



## The genus *Orobothriurus* Maury in central Argentina with description of a new species from El Nevado mountain chain in Mendoza Province (Scorpiones: Bothriuridae)

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### Abstract

New data on the scorpion genus *Orobothriurus* Maury 1976 in central Argentina are provided. *Orobothriurus grismadoi* n. sp. is described; this species occurs in high altitudes in El Nevado mountain chain, an isolated orographic system in Southern Mendoza, Argentina, separated by almost 200 km from the Andes Mountain chain. This species is closely related to *Orobothriurus alticola* (Pocock, 1899). This is the southernmost record for the genus about 300 km south from previous records. *Orobothriurus bivittatus* (Thorell, 1877) is synonymised with *O. alticola* based on material recently collected in El Tontal mountain chain. We also provide new data about the distribution and intraspecific variability of *O. alticola*.

**Key words:** Scorpiones, *Orobothriurus*, new species, El Nevado, Argentina

### Introduction

Most species of the genus *Orobothriurus* Maury 1976 occur at high altitudes above 2500 m. a.s.l. (Acosta 2005; Acosta & Ochoa 2000, 2001; Maury 1976; Ochoa 2004; Ochoa & Acosta 2002, 2003; Ojanguren-Affilastro 2005). However, some species have also been collected in areas of the Lomas biotope in the coastal Pacific desert of northern Chile and southern Peru (Ochoa & Acosta 2002; Ochoa 2004; Ojanguren-Affilastro 2003a). Most high altitude species are found in the Andes mountain chain, but some species appear to be endemic of other orographic systems east of the Andes in western Argentina like El Tontal (Acosta 2005) and Famatina (Acosta & Ochoa 2001).

The knowledge about the diversity of genus *Orobothriurus* in Argentina (as in the rest of the countries where it is distributed) is still scarce due to the rigorous environment where it inhabits. Most records belong to short campaigns to restricted areas, so that the actual diversity and distribution of the species of this genus is still not known. Up to now, only three species of *Orobothriurus* have been described for Argentina: *Orobothriurus alticola* (Pocock 1899), from the Andes of central Mendoza and San Juan Provinces (Ojanguren Affilastro 2005), *Orobothriurus bivittatus* (Thorell 1877), from the Tontal mountain chain in the Precordillera of San Juan province (Acosta 2005), and *Orobothriurus famatina* Acosta & Ochoa 2001, from the Famatina Mountain Chain in the Precordillera of La Rioja province (Acosta & Ochoa 2001). There are also other records of several undescribed species from central and northern Argentina (Ojanguren Affilastro 2005, Acosta & Ochoa 2001), but most of them comprise small numbers of specimens making impossible an accurate description of them (Acosta & Ochoa 2001).

Acosta (2005) redescribed the enigmatic species *O. bivittatus*. In his redescription Acosta mentions that the differences between *O. bivittatus* and the closest species *O. alticola* were so subtle, that he could not assure if they were different species or subspecies. Acosta only studied a single adult specimen and the poorly preserved juvenile holotype, so he was not able to assess the intraspecific variability. We have been able to collect large series of *Orobothriurus* from the Tontal mountain chain, and we consider that these specimens actually belong to *O. alticola*. Based on this new evidence, we synonymise *O. bivittatus* with *O. alticola*. New data about the distribution of *O. alticola* are provided, extending its distribution 150 km south to the Andean locality of Laguna Diamante in central Mendoza Province, Argentina.

In recent years researchers of the Entomology Laboratory of the IADIZA have been carrying out several field surveys to high altitude localities of Mendoza province, in Western Argentina, in order to study the diversity of the arthropod fauna of the region. During a recent expedition to the isolated mountain chain of El Nevado in Southern Mendoza, several specimens of an undescribed species of *Orobothriurus* have been collected with pitfall traps. The species, *Orobothriurus grismadoi* n. sp., closely related with the Andean species *O. alticola*, is described in the present publication.

## Methods

Descriptive terminology follows Mattoni and Acosta (2005) for the hemispermatophores; Vachon (1974) for the trichobothria; and Francke (1977) for the pedipalpal and metasomal carinae (acronyms for pedipalpal carinae are as follows: DI: dorsal internal; DE: dorsal external; VI: ventral internal. Acronyms for metasomal carinae are as follows: DL: dorsolateral; LIM: lateral inframedian; LSM: lateral supramedian; VSM: ventral submedian; VL: ventrolateral; VM: ventromedian). Abbreviations of collections are as follows: AMNH: American Museum of Natural History, New York; CDA: Cátedra de Diversidad Animal I, Universidad Nacional de Córdoba; IADIZA: Instituto Argentino de Investigaciones de las Zonas Áridas; MACN-Ar: Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia'. Illustrations were produced using a Leitz Wetzlar stereomicroscope and a Camera Lucida. Photographs were taken using a Nikon DXM 1200 Digital Camera attached to a Nikon SMZ 1500 stereomicroscope, the focal planes were subsequently assembled with Helicon Focus 3.10.3 (<http://helicon.com.ua/heliconfocus/>). Photographs of pigment pattern and hemispermatophores were taken using white light, photographs of external morphology were taken using UV lamps. Measurements, taken using an ocular micrometer, are recorded in mm (see Figs. 18 and 19 for details about hemispermatophore measurements). Angles were measured from the digital photographs using Image Tool 3.00 (© UTHSCSA, 1996-2002). The distribution map was generated using ArcMap 9.0 (Environmental Systems Research Institute [ESRI], Redlands, California), by superimposing the point locality records of species on coverages depicting the political boundaries and topography of Argentina and Chile. The topographic coverage (as a shaded relief) was generated from digital elevation model files (~90 m resolution) from the CGIAR-CSI Consortium website (<http://srtm.csi.cgiar.org/>). Point locality records were georeferenced in the field with a portable Global Positioning System (Garmin® Etrex and Etrex Vista) or using the GeoNet Names Server (GNS, <http://earth-info.nga.mil/gns/html/>). The statistical analyses were performed with NCSS 2007 (© Hintze, 2007).

## Results

### *Orobothriurus grismadoi* n. sp.

figs. 1, 3–13, 15–17, 20–24, 35, Tables 1 & 2

**Type series (21 specimens).** ARGENTINA, *Mendoza Province*, Malargüe Department, Cerro Nevado.

**Holotype male:** 35°35'45.06"S; 68°30'24.12"W, 3130 m a.s.l., Fernández Campón & Lagos Silnik coll., 25/

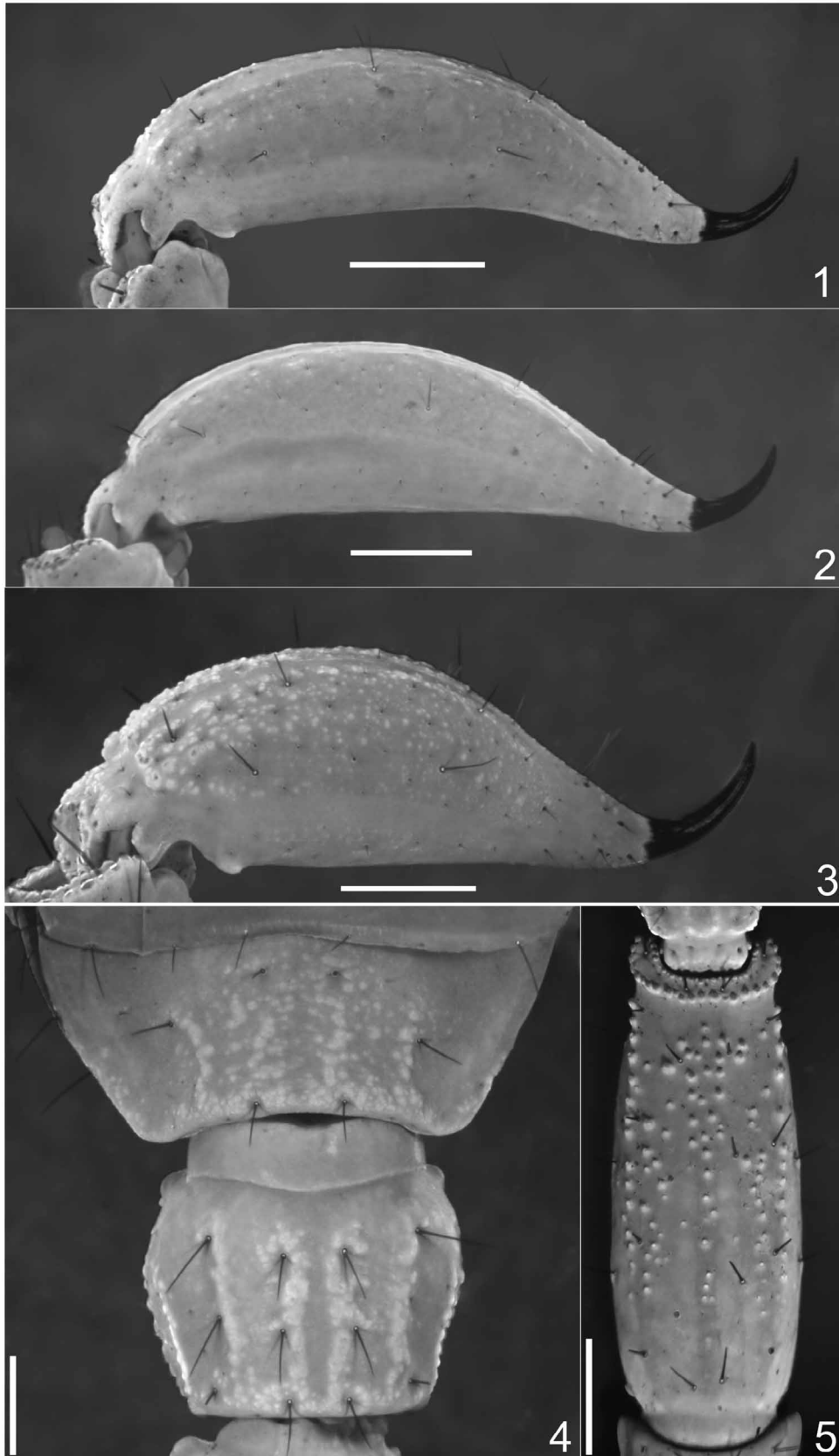
II/2006, (MACN-Ar 17986). **Paratypes:** same data, 6 males, 2 females (MACN-Ar 17987); 2 males (CDA); 1 juvenile (IADIZA). 35°36'2.46"S; 68°30'40.92"W, 2953 m a.s.l., Fernández Campón & Lagos Silnik coll., 25/II/2006, 5 males (IADIZA), 1 male (AMNH); II/2006, 1 male (AMNH.35°36'4,08"S 68°30'44,28"W, 2949 m a.s.l., Fernández Campón & Lagos Silnik coll., 7/I/2006, 1 juvenile, (IADIZA). 35°36'4,08"S 68°30'44,28"W, 2900 m a.s.l., G. Flores coll., 16/XI/2004, 1 female (CDA).

**Etymology:** This species is named after the Argentinean arachnologist Cristian Grismado from the MACN, who has been very helpful identifying part of the spiders collected in the Andean campaigns of the IADIZA and providing information on the subject, whenever he was asked.

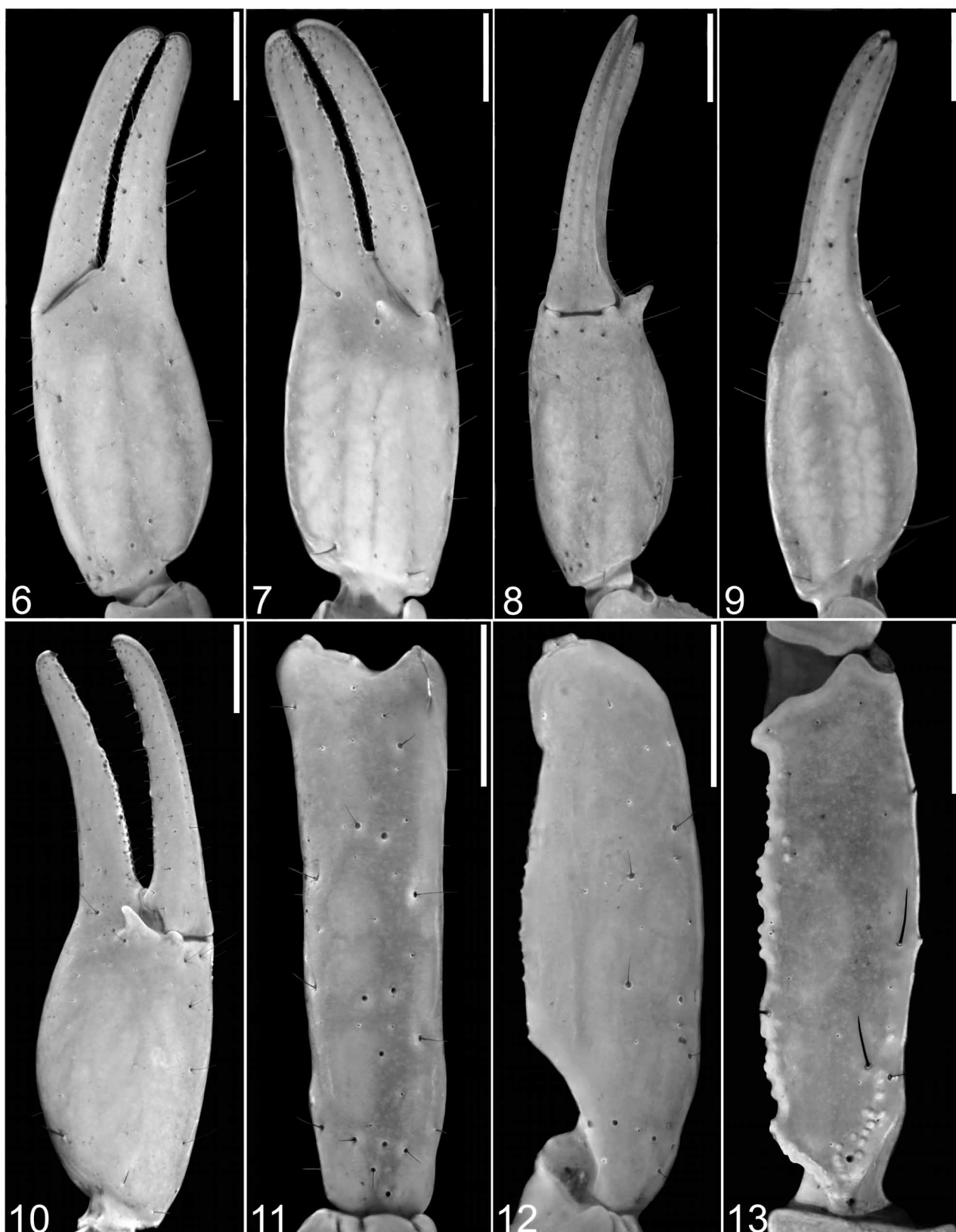
**Diagnosis:** *Orobothriurus grismadoi* is closely related to *O. alticola* from the Andean sector of Mendoza and San Juan provinces in Argentina. Both species can be separated by the shape of the hemispermatophore, in *O. grismadoi* the angle formed by the apex with the rest of the distal lamina (Fig. 18) is smaller than in *O. alticola* (Table 2). In addition the apex of *O. grismadoi* is slender than in *O. alticola* (Figs. 20–34). Males of both species can also be separated by the shape of the telson which is slender in *O. grismadoi*; additionally in *O. grismadoi* males the dorsal surface of the vesicle is always concave, whereas in *O. alticola* males it is straight (Figs. 1, 2). *Orobothriurus grismadoi* is also more densely pigmented than *O. alticola*. In *O. alticola* the tergite VII has two lateral spots that leave a median unpigmented stripe (Fig. 14), whereas in *O. grismadoi* this segment is almost completely covered by dark pigment and there is no median unpigmented stripe (Fig. 15).

**Description. Colour:** General colour yellowish, with dark brown spots. *Carapace:* anterior margin unpigmented, except for a median dark stripe over the anterior longitudinal sulcus that reaches the anterior margin; ocular tubercle and area around the lateral ocellus dark brown or black; dark spot in the median part of the carapace surrounding the ocular tubercle; lateral margins with two big lateral spots, and two posterolateral spots; posterior margin reticulated. *Chelicerae:* entire dorsal surface reticulated, ventral surface unpigmented. *Tergites:* I–VI with two lateral dark spots occupying almost the whole lateral margins, separated by a thick median unpigmented stripe; *tergite:* VII with two lateroposterior dark spots, two paramedian dark spots and a median dark spot, all connected by a reticular pigment, so that there is no a median unpigmented stripe (Fig. 15). *Sternites:* III–VI unpigmented; VII with two diffuse lateral dark spots. *Sternum, genital opercula* and *pectines* unpigmented. *Metasomal segments:* segments I–III: dorsal surface with a median triangular spot that occupies most of the surface between the DL carinae; lateral surface with a triangular spot occupying most of the area between the LSM and the VL carinae; ventral surface with three longitudinal dark stripes, two VL and one VM, that do not join between them in any segment, the VL stripes are partially fused with the lateral spots. Segment IV: dorsal surface slightly pigmented in its median part and over the DL carinae; lateral surface slightly pigmented over the LSM carinae; ventral surface as in segments I–III. Segment V: dorsal surface with two faint longitudinal dark stripes and two DL dark stripes; lateral surface faintly reticulated; ventral surface like segments I–IV. *Telson:* vesicle with dark reticular pigment in dorsal and ventral surfaces; aculeus dark brown. *Legs:* all segments with dark spots except the telotarsus; femur and patella densely pigmented on the dorsal surface and near the articulations. *Pedipalps:* femur densely pigmented near the articulation with patella, and over the DE carina, slightly pigmented over the DI carina and in the external margin; patella slightly pigmented near the articulations over the DE carina and in the external margin; chela, with six complete longitudinal pigment stripes over the hand and with a ventrointernal spot near the articulation with patella; fingers and articulation with fingers densely pigmented.

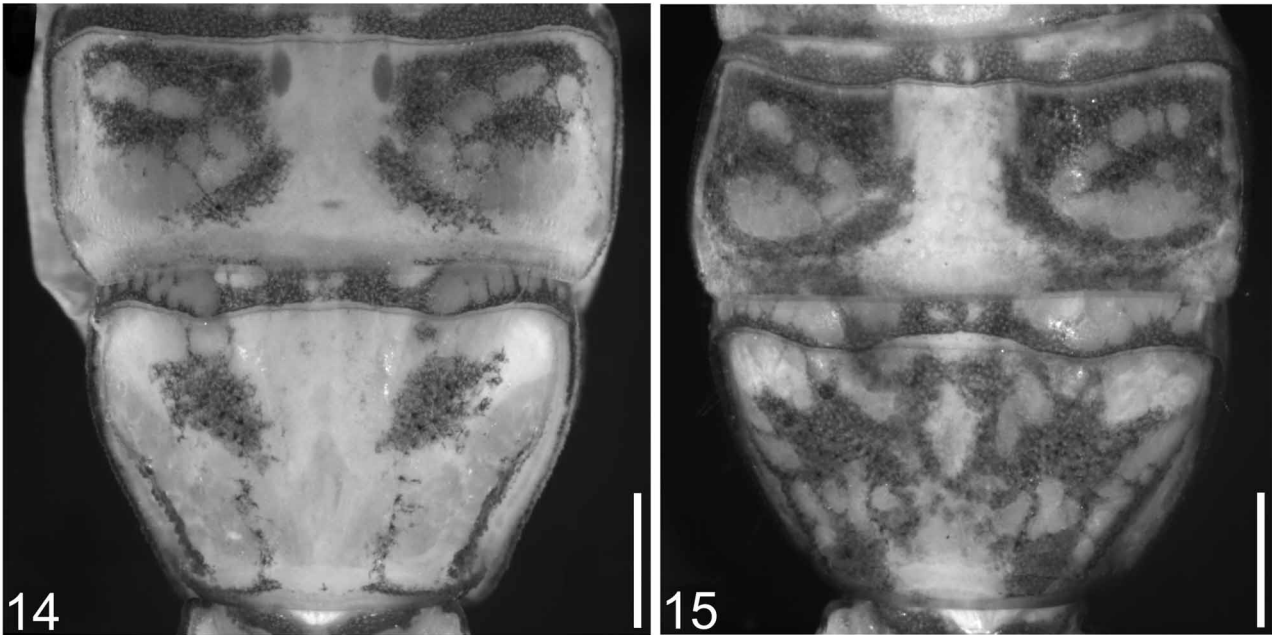
**Morphology:** Measurements of a male paratype (MACN–Ar) and a female paratype (MACN–Ar) are recorded in Table 1. Total length in males 26.5–32 mm (N = 10, mean = 29.8), 25, 27 and 34.1 mm in the three studied females. *Carapace:* in males tegument finely granular in the median area, with more developed granules near the lateral margins; smooth in females; anterior margin almost straight or with a poorly developed median notch; anterior longitudinal sulcus poorly developed; ocular tubercle very low, median eyes two diameters apart, interocular sulcus well developed; posterior sulcus, posterolateral sulci and postocular furrow deeply marked. *Chelicerae:* with two subdistal teeth. *Tergites:* tergites I–VI smooth in females, finely



**FIGURES 1–5.** 1, 3–5. *Orobothriurus grismadoi* n. sp.. 1. Telson, male, lateral aspect; 3. Telson, female, lateral aspect; 4. Sternite VII and metasomal segment I, female, ventral aspect; 5. Metasomal segment V, male, ventral aspect. 2. *Orobothriurus alticola*. Telson, male, lateral aspect. Scale bars: 1mm.



**FIGURES 6–13.** *Orobthriurus grismadoi* n. sp.. 6. Left pedipalp chela, male, retrolateral aspect; 7. Left pedipalp chela, female, prolateral aspect; 8. Right pedipalp chela, male, ventral aspect; 9. Left pedipalp chela, female, dorsal aspect; 10. Left pedipalp chela, male, prolateral aspect; 11. Left pedipalp patela, male, retrolateral aspect; 12. Left pedipalp patela, male, ventral aspect; 13. Left pedipalp femur, male, dorsal aspect. Scale bars: 1mm.



**FIGURES 14–15.** Tergites VI and VII, dorsal aspect showing the pigmentation pattern. 14. *Orobthriurus alticola*; 15. *Orobthriurus grismadoi* n. sp. Scale bars: 1mm.

granular in males; tergite VII: with four longitudinal carinae, two lateral occupying almost 2/3 of the total length of the segment posteriorly, and two internal occupying a half of the segment posteriorly; area between internal carinae finely granular, area between external and internal carinae densely granular, area between external carinae and lateral margins smooth. *Sternites*: sternites III–VI granular in their median part in males, smooth in females, spiracles elongated and narrow; in males sternite VII with two longitudinal carinae occupying the posterior 2/3 of the segment, area between carinae densely granular; similar in females but with four longitudinal carinae. *Pectines*: 20–22 pectinal teeth in males (N = 10; median = 22); 18–18, 18–18 and 19–19 in the three studied females. *Metasomal segments*: segment I: ventral surface usually with six ventral macrosetae and six ventrolateral macrosetae (Fig. 4); VSM and VL carinae well developed (specially in females); LSM and LIM carinae only present in the posterior two thirds of the segment, with one macroseta near the basal margin of the LIM carina; DL carina granular, occupying the entire length of the segment; distal granules of DL and LSM carinae two or three times bigger than the other granules and with a very acute tip. Segment II: ventral surface usually with six ventral macrosetae and six ventrolateral macrosetae, tegument is smooth or with VSM carinae barely marked; LSM and LIM carinae restricted to the posterior half of the segment, with one macroseta on the LSM carina; DL carina granular, occupying the entire length of the segment; the distal granules of DL and LSM carinae two or three times bigger than the other granules and with a very acute tip. Segment III: similar to segment II but ventrally smooth; LSM and LIM carinae restricted to the posterior third of the segment. Segment IV: ventral surface as segment III; LIM carina absent, LSM carina reduced to a posterior crest strongly developed with two macrosetae; DL carina granular, occupying the entire length of the segment with posterior granules strongly developed and one posterior macroseta. Segment V: ventral surface with eight ventral macrosetae, eight VL macrosetae and four posterior macrosetae; VL carinae present in the posterior three quarters of the segment; VSM carinae very close to the VL carinae fusing with them in the anterior and posterior thirds of the segment; VM carina present in the posterior three quarters of the segment, fusing in the posterior half with the ventral granulation of the segment (Fig. 5); lateral margin smooth with four or five LSM macrosetae; DL carina reduced to some granules in the posterior half of the segment, with one macroseta in the median part. *Telson*: vesicle elongated and with smooth tegument in males, globose and granular in females (Figs. 1, 3); in males no evident telson gland and dorsal surface concave (Fig. 1); aculeus short and curved. *Legs*: femur and patella slightly granular, the rest smooth; with

two well developed and symmetrical basitarsal spurs; telotarsi elongated, with well developed VL spines (tarsus I: 1-1, tarsus II: 2-2, tarsi III–IV: 3-3); telotarsal unguis curved and symmetrical. *Pedipalps*: femur: DI and VI carinae granular and extending the entire length of the segment, DE carina slightly granular near its base in males (Fig. 13), blunt in females. Patella: DI and VI carinae slightly granular and extending along the entire length of the segment (Figs. 11, 12). Chela: slender, with elongated fingers and smooth tegument (Figs. 6–10); males with a conic apophysis near the articulation with the movable finger (Figs. 8, 10), females with a low bulge (figs. 7, 9); internal surface of the fingers with a median row of denticles and four or five pairs of internal and external accessory denticles. *Trichobothrial pattern*: neobothriotaxic major type C (Figs. 6–13), with one accessory trichobothrium in the 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*). *Hemispermatothore*: slender, in most specimens the basal part of the distal lamina is slightly inclined in respect to the basal portion, apex elongated and very inclined in respect to the basal part of the distal lamina; frontal crest longer than the half of the lamina, divided into two parts, basal part oblique, distal part parallel to the posterior margin of the lamina, slightly undulated; distal crest curved like the posterior margin; lobe region similar to hemispermatothores of the other species of the genus, with basal lobe protruding up to the median part of the frontal crest (Figs. 16, 17, 20–24).

**TABLE 1.** *Orobothriurus grismadoi* n. sp.. Measurements in mm of the male holotype (MACN-Ar 17986) and a female paratype (MACN-Ar 17987).

Measurements in mm	<i>Orobothriurus grismadoi</i> n. sp.	
	Male holotype	Female paratype
Total length	30.36	24.86
Carapace, length	3.47	3.39
Carapace, anterior width	2.42	2.34
Carapace, posterior width	3.96	3.79
Mesosoma, total length	9.21	7.03
Metasoma, total length	13.36	10.82
Metasomal segment I, length/width/height	2.2/2.04/1.64	1.76/2.12/1.68
Metasomal segment II, length/width/height	2.24/1.88/1.56	1.88/2.00/1.68
Metasomal segment III, length/width/height	2.32/1.8/1.56	2/1.96/1.68
Metasomal segment IV, length/width/height	2.8/1.76/1.52	2.16/1.84/1.66
Metasomal segment V, length/width/height	3.8/1.72/1.32	2.92/1.84/1.46
Telson, length	4.32	3.62
Vesicle, length/width/height	3.4/1.48/1.12	2.66/1.58/1.2
Aculeus, length	0.92	0.96
Pedipalp, total length	11.92	10.74
Femur, length/width	3.36/1	2.72/1.06
Patella, length/width	3.28/1.04	2.85/1.06
Chela, length/width/height	5.82/1.50/1.66	5.17/1.34/1.54
Movable finger, length	3.10	2.95

**Distribution and habitat.** Argentina, Mendoza Province, Malargüe Department.

*Orobothriurus grismadoi* occurs in southern Mendoza province, in the Payunia District of the Central Patagonia biogeographic province (Morrone *et al.* 2002) (Fig. 35). This species is restricted to high altitude habitats on the Cerro Nevado, an extra-Andean mountainous range located 200 km east of the Andes. The Nevado range is separated from the Andean range by a plateau of 1800 m a.s.l. It extends North-South

between 34° and 36° S, parallel to the Andes, with a maximum altitude of 3833 m a.s.l (summit of Cerro Nevado). In the lower part of this range, the vegetation is a shrub steppe of *Neosparton aphyllum* Gillies and Hook (Verbenaceae) and *Sporobolus rigens* (Trinius) Desvaux (Gramineae) on sandy and basaltic soils. At medium level (volcanic plateau) the steppe is characterized by *Adesmia pinnifolia* Gillies ex Hook. and Arn. (Fabaceae) and *Anarthrophyllum rigidum* Hieronymus (Leguminosae). The top level has low vegetation with *Panthacantha ameghinoi* Spegazzini (Solanaceae) as a dominant species (Flores & Carrara 2006). *Orobothriurus grismadoi* was caught in pitfall traps located in *P. ameghinoi* habitat between 2900–3130 m a.s.l. Among the 21 individuals sampled, two were sampled in early summer (16-XII-04 and 7-I-06). The remaining individuals (most of them adults) were caught in late summer (25-II-06). Pitfall traps were located in sites with vegetation. No pitfall traps were located above 3200 m a.s.l where vegetation is absent. Thus, it is possible that *O. grismadoi* is present at higher altitudes, as other members of the genus can reach 4000 m in the Andes. Although there were traps set in the same sites, the previous year, there were no individuals of *O. grismadoi* caught.

### ***Orobothriurus alticola* (Pocock 1899)**

Figs. 2, 18–19, 25–35, Table 2

*Bothriurus alticola* Pocock 1899: 357–358, Fig. 1. Lowe & Fet 2000 (Complete synonymic list until 1998). Acosta 2002: 176, 177; Acosta 2005: 1, 2, 8, 9 12. Acosta & Ochoa 2000: 135, 136, 143; Acosta & Ochoa 2001: 203–205, 208, 209. Ojanguren-Affilastro 2005: 176, 178, 179, 180, 220, 241.

Type material. Syntypes: ARGENTINA, Mendoza Province, Puente del Inca, 32°49'9.15"S, 69°55'1.82"W, 2721 m a.s.l., 1 male, 1 female (BMNH).

**New synonym:** *Cercophonius brachycentrus bivittatus* Thorell 1877: 183. Acosta 2005 (Complete list of synonyms until III/2005); Acosta 2006: 20–21. Ojanguren-Affilastro 2005: 181–183, 220, 241. ICZN 2008: 69–70.

**Type material.** Holotype: ARGENTINA, San Juan, juvenile (NRS).

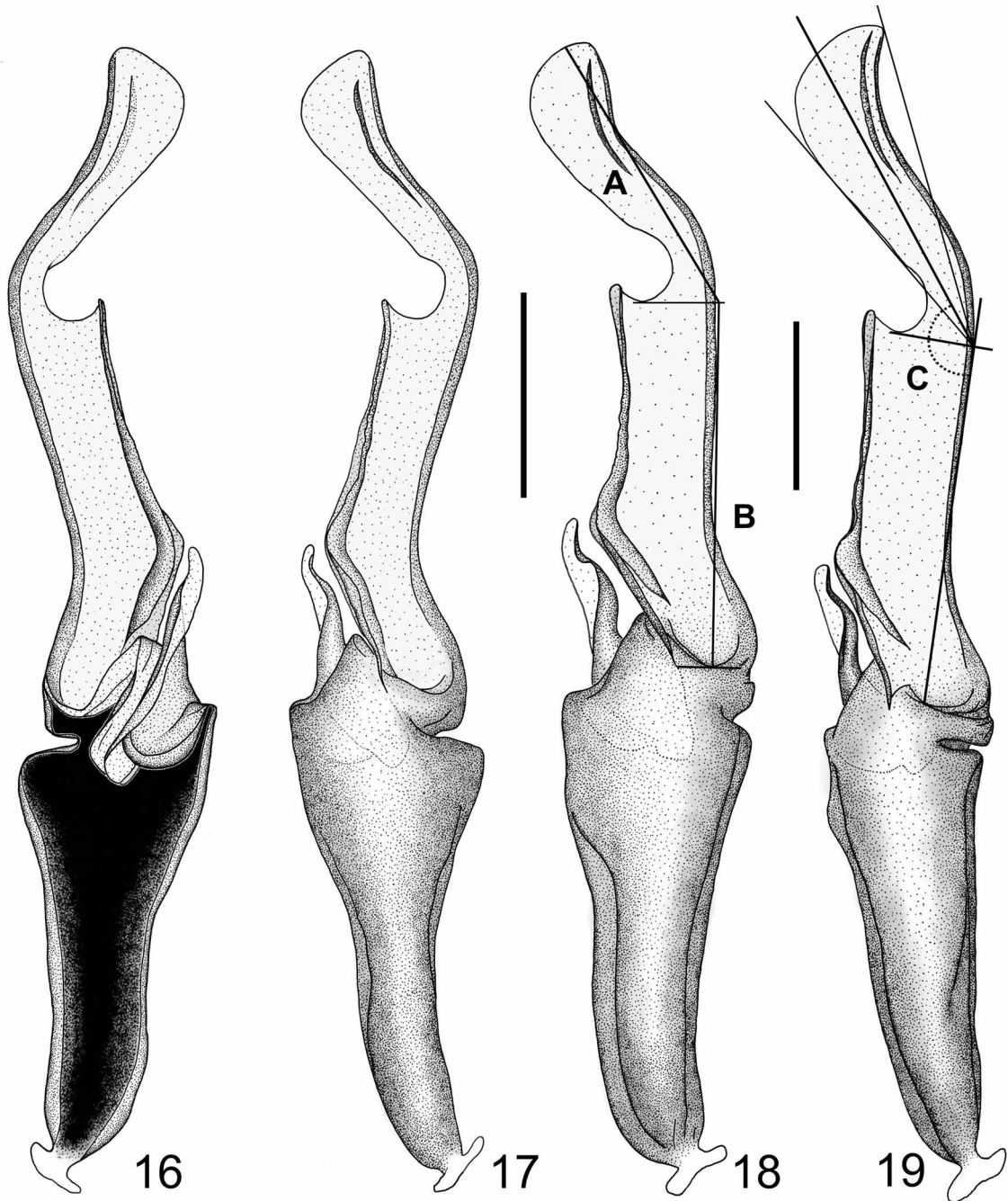
**Additional material:** ARGENTINA, *San Juan Province*, Cerro El Tontal, path to radio anthem, 31°31'24.7"S, 69°12'23.3"W, 3600 m a.s.l., A. A. Ojanguren-Affilastro, L. Compagnucci & L. Piacentini coll., 25/I/2006, 8 males, 4 females, 9 juveniles (MACN-Ar); between Paso de Agua Negra and Aduana, Vega and surrounds, 30°17'33.1"S 69°46'45.6"W, 4005 m a.s.l., C. Mattoni & A. Ojanguren coll., 27/I/2005, UV sampling, 2 males and 2 females (AMNH); (same data) 2 males and 2 females (CDA); (same data) 4 males, 4 females, 2 juveniles (MACN-Ar). *Mendoza Province*, Laguna Diamante, 34°11'47,22", 69°22'29,4", 3344 m a.s.l., F. Fernández Campón & S. Lagos Silnik coll., 17/II/2005, 11 males (MACN-Ar); 34°14' 24,48", 69°30' 22,08", 3573 m a.s.l., 17/II/05, 5 males, 1 female, 5 juveniles, (IADIZA); 34°11'50,16"S; 69°32'10,32"W, 3398 m a.s.l., 24/II/06, 26 males, 1 female, 1 juvenile, (IADIZA); 34° 14'22,86", 69 30'27,96", 3574 m a.s.l., 24/II/06, 1 male, 1 female, 1 juvenile, (IADIZA). Las Cuevas, 32° 48'34,98", 70 04'16,44", 3329 m a.s.l., F. Fernández Campón & S. Lagos Silnik coll., 26/II/06, 1 male, 1 female, 1 juvenile, (IADIZA). Puente del Inca, Mendoza, (2700 m a.s.l., G. Flores & J.A. Ochoa coll., 15/XII/2001, 1 juvenile (IADIZA).

**Remarks.** Acosta (2005) made an excellent taxonomic and historic revision of *Orobothriurus bivittatus*. He deduced the actual type locality of *O. bivittatus*, somewhere in the Tontal mountain chain. He studied the species holotype, a poorly preserved juvenile, as well as a single adult male specimen collected by him in this area. Based on this material he considered *O. bivittatus* as a valid species closely related to *O. alticola*. Later, Acosta (2006) applied to the International Commission of Zoological Nomenclature (ICZN) to designate as a neotype the recently collected adult male, to replace the juvenile holotype, which does not show many diagnostic features (including the hemispermatothore). The proposed replacement of the holotype was not accepted by the ICZN, because the original material still exists and, according to them, there is no exceptional need to designate a neotype (ICZN, 2008).

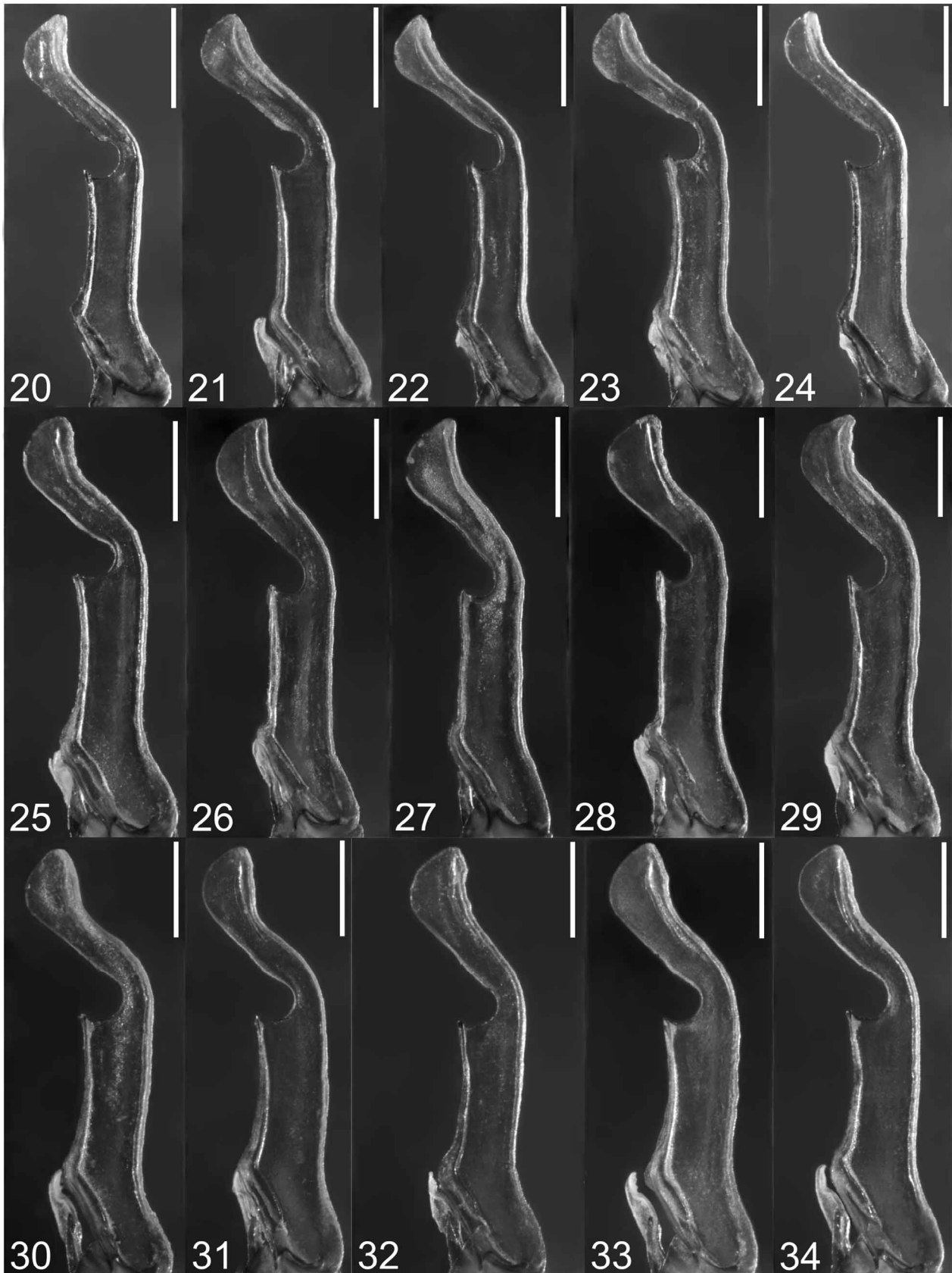
However, when trying to support the recognition of *O. bivittatus* as a different species (separated from *O. alticola*), Acosta (2005: p. 8) stated:



“Similarities concern both the pigment pattern and the external morphology, being difficult indeed to find a sharp morphological discrimination. Only the hemispermatophore provides reliable differences. The fact that just one male of *O. bivittatus* is hitherto available – i.e. variability remains unknown – lessens to some extent the strength of these conclusions, but the differences encountered, together with the apparent geographical isolation, support the latter being regarded as an independent entity.”



**FIGURES 16–19.** Left hemispermatophore. 16, 17. *Orobthriurus grismadoi* n. sp. 16. Internal aspect; 17. External aspect. 18. *Orobthriurus alticola*, (El Tontal, San Juan province, Argentina), external aspect, showing the distal lamina measures analyzed: A= apex length, B= distal lamina length. 19. *Orobthriurus alticola*, (Puente Del Inca, Mendoza province, Argentina), external aspect, showing the angle (C) between apex and distal lamina base. Scale bars: 1mm.



**FIGURES 20–34.** Left hemispermatophores, distal lamina, external aspect. 20–24. *Orobthriurus grismadoi* n. sp.. 25–34. *Orobthriurus alticola*. 25. Puente del Inca, Mendoza province, Argentina; 26–28. Paso del Agua Negra, San Juan province, Argentina; 29. Laguna Diamante, Mendoza province, Argentina; 30–34. El Tontal, San Juan province, Argentina. Scale bars: 1mm.

Acosta (2005) mentioned several differences between *O. alticola* and *O. bivittatus*: (1) the apex of the hemispermaphore is proportionally shorter in *O. alticola* than in *O. bivittatus*, representing a 38% of the total length of the distal lamina in the first species and a 47% in *O. bivittatus*, this being the most remarkable difference between species. He also mentioned that in *O. bivittatus* the upper margin of the frontal crest forms a spur like projection that is not present in *O. alticola*. (2) *Orobothriurus alticola* males bear VSM carinae on metasomal segment II that are absent in *O. bivittatus*. (3) *Orobothriurus alticola* has metasomal segment IV with 6 VSM macrosetae whereas *O. bivittatus* bears 8. (4) *Orobothriurus alticola* males measures 27 to 31.5 mm, whereas the single specimen of *O. bivittatus* was only 24.4 mm.

In a recent trip to the Tontal mountain chain we have collected several specimens of *Orobothriurus* in the same area where Acosta collected the single adult specimen mentioned in his publication. This new material allowed us to assess the morphological variability of the population. Acosta (2005) did not gave details about the protocol used to measure the distal lamina of the hemispermaphore and its apex, neither did he give a range of variability of hemispermaphore relative length in *O. alticola* although he had access to several specimens of this species. Since there is some degree of variability in the shape and size of the hemispermaphore apex in *Orobothriurus* species, a figure showing the way we measured this structure (Fig. 18) is presented, as well as photos of hemispermaphores of several *O. alticola* specimens from different Andean populations, and from the *Orobothriurus* population of El Tontal (Figs. 25–34). We measured the total length of the distal lamina and the apex of the distal lamina. We found that in Andean *O. alticola* specimens the apex represents a 40.87 to 45.33% of the total length of the distal lamina (N=11, media=43.16), whereas in the specimens from the Tontal it represents a 43.58 to 46.08 % (N=8, media=44.46). The ANOVA statistical analyses of the relation length of the apex / length of distal lamina, including measures from *O. grismadoi* as well, cannot distinguish any differences between the populations (Table 2). There are not significant differences also between *O. alticola* specimens from El Tontal and from the Andes regarding the angle between the apex and the distal lamina (Fig. 19), (Table 2). The spur like projection of the frontal crest is present in some specimens from El Tontal as well as in some specimens of Andean populations of *O. alticola* (Figs. 25–34).

**TABLE 2.** Results of ANOVA one-way analyses assessing variability between hemispermaphore of different *Orobothriurus* populations. Values are expressed as the mean  $\pm$  standard deviation. Letters in bold indicate results from Tukey-Kramer Multiple-Comparison Test: equal letters mean homogeneous groups. Abbreviations: F= F-ratio ANOVA statistic; P= probability of equal medians (\*indicates significant differences); N= sample size.

	<i>Orobothriurus grismadoi</i>	<i>Orobothriurus alticola</i> (Andean specimens)	<i>Orobothriurus alticola</i> (El Tontal specimens)
Relation apex/lamina	0.442 $\pm$ 0.009	0.432 $\pm$ 0.014	0.445 $\pm$ 0.010
N	7	11	8
F= 3.19, P= 0.06	<b>A</b>	<b>A</b>	<b>A</b>
Angle apex-lamina base (on degrees)	137.14 $\pm$ 1.96	141.21 $\pm$ 2.22	142.20 $\pm$ 2.79
N	5	5	5
F= 6.50, P= 0.012*	<b>A</b>	<b>B</b>	<b>B</b>

Males of *O. alticola* of Andean localities, as well as specimens from El Tontal usually do not bear VSM carinae in metasomal segment II, however some specimens in both populations have vestigial VSM carinae.

The VSM setae of metasomal segment IV vary from 6 to 8 in specimens from El Tontal (N=21; median=7), and in Andean specimens of *O. alticola* they vary from 6 to 9 (N=12; median=7).

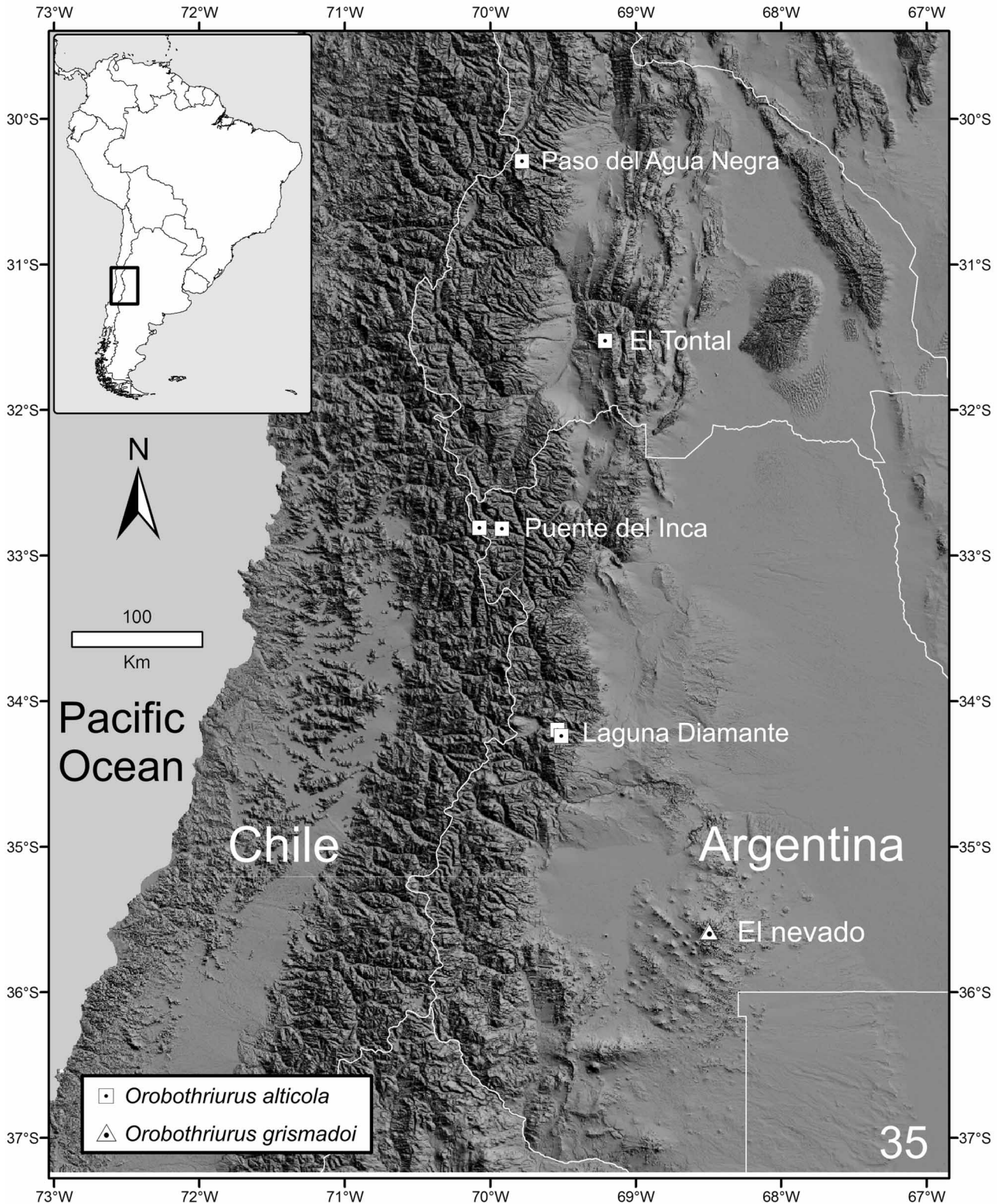


FIGURE 35. Map of central Argentina showing the known distribution of the *Orobthriurus* species of the area.

Total length of males specimens from El Tontal studied by us ranges from 25 to 31 mm (N=8; media=27.80 mm), whereas the total length of *O. alticola* males ranges from 26.9 to 31.5 mm (mean=28.7 mm) in specimens from Puente del Inca, from 27.1 to 31.5 mm (mean 28.9 mm) in specimens from Paso del Agua

Negra (Acosta 2005); and from 32 to 36.5 mm in specimens from Laguna Diamante (N=11; mean 34.1 mm).

Acosta (2005) mentioned that the tergite VII of the adult male specimen from El Tontal he studied was almost completely covered by pigment, without a median unpigmented stripe. This is an unusual characteristic in this genus that could be a strong diagnostic character (Ochoa 2004). However, only 3 of the 21 specimens from El Tontal revised by us share this character, being the rest of the specimens similar to the Andean specimens of *O. alticola*.

The specimens of *Orobothriurus* from El Tontal we studied were collected in the same area, altitude, and environment as the Acosta's adult male specimen. The morphological characteristics of El Tontal specimens are similar to those of the specimens studied by Acosta, and no sympatric species are known to occur in this genus. Therefore we consider El Tontal and Acosta's specimens to be the same species. According to our results *Orobothriurus* specimens from El Tontal cannot be distinguished from the Andean specimens of *O. alticola*, so we decided to consider them as belonging to the same species, therefore synonymising *O. bivittatus* with *O. alticola*. The name *Orobothriurus bivittatus* (Thorell 1877) should have priority over *Orobothriurus alticola* (Pocock 1899). However this change would threaten nomenclatural stability (Acosta 2002; ICZN 2004) so the name *O. alticola* should be preserved over *O. bivittatus*.

In upper level of El Tontal mountain chain *O. alticola* is sympatric with *Brachistosternus montanus* Roig Alsina 1977, this being the first record of this species in the Precordillera. This Andean species of scorpion occurs in the same altitudes and environments as *O. alticola*, and has a similar distribution in the Andean sector of central western Argentina (Ojanguren Affilastro 2003b, 2005).

**Comments:** Because of the high distance that separates it from the Andes mountain chain (200 km), the upper level of the Nevado orographic system is an area of endemism for high altitude arthropod fauna, with closely related species found at high altitude locations in the Andean range. Roig-Juñent *et al.* (2007) have described a species of carabid beetle, *Cnemalobus nevado* Roig-Juñent *et al.* 2007, from the same sites where *O. grismadoi* was collected. Its sister species, *Cnemalobus diamante* Roig-Juñent *et al.* 2007, occurs in high altitude locations in the Andean range (Laguna Diamante, Mendoza) (Roig-Juñent *et al.* 2007). Another closely related species, *Cnemalobus mendozensis* Roig-Juñent 1993, inhabits the plateau connecting both high altitude sites (Roig-Juñent 1993). Other endemics to the Nevado are carabid beetles such as *Baripus nevado* Roig-Juñent *et al.* 2008, *Trechisibus nevadoi* Roig-Juñent & Sallenave 2005 (Roig-Juñent *et al.* 2008), and tenebrionid beetles of the genus *Nyctelia* Latreille, 1925 (Flores & Carrara 2006) and *Falsopraocis* Kulzer, 1958 (Flores, 2000).

The upper level of the Tontal orographic system could also be considered as another area of endemism for high altitude arthropod fauna, with one species of tenebrionid beetle recently described for that area, *Psectracselis argentina* Flores 2007 (Flores 2007). However, our results show that this is not the case for scorpions, with both east Andean scorpion species known from this latitude present in the Tontal (*O. alticola* and *B. montanus*). Even if nowadays the Puna and high Andean vegetation of the upper level of the Tontal (where both species are restricted) are isolated from that of the Andes, the distance that separates both is only about 50 km (Fig. 35), (compared to the 200 km that separate the Nevado from the Andes), with an area of intermediate altitude between them. This could have favoured the flow of the scorpion fauna between both areas up to a recent past.

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