

Revision of the genus *Sofia* Arias, 2005, from Southern Chile (Coleoptera, Elateridae, Pomachiliini)

by Elizabeth T. ARIAS-BOHART

Essig Museum of Entomology, University of California 1101 Valley Life Sciences Building,
Berkeley 94720, California, U.S.A. <etarias.bohart@berkeley.edu>

Abstract. – A revision of the Southern South American genus *Sofia* Arias, 2005 (type-species: *Nemasoma sulcatum* Solier, 1851, by monotypy), is presented with new distributional information. Two species are included: *Sofia sulcata* (Solier, 1851) and *S. flordelago* n. sp.

Résumé. – Révision du genre *Sofia* Arias, 2005, du Chili méridional (Coleoptera, Elateridae, Pomachiliini). Le genre *Sofia* Arias, 2005, du sud de l'Amérique latine (espèce-type: *Nemasoma sulcatum* Solier, 1851, par monotypie), est révisé et de nouvelles données sur sa répartition géographique sont apportées. Deux espèces sont à présent incluses dans le genre: *Sofia sulcata* (Solier, 1851) and *S. flordelago* n. sp.

Resumen. – Revisión del género *Sofia* Arias, 2005, del sur de Chile (Coleoptera, Elateridae, Pomachiliini). Se presenta la revisión del género del sur de América del sur, *Sofia* Arias, 2005 (especie-tipo: *Nemasoma sulcatum* Solier, 1851, por monotipia), se proporciona su distribución, y dos especies: *Sofia sulcata* (Solier, 1851) y *S. flordelago* n. sp.

Keywords. – Elaterinae, *Sofia*, South America, Chile, revision, taxonomy, new species.

In 1851, SOLIER described the genus *Nemasoma* with only one species, *N. sulcatum*. However, the genus name was preoccupied by *Nemasoma* Koch, 1847 (Myriapoda, Diplopoda). *Sofia* is the replacement name (ARIAS, 2005).

During several expeditions to southern Chilean temperate rain forests, a new species of the genus *Sofia* was discovered mainly in the canopy of *Nothofagus* trees (ARIAS *et al.*, 2008).

MATERIALS AND METHODS

Specimens and primary types repositories are from institutional and private collections. Abbreviations used here follow those provided by the collection holder or ARNETT *et al.* (1993).

Conventions. – ANIC, Australian National Insect Collection, Canberra, Australia; BMNH, The Natural History Museum, London, England; CAS, California Academy of Sciences, San Francisco, California, USA; EMEC, Essig Museum of Entomology, Berkeley, California, USA; ETA, Elizabeth Arias-Bohart private collection (Berkeley, California); IFML, Instituto Fundación Miguel Lillo, Tucumán, Argentina; IRSNB, Institut Royal des Sciences naturelles de Belgique, Brussels, Belgium; MNHN, Muséum national d'Histoire naturelle, Paris, France; MNNC, Colección Nacional de Insectos, Museo Nacional de Historia Natural, Santiago, Chile; SRC, Sergio Riese private collection, Genova, Italy; ZMHB, Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

Type specimens repositories are indicated in descriptions. Measurements were made with a calibrated ocular micrometer as follows: total body length from the frontal margin to elytral apex; elytral length and maximum width of the elytra, when both sides are in focus.

Morphometric indices were calculated as follows.

- The eyes index EI was obtained by subtracting the width between the eyes by the maximum width including the eyes, and dividing it by the maximum width between the eyes.
- The body index BI, by dividing the total body length by the maximum body width.
- The pronotal index PI, by dividing the length of the pronotum at midline by the width of the pronotum at the base of anterior angles.

– The pronotal elytral index PEI, by dividing the length of the pronotum by the length of the elytra (CALDER, 1996).

– The elytral index ELI, is obtained by dividing the length of the elytra from edge of humeri to elytral apex, by the maximum width of the elytra.

– The antennomere proportion AP lists the lengths of antennomeres 2 through 11 (antennomere 1 is difficult to measure because it is curved), as percentage of the total antennal length. Length is measured in lateral view.

– The tarsomere proportion TP lists the lengths of tarsomeres 1 through 5, as percentages of the total tarsus length measured in the lateral view.

Wing vein nomenclature follows that of DOLIN (1975), KUKALOVÁ-PECK & LAWRENCE (1993, 2004).

Specimens from which the genitalia were removed were first relaxed overnight in warm water with a few drops of soap added, and then placed in 10 % KOH solution overnight. For examination of the male genitalia, the last abdominal segments were removed and placed in water with a few drops of soap in a Petri dish and left overnight. Then, male genitalia were extracted and placed into a small vial with 90 % alcohol and placed on the pin under the specimen. BECKER (1958) was followed for female genitalia examination. Female genitalia were placed in a small vial with glycerin and placed on the pin under the specimen.

Drawings were made using a camera lucida on a Leica MZ7 dissecting scope. Places and names in the recorded labels are the original spellings from specimens. Scanning electronic microscopic photos were taken by Julien Cillis at the Institut Royal des Sciences naturelles de Belgique.

Genus *Sofia* Arias, 2005 (fig. 1-3)

Sofia Arias, 2005: 22. Replacement name for *Nemasoma* Solier, 1851: 10, *nec* Koch, 1847: 47 (Myriapoda). Type-species: *Nemasoma sulcatum* Solier, 1851.

Diagnosis. – This genus differs from all other elaterid genera in the combination of the following features: frontoclypeal carina across front of frons complete, frontoclypeal carina intercepting labrum medially; antennal insertions not visible from above; prothorax sub-quadrate and slightly convex; posterior angles small; apical portion of the wing with two small plates close to each other; mesosternal cavity more or less oval, sides sharply defined, dentate, mesosternal cavity extending posteriorly 0.7× mesocoxal diameter; mesocoxae subglobular; female genitalia subglobular, with a semi-elongate umbrella shaped sclerotized structure dorsally, and with two lateral sclerotized fan shaped structures opposite to each other.

Description. – Body of male narrow, parallel-sided (BI: 3.34-3.75) (fig. 1-2); brown or blackish brown, integument shiny or dull; length 4.2-5.7 mm; antennomere 9 reaching apex of posterior angles.

Head. Strongly declined at base, punctate; vestiture long, goldish; frontoclypeal region sloping to base of clypeus, bordering frontally clypeus; frontoclypeal carina complete across front of frons, slightly protruded on its sides; clypeus narrow at middle, labrum transverse (fig. 3); eyes small (EI: 0.4); antennomere 4 through antennomere 10 serrate, with gold vestiture; mandibles bidentate, maxillary and labial palps with apical segments securiform.

Prothorax. Elongate, about 0.90-1.03× as long as greatest width; narrowed anteriorly to receive head; lateral margins entirely carinate; inclined mesodorsally; lateral carina directed strongly ventrally, visible only on posterior half; pronotal lateral margin joining pronotosternal suture apex; pronotum punctate; pronotal basal area slightly declivous to prescutum; pronotal basal margin straight; incised at each side of base of pronotum, near base of posterior angles; notch of prescutum small, V-shaped; posterior angles small, acute, uni-carinate, straight or slightly divergent; gold vestiture (fig. 4).

Prosternum slightly convex; anterior edge produced forward; antennal groove present; prosternal suture appearing double, sinuate and marginate at procoxal margin; prosternal process (prosternal spine) angulate near base, narrowed posteriorly, curved in lateral view, extending behind procoxae; hypomeron simple, impressed posteriorly; procoxae subglobular, procoxal cavities separated by $1.1\times$ diameter of procoxal cavity.

Scutellum. Declivous, anteriorly simple and well defined, posteriorly acute, gradually declivous to prescutum; without longitudinal carina; mesosternal cavity elongate, sides dentate, moderately deep, directed posteriorly, posterior margin of mesosternal cavity extending $0.7\times$ mesocoxae diameter in distance posteriorly (fig. 6); mesocoxae longer than wide, not excavate from dorsal view; mesocoxal cavity open to mesepimeron and mesepisternum; mesosternite and metaventrite separated by distinct external suture.

Elytra. About $2.19-2.62\times$ as long as greatest width, and $2.64-3.14\times$ as long as pronotum; anteriorly carinate; humeri well developed; parallel-sided on most of their length, gradually converging posteriorly; striate, with 10 striae; apex truncate or marginate; gold vestiture.

Hind wings. About $2.66\times$ as long as greatest width, length 5.8 mm and width 2.2 mm. Apical portion free of vein about $2.93\times$ its length. Apical portion of the wing with two soft plates close to each other (see arrow on fig. 7); r_4 present, wedge cell present, its width $3.16\times$ its length; joint of $MP_3 + MP_4 + CuA_1$ slightly bifurcate at origin; radial cell $2.60\times$ its width, $MP_3 + MP_4 + CuA_1$ not connected with MP_{1+2} ; wedge cell base not contiguous with connective vein between $MP_4 + CuA_1$ (fig. 7).

Metathoracic coxal plate. Widest region closest to medial body line, proximal area to middle axis body line truncate, sub-medially curved, with setae decumbent, gold.

Legs. Tarsomeres 1 through 4 decreasing in length distally, tarsomere 4 oblique and smaller in size compared with other tarsomeres.

Abdomen. Abdominal ventrites not strongly sclerotized; finely punctate; vestiture thin, dense, last ventrite slightly sinuate.

Female genitalia. Ovipositor not heavily sclerotized; vagina elongate and slightly enlarged towards the apex, two elongate glands similar in shape before bursa; bursa copulatrix 0.78 mm in length and 0.61 mm in diameter; subglobular, with sclerotized internal structures, two sclerotized fan shaped structures with teeth alternating between long and short, and another short sclerotized structure dorsally, umbrella shaped. Spermathecal gland small, attached to apex of bursa copulatrix (fig. 8).

Male genitalia. Parameres articulated with mean lobe, not fused together medially. Basal piece distinctly separated; parameres not reaching apex of aedeagus; apex of aedeagus more or less curved.

Distribution. – Chile. Provinces: Arauco, Cautín, Malleco.

Remarks. –The genus *Sofia* differs from the genus *Deromecus* Solier, 1851 (in which it was placed before) by presence of the following distinct characters: frontoclypeal carina intercepting clypeus, posterior angles of pronotum small (fig. 4), mesocoxae from dorsal view non excavate, base of wedge cell not connecting with $MP_4 + CuA_1$, whereas the genus *Deromecus* presents a frontoclypeal carina not intercepting clypeus, posterior angles larger (fig. 5); mesocoxae from dorsal view partly excavate, base of wedge cell connecting with $MP_4 + CuA_1$.

Sofia sulcata (Solier, 1851) (fig. 1, 9, 11, 13)

Nemasoma sulcatum Solier, 1851: 11.

Deromecus sulcatus (Solier); FLEUTIAUX, 1907: 191.

Sofia sulcata (Solier); ARIAS, 2005: 22.

LECTOTYPE: on a card. Label information only lists “Chile” (MNHN).

Other material studied. – 2 ♂, Chile, Contulmo, 14.XII.1985, *L. E. Peña* (MNNC); 3 ♂, Chile, Contulmo, 1.XII.1985, *L. E. Peña* (SRC); 2 ♀, same date (ETA); 1 ♂, Chile, Angol, Malleco, El Manzano, 2.XI.1981, *L. E. Peña* (MNNC).

Description. – Body of male brown; tegument dull; total length of lectotype 4.4 mm, maximum width 3.1 mm; BI: 3.37-3.75, PI: 0.90-0.97, PEI: 2.82-3.0, ELI: 2.67-2.62 (fig. 1).

Head. Dark brown; antenna light brown; antennomeres 4 through 11 lighter at apex; antennomere 3 $1.70\times$ antennomere 2, antennomere 10 $1.68\times$ antennomere 11; AP: 9.55-5.61-8.42-10.11-9.55-11.23-10.69-10.69-8.98-15.16 (fig. 9).

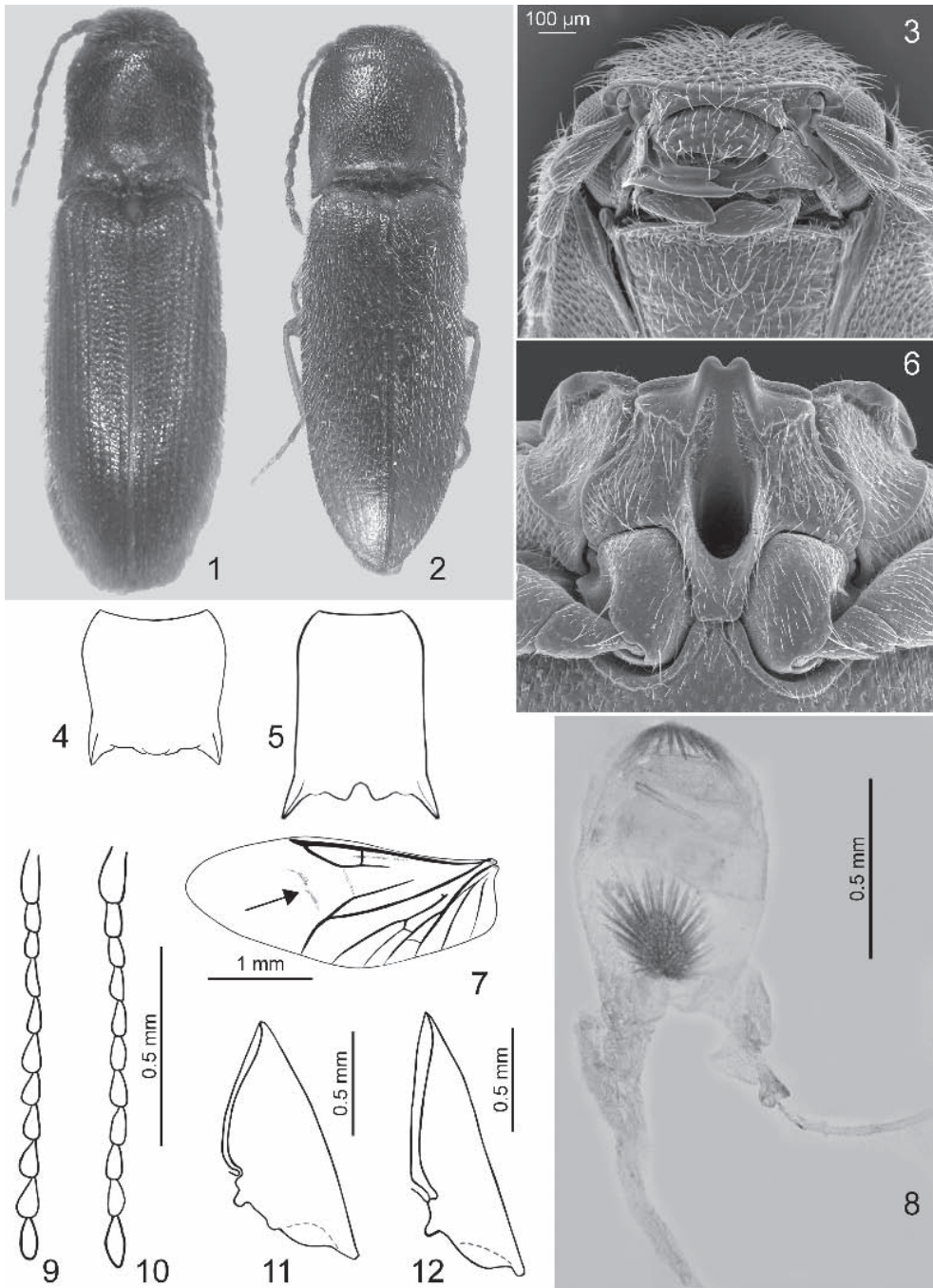


Fig. 1-12. – 1, *Sofia sulcata* (Solier), imago. – 2, *S. flordelago* n. sp., imago (by Yves Laurent and Isabelle Bachy, IRSNB). – 3, *S. flordelago* n. sp., scanning electron micrograph of frontal head (by Julien Cillis, IRSNB). – 4-5, Relative size of posterior angles: 4, small posterior angles (*Sofia*); 5, large posterior angles (*Deromecus*). – 6, *Sofia flordelago* n. sp., scanning electron micrograph of mesoventral cavity (by Julien Cillis, IRSNB). – 7, *S. sulcata* (Solier), wing venation. – 8, *S. sulcata* (Solier), female genitalia. – 9-10, Antennomeres: 9, *S. sulcata* (Solier); 10, *S. flordelago* n. sp. – 11-12, Hypomera: 11, *S. sulcata* (Solier); 12, *S. flordelago* n. sp.

Prothorax. Brown; parallel-sided; convex throughout; punctate-rugulose (PI: 0.90-0.97); posterior pronotal angles more or less straight; prosternum strongly convex; hypomeron subglobose medially (fig. 11); procoxae separated by $0.55\times$ procoxal diameter; prosternal process length $0.66\times$ procoxal diameter after procoxae.

Scutellum. Lighter brown, $1.0\times$ longer than wide; mesocoxae separated by $0.7\times$ mesocoxal diameter; posterior margin of mesosternal cavity extending posteriorly $0.6\times$ mesocoxal diameter.

Elytra. Brown; elytral punctures aligned in rows and intervals rugulose; apex slightly truncate; (ELI: 2.37-2.62).

Legs. Light brown; second and third pairs of legs with the same coloration than abdominal ventrites; vestiture light yellowish brown; tarsomere 1 $3.7\times$ longer than tarsomere 4; TP: 28.9-23-24-7.7-16.4.

Aedeagus. Length 0.4 mm, $2.96\times$ as long as wide, apex broadly rounded; median lobe planar, apex more or less rounded; basal piece $2.96\times$ total length of aedeagus; parameres more or less straight, apex curved (fig. 13).

Distribution. – Chile. Provinces: Arauco, Malleco.

Remarks. – *Sofia sulcata* can be recognized by the following characters: body brown dull, antennomere 3 $1.70\times$ longer than antennomere 2, posterior pronotal angles straight, BI: 3.37-3.75, PEI: 2.82-3.0, and non explanate elytral apex.

***Sofia flordelago* n. sp.** (figs. 2, 8, 10, 12, 14)

HOLOTYPE: ♂, “16-CHILE IX Region Villarrica, Flor del Lago ranch, 22.III.2005, $39^{\circ}12.456'S - 72^{\circ}8.109'W$, 290 m, Fogging *Nothofagus obliqua* (Roble), Arias et al., UC Berkeley” (MNNC). Mounted on a point.

PARATYPES. 10 ♂, “14-CHILE IX Region Villarrica, Flor del Lago ranch, 22.III.2005, $39^{\circ}11.623'S - 72^{\circ}6.650'W$, 353 m, Fogging *N. dombeyi* (Coigüe), Arias & Andrews, UC Berkeley” (ANIC, BMNH, CAS, EMEC, IFML, IRSNB, MNHN, MNNC, ZMHB); 3 ♂, “16-CHILE IX Region Villarrica, Flor del Lago ranch, 22.III.2005, $39^{\circ}12.456'S - 72^{\circ}8.109'W$, 290 m, Fogging *N. obliqua* (Roble), Arias et al. UC Berkeley” (SRC, ZMHB, ETA); 2 ♀, “7- CHILE IX Region Villarrica, High Flor del Lago ranch, 440 m, $39^{\circ}10.052'S - 71^{\circ}58.892'W$, 12.I.2003, 12:00 PM, Fogging *N. dombeyi*, Arias et al. UCB” (MNNC, SRC); 1 ♂, “Chile IX Region, 21.I.2006, Lonquimay, Las Raíces, $38^{\circ}33.554'S - 71^{\circ}30.055'W$, 993 m, 11:20 AM, Fogging *N. dombeyi*, Arias et al. UCB” (ETA).

Description. – Body of male blackish-brown; integument shiny; total length of holotype 5.1 mm, maximum width 2.2 mm; BI: 3.44, PI: 1.0, PEI: 3.04, ELI: 2.53 (fig. 2).

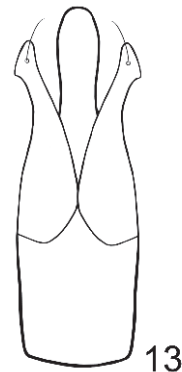
Head. Dark brown; antenna light brown, antennomeres 4 through 10 strongly lighter at apex; antennomere 3 $1.28\times$ longer than antennomere 2, antennomere 10 $1.1\times$ longer than antennomere 11; AP: 10.4-8.09-9.24-8.67-9.82-10.4-9.24-9.82-11.56-12.75 (fig. 10).

Prothorax. Blackish-brown, base reddish brown; sides slightly sinuate; punctulate; PI: 0.91-1.03; PEI: 2.64-3.14; convex anteriorly; posterior pronotal angles slightly divergent; hypomeron with lateral carina more or less straight (fig. 12); procoxae separated by $1.0\times$ procoxal diameter; prosternal process length 0.66 time procoxal diameter after procoxae.

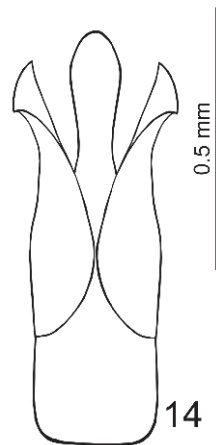
Scutellum. Light yellowish brown; $1.07\times$ longer than wide; mesocoxae separated by $0.66\times$ mesocoxal diameter.

Elytra. Blackish-brown; elytral punctures aligned in rows and intervals strongly rugulose; apex explanate (ELI: 2.19-2.57).

Legs. Yellowish brown, second and third pairs of legs lighter than abdominal ventrites; vestiture yellowish brown; tarsomere 1 $2.7\times$ longer than tarsomere 4; TP: 32.8-17.9-16.5-12-20.8.



13



14

Fig. 13-14. – Male genitalia. – 13, *Sofia sulcata* (Solier). – 14, *S. flordelago* n. sp.

Aedeagus. Length 0.5 mm, 2.75× as long as wide; median lobe planar, apex more or less acute; basal piece 3.9× total length of aedeagus, distinctly separate; parameres more or less sinuate, apex strongly acute (fig. 14).

Etymology. – This species is dedicated to my friend Pablo Wagner, for his dedication to nature conservation, and for always facilitating my research in his farm “Flor del Lago” (Chile, Villarrica).

Distribution. – Chile. Provinces: Cautín, Malleco.

Remarks. – *Sofia flordelago* n. sp. can be recognized by the following characters: blackish-brown shiny body, BI: 3.34-3.69, PEI: 2.96-3.14, antennomere 3 1.28× longer than antennomere 2, pronotum slightly convex anteriorly, and elytral apex explanate.

ACKNOWLEDGMENTS. – Patrick Grootaert provided access to the type material, and facilities to conduct my research in the IRSNB. Julien Cillis for taking the scanning electronic micrograph photo, Yves Laurent and Isabelle Bachy for taking color photo at IRSNB. Stéphane Boucher and Antoine Mantilleri kindly provided access to the type material and facilities at the MNHN. Two anonymous reviewers made valuable suggestions. Sergio Riese provided Chilean Elateridae material for my studies. This research was supported by the Fulbright Scholar Program, the Evert and Marion Schlinger Foundation, and the NSF-DEB 445413 to E. T. Arias and K. W. Will.

REFERENCES

- ARIAS E. T., 2005. – A replacement name for a click beetle genus from Chile: *Sofia* (Coleoptera: Elateridae). *The Coleopterists Bulletin*, **59** (1): 22.
- ARIAS E. T., RICHARDSON B. J. & ELGUETA M., 2008. – The canopy beetle faunas of Gondwanan element trees in Chilean temperate rain forests. *Journal of Biogeography*, **35** (5): 914-925.
- ARNETT R. H. JR., SAMUELSON G. A. & NISHIDA G. M., 1993. – The Insect and Spider Collections of the World. Sandhill Crane Press Inc., Gainesville, Florida, 310 p.
- BECKER E. C., 1958. – The phyletic significance of the female internal organs of reproduction in the Elateridae. *Proceedings of the Tenth International Congress of Entomology*, **1**: 201-205.
- CALDER A. A., 1996. – *Click Beetles: Genera of the Australian Elateridae (Coleoptera)*. Monographs on Invertebrate Taxonomy, Vol. 2. CSIRO Publishing, Collingwood, Victoria, x + 401 p.
- DOLIN V. G., 1975. – Wing venation of click beetles (Coleoptera: Elateridae) and its importance for taxonomy of the family. *Zoologicheskii Zhurnal*, **54**: 1618-1633 [In Russian].
- FLEUTIAUX E., 1907. – Révision des Elateridae du Chili. *Revista Chilena de Historia Natural*, **11**: 160-232.
- KUKALOVÁ-PECK J. & LAWRENCE J. F., 1993. – Evolution of the hind wing in Coleoptera. *Canadian Entomologist*, **125**: 181-258.
- 2004. – Use of hind wing characters in assessing relationships among coleopteran suborders and major endoneopteran lineages. *European Journal of Entomology*, **101** (1): 95-144.
- SOLIER A., 1851. – *Coleópteros elateroideos* (p. 5-38). In: Gay C. (ed.), *Historia física y política de Chile*, vol. 5. Paris, 285 p.