and VSM on caudal segments I–II) are more developed in *B. patagonicus* (specially the DSM carinae), and show more intermediate granules (Figs 16, 17, 20, 29). The males and females of *B. sanctaerucis* have a smaller telson length/height ratio than the specimens of *B. patagonicus*, and the dorsal glandular depression of the male telson is larger on *B. patagonicus*.

Additionally, most of the *B. sanctaerucis* specimens have four pairs of ventrolateral setae (Fig. 28), and almost all *B. patagonicus* have only three pairs. The trichobothria on *B. sanctaerucis* (Figs 18, 19, 21, 22) are markedly smaller to all the other *Bothriurus* species.

**Description.** – Coloration. The general colour is yellow-reddish, with markings of dark brown. Yellow legs with diffuse markings on the prolateral side of femur and tibia; pectines light yellow; spotted pedipalps with diffuse dark markings on dorsal and external face. Pigmentation of carapace: pentagonal central spot on the median-anterior half connected to a pair of laterals irregulars

spots, dark ocular prominence, with connecting pigment bands toward the lateral eyes; anterior central area with transversal spot, with a clear area towards the ocular prominence; posterior area with irregular pigmentation mostly concentrated near the postero-lateral margins. Tergites: completely spotted pretergites; the pigment covers anterior two thirds of tergites I to VI, VII with pigment only in anterior fourth. Sternites yellowish, immaculate. Metasoma: on ventral side three stripes of pigment join at distal fourth of segments II–V (Fig. 26), the central stripe with clear areas, segment I only have two thin and diffuse lateral stripes; lateral face without stains; on segment I–IV one dorsal central irregular spot, roughly triangle-like, segment V dorsally immaculate. Telson ventrally blackish, with bright bands: two thin and ventral, one lateral; dorsal surface with diffuse pigmentation, and a small oval central area without pigment.

Carapace. Tegument finely granular in males, smooth in females. Anterior edge right, with only lateral ocular, central median and posterior median furrows (with deep fissure among the last ones), and posterior lateral furrows; eyes separate 1.1–1.3 diameters.

Tergites. Tegument of tergites I–VI finely granular in males, smooth in females. I–VI without carinae; VII with four short carinae in the posterior half, two lateral and two paramedian.

Sternites. III–VI finely granular on males, with the most pronounced granules toward sternite VI, smooth on females; sternite VII (Fig. 23) with four vestigial carinae (two paramedians, two laterals) on distal half (less developed on males). Stigmata small, oval, slightly oblique, almost parallel to the distal margin of sternites.

Sternum. Slitlike, represented by a narrow transversal plate, slightly V shaped. Medial longitudinal furrow weak.

Genital operculum. Loosely joined together along the anterior one-fourth of their length in males; completely joined in females. Each plate isosceles triangle-shaped in males, with the more acute angle towards posterior; equilateral triangle-shaped in females. Genital papillae absent.

Metasomal segments I–IV. DSM carinae incomplete or poorly developed, very weak, with blunt granules, only the posterior ones in each segment developed (Fig. 16); DL carinae present only on distal third of segments, weak, almost without granules; area between DSM and DL carinae with

some small scattered granules in segment I; ML carinae vestigial (without granules) on distal fourth of segments I and II, very weak on III, absent on IV; ventral area of segments III and IV smooth, without carinae; segment I with VL and VSM carinae vestigial (tegument elevation, without granules), strong (more developed on females); segment II of females with VL and VSM carinae vestigial (as in the segment I, less developed) on anterior third; ventral surface of segment II of males smooth.

Metasomal segment V and telson. DL carinae represented only by big granules on the distal ends (Figs 16, 20); ML carinae represented as a great blunt granule in distal third (in the base of one ML setae, more noticeable in males); VL carinae developed on distal two thirds of segment (Fig. 17); VSM carinae short, slightly oblique, composed of three to four granules from the middle to three quarters of the segment; VM carinae on the distal half of the segment, bifurcated posteriorly; area between ventral keels almost smooth, with only a few small granules; three or four pairs of VL setae (Fig. 28, see variability below). Telson of male with oval vesicle (Fig. 16), ventral surface with small granules on proximal half, dorsal surface smooth, with subtle, small glandular depression in median line of the vesicle; telson of female (Fig. 20) larger than that of male (see variability below), without dorsal glandular depression.

Chelicera. With one subdistal tooth on movable finger (Fig. 27). Dorsally with a single macroseta at the base of fixed finger; ventral aspect of movable finger and manus with some macrosetae.

Pedipalp. Femur tricarinate, dorsoexternal carina vestigial, with only a few sparse granules, dorsointernal and ventrointernal carinae present in the proximal third with sparse granules, prolateral and dorsal surfaces with scattered granules; patella with two carinae (Fig. 18), dorsointernal and ventrointernal carinae feeble, weak; chela without carinae, only a few vestiges in the fingers; chela of male very dilated (Figs 18, 19), fingers short, with a strong conical apophysis on prolateral side near movable finger, dorsally curved, and with soft depression above the apophysis, tegument smooth; chela of female less inflated (Figs 21, 22), with fingers proportionally longer than males, with small blunt granule in the position of the apophysis of the male, tegument smooth. Tichobotria very small (Figs 18, 19, 21, 22), trichobothrial pattern type C, neobothriotaxic major, with the fol-

lowing segment totals: femur 3 (1 *d*; 1 *i*; 1 *e*), patella 19 (2 *d*; 1 *i*; 13 *e*; 3 *v*) and chela 27 (21 manus–5 *V*–, 10 fixed finger); chela: *Esb* near to *Eb*<sub>1</sub> and *Eb*<sub>2</sub>.

Legs. Without carinae or granules. Tibial spur absent, prolateral and retrolateral pedal spurs well developed. Basitarsi with spiniform macrosetae on prolateral and retrolateral margins, and on ventral surface; leg I with 4 macrosetae, II with 8, III and IV with 5; basitarsi I with 3 ventral longitudinal rows (one median, one ventroprolateral, one ventroretrolateral) of short hyaline setae, developed on distal third; basitarsi II with one row (ventroretrolateral) poorly developed on distal fourth. Telotarsi I–IV with paired ventrosubmedian rows of macrosetae (setiform on telotarsi I, spiniform the remaining) and a ventromedian row of hyaline setae; counts of macrosetae in the pro- and retrolateral rows: telotarsi I with 1/1, II with 2/2, III with 3/3, IV with 3/3. Telotarsal unguis short (around one third of tarsus length), distinctly curved, and of equal length.

Pectines. With a single row of median lamellae, 13 lamellae in males, 12–13 in females. Pectinal teeth: males 14–17 (holotype 17–17), females 13–15 (see variability on Table 2); males with larger teeth, beginning in the proximal third of the basal median lamella, females with smaller teeth, beginning at distal end of the basal median lamella.

Hemispermaphore. Distal lamina slender, slightly S-curved (Figs 24, 25); c.d. parallel to L. edge, partitioned, distal portion curved, proximal straight; l.b. laminar, bifid; l.i. with one spiniform apophysis on the external face; l.e. with semilunar shelf; r.d.p. well developed.

Variability. – Total length: males 30.29–37.73, 34.58 ± 2.37 (n=9), females up to 33.06. Length/height telson ratio: males: 2.87–3.11, 2.98

± 0.08 (n=10); females: 2.42–2.84, 2.60 ± 0.13 (n=7). Left hemispermaphore total length: 6.32–7.74, 7.06 ± 0.46 (n=7; holotype: 6.58). Measurements of holotype ♀ and paratype ♂ are presented in Table 1. VL pairs of setae on metasomal segment V (left/right): 3/3 (8 specimens), 3/4 (4), 4/3 (4), 4/4 (13) (Fig. 27). Hemispermaphore: The c.d. present some degree of variation in the shape of the distal portion, the males from Calafate, Península Magallanes and one male from Piedra Clavada (paratype MACN-Ar 11093) have the distal portion of the crest almost straight, in contrast, in two males from Piedra Clavada it is strongly curved. Pigmentation pattern: in juveniles the pigmentation can be more extended, but always following the general pattern described before. Some specimens have a light clear stripe on the central area of the tergites, or less pigmentation in this area. The ventral lateral pigment stripes on metasomal segment I are occasionally lacking, and the segment II can have a diffuse pigmentation pattern.

Remarks. – When discussing *B. patagonicus*, Maury (1968) stated that the scarcity of material of both sexes, and from intermediate localities, prevented him from identifying this south ‘form’ as a new species. Maury mentioned that for some characters (height of the vesicle of the telson, number of pectinal teeth, carinae of the sternites and metasomal segments) a south-north grade was present (he included *B. huincul* in the north, *B. patagonicus* in the center and part of *B. sanctaecrucis* to the south). I have been able to review a larger quantity of specimens, including many adult. Some of the specimens that Maury observed were not found in the MACN-Ar collection, including some from intermediate points among the area of distribution of *B. patagonicus* and *B. sanctaecrucis*

Table 2. Variability on the number of pectinal teeth on *Bothriurus patagonicus* Maury, *B. sanctaecrucis* sp. n. and *B. huincul* sp. n. n = number of pectines.

	Sex	Number of pectinal teeth								n
		12	13	14	15	16	17	18	19	
<i>Bothriurus patagonicus</i>	♀			7	16	27	15	1		66
	♂	4	10	19	2					35
<i>Bothriurus sanctaecrucis</i> sp. n.	♀				9	10	6			25
	♂		5	11	8					24
<i>Bothriurus huincul</i> sp. n.	♀						8	14	2	24
	♂	2	-	10	17	10				39

(from e.g.: Lake Fontana and Río Mayo, in Chubut Province, which Maury assigned to his “south form”). However, new records have expanded the distribution of *B. patagonicus* further to the southeast (Río Mayo, Chubut; Fig. 1), filling in some ‘gaps’. The scarce interpopulational variability I observed for this species across its expanded range leads me to conclude that the ‘gradation’ observed by Maury is spurious. In contrast, the morphology of the ventral carinae of the sternite VII and of the metasomal segment I in males and females, as well as the height of the telson (reflected in the length/height ratio) offer robust diagnostic characters for this species. Even in the extreme south of the range of *B. patagonicus* (Río Mayo), the differences from *B. sanctaecrucis* are well marked.

**Distribution.** – Recorded only from the center and south of the Santa Cruz Province (Fig. 1), the distribution possibly extends further north to the southeast Chubut Province, when the specimens observed by Maury (1968) are included. *Bothriurus sanctaecrucis* shows an extremely similar distribution to that of *Urophonius granulatus* (Maury 1978), which embraces the Santa Cruz Province almost completely and also occurs in the extreme south of Chile. The sympatry of species of *Bothriurus* and *Urophonius* has already been observed in other places (Maury 1973; Acosta & Maury, 1998; Acosta 2003). I have observed that the Sierra Pire Mahuida juvenile specimen (loc. 53 in the map of Maury 1968, north-central limit of the Chubut Province) does not correspond to either *B. sanctaecrucis* or *B. patagonicus* (Maury assigned it to the “south form”), and could be a new species, although discovering adult specimens is necessary to confirm this.

### ***Bothriurus patagonicus* Maury, 1968**

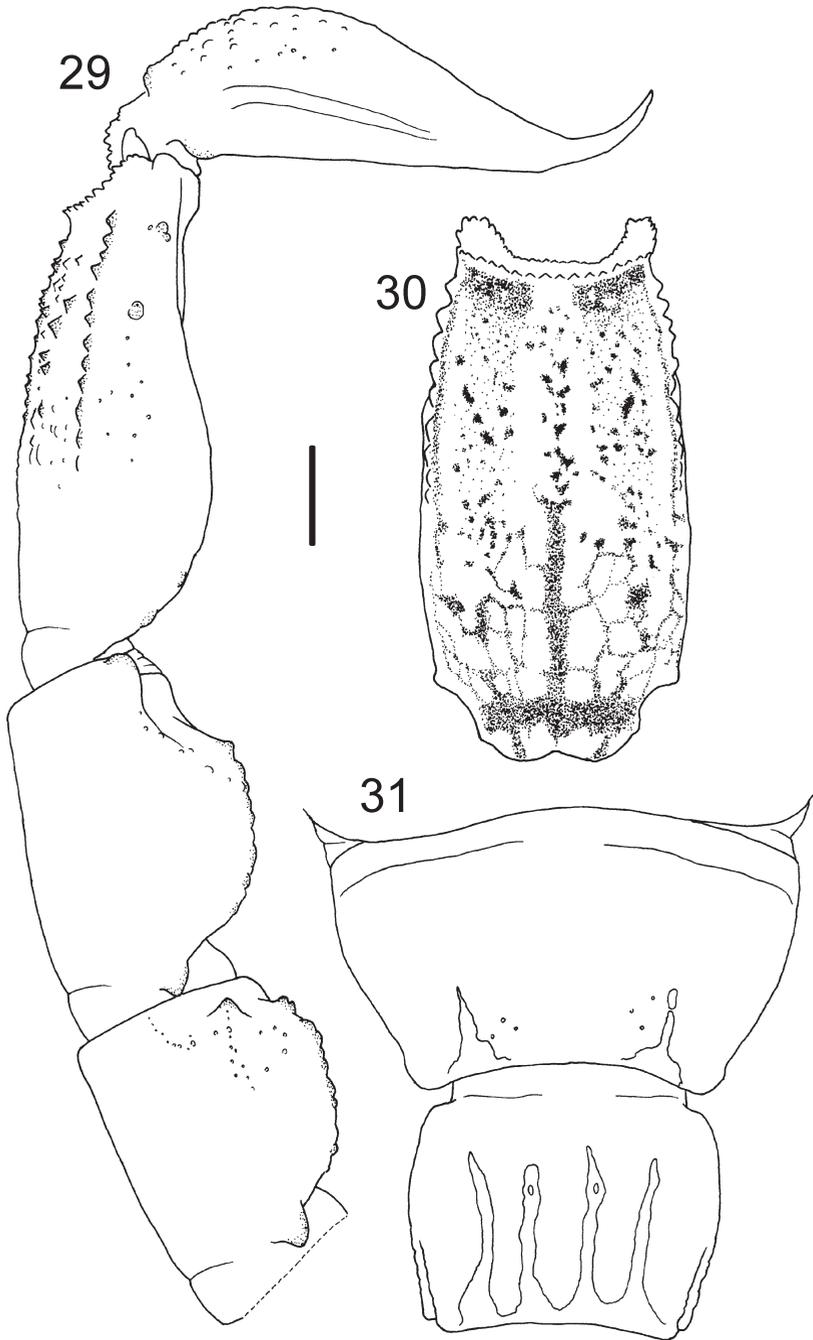
(Figs 29–31)

*Bothriurus patagonicus* Maury, 1968: 151; Lowe and Fet 2000: 24 (complete reference list until 1998); Ojanguren Affilastro 2005: 212–218 (redescription); Lourenço and Qi 2006: 288–289.

**Type material.** – ARGENTINA: Neuquén Province: 1 ♂ holotype (examined, MACN-Ar 6067), San Martín de los Andes, 40°10'S 71°21'W, 28.ii.1968, E. Maury, N. Müller. Paratypes (same loc. as holotype): 1 ♀ (labeled “allotypus”, examined, MACN-Ar 6068), 2 ♂ (not examined, MACN-Ar 6071), ii.1958, S. Schajovskoy; 1 ♀, 8 ♂, 4 juv. (not examined, MACN-Ar 6069), 28.ii.1968, E. Maury, N. Müller; 3 ♀ (not examined, MACN-Ar 6070), ii.1956, H. Molinari.

**Additional material.** – ARGENTINA: Neuquén Province: San Martín de los Andes, 40°10'S 71°21'W, i.1948, A. F. Prosen, 1 ♂ (CDA 000.091); ii.1960, Foerster, 1 ♀, 1 juv. (CDA 000.092); i–ii.1969, J. Carnoto, 1 ♀ (AMNH); same loc. (“Cuartel de Caballería”, id. date and coll., 24 ♀ (MACN–Ar); junction of routes 231 and 237, 17 km NE of San Carlos de Bariloche, 41°2'12.192"S 71°9'15.696"W, 808 m, Patagonian steppe, sandy volcanic soil, u.v., 6.i.2006, C. Mattoni, M. Vivanco, 3 ♀, 2 ♂, 1 juv. (AMNH), 2 juv. (AMCC 163253); 6 km W Nahuel Huapi, 41°01'S 71°13'W, 970m, dry, rocky mountainside, 11.i.1986, N. I. Platnick, P. A. Goloboff, R. T. Schuh, 1 juv. (AMNH). Río Negro Province: 15 km E San Carlos de Bariloche, 41°06'S 71°10'W, 790m, dry scrub, 14.i.1986, N. I. Platnick, P. A. Goloboff, R. T. Schuh, 1 juv. (AMNH); Norquínco, 41°51'S 70°55'W, 20.vi.1966, A. Kovacs, 1 juv. (AMNH); Norquínco, 41°54'51.4"S 71°0'75.2"W, 829 m, under stones, 23.i.2005, M. Magnanelli, E.G. López, 1 ♀, 2 ♂, 2 juv. ♂, 4 juv. (AMCC 163252); El Bolsón, 41°58'S 71°31'W, 4.xi.1966, A. Kovacs, 1 ♂, 2 juvs. (AMNH); 19.i.1965, 2 ♂, 3 juv. (AMNH); 2.ii.1965, 2 ♂, 4 juv. (AMNH); 2.iii.1964, 2 ♂ (AMNH); El Bolsón, Río Azul, 42°05'S 71°37'W, 19.i.1966, A. Kovacs, 1 ♂, 2 juv. (AMNH); 5.xii.1962, 1 ♀, 1 juv. (AMNH); El Bolsón, 41°56'39.6" S 71°33'5.8" W, 564 m, forest, 23.i.2005, M. Magnanelli, E.G. López, 15 ♀, 20 ♂, 5 juv. (AMNH), 1 ♀, 1 ♂, 1 subad. ♀, 1 subad. ♂, 3 juv. ♀, 3 juv. ♂, 6 juv. (AMCC 163250). Chubut Province: Epuyén, 42°14'S 71°21'W", 18.xi.1962, A. Kovacs, 5 juv. (AMNH); 15 km S Epuyén, 42°22'S 71°22'W, 700m, patagonian scrub, 15.i.1986, N. I. Platnick, P. A. Goloboff, R. T. Schuh, 1 ♂ (AMNH); Cholila, 42°21'S 71°39'W, 12.xii.1965, A. Kovacs, 1 ♂ (AMNH); Los Altares, 43°54'S 68°25'W, 15.ii.1967, A. Kovacs, 1 ♂ (AMNH); Esquel, Laguna La Zeta, 42°53'32.7"S 71°20'48.4"W, 773 m, 21.i.2005, M. Magnanelli, E.G. López, 32 ♀, 41 ♂, 13 juv. (AMCC 163251); Río Mayo, 45°40'56.4"S 70°16'51.1"W, 438 m, 20.i.2005, M. Magnanelli, E.G. López, 3 ♀, 20 ♂, 15 juv. (AMNH), 1 ♂, 3 subad. ♀, 2 subad. ♂, 1 juv. ♀ (AMCC 163254).

**Diagnosis.** – *Bothriurus patagonicus* can be separated from the other Patagonian *Bothriurus* species with one subdistal tooth on the chelicerae on the basis of the ventral carinae of sternite VII and metasomal segment I (Fig. 31): absent on *Bothriurus* sp. from Meseta Somuncurá, more developed on *B. sanctaecrucis* and different on *B. huinacul*. As described by Maury (1968), the hemispermatophore has one apophysis on the l.i. external face, in common with *B. sanctaecrucis* and *Bothriurus* sp. from Meseta Somuncurá, and *B. huinacul* has two. As noted by Maury (1968), the pigmentation of the ventral side of metasomal segment V follows (in most of the adults specimens) the carinae, with a great concentration of pigment under the granules (Fig. 30); this characteristic has never been observed in remaining species. The more related species appears to be *B. sanctaecru-*



Figs 29–31. *Bothriurus patagonicus* Maury. 29–30. Male from San Martín de los Andes (AMNH); 29. Metasomal segments III–V and telson, lateral view; 30. Pigmentation pattern of metasomal segment V, ventral view (carinae omitted); 31. Female from El Bolsón (AMNH), sternite VII and metasomal segment I, ventral view. Scale bar = 1 mm.

*cis*, which has a lower telson length/height ratio than *B. patagonicus*, and less developed DSM metasomal carinae (Fig. 29). Additionally, *B. patagonicus* usually has three pairs of VL setae on caudal segment V, and *B. sanctaecrucis* more frequently have four (Fig. 27).

**Variability.** – Total length: males 26.04–34.42; females up to 36.44. Length/height telson ratio: males: 3.16–3.72,  $3.51 \pm 0.14$  (n=17); females: 2.69–3.08,  $2.91 \pm 0.12$  (n=11). Left hemispermatophore total length: 6.19–6.71,  $6.47 \pm 0.19$  (n=6). VL pairs of setae on metasomal segment V (left/right): 3/3 (88 specimens), 3/4 (2), 4/3 (1), 4/4 (1). Number of pectinal teeth: males 14–18, females 12–15 (see Table 2). Specimens coming from Río Mayo, show the ventral carinae of sternite VII and metasomal segment I extremely reduced, being only noticeable in a few females and juveniles.

**Remarks.** – The number of pectinal teeth given by Maury (1968) differs slightly from those observed here: “males 15–17 (more frequently 16, n=9), females 12–19 (frequently 14, n=26), and juveniles 11–18 (commonly 14, n=38)”. The upper extreme reported for the females is probably wrong, there are no scorpion with females possessing more pectinal teeth than the males (Polis & Sissom 1990); perhaps Maury confused some juvenile males with females.

### ***Bothriurus burmeisteri* Kraepelin, 1894**

(Figs 32, 33)

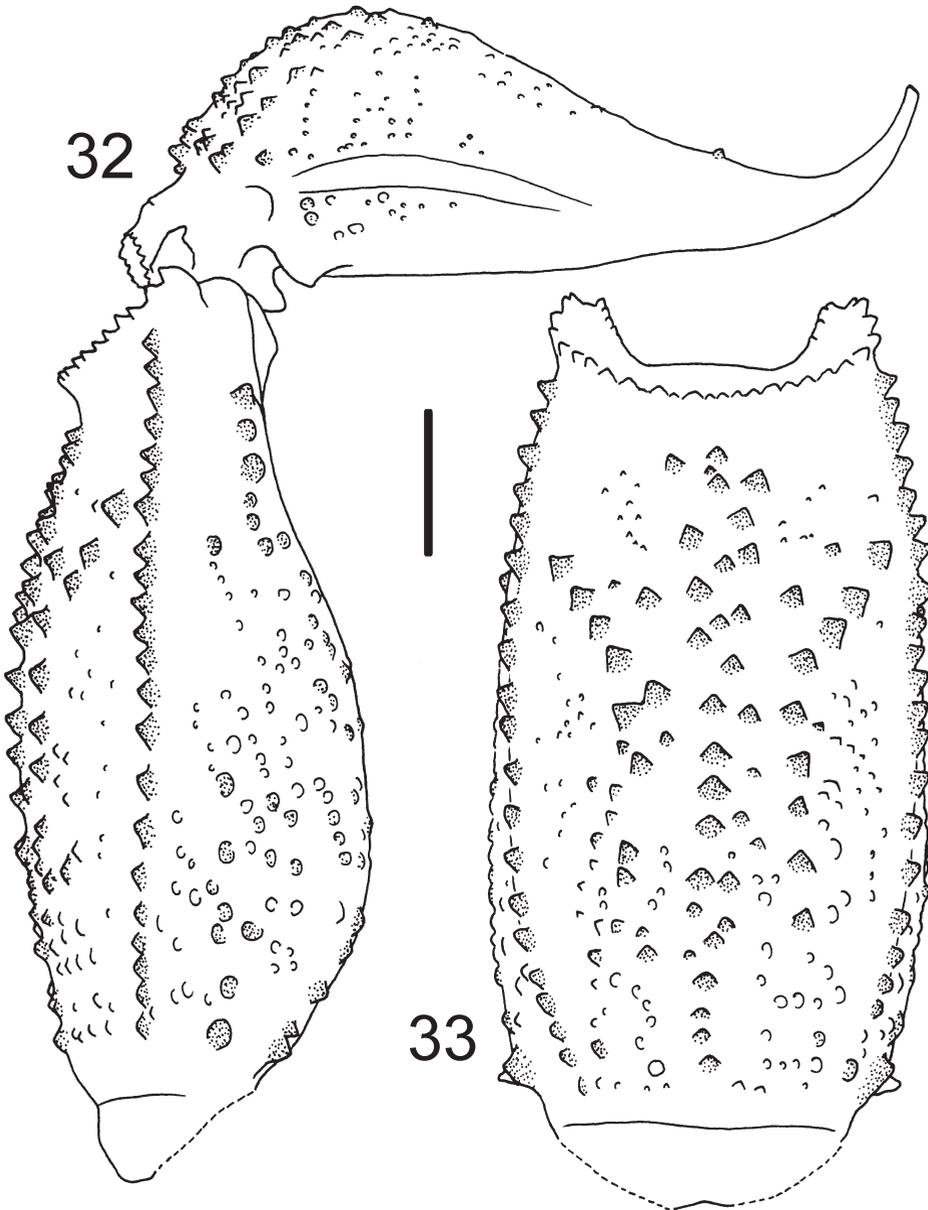
*Bothriurus burmeisteri* Kraepelin, 1894: 227–228; Lowe and Fet 2000: 29 (complete reference list until 1998); Ojanguren Affilastro 2005: 198–201 (redescription).

**Type material.** – ARGENTINA: holotype ♀ and one paratype juv. ♂ (ZMH, not examined). According to the label made by Kraepelin that is in the tube: “*Bothriurus burmeisteri*, Original exemplaren ♀, Burmeister 1891. Argentinien”, the material was collected by Herman Burmeister in 1891.

**Additional material.** – ARGENTINA: Mendoza Province: Punta de Vacas, 32°51.055'S 69°45.607'W, 2427 m, under stones on hard, loamy ground, Alto-Andean vegetations (low grass and spiny shrubs), 2.xi.2003, C. Mattoni, J. Ochoa and L. Prendini, 2 juv. (AMCC 163269); E Picheuta, W Uspallata, 32°40'S 69°31'W, 1800 m, 27.i.1970, L.E. Peña, 5 juv. (AMNH); Salar del Nihuil, 20 Km S de El Nihuil, 6.iii.2000, G. Flores, 2 ♀ (IADIZA); 84 Km S de El Nihuil, 6.i.2003, G. Flores, 1 juv. (IADIZA); Reserva La Payunia, 5.i.2003, S. Roig, G. Flores, G. Debandi, 3 ♀ (IADIZA); La Salinilla, 30 Km S from ranger's office, Reserva La

Payunia, 7.i.2003, G. Flores, 1 ♀, 1 juv. (IADIZA); Reserva La Payunia, 19 Km S from ranger's office, 7.i.2003, G. Debandi, S. Roig, 1 ♂ (IADIZA); Reserva La Payunia, 6.i.2003, G. Flores, S. Roig, 3 juv. (IADIZA). Neuquén Province: Picún Leufú, 39°32'13.5"S 69°13'21.8"W, 399 m, 25.i.2005, M. Magnanelli, E.G. López, 4 ♀, 4 ♂, 3 juv. (AMNH), 1 ♂, 1 subad. ♀, 2 juv. ♀, 1 juv. ♂ (AMCC 163257), 3 subad. ♀, 1 subad. ♂, 1 juv. ♂ (AMCC 163259); Piedra del Aguila, 40°25'58.1"S 70°37'34.2"W, 642 m, 24.i.2005, M. Magnanelli, E.G. López, 8 juv. (AMCC 163266). Río Negro Province: Paso Córdova, 'Valle de la Luna' trail, 39°07'39.2"S 67°40'36.7"W, 289 m, u.v. on Monte habitat, 18.i.2006, C. Mattoni, M. Vivanco, 3 ♀, 13 ♂, 10 juv. (AMNH), 2 ♂, 3 juv. (AMCC 163270); Chimpay, N of town, near old cemetery, 39°09'17.0"S 66°08'21.3"W, 289 m, u.v. on Monte habitat, 19.i.2006, C. Mattoni, M. Vivanco, 5 ♂, 5 juv. (AMNH), 1 ♀, 1 subad. ♀, 2 juv. (AMCC 163271); Meseta de Somuncura, 41°13'S 66°27'W, 800 m, 7.i.2003, A. Ojanguren Affilastro, 2 juv. (AMCC 163260); Sierra Grande, 41°37'33"S 65°24'6.9"W, 308 m, 13.i.2005, M. Magnanelli, E.G. López, 6 juv. (AMNH), 2 ♀, 2 subad. ♀, 4 juv. ♀, 3 juv. ♂ (AMCC 163264); Las Grutas, road to Cerro Banderita, 40°45'18.3"S 65°2'38"W, 20 m, 11.i.2005, M. Magnanelli, E.G. López, 6 ♀, 3 ♂, 3 juv. (AMNH), 3 ♂, 2 subad. ♀, 2 juv. ♀ (AMCC 163265); Las Grutas, camping Oasis, 40°46'8.9"S 65°2'21.4"W, 14 m, 11.i.2005, M. Magnanelli, E.G. López, 2 ♀, 4 ♂, 6 juv. (AMNH); Las Grutas, 10.i.2002, A. Ojanguren Affilastro, L. Piacentini, 1 juv. (AMCC 163268). Chubut Province: Dique Florentino Ameghino, 43°41'31.4"S 66°36'53.7"W, 81 m, 13.i.2005, M. Magnanelli, E.G. López, 4 ♀, 1 ♂, 3 juv. (AMNH), 2 ♀, 3 ♂, 1 juv. (AMCC 163262); Río Mayo, 45°40'56.4" S 70°16'51.1"W, 438 m, 20.i.2005, M. Magnanelli, E.G. López, 8 ♀, 7 ♂, 3 juv. (AMNH), 2 ♂, 2 juv. ♀, 3 juv. ♂ (AMCC 163256); Comodoro Rivadavia, 45°43'55"S 67°29'23.1"W, 90 m, 15.i.2005, M. Magnanelli, E.G. López, 57 juv. (AMNH), 1 subad. ♀, 1 subad. ♂, 4 juv. ♀, 1 juv. ♂, 1 juv. (AMCC 163263); Fo-fo Cahuel, 42°24'S 70°42'W, 9.x.1966, A. Kovacs, 1 ♂ (AMNH); Cushamen, 42°12'S 70°50'W, 14.ix.1966, A. Kovacs, 1 juv. (AMNH); N Comodoro Rivadavia, Estancia Manantiales, Pico Salamanca, 45°35'S 67°20'W, 19–22.xi.1985, L.E. Peña, 1 ♀, 1 ♂ (AMNH); Los Tamariscos, 5 km N on route 20, 44°58'46.8"S 70°02'53.3"W, i.2004, C. Perez, 1 subad., 1 juv. (AMCC 163261). Santa Cruz Province: Los Antiguos, 46°34'18.3" S 71°38'44.8" W, 324 m, 19.i.2005, M. Magnanelli, E.G. López, 9 juv. (AMNH), 2 subad. ♀, 1 subad. ♂, 2 juv. ♀, 1 juv. ♂ (AMCC 163258); Destacamento Policial Las Sierras, SW of Pico Truncado, 47°18'14.2"S 68°31'57.7"W, 232 m, 16.i.2005, M. Magnanelli, E.G. López, 1 ♀, 12 subad. ♀, 12 ♂, 5 subad. ♂, 14 juv. (AMNH), 1 subad. ♂, 3 juv. ♀, 3 juv. ♂ (AMCC 163267); Puerto Deseado, Estancia La Madrugada, 47°06'S 60°29'W, 24–27.xi.1985, L.E. Peña, 1 ♀, 1 ♂, 1 juv. (AMNH). CHILE: Region XI (Aisén): Provincia General Carrera: Chile Chico, 46°33'S 71°44'W, 1 ♂, 26.ii.1977, G. Arraigada, UCCC 776; id. loc. y col., 1 juv., 5.ii.1983, MNHS; id. loc., 2 hembras, 3.ii.1989, MHNS.

**Diagnosis.** – *Bothriurus burmeisteri* is the largest species of the genus, and can be easily separated



Figs 32–33. *Bothriurus burmeisteri* Kraepelin, male from Salar del Nihuil (IADIZA). 32. Metasomal segment V and telson, lateral view; 33. Metasomal segment V, ventral view. Scale bar = 1 mm.

from all other *Bothriurus* spp. by the development of the metasomal carinae, particularly the DSM on segments I–IV and the ventral carinae on segment V, which are much more developed those in any

other species (Figs 30, 31). The most closely related species is *B. olaen* Acosta 1997, the other member of *burmeisteri* species group. Both species share the same general pigmentation pattern,

hemispermaphore, chelicera dentition, position of  $eb_4$  trichobothria (aligned with  $eb_3$  and  $eb_5$ , closer to  $eb_1$  in all other *Bothriurus* species with the same general kind of hemispermaphore), sternite VII with abundant blunt granulation (with no carinae), and habitus. They can be separated by the extent of the ventral carinae on metasomal segment V, that are complete in *B. burmeisteri*, and only occupy the distal half in *B. olaen*.

*Comments.* – The species of *Bothriurus burmeisteri* species group are closely related to the *patagonicus* group (Mattoni 2003; Ojanguren Affilastro 2005). *B. burmeisteri* is distributed from the San Juan Province (central west of Argentina) through Patagonia (Neuquén, Río Negro, Chubut and Santa Cruz Provinces), and with a single, unconfirmed record from Tierra del Fuego (Ojanguren Affilastro 2005) (Fig. 1). Its presence in Chile is only reported from Chile Chico (General Carrera Province) (Cekalovic 1986). Apparently, the species is not sympatric with other *Bothriurus* species, and inhabits both the Monte and the Patagonia biogeographic provinces.

As noticed by Ojanguren Affilastro (2005), there are two basic pigmentation types for this species; “typical” forms, mostly yellowish, with pigment on anterior half of each tergite, and with the longitudinal ventral bands of pigment of the metasoma not fusing in any segment; and “melanic” forms which show a dark brown coloration, with pigment covering the entire surface of tergites, and with the metasomal band of pigments uniting distally in each segment. The “typical” is the most common pigmentation pattern, and, according to unpublished notes of Emilio Maury, the holotype and paratype show this pattern. Some populations from Mendoza and San Juan Provinces are melanic, and a bit smaller in size. The specimens from northern Neuquén and southern Mendoza Provinces (region of Payunia Plateau, Soriano 1983) are extremely melanic and very robust forms. In some localities of Neuquén (Picún Leufú) and Río Negro (Las Grutas, Chimpay) Provinces specimens of both forms have been collected together. In one locality (Chimpay), the author observed two “mixed” couples mating, a male and female of different pigmentation types (the specimens are in the laboratory of Alfredo Peretti in Argentina, for behavioral studies). In the southern localities, Río Negro, Chubut and Santa Cruz Provinces, all the specimens belong to the

“typical” form. As stated by Ojanguren Affilastro (2005), it is possible that this polymorphic species could include one or more cryptic taxa. However, it would be necessary to perform detailed morphological and possibly molecular analyses to clarify it.

The synonymy of *Bothriurus borellianus* Mello-Leitão, 1934, known only from the type materials (1 female and two juveniles) with *B. burmeisteri*, proposed without further details by Bücherl (1963), is probably correct. The pigmentation pattern and morphology of the types are identical with the typical *B. burmeisteri* (E. Maury, unpublished notes). However, the type locality of *B. borellianus* (Temuco, Cautín Province, Chile) is probably wrong: Temuco is very humid, dominated by the *Nothofagus* forest (Gajardo 1995), and completely different from the semi-desert of Monte and Patagonia. Also, despite more than 100 years have elapsed since the type material of *B. borellianus* was collected, no additional specimens of *B. burmeisteri*/*B. borellianus* have been reported from Temuco.

## Discussion

### *Phylogenetic comments*

As previously mentioned by Acosta & Peretti (1998), it is possible to recognize in *Bothriurus* a clade that embraces the *flavidus*, *burmeisteri*, *prospicius*, *patagonicus*, *coriaceus*, *voyati* and *vittatus* species groups (Acosta & Maury, 1998; Acosta & Peretti, 1998; Mattoni 2002b, 2003; Ojanguren Affilastro 2005; Mattoni & Acosta, 2006). All these species groups share a general type of hemispermaphore, “*prospicius* type” (Acosta & Peretti 1998): with the distal lamina inclined and slightly S-shaped, and the lobes region simple with a spatulated basal lobe. Most of the species from this clade show two subdistal teeth on the chelicerae (except for the *patagonicus* group), and all of them have the trichobothria *Es*<sub>b</sub> near to *Eb*<sub>1</sub> and *Eb*<sub>2</sub> on the chelae. The *patagonicus* species group could be defined by the presence of one subdistal tooth on chelicerae; this is a reversal from the plesiomorphic condition of two teeth (Prendini 2000; 2003a; Mattoni 2003). The placement of *B. huincul* inside the *patagonicus* group remains controversial (Mattoni 2003), but it is very likely that it could be placed between the *patagonicus* and the *vittatus* species groups, considering its intermediate characters. These two

groups are also related to the *burmeisteri* and *coriaceus* groups, based mainly on the development of metasomal carinae and the general pigmentation pattern (Mattoni 2003).

### Zoogeographical comments

The distributional patterns observed in the species from the *patagonicus* group are very particular, and have been reported also for plants (Cabrera & Willink 1973) and other animals (Morrone 2001). The distribution of *B. patagonicus* coincides with the Patagonian Occidental district or province (the only exception being the record from center of Chubut Province, Los Altares, subject to confirmation); *B. sanctaecrucis* is distributed into the Patagonian Central district or province. The records of *B. huincul* are only from the high-Andean sub-humid steppe region that is more closely related to Patagonian territories than to the high-Andean boreal steppe (Gajardo 1995). As mentioned before, *B. huincul* is a putative member of the *patagonicus* group, and is related to the *vitatus* species group (from south-central of Chile), being geographically intermediate between them. Additionally, this group demonstrates a close relation to the *burmeisteri* group (from base of the Andes, prepuna of Bolivia and northwest of Argentina, through Patagonia to the central hills of Argentina) (Mattoni 2003; Ojanguren Affilastro 2005), and with the *coriaceus* group (distributed in central and northern Chile) (Mattoni and Acosta 2006). All these patterns reflect a connection between the scorpion fauna of central and northern Chile and northwest, west, central and southern Argentina (most of them arid areas). This connection has also been found in other arthropods, including representatives of Coleoptera (Carabidae, Curculionidae and Tenebrionidae), Orthoptera (Tristiridae), Diptera (Fannidae) and Araneae (Nemesiidae) (Roig Juñent and Flores 2001; Roig Juñent et al. 2003, 2006). Because the Andes (at least from latitude 37° S to the north) represent an effective barrier for the dispersion of most arthropods (including scorpions), this relation can effectively support the idea of a common origin for the eremic (i.e. related to arid areas) taxa from southern South America, predating the formation of the Andes range (Roig Juñent et al. 2006).

Supporting the previous hypothesis, some of the arid regions of southern South America appear to be much older than Andean orogeny (Shmida

1985; Hartley 2003; Hartley et al. 2005; Dunai et al. 2005; Lamb & Davis 2005; Clarke 2006; Roig Juñent et al. 2006), including Atacama Desert, the oldest South American desert (~150 mya, Hartley et al. 2005; Dunai et al. 2005). *Bothriurus* species do not show clear adaptations to aridity (except for the pulmonary stigmata, narrower in species living in arid lands), and are present in a wide variety of habitats, from semi-deserts to forest (Maury 1979; Lourenço 2002; Mattoni 2003; Ojanguren Affilastro 2005; Mattoni & Acosta 2006). Contrary to psammophilous *Brachistosternus*, they are almost absent from deserts, but some species, like *B. dumayi* Cekalovic 1974, can live in small areas of the coastal desert of northern Chile that receive some humidity from the sea fog (Mattoni & Acosta 2006; Agosto et al. in press). It is unclear if this distribution results from vicariance or recent dispersal, but vicariance seems more plausible in view of the actual distribution of *B. dumayi* on these isolated humidity oases (known as “lomas formations”, Dillon .....xx) as far as 23° north, separated by dry desert (Mattoni & Acosta 2006).

It appears that recent diversification in *Bothriurus* could be in part the result of the Andean uplift and the development of the Southern Ocean, that increased the aridity and enlarged the ancient arid and semi-arid areas (Hartley 2003; Lamb & Davis 2003; Clarke 2006), as suggested for *Brachistosternus* by Prendini (2003a). This diversification could be driven by the stenotopic habitat requirements of the species (e.g. restriction to particular granulometry and composition of the soil) (Prendini 2001). All *Bothriurus* species are pelophilous (can dig on hard substrata, as defined by Prendini 2001), and according to the predictions of Prendini (2001), most of them show an intermediate distributional range and a moderate vagility; but some cases, like *B. voyati* Maury 1973, exhibit an extremely short range (Acosta & Maury 1998). In arid areas, the diversity of *Bothriurus* is less than *Brachistosternus* (Ojanguren Affilastro 2005; Mattoni & Acosta 2006; Ojanguren et al. in press; Agosto et al. in press), following also the prediction for pelophilous species, which have a moderate speciation rate compared to psammophilous species, which show a high speciation rate (Prendini 2001).

Prendini (2003a) previously hypothesized that the ancestral habitat for Bothriuridae was mesic and forested. According to Mattoni (2003), the most basal *Bothriurus* species of the clade with the

“*prospicius* type” of hemispermaphore is *B. signatus* Pocock 1893. This species lives in coastal rain forest of southern Brazil (Mattoni 2003), and thus supports Prendini’s hypothesis.

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