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Two new high Andean species of *Liodessus* diving beetles from Venezuela (Coleoptera, Dytiscidae, Bidessini)

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http://zoobank.org/75DB5DB6-C3E5-4B3C-9B5C-15722723ED3B

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Abstract

Two new species of the diving beetle genus *Liodessus* Guignot, 1939 are described from high mountain regions in Venezuela: *Liodessus meridensis* **sp. nov.** from Laguna de Mucabají, Mérida and *L. venezuelensis* **sp. nov.** from Laguna de Mucabají and below Pico Bolívar, Mérida. We delineate the species using morphological characters such as male genital structure and beetle size, shape and color. Mitochondrial cox1 sequence data provided an additional character source. Both new species occur at altitudes above 3,500 m and were collected in shallow water at the edge of high-altitude ponds.

Key Words

Dytiscidae, *Liodessus*, new species, Venezuela, Mérida

Introduction

Liodessus Guignot, 1939 are small diving beetles, usually less than 3 mm long, and occur in the New World as well as the Afrotropical region (Biström 1988; Nilsson and Hájek 2021). In the high Andes, at altitudes from ca. 3,000 to nearly 5,000 meters, they are probably the most abundant aquatic beetles (Balke et al. 2020a; Balke et al. 2020b). However, diving beetles from such high altitudes of the Páramo and Puna regions remain poorly studied. Since 2019, eleven new species have been described from Peru (Balke et al. 2020a, b) and Colombia (Balke et al. 2020c; Balke et al. 2021; Megna et al. 2019). Since then, it has become apparent that many more remain to be discovered, most of them likely microendemics. To address this in a combined evidence framework, we established a DNA sequence-supported project for the study of these beetles (Balke et al. 2020a, b), using the Barcode of Life Data System (BOLD) of the Canadian Centre for DNA Barcoding and the 5' mitochondrial *cox1* gene fragment (www.boldsystems.org) (Ratnasingham and Hebert 2007). Here, we continue our collaborative research project on the water beetle fauna of the higher mountain regions of South America by reporting the discovery of two new species of *Liodessus* from Venezuela.

Materials and methods

The following acronyms are used in the text: CBP (Collection D. T. Bilton, Plymouth, UK); MIZA (Museo del Instituto de Zoología Agrícola "Francisco Fernández Yépez", Universidad Central de Venezuela, Maracay, Venezuela); SEMC (Natural History Museum and Biodiversity Research Center, University of Kansas) and ZSM (SNSB-Zoologische Staatssammlung, München, Germany, temporarily stored for further morphological work).

Morphological descriptions and photography. The description of morphological characters follows our previous work on *Liodessus* beetles, e.g. Balke et al. (2020b). Images were taken with a Canon EOS R camera. We used Mitutoyo 10× (habitus) or 20× (genital structures) ELWD Plan Apo objectives. These were attached to a Carl Zeiss Jena Sonnar 3.5/135 MC, used as a focus lens. Illumination was with three LED segments SN-1 from Stonemaster (https://www.stonemaster-onlineshop.de). Image stacks were generated with the Stackmaster macro rail (Stonemaster), and images were then assembled with the computer software Helicon Focus 4.77TM on an iMac with a Radeon Pro 5500 XT GPU.

DNA analysis. The DNA sequencing and data analysis protocols follow standard Canadian Centre for DNA Barcoding (CCDB) barcoding procedures (www.ccdb.ca). We delivered tissue samples to CCDB, which were processed and the barcode data uploaded to BOLD systems. We used a simple approach to calculate a neighbour-joining tree (p-distances) in Geneious software (version 11.0.4.), in order to learn if newly added entries could be assigned to existing species groups or not. This approach has been proven helpful in guiding the morphological descriptive process, not the least by enabling us to unambiguously identify the new species presented here, even in the absence of male specimens.

Results

***Liodessus meridensis* sp. nov.**

http://zoobank.org/CB562F9F-95AD-4537-ACA5-305AA84CB53C

Figs 1A, 2A, B, 3A, 4

Type locality. Laguna de Mucabají, Mérida, Venezuela.

Type material. ***Holotype*:** Male: Venezuela; Mérida, Laguna de Mucabají, 3,500 m, i.2004, 8.7964, -70.8255, García & Balke (MIZA). ***Paratypes*:** 13 exs same label data as holotype (MIZA, ZSM); 47 exs Venezuela: Mérida, ca. 5 km E Gavidia, 3,600 m, 23.I.2012, 8.6895,

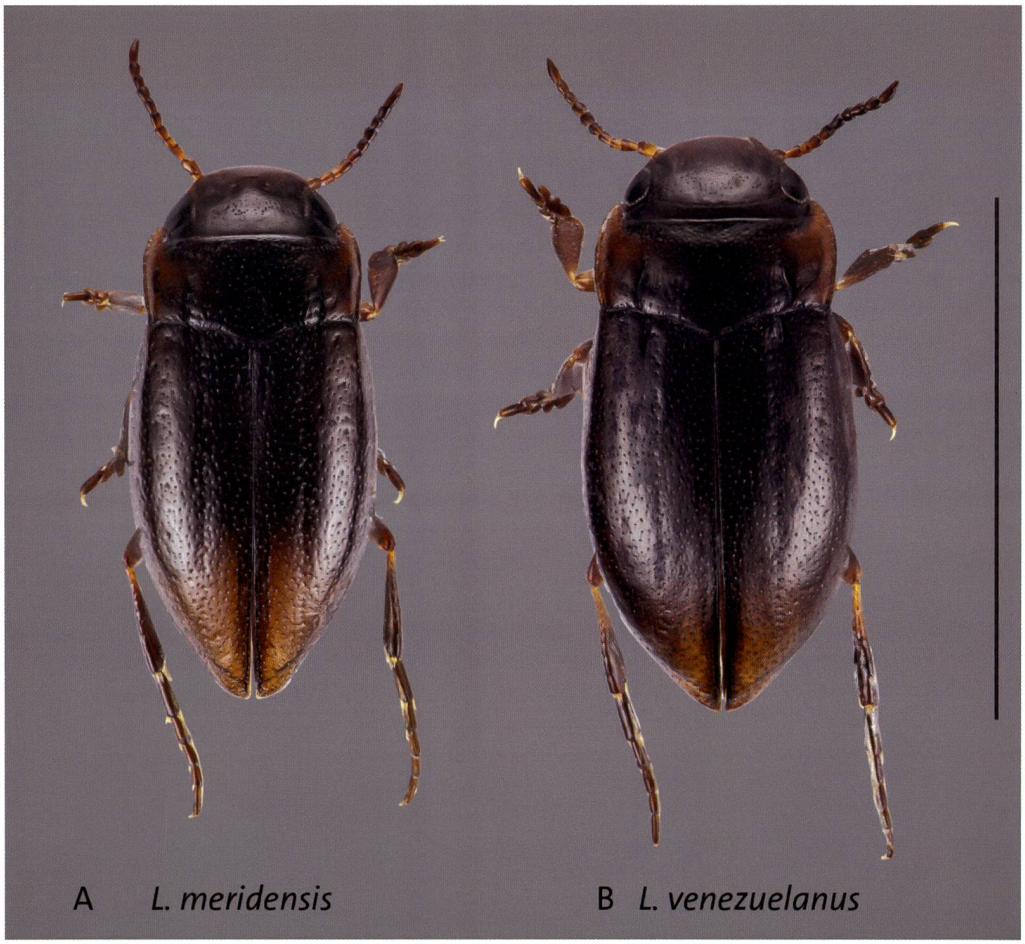

Figure 1. Dorsal habitus of *Liodessus* spp. nov. *L. meridensis* (**A**); *L. venezuelanus* (**B**). Scale bar: 2 mm.

-70.8817, Short, Arias & Gustafson, lagoon margin, VZ12-0123-03A (MIZA, SEMC).

Description. Habitus with only slight discontinuity between pronotum and elytron (Fig. 1A), pronotum widest before base and more parallel sided laterally (Fig. 1A). Total length (TL) 2.1 mm; length without head (TL-h) 1.9 mm; maximum width (MW) 0.9 mm.

Color. Very dark brown to blackish dorsally and ventrally, basal antennomeres, base of meso- and metatibia contrastingly of lighter color (Figs 1A, 2A, B).

Surface sculpture. Head with few larger and smaller setiferous punctures; with distinct microreticulation except on middle of head between the eyes (Figs 1A, 2A, B). Pronotum and elytron shiny; with moderately dense and coarse setiferous punctation (Fig. 1A).

Structures. Antenna stout. Head without occipital line; with rounded clypeus. Pronotum with distinct lateral beads; with distinct long and deep basal striae (Fig. 1A). Elytron with short basal stria; without sutural line; without basal epipleural transverse carina. Metathoracic wings not examined in holotype (in paratype: short, about half the length of elytron).

Genitalia. Median lobe of aedeagus of long, simple curvature in lateral view, more or less gradually narrowing towards tip; also gradually narrowing towards a narrow tip in ventral view; parameres of simple "Bidessini" type, two-segmented (Fig. 3A).

Female. Pronotum and elytra microreticulate, dull (specimens from Gavidia); shiny in the ones from Laguna de Mucabají.

Variation. Size variation of the paratypes is TL 2.1–2.3 mm; TL-h 1.8–2.0 mm; MW 0.9–1.1 mm. The elytral striae are hardly noticeable in a few paratypes.

Etymology. Named after the state of Mérida, in which the collecting localities are situated. The name is an adjective in the nominative singular.

Comparative notes. Distinguished from the other species of *Liodessus* by the diagnostic combination of the following features: Species from Venezuela; beetle smaller (TL 2.1–2.3 mm); very dark brown to blackish; head without occipital line; pronotal and elytral striae present; wings reduced considerably; shape of median lobe (narrow and "pointed" in lateral and ventral view, with its particular shape).

Figure 2. *Liodessus* spp. nov. Detail of head in dorsal view. *L. meridensis* (**A, B**); *L. venezuelanus* (**C, D**).

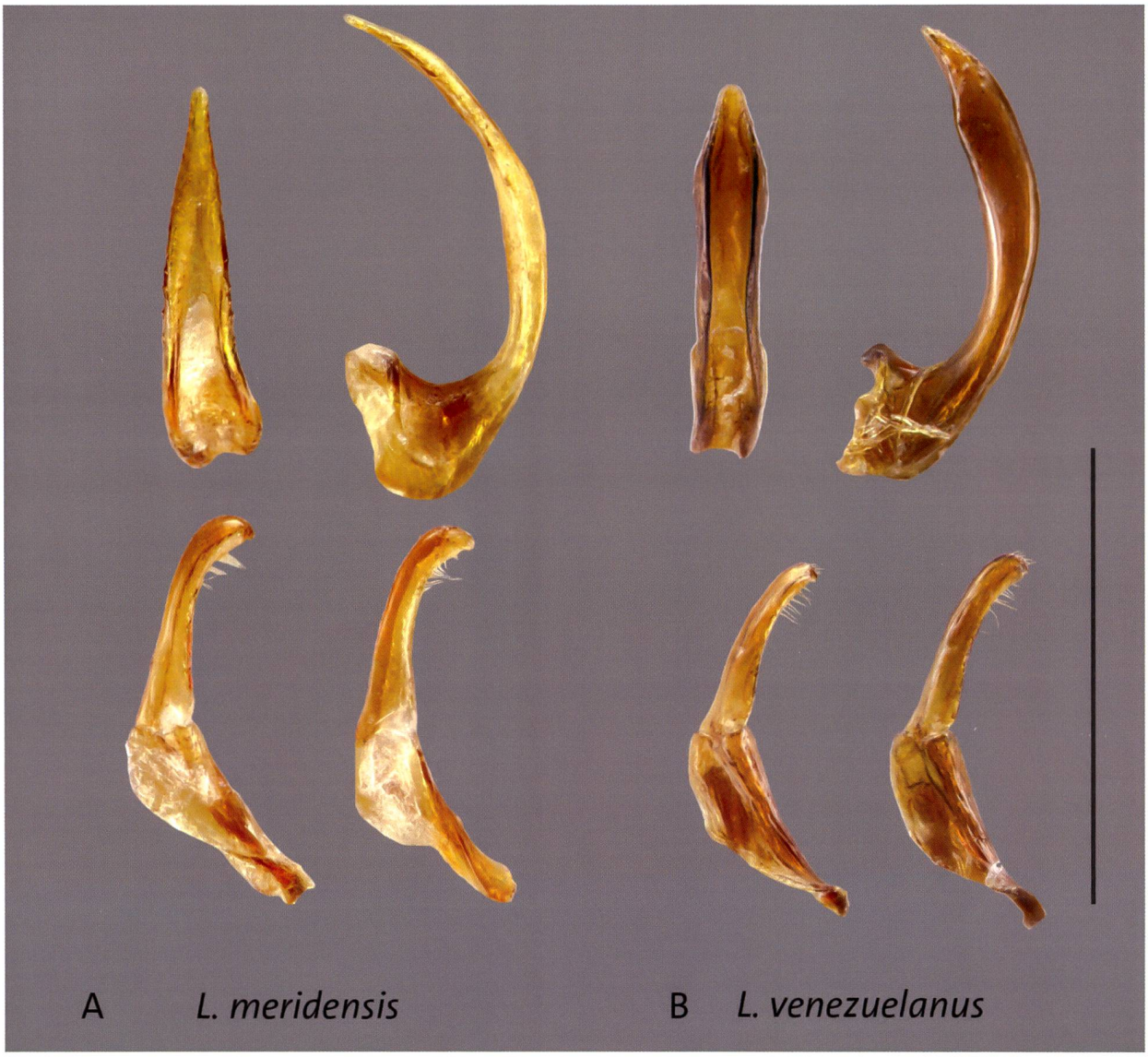

Figure 3. *Liodessus* spp. nov. Median lobe ventral and lateral views; parameres outer and inner surfaces, *L. meridensis* (**A**); *L. venezuelanus* (**B**). Scale bar: 0.5 mm.

BOLD platform. We provided 1 entry to our BOLD *Liodessus* project. The species is well delineated from all other *Liodessus*, with an uncorrected p-distance of around 9% or more.

Distribution. Known from around Mérida, Venezuela.

Habitat. Collected from shallow water at the edge of high-altitude ponds (Fig. 4).

Liodessus venezuelanus sp. nov.

http://zoobank.org/BD12A35E-2B7F-4D16-8BF5-B316DB57E2F6

Figures 1B, 2C, D, 3B, 4

Type locality. Laguna de Mucubají, Mérida, Venezuela.

Type material. ***Holotype***: Male: Venezuela; Mérida, Laguna de Mucubají, 3,500 m, i.2004, 8.7964, -70.8255, García & Balke" (MIZA). ***Paratypes***: 1 ex. same label data as holotype (ZSM); 8 exs Venezuela: Mérida, Pico Bolívar, Laguna de Gallo, 4,000 m, 6.XII.1998, 8.5269, -71.0722, Bilton (CBP, ZSM); 3 exs Venezuela: Mérida, ca. 5 km E Gavidia, 3,600 m, 23.I.2012, 8.6895, -70.8817, Short, Arias & Gustafson, lagoon margin, VZ12-0123-03A (MIZA, SEMC).

Description. Habitus with more evident discontinuity between pronotum and elytron (Fig. 1B), pronotum widest before base and more rounded laterally (Fig. 1B). Total length 2.2 mm; length without head 2.0 mm; maximum width 1.0 mm.

Color. Very dark brown to blackish dorsally and ventrally, basal antennomeres, base of meso- and metatibia contrastingly of lighter color (Figs 1B, 2C, D).

Surface sculpture. Head with few larger and smaller setiferous punctures (Figs 1B, 2C, D); with distinct microreticulation except on middle of head between the eyes. Pronotum and elytron shiny; with moderately dense and coarse setiferous punctation (Fig. 1B).

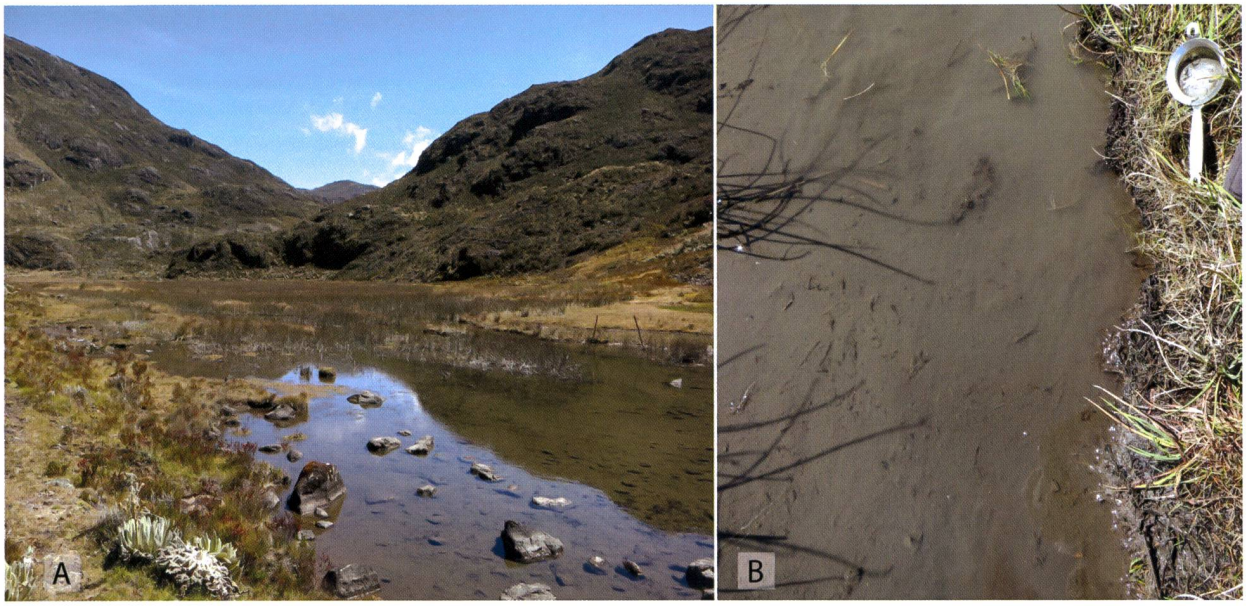

Figure 4. Habitat of *Liodessus* spp. nov. near Gavidia, Venenzuela, where both new species were collected (collecting event VZ10-0123-03A). Overview (**A**); detail of shallow water at the edge (**B**).

Structures. Antenna stout. Head with occipital line; with rounded clypeus. Pronotum with distinct lateral beads; with distinct long and deep basal striae (Figs 1A, B). Elytron with short basal stria; without sutural line; without basal epipleural transverse carina. Metathoracic wings not examined in holotype (in paratype: short, about half the length of elytron).

Genitalia. Median lobe of aedeagus broadened towards apex, then narrowing in lateral view; also broadening towards tip in ventral view, tip broadly rounded; parameres of simple "Bidessini" type, two segmented (Fig. 3B).

Female. Pronotum and/or elytra microreticulate, dull (specimens from Laguna de Gallo); shiny in the single females from Laguna Mucabají and Gavidia.

Variation. Size variation of the paratypes is TL 2.0–2.3 mm; TL-h 1.8–2.0 mm; MW 0.9–1.1 mm. In few paratypes, the elytral basal stria is not very obvious.

Etymology. Named after the country of origin. The name is an adjective in the nominative singular.

Comparative notes. Distinguished from other species of *Liodessus* by the diagnostic combination of the following features: Species from Venezuela; beetle relatively small (TL 2.0–2.3 mm); very dark brown to blackish; head without occipital line; pronotal and elytral striae present; wings reduced considerably; shape of median lobe (broad in lateral and ventral view, with its particular shape).

BOLD platform. We provided 1 entry to our BOLD *Liodessus* project. The species is well delineated from all other *Liodessus*, with an uncorrected p-distance of around 8% or more.

Distribution. Known from around Mérida, Venezuela.

Habitat. Collected from shallow water at the edge of high-altitude ponds (Fig. 4).

Checklist of the High Andean species of *Liodessus* Guignot, 1953

1. *Liodessus acollensis* Guignot, 1955: Peru
2. *Liodessus alpinus* Balke et al., 2020a: Peru
3. *Liodessus altoperuensis* Balke et al., 2020b: Peru
4. *Liodessus andinus* Guignot, 1957: Bolivia
5. *Liodessus azufralis* Megna et al., 2019: Colombia
6. *Liodessus bogotensis* Guignot, 1953: Colombia
7. *Liodessus caxamarca* Balke et al., 2020b: Peru
8. *Liodessus hauthi* Balke et al., 2020a: Peru
9. *Liodessus lacunaviridis* Balke et al., 2020a: Colombia
10. *Liodessus picinus* Balke et al., 2021: Colombia

11a. *Liodessus quillacinga quillacinga* Megna et al., 2019: Colombia

11b. *Liodessus quillacinga cochaensis* Megna et al., 2019: Colombia

11c. *Liodessus quillacinga cumbalis* Megna et al., 2019: Colombia

12. *Liodessus quimbaya* Megna et al., 2019: Colombia
13. *Liodessus rhigos* Balke et al., 2020a: Peru
14. *Liodessus thespesios* Balke et al., 2020a: Peru
15. *Liodessus meridensis* sp. nov.: Venezuela
16. *Liodessus venezuelanus* sp. nov.: Venezuela

Discussion

The two new species described here are the first high-altitude species of *Liodessus* reported from Venezuela, and we expect to discover additional species in the vast, unsampled Venezuelan mountain regions. Their phylogenetic position remains to be established based on a multigene dataset. Based on the single DNA fragment we utilized here, the two

species are genetically well delineated from all other known high-altitude *Liodessus*. It is well understood that one genetic marker alone cannot be the ultimate tool for taxonomy (Dietz et al. 2021), in particular markers such as *cox1*, which are not involved in speciation per se (Kwong et al. 2012). Rather, such DNA sequence data can be used to guide the sorting of specimens to operational units and support the taxonomic decision-making process. This approach has been utilized successfully to study very diverse beetle taxa (Riedel et al. 2013a; Riedel et al. 2013b; Tänzler et al. 2012), including our own previous work on *Liodessus*. The approach can be technically scaled up massively, using next-generation sequencing technology, which also reduces analytical costs (Srivathsan et al. 2021; Wang et al. 2018). Such data do not, however, replace taxonomic expertise and the evaluation of morphological structure (Riedel et al. 2013a).

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Consortium of European Taxonomic Facilities (CETAF) data use statement: "Data on genetic material contained in this taxonomic article are published for non-commercial use only. Utilization by third parties for purposes other than non-commercial scientific research may infringe the conditions under which the genetic resources were originally accessed, and should not be undertaken without obtaining consent from the original provider of the genetic material."

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