



## Two new scorpion species of genus *Brachistosternus* (Scorpiones: Bothriuridae) from northern Chile

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### Abstract

*Brachistosternus* (*Leptosternus*) *cepedai* n. sp. and *Brachistosternus* (*Leptosternus*) *coquimbo* n. sp. are described from Coquimbo region, in northern Chile. *Brachistosternus cepedai* n. sp. occurs in coastal dunes and is closely related to *Brachistosternus* (*L.*) *sciosciae* Ojanguren-Affilastro, 2002. On the other hand, *Brachistosternus coquimbo* n. sp. occurs at high altitudes in the Andes mountain chain and is related to *Brachistosternus* (*L.*) *montanus* Roig Alsina, 1977, and to several Andean species from Argentina and Chile. Adaptive characters of the psammophilous *Br.* (*L.*) *cepedai* n. sp. are discussed. 39 scorpion species are now known from Chile, ten of them occur in the Coquimbo Region, being the region with the more diverse scorpion fauna in the country.

**Key words:** Scorpiones; Bothriuridae; *Brachistosternus*; arid zones; new species; Chile

### Introduction

The arid zones of northern Chile possess a very diverse arthropod fauna (Cepeda-Pizarro *et al.* 2005a, 2005b; Jerez 2000; Rau *et al.* 1998). The scorpion fauna of this area is remarkably diverse and is composed mostly of endemic species with restricted distributions; the peculiar topography of the country (*e.g.* Andes mountain range, coastal mountain range, intermedial depressions and littoral plains) together with a wide range of microhabitat allow the presence of several different species within small geographic areas (Agusto *et al.* 2006; Cepeda-Pizarro *et al.* 2005a, 2006).

The coastal dunes of northern Coquimbo region, belong to the coastal desert of Huasco (Gajardo 1993), and are part of the Chilean transitional coastal desert (Agusto *et al.* 2006; Cepeda-Pizarro 1995). In the different habitats of this area, the presence of seven scorpion species has been recorded, *i.e.* *Caraboctonus keyserlingi* Pocock, 1893, *Bothriurus coriaceus* Pocock, 1893, *B. dumayi* Cekalovic, 1974, *B. pichicuy* Mattoni, 2002, *Brachistosternus* (*Leptosternus*) *artigasi* Cekalovic, 1974, *Br.* (*L.*) *roigalsinai* Ojanguren-Affilastro, 2002 and *Br.* (*L.*) *cekalovici* Ojanguren-Affilastro, 2005 (Agusto *et al.* 2006; Cekalovic 1974; Mattoni & Acosta 2006; Ojanguren-Affilastro 2005b). This system receives water from occasional winter rainfall, but especially from masses of fog from the Pacific Ocean, also called camanchaca or kamanchaca (Cepeda-Pizarro 1995; Paskoff & Manríquez 2004). Members of the genus *Brachistosternus* are the dominant scorpions in these areas, with about a 70 % of the scorpion population (Agusto *et al.* 2006).

On the other hand, the Andes mountain chain in this latitude has a strong elevation gradient with some peaks reaching more than 6000 m a.s.l. Precipitations occur mostly during winter as snow and allow the presence of steppe vegetation, with a high degree of endemism in its flora and fauna (Cepeda-Pizarro *et al.* 2006; Squeo *et al.* 1994). This steppe has several altitudinal levels, i.e. shrub steppe (or sub-Andean floor) between 2700 to 3500 m a.s.l, sub-shrub steppe between 3500 to 4250 m a.s.l, and high-Andean steppe from 4250 up to 4450 m a.s.l, after which the vegetation disappears (Cepeda-Pizarro 2004; Squeo *et al.* 1994, 2006a, 2006b). In recent years the knowledge of the scorpion fauna from the central Andes has increased, and several new species of genus *Brachistosternus* have been described (Ochoa 2004; Ochoa & Acosta 2002; Ojanguren-Affilastro 2002a, 2002b, 2004, 2005b).

In the last years the Laboratory of Entomology from the Universidad de La Serena (LEULS) has been carrying out several projects in order to study the diversity of the fauna of Coquimbo Region. As a result of these projects numerous undescribed arthropods have been discovered (Agusto *et al.* 2006; Cepeda-Pizarro *et al.* 2005a, 2005b; Pizarro-Araya & Jerez 2004), including several scorpion species, two of which are described in the present contribution. *Brachistosternus* (*L.*) *cepedai* **n. sp.** has been collected in coastal dunes in the northern part of the region, and has several morphological adaptations to psammophilous environments. *Brachistosternus* (*L.*) *coquimbo* **n. sp.** has been collected in high altitudes of the Andes, and is a typical Andean species of the genus (Ojanguren-Affilastro 2003a). The existence of *Br.* (*L.*) *coquimbo* **n. sp.** was mentioned by Ojanguren-Affilastro and Mattoni (Ojanguren-Affilastro & Mattoni 2006) in their description of *Br.* (*L.*) *perettii*; however, they were not able to describe this species due to the scarcity of specimens. In a recent trip to the Andean region of central Chile and Argentina, we have been able to collect more specimens that finally allow the description of the species.

## Methods

Descriptive terminology follows Maury (1974) for the hemispermatophores, Vachon (1973) for the trichobothria, Cekalovic (1973) for the androvestigia (a pair of glands situated on the dorsal surface of metasomal segment V in the adult male), Roig Alsina & Maury (1981) for the male telson gland, and Stahnke (1970) for the metasomal carinae, which are abbreviated as follows: DL = dorsolateral, LIM = lateral inframedian, LSM = lateral suprasedian, PL = paralateral, PM = paramedian, VL = ventrolateral, VM = ventromedian. Terminology for pedipalp carinae are according to Soleglad & Sissom (2001), and are abbreviated as follows: DI = Dorsal Internal, DE = Dorsal external, VI = Ventral Internal, VE = Ventral External. Abbreviations of studied collections (and curators) are as follows: AMNH: American Museum of Natural History, New York, USA (Lorenzo Prendini); CDA: Cátedra de Diversidad Animal I, Universidad de Córdoba, Córdoba, Argentina (Luis Acosta); LEULS: Laboratorio de Entomología Ecológica, Universidad de La Serena, La Serena, Chile (Jorge Cepeda-Pizarro); MACN-Ar: Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, National Arachnological Collection, Buenos Aires, Argentina (Cristina Scioscia); MZUC-UCCC: Universidad de Concepción Colecciones Científicas, Chile (Jorge Artigas); MNHN: Museo Nacional de Historia Natural, Chile (Mario Elgueta). Tissue samples of *Br.* (*L.*) *cepedai* **n. sp.** 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. Illustrations were produced using a Leitz Wetzlar stereomicroscope and camera lucida. Measurements, taken using an ocular micrometer, are in mm. Photographs were taken under long wave UV light using a Nikon D1X camera and a Microptics™ ML-1000 digital imaging system at the AMNH. Hemispermatophores were dissected and then examined in 80% ethanol. Geographic coordinates of the collecting sites were recorded using a GPS Garmin®. The distribution map (Fig. 1) was generated using ArcMap 9.0 (Environmental Systems Research Institute [ESRI], Redlands, California).

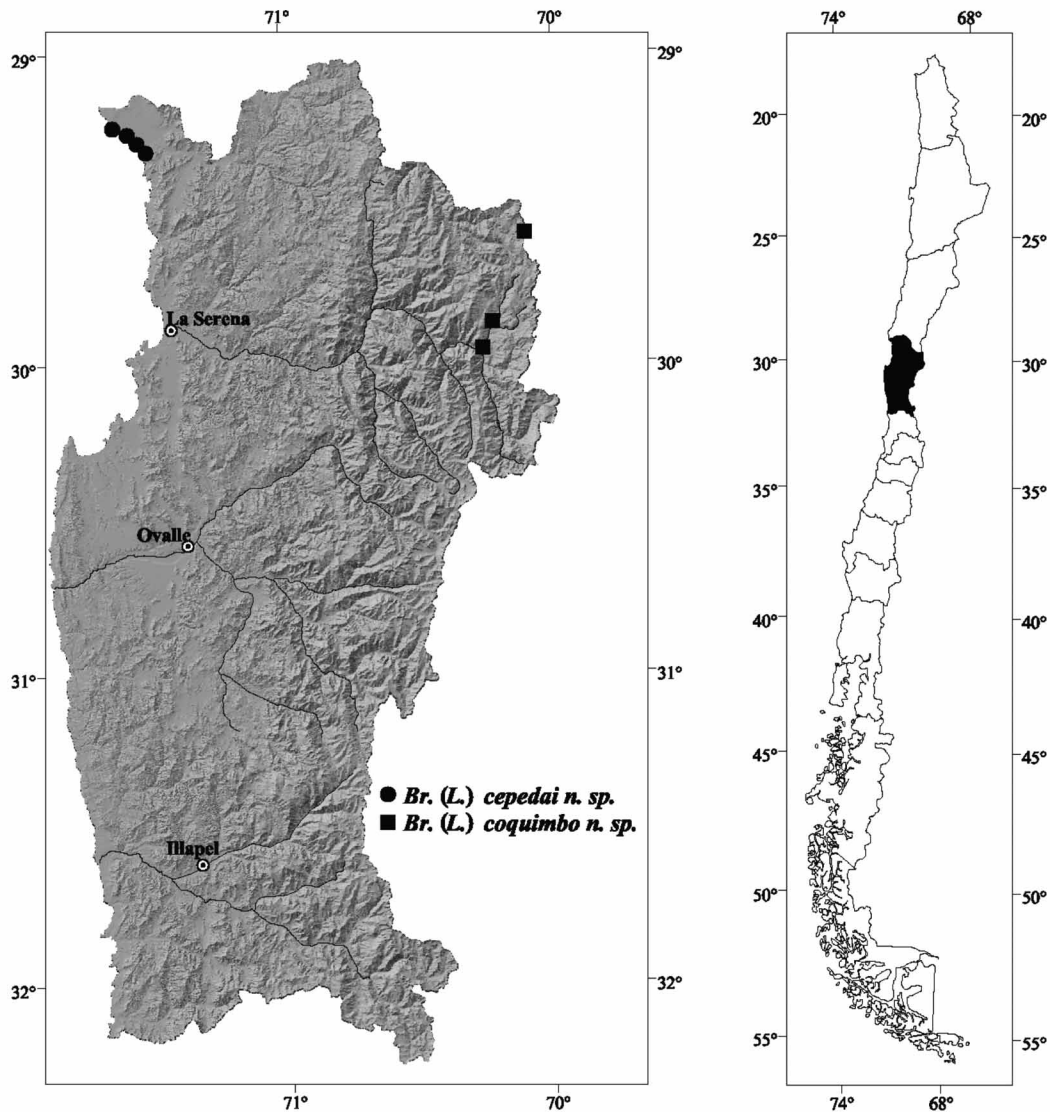


FIGURE 1. Map of Coquimbo region, Chile, with localities of *Brachistosternus (L.) cepedai n. sp.* and *Brachistosternus (L.) coquimbo n. sp.*

## Results

### *Brachistosternus (Leptosternus) cepedai n. sp.*

Figs. 1–10, 23, 24; Table 1

**Type material:** Holotype ♂: Chile, IV Región, Elqui Province, 5 km from Punta Choros, near the route to Choros, 29°14'29.0" S, 71°25'45.9" W, 12 m a.s.l, 22/II/2006, A.A. Ojanguren-Affilastro, L. Compagnucci, and A.C. Cuezso, UV sampling in dunes (MACN-Ar 12246). Paratypes: 2 ♂, same data as holotype (AMNH); 1 ♂, 1 ♀, same data as holotype (CDA); 20 ♂, 5 ♀, (same data as holotype) (MACN-Ar); 4 ♂, 7 ♀, same date as holotype (LEULS); 3 ♂, 10 ♀, 20 km from Punta Choros, 27°37'77" S, 67°53'126" W, 20 m a.s.l, 26/VIII/2005, D. Valdivia, UV sampling in dunes (MZUC-UCCC). 3 ♂, 10 ♀, 15 km from Punta Choros, 27°03'78" S, 67°55'851" W, 9/XI/2005, J. Pizarro, 2 m a.s.l, UV sampling in dunes (MNHN).

**Additional material.** 2 juveniles (AMCC [LP 5844]), same data as holotype.

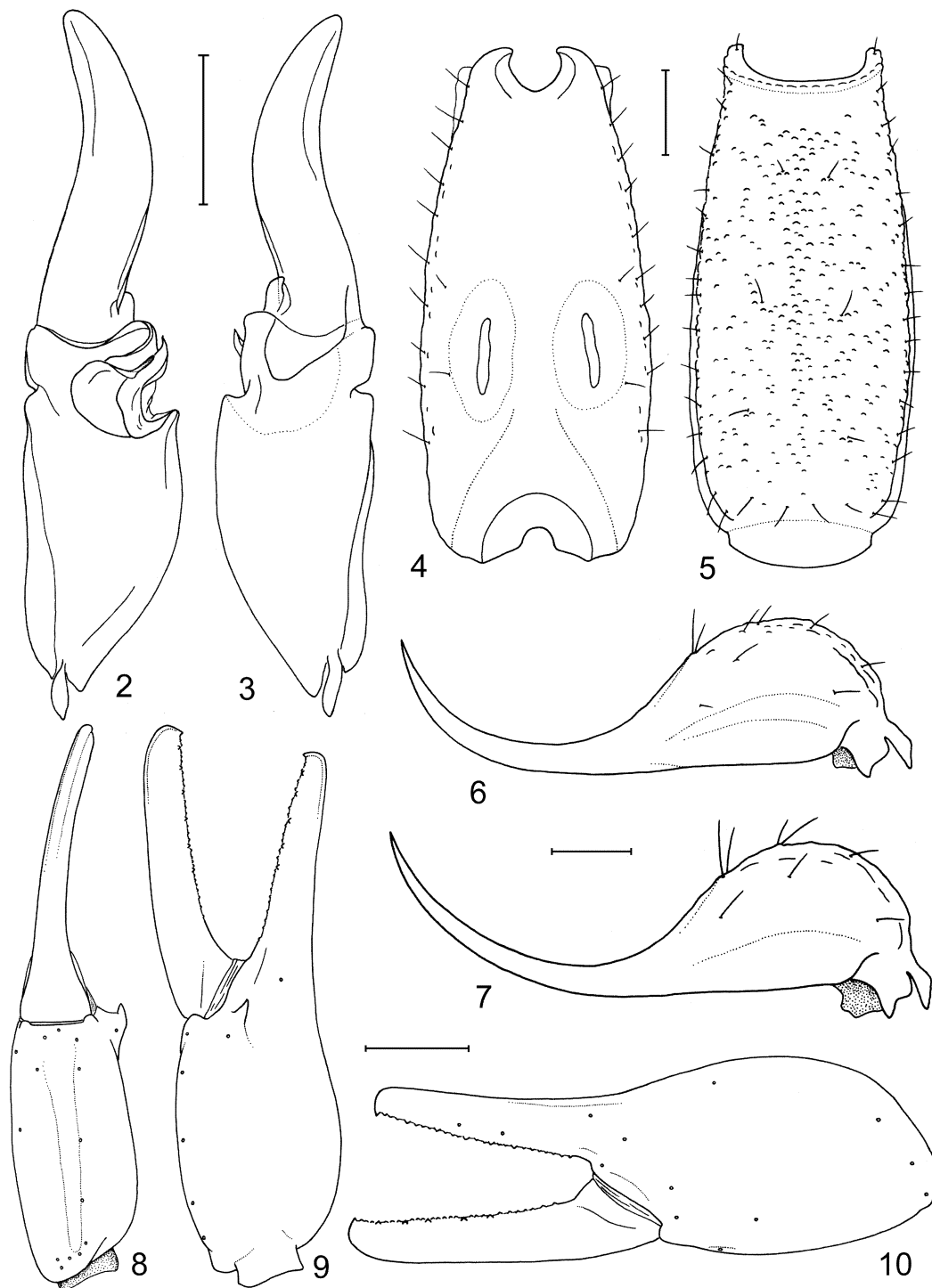
**Etymology.** This species is named after the Chilean biologist Jorge Cepeda-Pizarro, who has carried out an extensive research on the epigeal arthropods of the arid zones of northern Chile.

**Diagnosis.** *Brachistosternus (L.) cepedai* n. sp. is closely related to *Brachistosternus (L.) sciosciae* Ojanguren-Affilastro 2002. These two species can be distinguished by the following characters: (1) androvestigiae are present but poorly developed in males of *Br. (L.) cepedai* n. sp. whereas they are absent in males of *Br. (L.) sciosciae*. (2) Hemispermatothores of these species are morphologically different: in *Br. (L.) sciosciae* the distal lamina is straight and longer than the basal portion, whereas in *Br. (L.) cepedai* n. sp. it is curved and of the same length as the basal portion; in *Br. (L.) sciosciae* the basal triangle is vestigial, whereas in *Br. (L.) cepedai* n. sp. it is absent or reduced to a small bulge.

**Description:** Measurements of a male specimen and a female specimen (paratypes) are recorded in Table 1.

**TABLE 1.** Measurements of *Brachistosternus (Leptosternus) cepedai* n. sp. (Paratypes) and *Brachistosternus (Leptosternus) coquimbo* n. sp. (Holotype and Paratype). (In mm.).

	<i>Br. (L.) cepedai</i>		<i>Br. (L.) coquimbo</i>	
	Paratype ♂ LEULS	Paratype ♀ LEULS	Holotype ♂ MACN-Ar	Paratype ♀ MACN-Ar
Total length	42.2	40.52	49.23	39.67
Carapace, length	5.25	4.85	5.98	5.49
Carapace, anterior width	3.15	3.23	4.04	4.04
Carapace, posterior width	4.93	5.09	5.98	6.87
Mesosoma, total length	12.38	14.67	12.23	9.78
Metasoma, total length	19.47	16.15	24.15	18.74
Metasomal segment I, length	3.31	2.83	4.04	2.99
Metasomal segment I, width	3.23	2.75	3.79	3.34
Metasomal segment I, height	2.50	2.18	2.99	2.75
Metasomal segment II, length	3.64	2.99	4.53	3.23
Metasomal segment II, width	3.07	2.74	3.47	3.07
Metasomal segment II, height	2.51	2.18	2.91	2.67
Metasomal segment III, length	3.71	3.15	4.68	3.47
Metasomal segment III, width	2.91	2.42	3.31	2.91
Metasomal segment III, height	2.50	2.02	2.83	2.66
Metasomal segment IV, length	4.04	3.39	5.25	4.04
Metasomal segment IV, width	2.58	2.26	2.99	2.70
Metasomal segment IV, height	2.18	1.77	2.67	2.42
Metasomal segment V, length	4.77	3.79	5.65	5.01
Metasomal segment V, width	2.67	2.26	3.07	2.70
Metasomal segment V, height	2.02	1.61	2.50	2.26
Telson, length	5.01	4.85	6.87	5.66
Vesicle, length	2.42	2.26	4.04	2.99
Vesicle, width	1.77	1.69	2.30	2.10
Vesicle, height	1.61	1.54	2.18	1.78
Aculeus, length	2.58	2.58	2.83	2.66
Femur, length	3.64	3.07	5.33	4.00
Femur, width	1.13	1.21	1.29	1.37
Patella, length	3.23	3.23	4.60	3.88
Patella, width	1.45	1.37	1.69	1.65
Chela, length	6.2	5.74	8.16	14.8
Chela, width	1.65	1.54	1.61	3.42



**FIGURES 2–10.** *Brachistosternus (L.) cepedai* n. sp. 2. left hemispermatophore, ventral aspect; 3. left hemispermatophore, dorsal aspect; 4. metasomal segment V, male, dorsal aspect; 5. metasomal segment V, male, ventral aspect; 6. telson, male, lateral aspect; 7. telson, female, lateral aspect; 8. right pedipalp chela, male, ventral aspect; 9. right pedipalp chela, male, internal aspect; 10. left pedipalp chela, female, external aspect. Scale bars = 1 mm.

**Color:** Light yellow, with some faint spots on the carapace and the tergites. Chelicerae: not pigmented. Carapace: median ocular tubercle and area around lateral ocelli infuscated; without pigmentation except for a slight reticular pattern around the ocular tubercle. Tergites: with three faint spots, two laterals and one median;

the median spot darker than the lateral ones, (in poorly pigmented specimens the only visible spot of the tergites). Sternites: not pigmented. Metasoma: segments I–III, dorsal surfaces each with an antero-median narrow stripe, and two posterolateral dark spots, lateral and ventral surfaces not pigmented, ventral surface with a narrow VM stripe, that is absent in poorly pigmented specimens; segment IV, dorsal surface with an antero-median narrow stripe, lateral surfaces unpigmented, ventral surfaces with a narrow VM stripe; segment V, dorsal and lateral surfaces similar to segment IV, ventral surface with a narrow VM stripe and with two narrow VL stripes, that do not join with the VM stripe. Telson: vesicle not pigmented; aculeus dark brown. Pedipalps: femur slightly pigmented on the posterior margin, and near the articulation with the patella; patella slightly pigmented on anterior and posterior margins; chela not pigmented. Legs: femur slightly pigmented near articulation with patella; remaining segments not pigmented.

**Morphology.** Carapace: anterior margin convex with a slight median projection; anterior longitudinal sulcus well developed; ocular tubercle well developed, situated anteromedially, interocular sulcus weakly developed, median ocelli almost two diameters apart; three pairs of lateral ocelli, considerably smaller than the median ones; anterior and posterior longitudinal sulci, lateral sulcus and postocular furrow well developed; carapace lateral surfaces slightly granular, smooth near the ocular tubercle and the anterior longitudinal sulcus. Chelicerae with two subdistal teeth. Hemispermatophore: cylindrical apophysis vestigial (Fig. 2); distal lamina narrow, curved, similar in size to, or slightly longer than the basal portion (Fig. 3); basal triangle absent, or reduced to a small bulge; internal spines, basal spines and row of spines absent. Mesosoma: Tergites I–VI, entirely smooth in females, they are smooth in anterior two-thirds, and slightly granular in the posterior third in males; tergite VII, surface slightly granular in the posterior two-thirds, two PL and two VL carinae apparent in the second half. Sternites: granular in males, smooth in segments I–IV and coarsely granular in segment V in females; spiracles narrow, and medium-sized. Sternum type 2 (Soleglad & Fet 2003) much wider than long, apex width almost equal to posterior width, posterior emargination quite well developed, with convex lateral lobes conspicuously separated. Pectines: pectinal teeth, 25–29 in males ( $N = 20$ ; median = 27), 17–23 in females ( $N = 20$ ; median = 21). Metasoma: segments I–IV each with a pair of dorsolateral macrosetae, segment V with one or two pairs of dorsal macrosetae; metasomal segments I–III: dorsal and ventral surfaces densely granular in males, smooth in females, lateral surface densely granular except the area between LSM and LIM carinae; LSM and LIM carina present only in the posterior two thirds of the segment, DL carina extending the entire length of segment, but almost indistinguishable because of the granules of the tegument; metasomal segment IV: ventral surface smooth, covered by scattered macrosetae; DL carina weakly developed, extending the entire length of segment; LIM carina poorly developed, only present in the distal quarter of the segment; LSM carina apparent only at the anterior and posterior margins of the segment; VL carina present on the entire length of the segment but poorly developed, only represented by a slight elevation of the tegument; surfaces between carinae smooth in females and slightly granular in males. Metasomal segment V: androvestigia small-sized, and very narrow, located submedially (Fig. 4); dorsal and lateral surfaces slightly granular (male) or smooth (female); ventral surface sparsely granular, more densely granular in the posterior third of the segment (Fig. 5); ventral macrosetae usually comprising four rows, the first row with four macrosetae, the rest with one or two macrosetae; DL carinae weakly developed; VL carinae well developed, extending the entire length of segment; VM carina absent or weakly developed, represented only by some granules in the posterior half of segment. Telson: Vesicle with rounded ventral surface, lower in males; vesicle surface sparsely granular, with four granules slightly more developed than the rest and related with 4 macrosetae; telson gland absent or not evident; aculeus slightly curved, of the same length as the vesicle (Figs. 6, 7). Pedipalps: Femur: DI and VI carinae granular and well developed, DE carina only present in the proximal half of the segment, internal surface granular, remaining surfaces smooth, one macroseta (M1) associated with *d* and *e* trichobothria; patella: DI and VI carinae granular and well developed in males, less granular in females, remaining surfaces smooth; chela: smooth, VM carina weakly developed (Fig. 8), internal apophysis of male well developed (Fig. 9), fingers with a median row of denticles and five or six pairs of accessory den-

ticles each, external denticles overlapping with median row near the base of the finger. Trichobothrial pattern of subgenus *Leptosternus* (Figs. 8–10): Neobothriotaxic Major Type C, with one accessory trichobothrium in V series of chela; femur with 3 trichobothria (1 *d*, 1 *i* and 1 *e*); patella with 19 trichobothria (3 *V*, 2 *d*, 1 *i*, 3 *et*, 1 *est*, 2 *em*, 2 *esb*, and 5 *eb*); chela with 27 trichobothria (1 *Est*, 5 *Et*, 5 *V*, 1 *Esb*, 3 *Eb*, 1 *Dt*, 1 *Db*, 1 *et*, 1 *est*, 1 *esb*, 1 *eb*, 1 *dt*, 1 *dst*, 1 *dsb*, 1 *db*, 1 *ib*, 1 *it*). Legs: ventral surface of the femur with two longitudinal carinae, the rest of the surface smooth; telotarsi I and II: each with inner unguis ca. 15% shorter than external, and with the inner pedal spur absent or vestigial (Figs. 23, 24).

**Variation:** Pedipalp chela length/height ratio, male 2.77–3.26 (N = 20; mean = 3.09), female 2.25–3.44 (N = 20; mean = 2.88); pedipalp chela length/width ratio, male 3.85–4.54 (N = 20; mean = 4.18), female 3.78–4.42 (N = 15; mean = 4.11); metasomal segment V, length/width ratio, male 1.8–1.95 (N = 20; mean = 1.86), female 1.78–1.97 (N = 20; mean = 1.89); metasomal segment V, ventral macroseta 7–10 (N = 20; median = 8); metasomal segment V, ventrolateral macroseta 11–17 (N = 20; median = 14); telotarsus III, dorsal macroseta 12–15 (N = 20; median = 14); telotarsus III, ventrointernal macroseta 10–12 (N = 20; median = 11); telotarsus III, ventroexternal macroseta 5–7 (N = 20; median = 7); basitarsus III, dorsal macroseta 6–8 (N = 20; median = 7); total length (mm), male 36.5–48 (N = 20; mean = 41.5), female 39–66 (N = 18; mean = 62.3).

**Distribution and ecology.** *Brachistosternus (L.) cepedai* n. sp. inhabits in the Coquimbo Region of northern Chile; all specimens have been collected in coastal dunes and in the coastal steppe near the localities of Choros and Punta Choros (Fig. 1). The localities where this species has been collected fall within the coastal desert of Huasco, pertaining to the transitional coastal desert of Chile (Gajardo 1993, Cepeda-Pizarro 1995).

*Brachistosternus (L.) cepedai* n. sp. inhabits in sandy areas with scarce vegetation, usually *Crystaria glaucophylla* Cav. (Malvaceae) and *Tetragonia maritima* Barn. (Aizoaceae). This species lives in sympatry with the bothriurids *Bothriurus coriaceus* Pocock 1893, *Brachistosternus (L.) roigalsinai* Ojanguren-Affilastro 2002, and an undescribed *Brachistosternus* species, and the iurid *Caraboctonus keyserlingi* Pocock 1893, being the later absent from the coastal dunes.

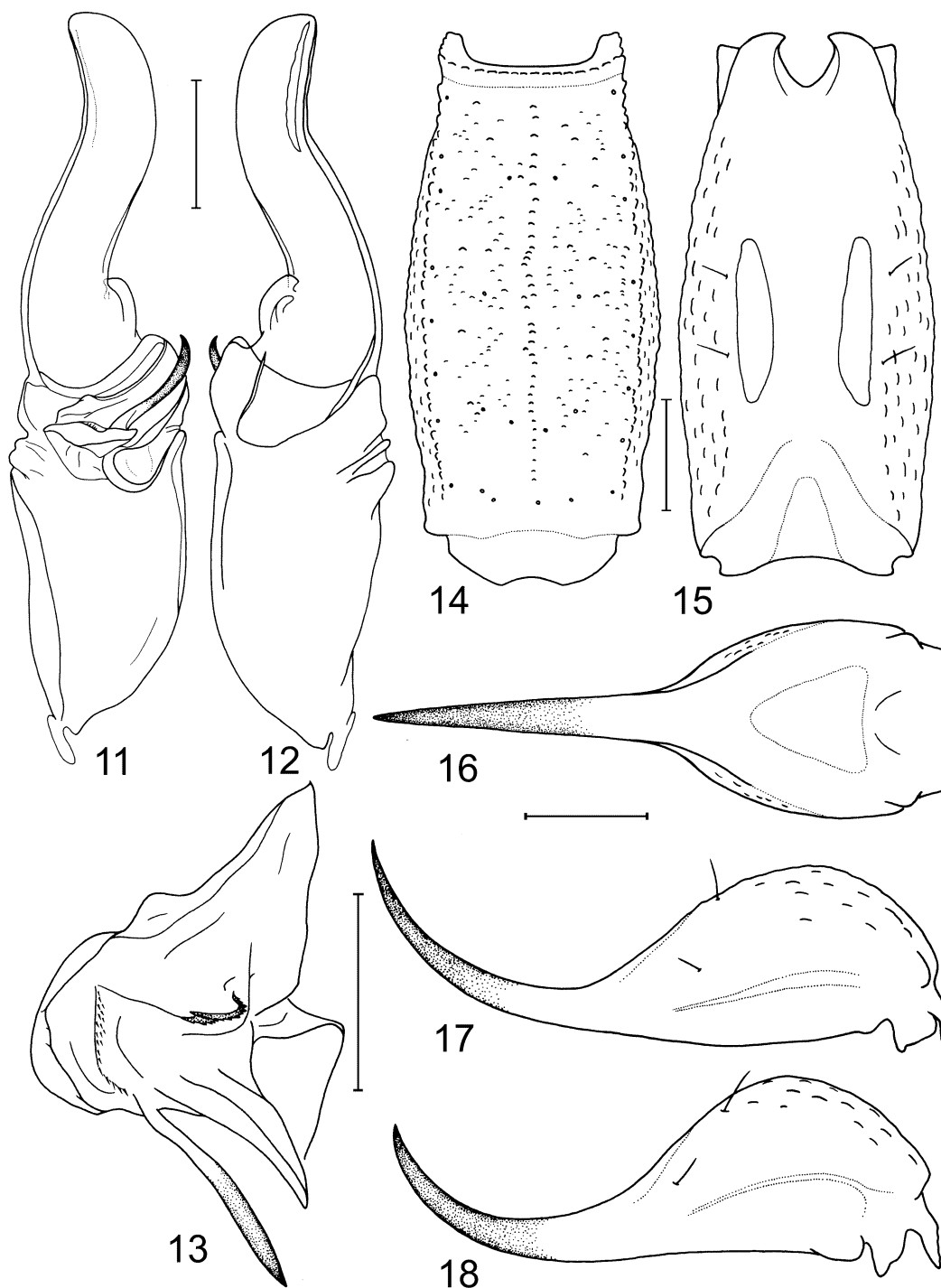
### ***Brachistosternus (Leptosternus) coquimbo* n. sp.**

Figs. 1, 11–22; Table 1

**Type material:** Holotype ♂: Chile, IV Región, Coquimbo, between Juntas and Paso del Agua Negra, 30°16'14.5" S, 69°58'27.9" W, 3000 m a.s.l, 6/II/2006; A.A. Ojanguren, L. Compagnucci & C. Cuezco (MACN-Ar). Paratypes: 4 ♂, 1 juvenile; same data; 1 ♂, Cancha Sky, El Indio mine, 29°51'00'' S, 70°03'00'' W, 3300 m a.s.l; 15/II/1992, H. Vásquez; 1 ♀, Sancarrón, El Indio mine, 29°33'00'' S, 70°14'00'' W; 5/II/1993; H. Vásquez (MACN-Ar).

**Etymology:** The name of this species refers to the Chilean region where it has been collected.

**Diagnosis:** *Brachistosternus (L.) coquimbo* n. sp. is closely related with *Brachistosternus (L.) montanus* Roig Alsina, 1977. The two species can be distinguished by the following characters: (1) *Br. (L.) coquimbo* has a narrower pedipalp chela. In males the chela length/width ratio varies from 4.7 to 5.09 (N = 6; mean = 4.85), and in the only studied female it is 4.33, whereas in the males of *Br. (L.) montanus* it varies from 4.01 to 4.37 (N = 15; mean = 4.25) and in females it varies from 3.9 to 4.16 (N = 10; mean = 4.07); (2) in *Br. (L.) coquimbo* males the chela length/height ratio varies from 3.63 to 3.93 (N = 6; mean = 3.81) and is 3.5 in the only studied female; whereas in *Br. (L.) montanus* males it varies from 3.01 to 3.31 (N = 15; mean = 3.17), and in females it varies from 3.06 to 3.23 (N = 10; mean = 3.14). *Brachistosternus (L.) coquimbo* n. sp. lives in sympatry with *Brachistosternus (L.) perettii* Ojanguren-Affilastro & Mattoni 2006. The two species are easily distinguishable: *Br. (L.) perettii* do not possess a VM carina of metasomal segment V whereas it is well developed and extends on the entire length of the segment in *Br. (L.) coquimbo*.



**FIGURES 11–18.** *Brachistosternus (L.) coquimbo* n. sp. 11. left hemispermatophore, ventral aspect; 12. left hemispermatophore, dorsal aspect; 13. left hemispermatophore, detail of lobe region; 14. metasomal segment V, male, dorsal aspect; 15. metasomal segment V, male, ventral aspect; 16. telson, male, dorsal aspect; 17. telson, male, lateral aspect; 18. telson, female, lateral aspect. Scale bars = 1 mm.

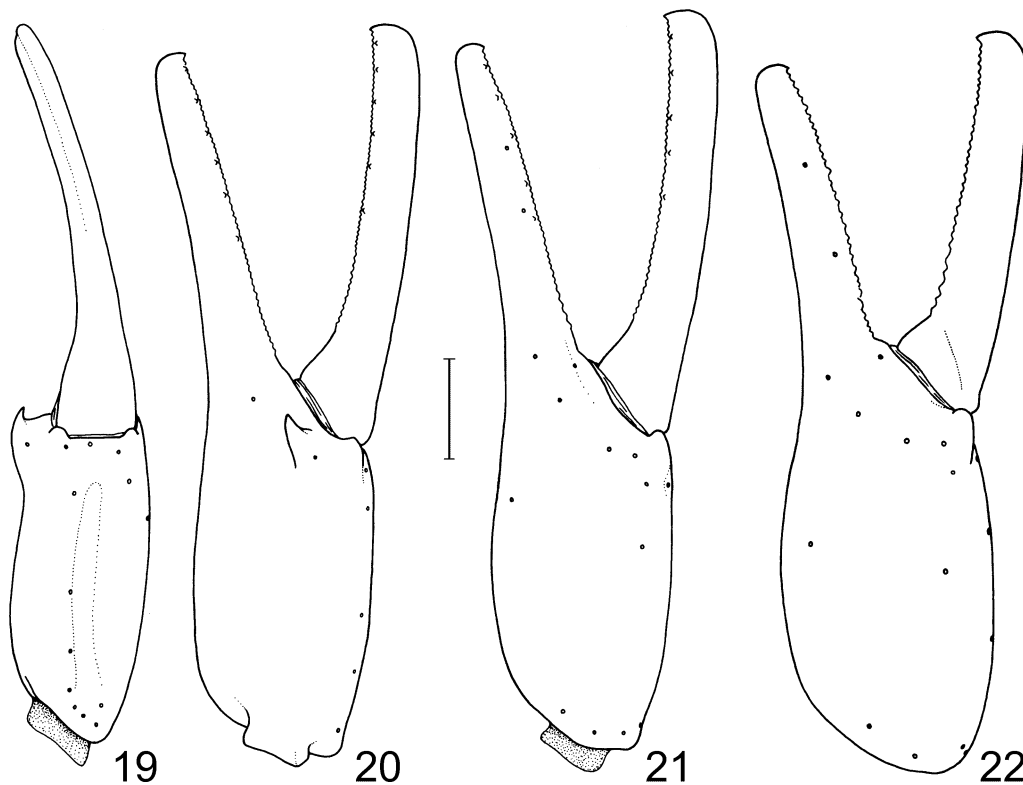
**Description:** Measurements of a male specimen and a female specimen are recorded in Table 1. **Colour.** General colour dark yellow with a dense dusky pattern. Chelicerae: with a dark spot near the base of the fingers, movable finger with a dark spot on the external surface. Carapace: densely pigmented; ocular tubercle



and lateral ocelli black; area around the ocular tubercle densely pigmented, with two lateral dark stripes from the lateral sulci to the lateral ocelli, and with two posterolateral dark spots; remaining tegument with reticulate pattern. Tergites I–VI: each tergite with three dark spots, two lateral and one median spot, connected by dense reticular pigmentation. Tergite VII with five dark spots, two antero-lateral, two postero-lateral, and an antero-median spot, sometimes connected by a faint reticular pattern. Sternites: not pigmented. Metasoma: metasomal segments I–III: dorsal surface with an antero-median thin stripe, and two posterolateral dark spots; lateral surfaces depigmented; ventral surface with one thick VM and two thin VL stripes, joined distally; VM stripe barely visible in segment I, absent in some specimens, more noticeable in segment II, and well marked in segment III. Metasomal segment IV: dorsal surface with a faint small antero-median spot, and with two small posterolateral dark spots; lateral surfaces with reticulate pigment; ventral surface with one thick VM and two thin VL stripes joining in the posterior third of the segment, and connected by reticular pattern in the remaining surface. Metasomal segment V: dorsal surface with two DL faint stripes; lateral surface with slight reticular pattern; ventral surface with one thin, dark VM and two thick VL stripes that join in the posterior third of the segment; in the anterior half of the segment the VL stripes divided in four thin lines, two VL and two VSM, that join in the posterior half of the segment. Telson: vesicle with the ventral and dorsolateral surfaces densely pigmented; aculeus dark brown. Pedipalps: femur densely pigmented near patella articulation, and in the anterior and posterior surfaces, with a dark stripe on the DE margin; patella with one DI and one DE stripe, densely pigmented near chela articulation, remaining surfaces with dense reticular pattern; chela manus with longitudinal stripes joined by a faint reticular pigment, fingers not pigmented. Legs: femur and patella densely pigmented, remaining segments not pigmented.

**Morphology.** Carapace: Anterior margin with a slight median bulge; tegument smooth near the ocular tubercle, lateral surfaces densely granular; ocular tubercle slightly anterior to the middle of the carapace, interocular sulcus deeply marked, median ocelli two diameters apart, with a seta behind each eye; anterior, laterals and posterior longitudinal sulci well marked, postocular furrow deeply marked. Chelicerae with two sub-distal teeth. Hemispermatophore: distal lamina thick and slightly curved, approximately of the same size as the basal portion (Figs. 11, 12); cylindrical apophysis well developed, longer than the laminar apophysis; basal triangle well developed, formed by 2 or 3 crests; internal spines absent; basal spines and row of spines poorly developed, and aligned along the same axis (Fig. 13). Mesosoma: Tergites I–VI finely granular in the distal margin, remaining areas smooth. Tergite VII smooth in the median area, remaining areas densely granular, with two lateral carinae in the posterior half of the segment. Sternites: Sternite I smooth in the anterior half of the segment, coarsely granular in the posterior half; Sternites II–V densely granular. Spiracles narrow and well developed. Sternum type 2 (Soleglad & Fet 2003) much wider than long, apex width almost equal to posterior width, posterior emargination quite well developed, with convex lateral lobes conspicuously separated. Pectines: pectinal teeth 29–34 in males ( $N = 5$ ; median = 32), 29–30 in the only studied female. Metasoma: Metasomal segments I–III: tegument densely granular; LSM and LIM carinae present on the distal 3/4 of the segment; DL carina weakly developed, extending on the entire length of the segment. Metasomal segment IV: dorsal and lateral surfaces granular; ventral surface smooth with a large number of scattered setae; DL carinae and LSM carinae extending on the entire length of the segment, but poorly developed; LIM carina only present in the last third of the segment. Metasomal segment V: slightly wider in its median part than near the anterior and posterior margins in males (Fig. 14); dorsal surface smooth; androvestigia long and well developed, occupying almost 50 % of the dorsal surface (Fig. 15); lateral surface granular; LSM and DL carinae granular, extending the entire length of the segment but poorly developed; ventral surface irregularly granular, specially in the second half of the segment; VL and VM carinae extending on the entire length of the segment; four rows of ventral setae, two basal rows of four setae and two posterior rows of one or two setae each. Telson: dorsal gland in males almost triangular and well developed (Fig. 16); vesicle with rounded ventral surface (Figs. 17, 18), ventral surface slightly granular; aculeus slightly curved, of the same length as the vesicle. Pedipalps: Femur: internal surface slightly granular; VI, DE, and DI carinae granular, extending on the entire

length of the segment, but poorly developed; remaining surfaces smooth. Patella: internal surface with scattered granules; DI and VI carinae extending on the entire length of the segment, but poorly developed; remaining surfaces of the tegument smooth. Chela: manus very narrow, with smooth tegument; ventrointernal carina poorly developed (Fig. 19); prolateral apophysis well developed in males; movable finger with a median row of granules and 5 or 6 internal and external granules that do not overlap with the median row of granules. Trichobothrial pattern of subgenus *Leptosternus* (Figs. 19–22): Neobothriotaxic Major Type C, with one accessory trichobothrium in V series of chela; femur with 3 trichobothria (1 *d*, 1 *i* and 1 *e*); patella with 19 trichobothria (3 *V*, 2 *d*, 1 *i*, 3 *et*, 1 *est*, 2 *em*, 2 *esb*, and 5 *eb*); chela with 27 trichobothria (1 *Est*, 5 *Et*, 5 *V*, 1 *Esb*, 3 *Eb*, 1 *Dt*, 1 *Db*, 1 *et*, 1 *est*, 1 *esb*, 1 *eb*, 1 *dt*, 1 *dst*, 1 *dsb*, 1 *db*, 1 *ib*, 1 *it*). Legs: Tegument finely granular in femur; telotarsi I and II with the inner unguis 5 to 10 % shorter than the external one; internal and external basitarsal spurs well developed, of the same size in all segments.

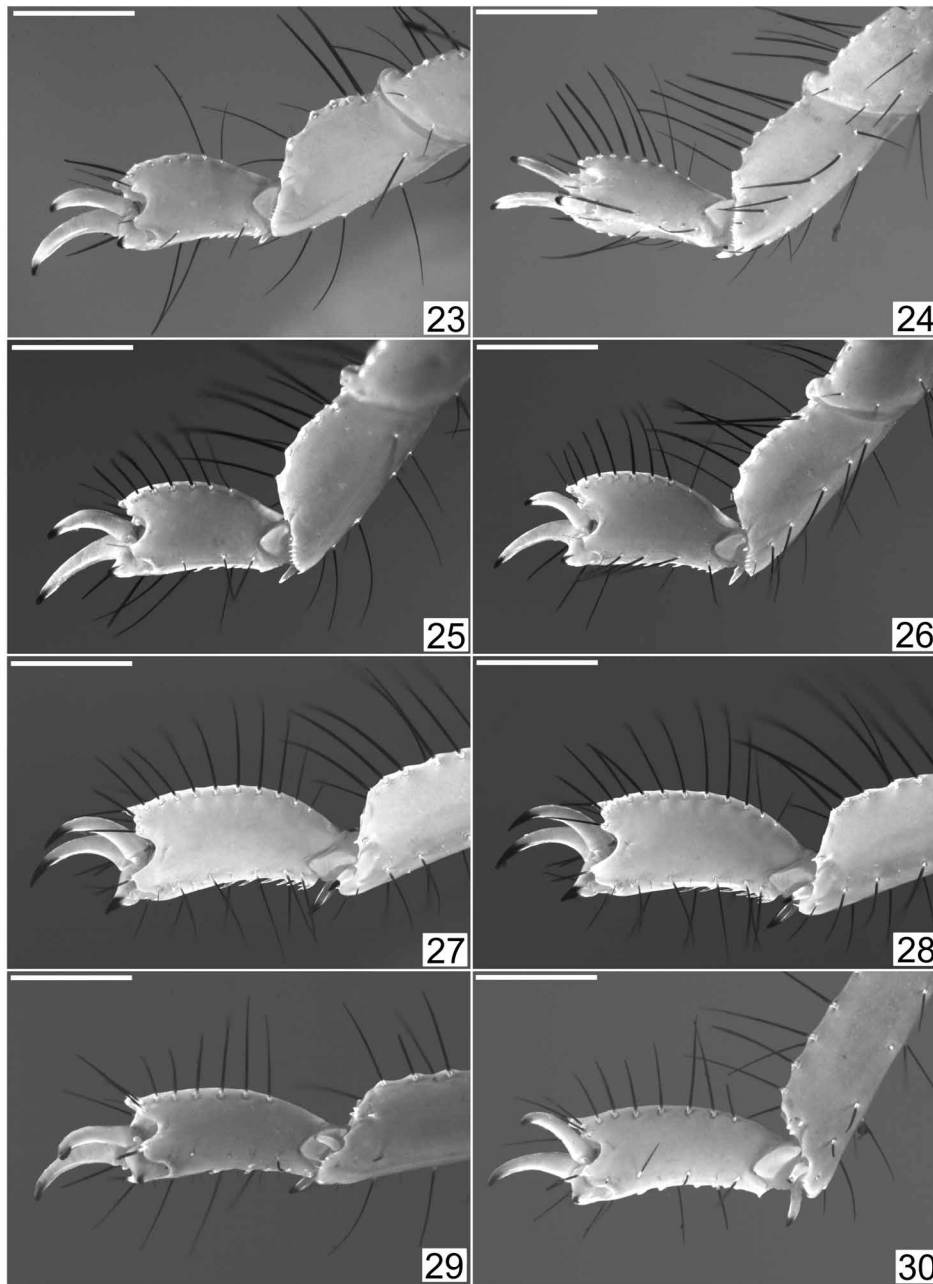


**FIGURES 19–22.** *Brachistosternus* (*L.*) *coquimbo* n. sp. 19. Left pedipalp chela, male, ventral aspect; 20. left pedipalp chela, male, internal aspect; 21. right pedipalp chela, male, external aspect; 22. right pedipalp chela, female, external aspect. Scale bars = 1 mm.

**Variation:** Pedipalp chela length/height ratio, male 3.63–3.93 (N = 6; mean = 3.81), female 3.5; pedipalp chela length/width ratio, male 4.7–5.09 (N = 6; mean = 4.85), female 4.33; metasomal segment V, length/width ratio, male 1.5–1.7 (N = 6; mean = 1.61), female 1.4; metasomal segment V, ventral macroseta, 11–13 (N = 7; median = 12); metasomal segment V, ventrolateral macroseta, 8–9 (N = 7; median = 8); telotarsus III, dorsal macroseta, 10–12 (N = 7; median = 11); telotarsus III, ventrointernal macroseta, 5–8 (N = 7; median = 7); telotarsus III, ventroexternal macroseta, 6–8 (N = 7; median = 7); basitarsus III, dorsal macroseta, 5–9 (N = 7; median = 8); total length (mm), males, 49–57 (N = 6; mean = 53), female: 44.

**Distribution and ecology:** *Brachistosternus* (*L.*) *coquimbo* n. sp. has been collected in the Andean sector of Coquimbo Region, (Chile), between 2850 to 3000 m a.s.l (Fig. 1). All localities are located within the high-Andean steppe of Doña Ana botanical subregion, of the Andean desert botanical region (Cepeda-Pizarro *et al.* 2006; Gajardo 1993; Squeo *et al.* 2006a, 2006b).

*Brachistosternus* (*L.*) *coquimbo* **n. sp.** occurs in areas with fine clay substratum with scattered rocks. The vegetation of this area is composed mostly of small shrubs. This species has been collected in sympatry with *Br. (L.) perettii*, and with an undescribed species of *Orobothriurus* Maury, 1976, closely related to *O. alticola* (Pocock, 1899).



**FIGURES 23–30.** Prolateral view of right leg telotarsi I and II of four *Brachistosternus* species. 23–24. *Brachistosternus cepedai* **n. sp.**, 23. telotarsus I; 24. telotarsus II. 25–26 *Brachistosternus sciosciae*. 25. telotarsus I; 26. telotarsus II. 27–28 *Brachistosternus roigalsinai*. 27. telotarsus I; 28. telotarsus II. 29–30 *Brachistosternus montanus*. 29. telotarsus I; 30. telotarsus II. Scale bars 1 mm.

## Discussion

The genus *Brachistosternus* is remarkably diverse in the coastal deserts of Chile and Peru (Ojanguren-Affilastro 2002c; Ochoa 2002, 2004, 2005), and in the Andes (Ojanguren-Affilastro 2002a, 2002b; Ojanguren-

Affilastro & Mattoni 2006; Ochoa & Acosta 2002; Ochoa 2004). Apparently the great variety of microhabitats and the strong elevation gradients in these xeric areas have triggered an extensive rate of speciation within the genus. In Coquimbo region, *Brachistosternus* is the most abundant and diverse genus of family Bothriuridae (Agusto *et al.* 2006).

*Brachistosternus (L.) cepedai* **n. sp.** is a typical psammophilous species of genus *Brachistosternus*, with some typical ecomorphological adaptations, i.e. the pale color, the long telotarsal setae, the weak development or absence of the inner pedal spur, and the great difference in the development of the inner and external unguis of telotarsi I and II (Figs. 23, 24) (Prendini 2001). Most of these adaptations are shared with other psammophilous species of the genus such as *Brachistosternus (L.) multidentatus* Maury, 1984, *Br. (L.) sciosciae* (Figs. 25, 26), *Br. (L.) telteca* Ojanguren-Affilastro, 2000, and *Br. (L.) zambrunoi* Ojanguren-Affilastro, 2002 (Maury 1984; Ojanguren-Affilastro 2000, 2002b, 2003b), and also with species of genus *Vachonia* Ábalos, 1954, that also inhabit these kind of environment (Ábalos 1954; San Martín 1964; Ojanguren-Affilastro 2005a). In contrast, non psammophilous *Brachistosternus* species, have the inner and external unguis of similar size, and the internal basitarsal spur are well developed (Figs. 27–30).

*Brachistosternus (L.) cepedai* **n. sp.** is the sister species of *Br. (L.) sciosciae*, which inhabits in similar environments, in Atacama region in northern Chile (Ojanguren-Affilastro 2002c, 2005b). Both species have very similar hemispermatophores, which lack most of the typical internal structures of this genus. In *Br. (L.) cepedai* **n. sp.** the internal structures are the least developed of the genus lacking even the basal triangle, that is vestigial in *Br. (L.) sciosciae*. Besides *Brachistosternus (L.) paulae* Ojanguren-Affilastro, 2003, from southern Patagonia, has an hemispermatophore with similar characteristics as the two former species (Ojanguren-Affilastro 2003b), but in this species most of the internal structures are slightly more developed than in the Chilean species. The Chilean species are very difficult to put into one of the known species groups of the genus. Their phylogenetic relationships with other species of the genus are therefore not clear. However, preliminary cladistic analysis tend to group these species in a clade together with the species of plains from Argentina, northern Chile and southern Peru (Ojanguren-Affilastro & Ramírez, unpublished data).

The areas of distribution of *Br. (L.) cepedai* **n. sp.** and *Br. (L.) sciosciae* are separated by 300 km.. These species only occur in sandy areas, so it seems that the areas with clay substratum that occupy most of northern Chile, represent a biogeographic barrier for these highly adapted ultrapsammophilous species.

In the Andean sector of Coquimbo region, we have also collected an undescribed species of Bothriuridae that belongs to an undescribed genus (Mattoni, unpublished data). The presence of this new genus (with two species restricted to Coquimbo) is another confirmation of the high degree of endemism of the scorpion fauna of the region; which is revealing to be comparable to that of the rain forests of Chilean Patagonia. With these two new species the number of known species of this region is elevated to ten, and to thirty nine the total number of species in the country.

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