



First Harvestman Record for the Juan Fernández Archipelago, Chile, with Morphological Notes on *Acropsopilio chilensis* (Opiliones: Caddidae: Acroposopilioninae)

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Abstract

Acropsopilio chilensis Silvestri, 1904 (Eupnoi: Caddidae: Acroposopilioninae), is recorded for Robinson Crusoe Island, Chile. This is the first harvestman species recorded for the Juan Fernández Archipelago and also the first extra-continental record for this species. During the comparison with continental co-specific specimens, some previously unknown, remarkable morphological characteristics were discovered, among them: the absence of ovipositor seminal receptacles and tracheal system, small and probably imperforate spiracles and the presence of a subdistal spiny structure, maybe a stylus, in the major branch of the penis.

Key words: Opiliones, Eupnoi, genital morphology, respiratory system, volcanic island, biodiversity

Introduction

The Juan Fernández Archipelago is one of the priority sites for nature conservation worldwide, and was declared a Chilean National Park in 1935 and Biosphere Reserve in 1977. Because of its isolation and recent volcanic origin, this archipelago of the Nazca Plate represents an exceptional laboratory for understanding evolutionary and biogeographical processes modeling the flora and fauna of isolated islands and contributions that increase the knowledge of its biota are highly valuable.

The volcanic origin of the archipelago was dated as ranging between 1–4 mya. (Stuessy *et al.* 1984), and its terrestrial biota is a mosaic resulting from spatially and historically diverse dispersal events mainly originating from South and Central America, Polynesia and New Zealand (Danton 2004). Some groups exhibit a considerably high degree of endemism, such as vascular plants (60–70%, Hoffman & Marticorena 1987; Stuessy *et al.* 1984) and arthropods (60–70%, Peña 1987). Harvestmen have not been recorded from the archipelago up to now. The goal of the present contribution is to report the occurrence of a representative of this order on the archipelago as well as to clarify some obscure morphological aspects of the recorded species.

Material and methods

The newly recorded specimens were collected on the Robinson Crusoe Island located 670 km west of continental Chile in the Pacific Ocean (Fig. 1). For comparison continental specimens from the arachnological collection of the Argentinean Museum of Natural Sciences (MACN-Ar) were also studied. Field collections were conducted from February 16 to February 20, 2011, using pitfall traps. The traps consisted of two plastic cups of 7.4 × 10.2 cm and

7.6 × 12.0 cm in size placed inside each other, so the smaller was easy to remove. This inner cup was filled to one third of its capacity with a mixture of water (80%), ethanol (10%) and laundry detergent (10%). The traps operated for four days. All collected specimens were deposited at the MACN-Ar.

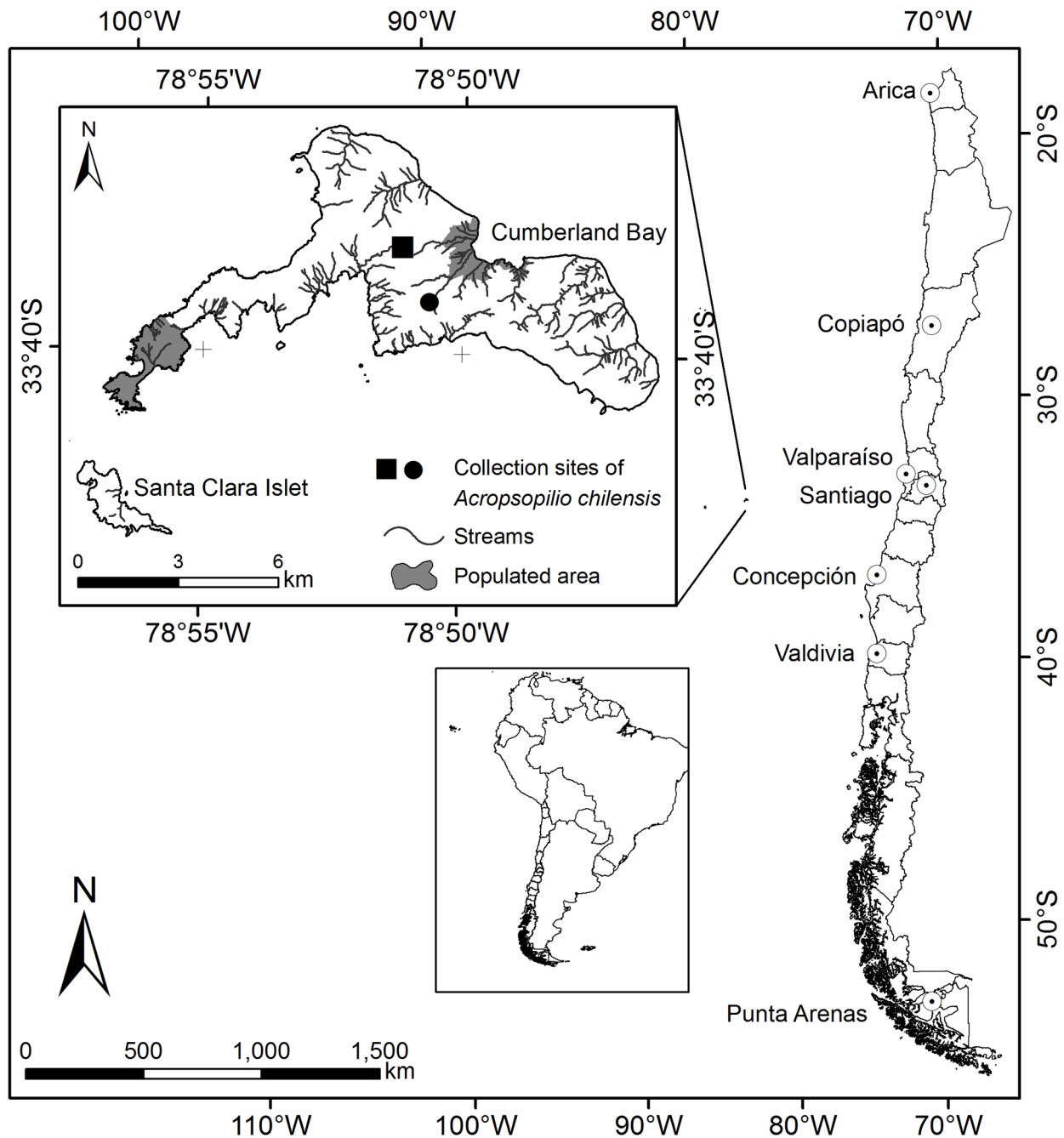


FIGURE 1. Map showing the collection sites of *Acropsopilio chilensis* on Robinson Crusoe Island. Solid circle represents the collection locality with environment dominated by *Myrceugenia fernandeziana* (Myrtaceae) and solid square the collection locality with environment dominated by an association between *Thyrsopteris elegans* (Thyrsopteridaceae) and a *Dicksonia berteriana* (Dicksoniaceae).

For investigation female ovipositors were temporarily mounted in clove oil, and male genitalia in glycerol. To search for expansible areas in the male genitalia, the penis was immersed in hot lactic acid for 10 minutes and then transferred to distilled water (Acosta *et al.* 2007). The genitalia were drawn using a *camera lucida* attached to an Olympus BH-2 compound microscope. Photomicrographs were made with a Nikon DXM1200 digital camera and stereomicroscope preparations with a Leica DFC 290 digital camera attached to a Leica M165C stereomicroscope, and the focal planes stacked with Helicon Focus 3.10.3 and 4.62 Pro (www.heliconsoft.com).

In order to check for the existence of a tracheal system, one specimen was dissected and digested in hot 10% KOH solution, then mounted and observed under a scanning electron microscope (SEM). For SEM preparation the specimens were dehydrated using increasing concentrations of ethanol (80%, 90%, 95%, 100%), and finally critical-point dried. They were mounted on adhesive copper tape (Electron Microscopy Sciences, EMS 77802) affixed to a stub. Prior to examination under high vacuum with a FEI XL30 TMP, surfaces were sputter-coated with Au-Pd.

Specimens examined: *Acropsopilio chilensis* Silvestri, 1904: CHILE: Región V: Juan Fernández Archip.: Is. Robinson Crusoe, área de Plazoleta El Yunque, 33.65276S 78.84403W (GPS ± 25 m), 299m a.s.l., 16–20.Feb.2011, *Myrceugenia fernandeziana* forest, Plot 1, pitfall trap, Ramírez M., Soto E., Pizarro J. (MJR-loc-05), two females (MACN-Ar 31083); as previous but trail behind the Selkirk overlook (Mirador Selkirk), 33.63790S 78.85302W (GPS ± 110 m), 460–470m a.s.l., 20.Feb.2011, *Myrceugenia fernandeziana* forest with arboreal ferns, pitfall trap, Ramírez M., Soto E., Pizarro J. (MJR-loc-12), one female (MACN-Ar 31088). Región IX: Cautín Prov.: Parque Cerro Nielol, Temuco, 15.Jan.1989, Maury E. leg., 12 females (MACN-Ar 31085). Región X: Osorno Prov.: Camping "No me olvides", 7 km. E de Entrelagos, 30.Jan.1991, Maury E. leg., one male and two females (MACN-Ar 31087). ARGENTINA: Santa Cruz Prov.: Arroyo Las Monjas (15 km E of Glaciar Perito Moreno), 23.Jan.1988, Maury E. leg., one female (MACN-Ar 31086).

Characterization of the collection locality: The Robinson Crusoe Island has a Mediterranean-type climate moderated by maritime influences, with an average annual temperature of 15°C. Temperatures average 18.7°C in the summer and 7.3°C in the winter with extremes of 25°C in February and 3°C in August (Juan Fernández Archipelago; Hajek & Espinoza 1987). Precipitation is frontal during the winter and convectional in the summer, with rain about every three days following accumulation of sufficient humidity in summer. The annual precipitation is 1041.5 mm with 75.8% of the total precipitation between April and October. The highest rainfall recorded over a calendar month occurs in June (173 mm) and the lowest in January (28 mm) (Novoa & Villaseca 1989). The harvestmen were collected in two different habitats: one dominated by *Myrceugenia fernandeziana* (Hooker & Arnott) Johow (Myrtaceae) (endemic upper montane forest), also including populations of *Drimys confertifolia* Phil (Winteraceae) and a few specimens of *Gunnera bracteata* Steud. ex Benn (Gunneraceae), a species that occurs at low altitudes in forest openings and in the most humid part of the Plazoleta el Yunque; and a second one dominated by a community of arboreal ferns, an association between *Thyrsopteris elegans* (Thyrsopteridaceae) and *Dicksonia berteriana* (Colla) Hook. (Dicksoniaceae), including *Drimys confertifolia* and *Myrceugenia fernandeziana* specimens (Greimler *et al.* 2002). All the specimens from Robinson Crusoe Island were collected in forested areas, but no significant collection effort was made in urbanized areas (Fig. 1).

Results and discussion

Only two pitfall traps included a total of three opilionid specimens of a single species. All specimens were congruent in external and ovipositor morphology with *Acropsopilio chilensis* Silvestri, 1904 (Eupnoi: Caddidae: Acropsopilioninae). We compared with continental specimens identified by Maury *et al.* (1996) as *A. chilensis*, collected in Cerro Nielol [38.716776S 72.585510W], less than 30 km from the type locality (Pitrufquén) in Chile. This material had already been compared with the holotype of *A. chilensis* (Capocasale 2004b), confirming Maury's identification (Capocasale 2004b). Our material hence represents the first harvestmen species recorded for the Juan Fernández Archipelago.

The Robinson Crusoe specimens differ only slightly from the continental ones. External coloration is darker and one additional ventral minor setiferous tubercle on the femur of the pedipalp (Fig. 2) is present, a characteristic that was also reported in the specimen illustrated by Canals (1932) (sub *Acropsopilio chilensis* var. *Ogloblini* [Sic.]) and Capocasale (2004a: fig. 1).

The specimens from Robinson Crusoe have a small prong on their female genitalia, in one of the major branches of the ovipositor *sensillum* (Fig. 3a). This small prong was also observed in specimens of *Acropsopilio chilensis* from Arroyo Las Monjas, near Glaciar Perito Moreno, Argentina (Fig. 3b) but its absent in a Cerro Nielol-female from near the type locality in continental Chile (Fig. 3c). All these small differences are herein interpreted as intraspecific variations.



FIGURE 2. *Acropsopilio chilensis* MACN-Ar 31083 (Robinson Crusoe Island, Chile). Female. (a) lateral view; (b) dorsal view. Arrow points to the additional ventral minor setiferous tubercle on the femur of the pedipalp.

All the specimens collected were females. Parthenogenesis was suggested as one of the probable causes for the paucity of collected males in some species of Caddidae (Shear 1975), including several Acropsopilioninae such as *Acropsopilio boopsis* (Crosby), *A. chomulae* (Goodnight & Goodnight), *A. neozealandiae* (Forster) and *A. chilensis* (Shear 1996, 2004; McCartney *et al.* 2007). Up to now, of 128 specimens reported of *A. chilensis* (Silvestri 1904; Canals 1932; Ringuet 1959, 1962; Cekalovic 1974, 1985; Gruber 1974; Shear 1975; Kury 1994; Maury *et al.* 1996; Capocasale 2004a) only one male was detected (Capocasale 2004a), rendering parthenogenesis as most plausible explanation.

Acropsopilio chilensis seems to be widespread in South America (Maury *et al.* 1996: fig. 1). Most records are from the southern part of the Andean Region, but populations have been recorded in the Yungas (Argentina), Paranaense (Argentina, Brazil) and Serra do Mar (Brazil) regions (Maury *et al.* 1996), forming an interesting disjunct pattern. Outside these regions the species was also recorded from Punta Lara (Buenos Aires, Argentina) and Arequita (Lavalleja, Uruguay) (Ringuet 1962, Capocasale 2004a).

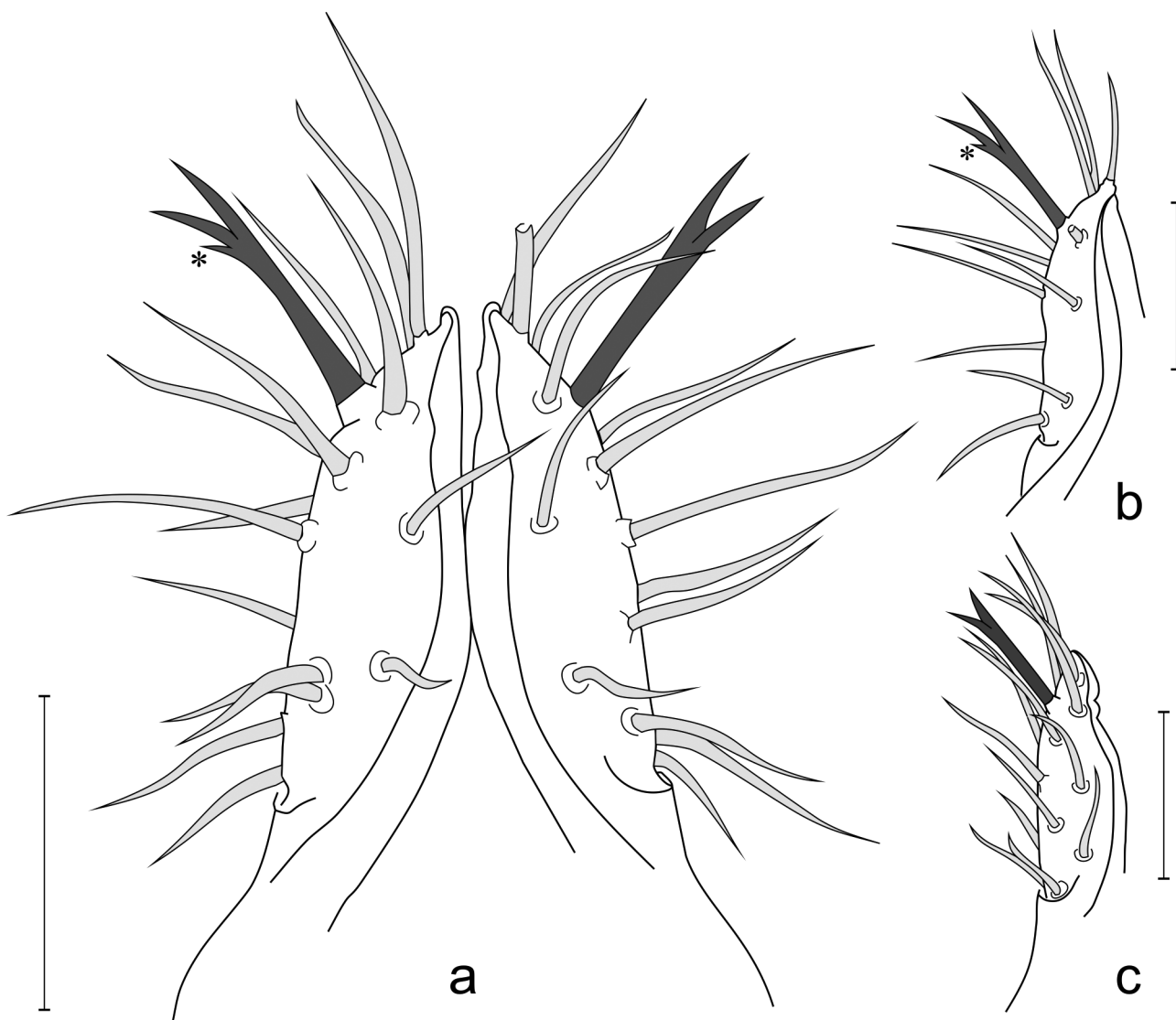


FIGURE 3. *Acropsopilio chilensis*. (a) Ovipositor tip from MACN-Ar 31083 (Robinson Crusoe Island, Chile); (b) left furca from MACN-Ar 31086 (Arroyo Las Monjas, Argentina); (c) left furca from MACN-Ar 31085 (Parque Cerro Nielol, Chile). Sensillum in dark grey. Asterisk indicate small additional prong in one of the major branches of the ovipositor sensillum.

Despite this extensive geographical distribution, the Robinson Crusoe Island specimens constitute the first extra-continental record for *Acropsopilio chilensis*. Transoceanic dispersal across the Pacific was recently suggested for zalmoxid harvestmen (Sharma & Giribet 2012). Natural processes or synanthropic introduction both could explain the presence of *A. chilensis* on Robinson Crusoe Island, but future molecular work may help estimating the age of colonization. The great morphological similarity seems to be one of the problems in *Acropsopilio* species recognition; McCartney *et al.* (2007) stated that *A. neozealandiae* appears to be virtually identical to *Acropsopilio australicus* Cantrell from Queensland but recognized that: "... further morphological and genetic research is clearly required to establish if these are indeed two species, or whether there is one widespread species that shows little variation between countries separated by several thousand kilometers of ocean...". *Acropsopilio boopis*, *Caddo agilis* Banks and *Caddo pepperella* Shear, have been recorded as both eastern North American and Japanese populations (Suzuki 1976). Shultz and Regier (2009) recently proved divergence of these two *Caddo* species before acquiring their disjunct geographic distributions. These authors supported Suzuki's (1976) habitat-fragmentation instead of Shear's (1975, 1996, 2004) parallel evolution hypothesis to explain this biogeographic pattern (Shultz & Regier 2009).

Morphological remarks on *Acropsopilio chilensis*

Ovipositor.—The ovipositors of the Robinson Crusoe specimens exhibit apically two strong bifid sensilla (with or without small prong in major branches) seen as well in the ovipositors of specimens from continental Chile and Argentina (Figs. 3 and 4, also see Capocasale 2004a: fig. 3). Bifid sensilla are also present in *Acropsopilio australicus*, *A. chomulae* and *A. neozealandiae* but seem absent in *A. boopsis* and *Acropsopilio venezuelensis* González-Sponga, but the drawings provided for this latter species (González-Sponga 1995) are very schematic and therefore the ovipositor morphology of this species needs to be re-studied.

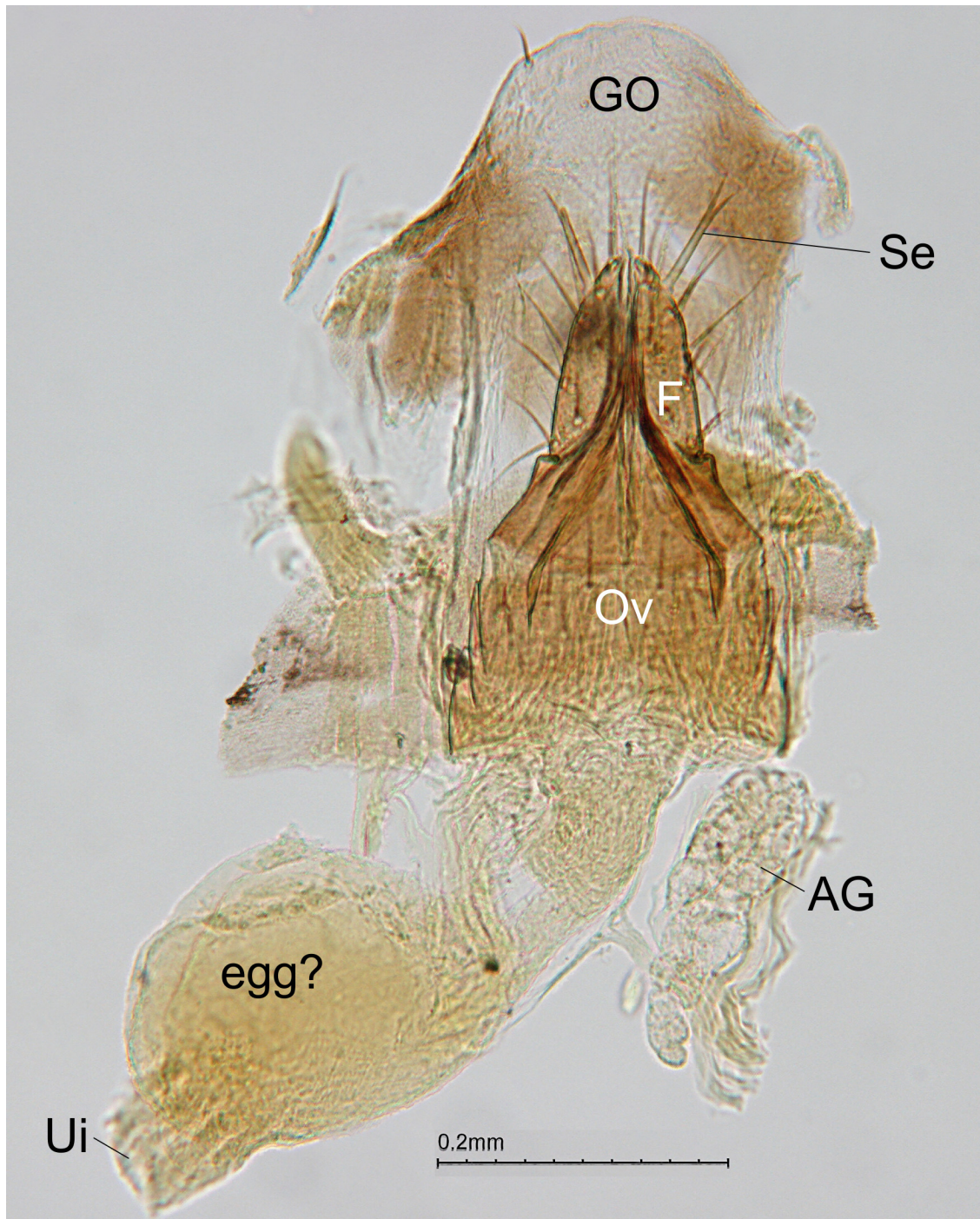


FIGURE 4. *Acropsopilio chilensis* MACN-Ar 31085 (Parque Cerro Ñielol, Chile). Dorsal view of ovipositor. GO: genital operculum; Se: sensillum; F: furca; Ov: ovipositor; AG: accessory gland; Ui: uterus internus.

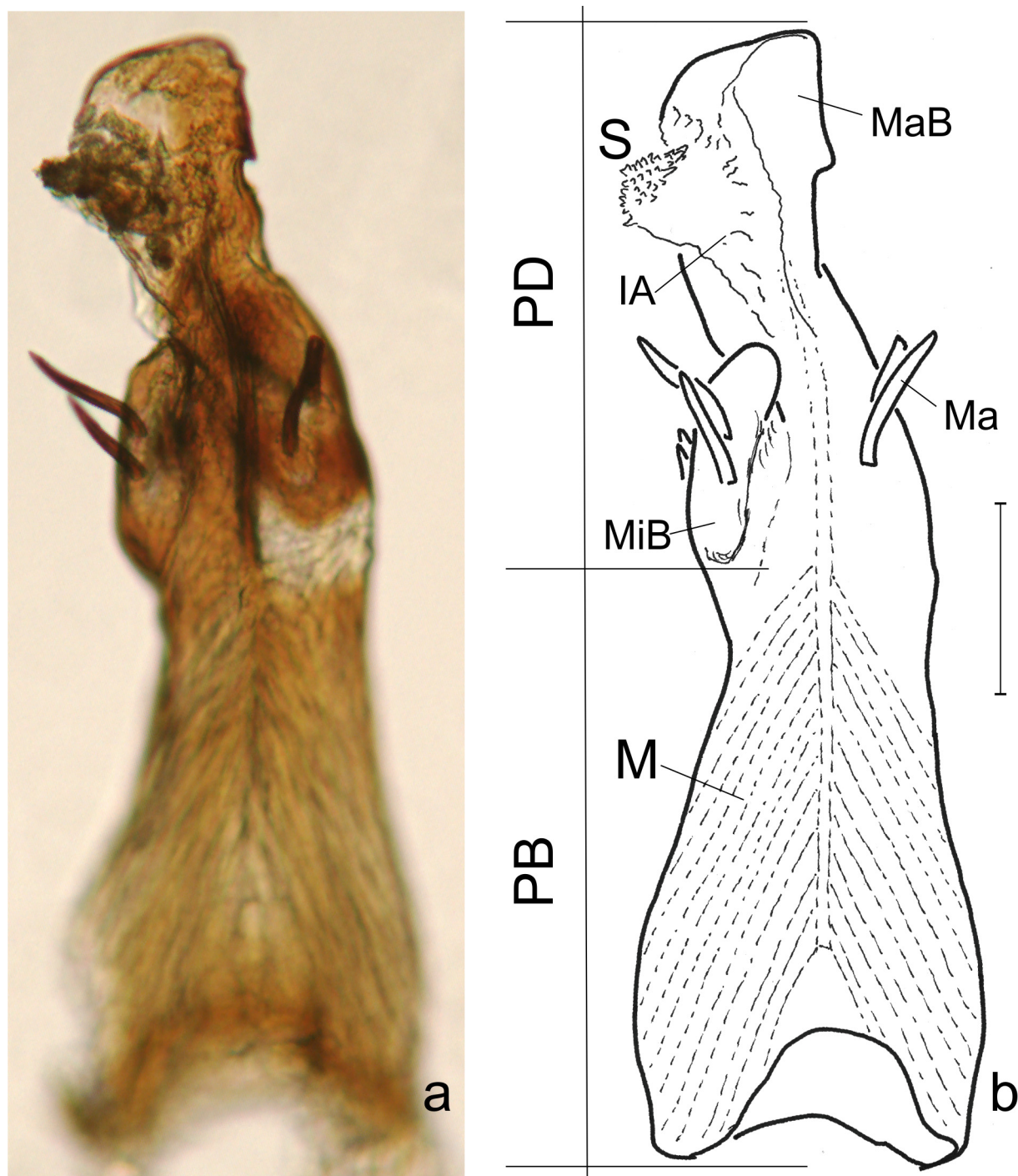


FIGURE 5. *Acropsopilio chilensis* MACN-Ar 31087 (Camping "No me olvides", 7 km. E de Entrelagos, Chile). (a) penis picture showing the strong sclerotization; (b) penis drawing showing the internal musculature and component parts; (a–b) penis not expanded. IA: inflatable area; M: muscles; Ma: macrosetae; MaB: major branch; MiB: minor branch; PB: pars basalis; PD: pars distalis; S: stylus?. Scale bar = 100 μ m.

Seminal receptacles were not detected in any of the ovipositors studied (either from Robison Crusoe Island or continental localities). They also lack in other species of *Acropsopilio* such as in *A. neozealandiae*, *A. boopsis* and *A. chomulae* (Forster, 1948; Suzuki, 1976 and Shear, 2004 respectively) and may be indicative for parthenogenesis (Shear 2004). We also observed a large uterus internus with accessory glands (Fig. 4).

Penis.—The penis of *Acropsopilio chilensis* was first studied by Capocasale (2004a), but only one view was illustrated (Capocasale 2004a, fig. 4). A reexamination of this structure (Figs. 5–7) allows us to describe additional features. The muscular-type penis is highly asymmetric with one major and one minor branch in the pars distalis

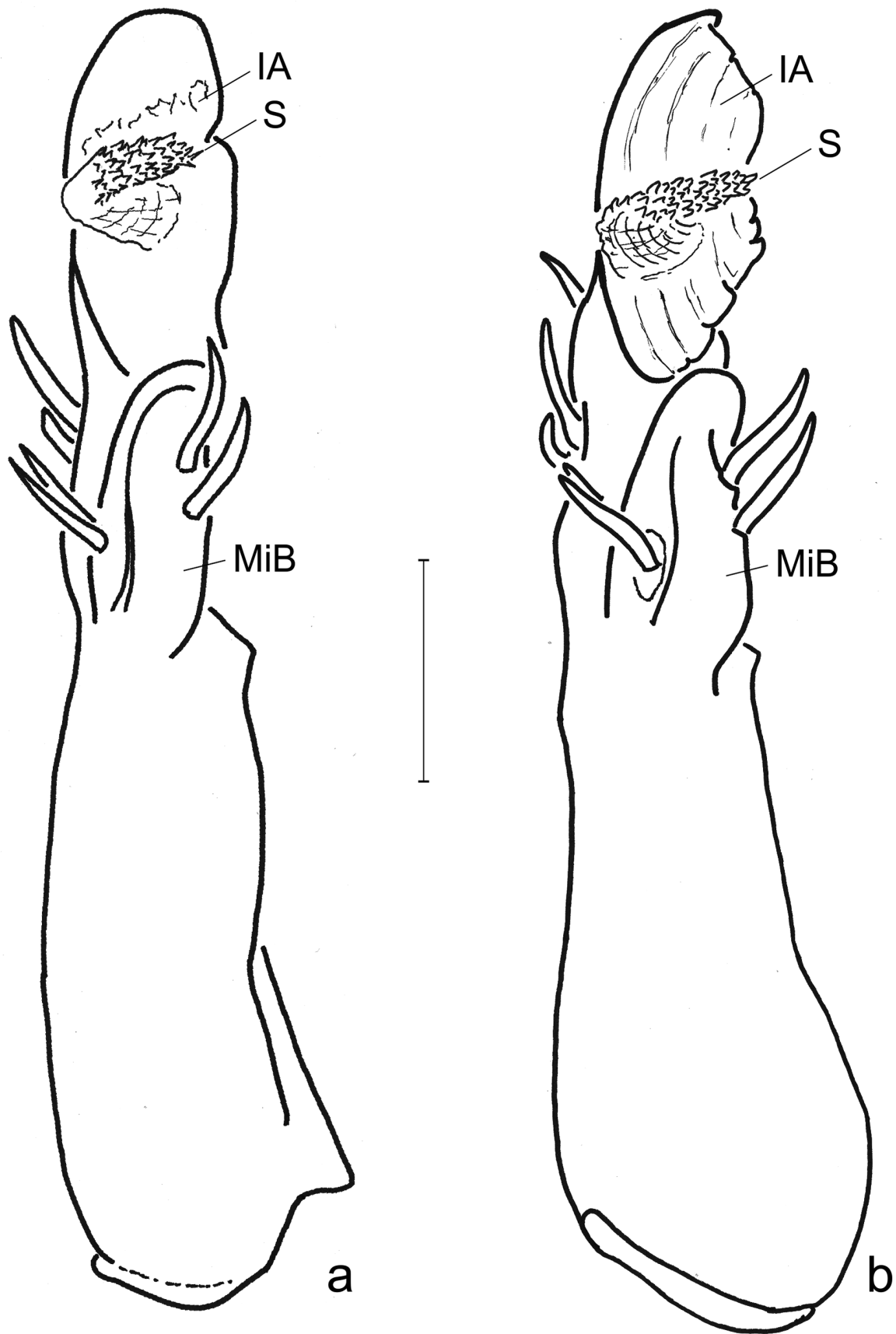


FIGURE 6. *Acropsopilio chilensis* MACN-Ar 31087 (Camping "No me olvides", 7 km. E de Entrelagos, Chile). (a–b) penis (the drawings correspond with a penis clock-wise rotated in respect to Fig. 5). (a) penis not expanded. (b) penis expanded. IA: inflatable area; MiB: minor branch; S: stylus?. Scale bar = 100 μ m.

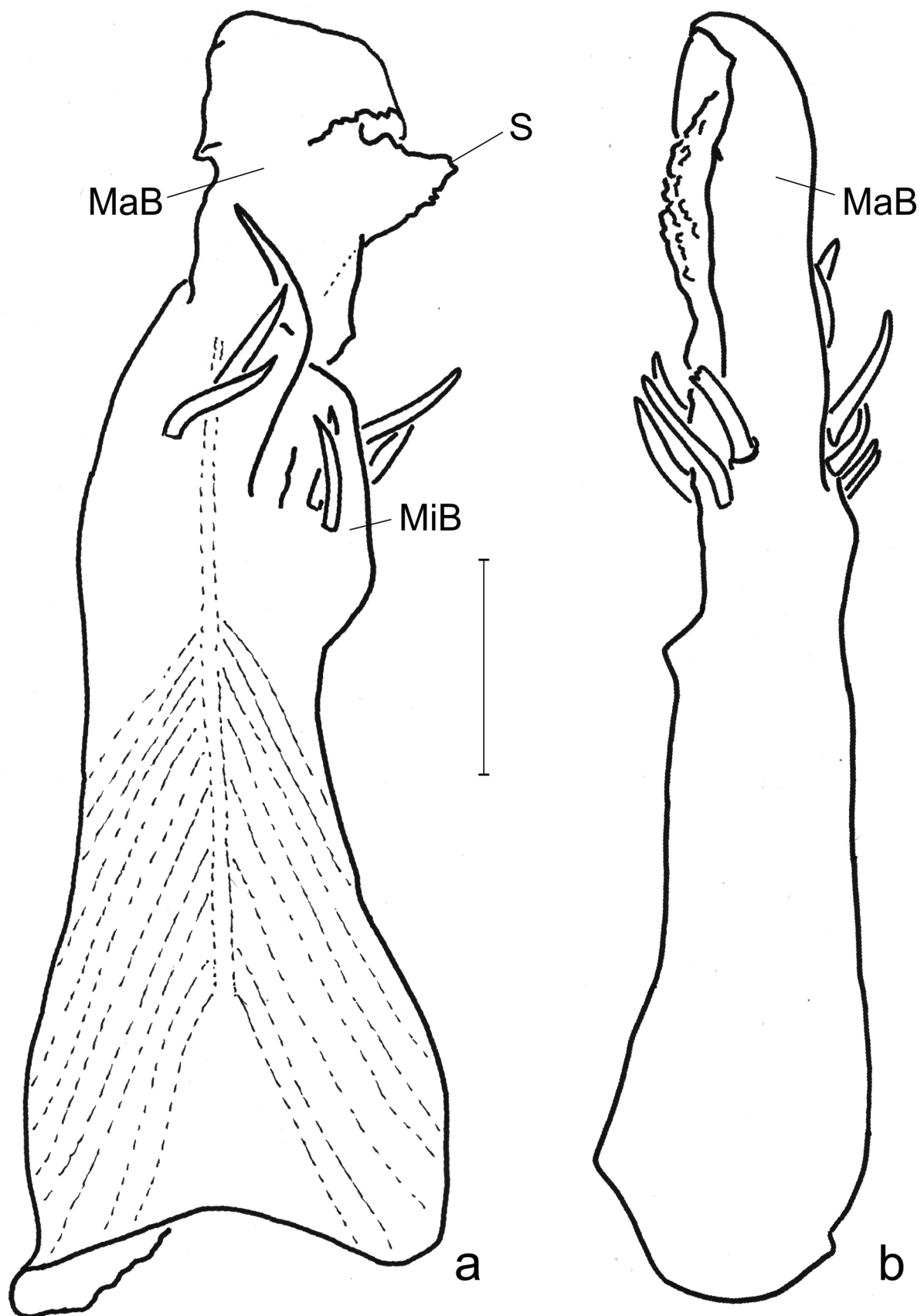


FIGURE 7. *Acropsopilio chilensis* MACN-Ar 31087 (Camping "No me olvides", 7 km. E de Entrelagos, Chile). (a–b) penis not expanded; (a) the drawing correspond with an about 90° clock-wise rotated penis in respect to Fig. 6a; (b) the drawing correspond with an about 180° clock-wise rotated penis in respect to Fig. 6a. MaB: major branch; MiB: minor branch; S: stylus?. Scale bar = 100 μ m.

(Fig. 5 b). The nine strong macrosetae are located basally in the pars distalis (Figs. 5–7) and sub-apically the major branch has a curved and spiny structure (maybe a stylus) (Figs. 5b, 6). The heavily sclerotized penis (Fig. 5a) thus forms a rigid structure and no evidence was seen of articulations among any compounded parts. The expanded penis shows only a small membranous-inflatable area at the base of the spiny structure (Fig. 6b, compare vs 6a); no other deformations were observed.

The only other penial morphology described within the genus was illustrated by Gonzalez-Sponga (1995) for *Acropsopilio venezuelensis*, but this apparently looks different from the *A. chilensis* penis. The drawing of Gonzalez-Sponga (1995) is very schematized and does not allow an objective comparison. The penial morphology of *A. chilensis* exhibits more affinities with the South African species of *Cadella* Hirst, sharing the asymmetry (major and minor branches), strong macrosetae and distal membranous areas, but lacking the pseudo-articulation between shaft/corpus penis and glans such as in *Caddella haddadi* Lotz, 2011 (see Lotz 2011, figs. 7–8).

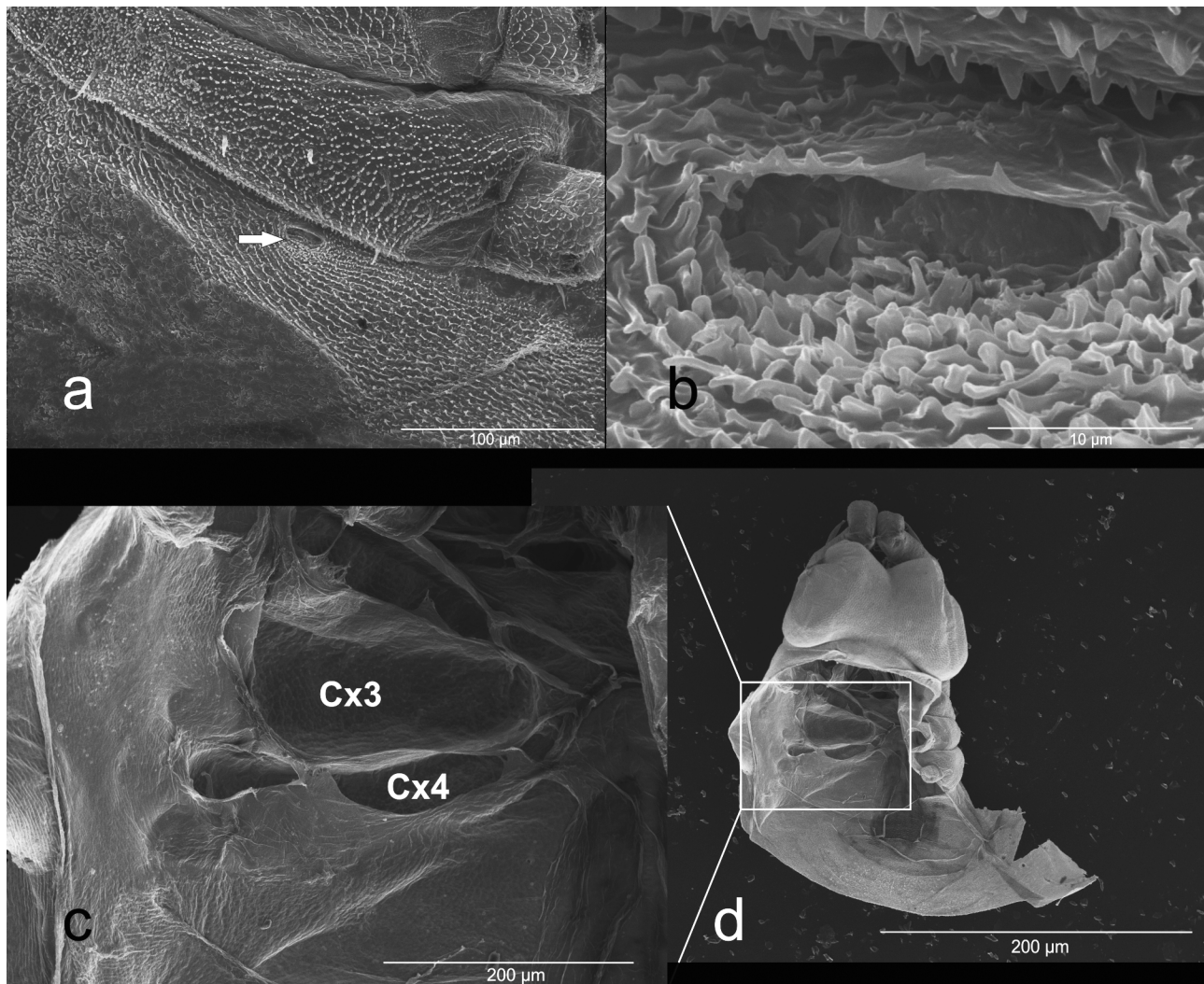


FIGURE 8. *Acropsopilio chilensis* MACN-Ar 31085 (Parque Cerro Ñielol, Chile). (a) ventral view of left coxa IV showing small spiracle (arrow). (b) detail of spiracle. (c) detail of dorsal left side (digested) showing the absence of tracheal tubes. (d) dorsal view of dissected and digested specimen to show position of Fig. 8c. Cx3: coxa III; Cx4: coxa IV.

Remarks on genital terminology: Caddoid penes show two extreme types: the “Phalangiid-like” penis of *Caddo agilis* (see Gruber 1974) versus the shorter “spiny asymmetrical” of *Caddella* spp., *Austropsopilio* and *Acropsopilio* spp. For *Cadella capensis* Hirst (1925) stated the “distal part of penis strengthened by chitinous strips and furnished with spines”; his “distal part” is probably homologous with the *pars distalis* concept used in this article (see below for *pars distalis* definition). Kauri (1961) divided the penis of *C. africana* in three areas: corpus penis (basal part), Mittelstück (central part) and Eichel (glans) with a spirally coiled thin stylus called a “Muto”. Shear (1975) described the penis of Acropsopilioninae as: “Penis complex, composed of several plates and

articulated spines, bearing a membranous glans and sometimes subject to 180 degrees of torsion" and recognized for *C. capensis* "four basic plates, two proximal and two distal" with a distal membranous glans. Starega (1988) described the penis of *Caddella croeseri* Starega, 1988, as containing three asymmetric parts: basal part (truncus), middle part (glans) and distal part (a membranous stylus). Lotz (2011) recognizes a "mid region" (with spines) and a glans for *C. haddadi*. As we can see, the terminology used to describe male genital structures of the "spiny asymmetrical" type and in Caddidae is very heterogeneous. The standardization of terminology for male genital morphology in this group of harvestmen exceeds the goal of the present contribution and deserves a further detailed study. Here we follow the terminology used by Macías-Ordoñez *et al.* (2011), defining a *pars basalis* as corresponding to most of the long shaft called the *truncus*; and a *pars distalis* as corresponding to the distal end of the *truncus* and the terminal or subterminal glans.

Tracheal system.—The spiracle of *Acropsopilio chilensis* are very small and seem to be imperforated (Fig. 8a, b) as was observed in *A. chomulae* (Shear 2004) but scanning micrograph did not allow resolution of the deepest layer. Ventrally no tracheal tubes were observed (Fig. 8c, d).

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References

- Acosta, L.E., Pérez-González, A. & Tourinho, A.L. (2007) Methods and Techniques of Study: Methods for taxonomic study. In: Machado, G., Pinto-da-Rocha, R. & Giribet, G. (Eds), *Harvestmen, the biology of Opiliones*. Harvard University Press, Cambridge, Massachusetts and London, pp. 494–505.
- Canals, J. (1932) Hallazgo de una variedad del "*Acropsopilio chilensi*" Silv. en nuestro país. (Nota previa). *Physis*, Sección C, 11, 150–154.
- Capocasale, R.M. (2004a) New data on *Acropsopilio chilensis*, Silvestri 1904 (Opiliones, Caddidae) with the description of the male. *Revista Ibérica de Aracnología*, 9, 287–290.
- Capocasale, R.M. (2004b) Un nuevo sinónimo de *Acropsopilio chilensis* Silvestri: *Acropsopilio normae* Cekalovic (Opiliones, Caddidae). *Revista Ibérica de Aracnología*, 10, 313–314.
- Cekalovic, T. (1974) *Acropsopilio normae* n. sp. de Opiliónido para la fauna chilena (Arachnida, Opiliones, Acropsopilionidae). *Boletín de la Sociedad de Biología de Concepción*, 48, 23–31.
- Cekalovic, T. (1985) Catálogo de los Opiliones de Chile (Arachnida). *Boletín de la Sociedad de Biología de Concepción*, 56, 7–29.
- Danton, P.H. (2004) *Plantas Silvestres de la Isla Robinson Crusoe guía de reconocimiento*. Corporación Nacional Forestal, Región de Valparaíso, Viña del Mar, Chile, 194 pp.
- Forster, R.R. (1948) A new genus and species of the Family Acropsopilionidae (Opiliones) from New Zealand. *Transactions of the Royal Society of New Zealand*, 77, 139–141.
- González-Sponga, M.A. (1995) Arácnidos de Venezuela. Nueva especie del género *Acropsopilio* de la Cordillera de la costa (Caddidae). *Boletín de la Academia de Ciencias Físicas, Matemáticas y Naturales*, 52, 167–168. [spurious printed date "1992"], 43–51.
- Greimler, J., López, P., Stuessy, T.F. & Dirnböck, T. (2002) The Vegetation of Robinson Crusoe Island (Isla Masatierra), Juan Fernández Archipelago, Chile. *Pacific Science*, 56, 263–284.
<http://dx.doi.org/10.1353/psc.2002.0022>
- Gruber, J. (1974) Bemerkungen zur Morphologie und systematischen Stellung von *Caddo*, *Acropsopilio* und verwandter

- Formen (Opiliones, Arachnida). *Annalen Naturhistorisches Museum in Wien*, 78, 237–259.
- Hajek, E. & Espinoza, G. (1987) Meteorología, Climatología y Bioclimatología de las Islas oceánicas chilenas. In: Castilla, J.C. (Ed.), *Islas Oceánicas Chilenas: Conocimiento Científico y Necesidades de investigación*. Pontificia Universidad Católica de Chile, Santiago, Chile, pp. 55–83.
- Hirst, A.S. (1925) On some new genera and species of Arachnida. *Proceedings of the Zoological Society of London*, 95 (4), 1271–1280.
<http://dx.doi.org/10.1080/03014220709510070>
- Hoffman, A.J. & Marticorena, C. (1987) La vegetación de las islas oceánicas chilenas. In: Castilla, J.C. (Ed.), *Islas Oceánicas Chilenas: Conocimiento Científico y Necesidades de investigación*. Pontificia Universidad Católica de Chile, Santiago, Chile, pp. 127–165.
- Kauri, H. (1961) Opiliones. In: Hanström, B., Brinck, P. & Rudebeck, G. (Eds.), *South African animal life. Results of the Lund University Expedition in 1950–1951. Vol. 8*. Almqvist & Wiksell, Uppsala, pp. 9–197.
- Kury, A.B. (1994) O registro mais setentrional de Caddidae na América do Sul (Arachnida, Opiliones, Palpatores). In: *Resumos do XX Congresso Brasileiro de Zoologia*, 72 pp.
- Lotz, L.N. (2011) Three new harvestmen species from southern Africa (Arachnida: Opiliones: Caddidae, Neopilionidae, Assamiidae). *Journal of Afrotropical Zoology*, 7, 3–8.
- Macías-Ordóñez, R., Machado, G., Pérez-González, A. & Shultz, J. (2010) Genitalic Evolution in Opiliones. In: Leonard, J. & Córdoba-Aguilar, A. (Eds.), *The Evolution of Primary Sexual Characters in Animals*. Oxford University Press, New York, pp. 285–306.
- Maury, E.A., Pinto da Rocha, R. & Morrone, J.J. (1996) Distribution of *Acropsopilio chilensis* Silvestri, 1904 in southern South America (Opiliones, Palpatores, Caddidae). *Biogeographica*, 72 (3), 127–132.
- McCartney, J., Shear, W.I. & Stringer, A.N. (2007) New records of *Acropsopilio neozelandiae* (Forster), and remarks on the sexual status of the species (Arachnida: Opiliones: Caddidae). *New Zealand Journal of Zoology*, 34 (2), 117–123.
<http://dx.doi.org/10.1080/03014220709510070>
- Novoa, R. & Villaseca, S. (1989) *Mapa Agroclimático de Chile*. Ediciones Instituto de Investigaciones Agrarias, INIA, Ministerio de Agricultura, Santiago, Chile, 221 pp.
- Peña, L.E. (1987) Consideraciones sobre la fauna de artrópodos terrestres de las islas oceánicas chilenas. In: Castilla, J.C. (Ed.), *Islas oceánicas chilenas: conocimiento científico y necesidades de investigaciones*. Ediciones Universidad Católica de Chile, Santiago, pp. 217–223.
- Ringuelet, R.A. (1959) Los arácnidos Argentinos del Orden Opiliones. *Revista del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"*, 5 (2), 126–439.
- Ringuelet, R.A. (1962) Notas sobre Opiliones. I. *Acropsopilio oglobini* Canals en la selva marginal de Punta Lara y la ubicación taxonómica de género *Acropsopilio* Silvestri. *Physis*, 23, 77–81.
- Sharma, P.P. & Giribet, G. (2012) Out of the Neotropics: Late Cretaceous colonization of Australasia by American arthropods. *Proceedings of the Royal Society of London B: Biological Sciences*, 279, 3501–3509.
<http://dx.doi.org/10.1098/rspb.2012.0675>
- Shear, W.A. (1975) The opilionid family Caddidae in North America, with notes on species from other regions (Opiliones, Palpatores, Caddoidea). *Journal of Arachnology*, 2, 65–88.
- Shear, W.A. (1996) *Hesperopilio mainae*, a new genus and species of harvestman from Western Australia (Opiliones: Caddidae: Acropsopilioninae). *Records of the Western Australian Museum*, 17, 455–460.
- Shear, W.A. (2004) Description of the female of *Acropsopilio chomulae* (Goodnight & Goodnight 1948) from Chiapas, Mexico (Opiliones, Caddidae, Acropsopilioninae). *Journal of Arachnology*, 32, 432–435.
<http://dx.doi.org/10.1636/h03-57>
- Shultz, J.W. & Regier, J.C. (2009) *Caddo agilis* and *C. pepperella* (Opiliones, Caddidae) diverged phylogenetically before acquiring their disjunct, sympatric distributions in Japan and North America. *Journal of Arachnology*, 37, 238–240.
<http://dx.doi.org/10.1636/h08-66.1>
- Silvestri, F. (1904) Descrizione di un nuovo genere di Opilioni del Chile. *Redia*, 2, 254–256.
- Staręga, W. (1988) A new species of *Caddella* (Opiliones: Caddidae) from South Africa. *Annals of the Natal Museum*, 29, 529–532.
- Stuessy, T.F., Foland, K.A., Sutter, J.F., Sanders, R.W. & Silva, M. (1984) Botanical and geological significance of potassium-argon dates from Juan Fernández Islands. *Science*, 225, 49–51.
<http://dx.doi.org/10.1126/science.225.4657.49>
- Suzuki, S. (1976) The harvestmen of family Caddidae in Japan (Opiliones, Palpatores, Caddoidea). *Journal of Science, Hiroshima University, Series B, Div. 1 (Zoology)*, 26, 261–273.