

Notable range extension of the genus *Biramus* Oswald, 1993 (Neuroptera: Hemerobiidae) and first record in Colombia

Camilo Castillo-Avila^{1,2}, Dennis Castillo-Figueroa^{3*}

Edited by

Angela Johana Espejo Mojica
editorus@javeriana.edu.co

1. Universidad Distrital Francisco José de Caldas, Maestría en Manejo, Uso y Conservación del Bosque, Bogotá, Colombia.

2. Universidad Distrital Francisco José de Caldas, Grupo de Investigación en Artrópodos KUMANGUI, Carrera 7 # 40b-53, Bogotá, Colombia

3. Universidad del Rosario, Faculty of Natural Sciences, Biology Department, Carrera 24 # 63C-69, Bogotá Colombia

*dennis.castillof@gmail.com

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Abstract

Biramus Oswald, 1993 is a hemerobiid genus (Neuroptera) distinguished by forewing morphological traits. This genus is distributed in Venezuela, Panama, Costa Rica, and Mexico. Here, we report *Biramus* in Colombia for the first time, based on a single female specimen collected in an upper Andean tropical mountain forest at an altitude above 3 000 m, in Guasca - Cundinamarca. This new record extends the genus' distribution by 440 km in the northwestern region of South America and represents its highest altitudinal record, expanding its elevational distribution by 1373 m.

Keywords: Altitudinal range; Brown lacewings; Distribution; Net-winged insects; Taxonomy.

1. Introduction

Neuropterans, also known as “net-winged insects”, constitute an ancient order that includes approximately 6 000 species distributed among 15 families [1, 2, 3, 4, 5, 6, 7]. Adults typically bear two pairs of broad membranous wings with elaborate reticulate venation, whereas larvae are characterized by possessing jaws and juxtaposed maxillae, forming a tube, which is essential for sucking fluids from their prey [8, 9]. Due to their predatory feeding habits, mainly in the larval stage, neuropterans, such as chrysopids, play a key role in the biological control of agricultural pests [10, 11, 8]. Neuropterans are widely distributed in all regions of the world, with large populations in temperate habitats, including xeric environments, grasslands and urban areas; however, their highest species diversity is found in tropical forests [8].

The cosmopolitan family of neuropterans, Hemerobiidae, commonly known as “brown lacewings”, comprises approximately 600 species [12, 2]. These small predatory insects have been the subject of research regarding their taxonomy, phylogeny, and biogeography [13, 14, 15]. Moreover, they are well-known for their utility in controlling agricultural and horticultural pests, such as aphids, especially during the winter months in Mediterranean climates when other natural enemies remain inactive [16, 17]. Over the last few years, brown lacewing diversity records have increased in the Neotropical region [18, 19], but many other ecosystems especially from the upper mountain regions remain to be explored [20].

Recent studies carried out along elevational gradients in the The Volcán Tacaná Biosphere Reserve in southern Mexico have shown that Hemerobiidae species are typically abundant in high-altitude regions [21, 22]. This suggests that this family may diversify more effectively at high elevations, relying on key adaptations and life histories, which have enabled them to colonize habitats with more extreme conditions [22, 23, 24].

Within Hemerobiidae, the genus *Biramus* Oswald, 1993 forms a monophyletic clade and is considered the sister group to the other brown lacewings of the subfamily Hemerobiinae [12]. Currently, *Biramus* comprises two known species: *B. lunatus* Oswald, 1993, distributed in Venezuela, and *B. aggregatus* Oswald, 2004, occurring in Panama, Costa Rica, and Mexico. These species have been recorded at altitudes ranging from below 100 m to 1767 m, primarily in tropical montane cloud forests [12, 13, 21, 22]. However, the genus' occurrence, in terms of geographical and altitudinal distribution, remains undocumented in northern South America.

Herein, we report for the first time the occurrence of the genus *Biramus* in Colombia. This finding extends the known distribution of the genus in northern South America towards the southwest, into the eastern range of the Colombian Andes, and represents its highest altitude record to date.

2. Materials and Methods

The present new record is based on a female specimen collected in the Eastern Andes of Colombia, specifically in peri-urban forests of the Cundiboyacense high plains, located within the Encenillo Biological Reserve in the municipality of Guasca at 3140 m elevation (4° 47' 20.318" N, 73° 54' 31.812" W, **Fig. 1**). The specimen was collected as part of a soil fauna sampling conducted throughout the four climatic seasons of 2022 (dry: Jan-Feb; wet: Apr-May; moderately dry: July-Aug; wet: Oct-Nov), under the legal national collection permit (ANLA - Resolución 530 del 27 de Mayo de 2014). The study aimed to assess soil fauna communities associated with leaf-litter decomposition and the successional gradient. To achieve this, we collected soil samples of 30 cm x 30 cm x 5 cm depth from a set of 14 permanent plots distributed in Guasca, Tabio, Guatavita, and the eastern hills of the capital city of Bogotá (Torca). These plots are part of a network of 36 20 m x 20 m plots and eight 50 m x 50 m plots. Further forest characteristics are provided in [25]. In the case of Guasca, we collected 12 soil samples from four permanent plots (*i.e.*, three samples per plot) during each of the climatic seasons ($n = 48$ samples in total). Within each soil sample, we stored two subsamples in separate plastic bags to distinguish between soil fauna found in the leaf litter and the soil fauna within the 0-5 cm soil depth [26].

In the laboratory, soil fauna was manually sorted under a light stereoscopic microscope (Leica 10447197 Ez4) and preserved in 70% ethanol. The specimen was deposited in the biological collection of Arthropods and other invertebrates of the Universidad Distrital Francisco José de Caldas (CAUD-216). Taxonomic identification was performed following the original description [13] and photographs were taken with a HAYEAR-6110 camera.

3. Results and Discussion

We found a female *Biramus* specimen (**Fig. 2**) in the soil layer of a mature upper Andean tropical forest at 3140 m in Bogotá's high-plateau region (Cundinamarca, Colombia). To date, this is the highest altitudinal record of the genus since earlier reports documented the altitudinal distribution of *Biramus* below an altitude of 2000 m [12, 21, 22]. This finding also represents the first recorded occurrence of *Biramus* in Colombia. The genus can be distinguished from other genera by the following characters: (1) radius bearing two Oblique Radial Branches (ORB) or radial sectors, (2) subcosta and anterior radial trace well separated in the basal half of the wing, (3) the first (more proximal) fork of ORB1 located distal to the most proximal fork of ORB2, and (4) the base of the union of the cross-vein of ORB1 without the anterior radial trace [12]. Precise taxonomic determination in Hemerobiidae, as in many groups of neuropterans, often requires analysis and comparison of specific somatic and genital characters in both sexes.

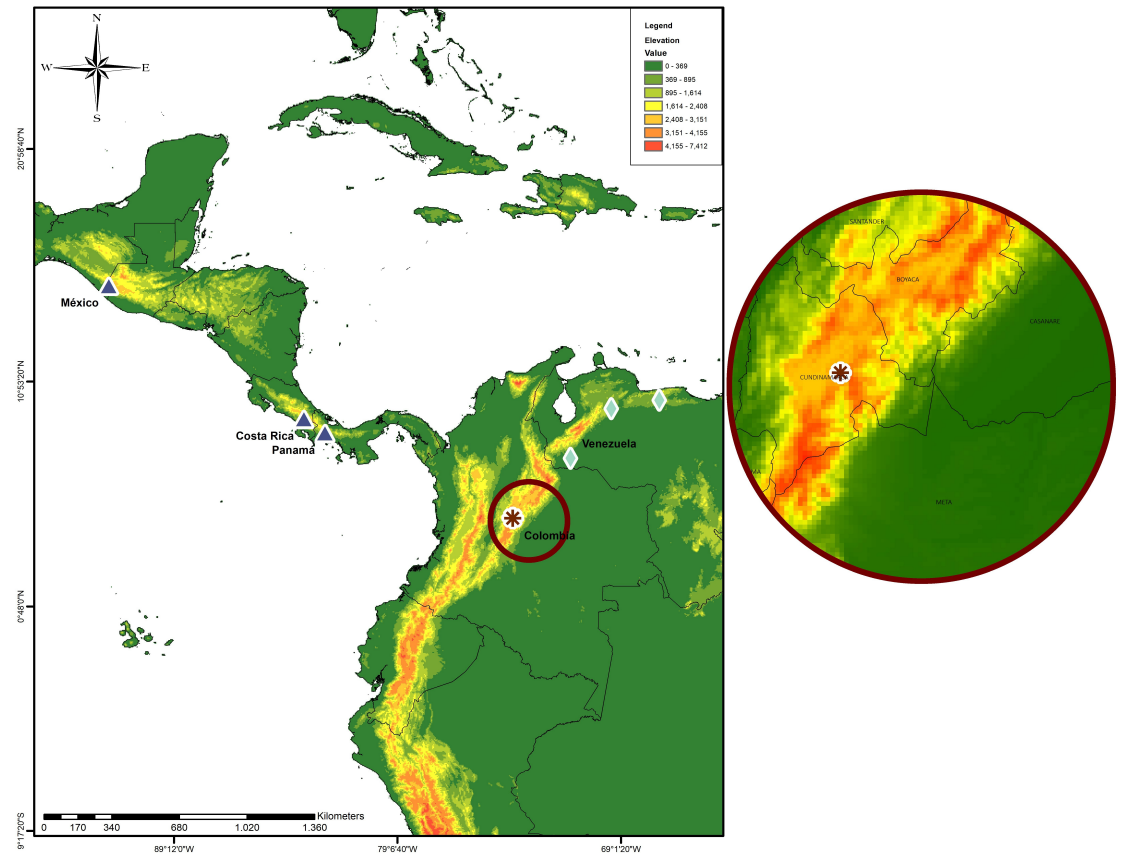


Figure 1. *Biramus* Oswald, 1993 (Neuroptera, Hemerobiidae) record location in Colombia. The asterisk marks the highest elevational record site of the genus in Guasca, Cundinamarca (Colombia) at 3140 m. Light blue diamonds correspond to records of *B. lunatus* Oswald, 1993 in Venezuela, and dark blue triangles to *B. aggregatus* Oswald, 2004 in Panama, Costa Rica, and Mexico.

In this particular case, the absence of a male specimen hindered a thorough species-level identification. However, the specimen is unlikely to be *B. lunatus* as its wing shape is notably different (elongate-oval, non-falcate, and lacks a hyaline region at the site of the forewing falcation, Fig. 2). Only the morphology of male genitalia will clarify the species identity and possibly the species' phylogenetic relationships.

The forests of Encenillo Biological Reserve where we found the specimen are dominated by native Andean plant species such as *Cavendishia bracteata* (Ericaceae), *Alnus acuminata* (Betulaceae), *Myrsine coriacea* (Primulaceae), *Gaiadendron punctatum* (Loranthaceae), *Drymis granadensis* (Winteraceae), *Weinmannia tomentosa* (Cunnoniaceae), *Bejaria resinosa* (Ericaceae), and *Viburnum triphyllum* (Viburnaceae). During our collection in October 2022, within the plot where the *Biramus* specimen was found, several invertebrate families were identified, mainly detritivores and herbivores, including millipedes (Trichopolydesmidae, Pyrgodesmidae), springtails (Entomobryinae), harvestmen (Stygnidae), isopods (Philosciidae), beetles (Curculionidae, Ptiliidae, Tachyporinae) and centipedes (Schendylidae, Scolopocryptopidae) [26]. Traditionally, brown lacewings are collected using complementary sampling methods in the understory, such as Malaise traps, yellow plate traps, black light traps, ground-level interception traps, black and white light traps, and entomological nets [21, 22]. In this work, we accidentally collected the genus by extracting soil samples.

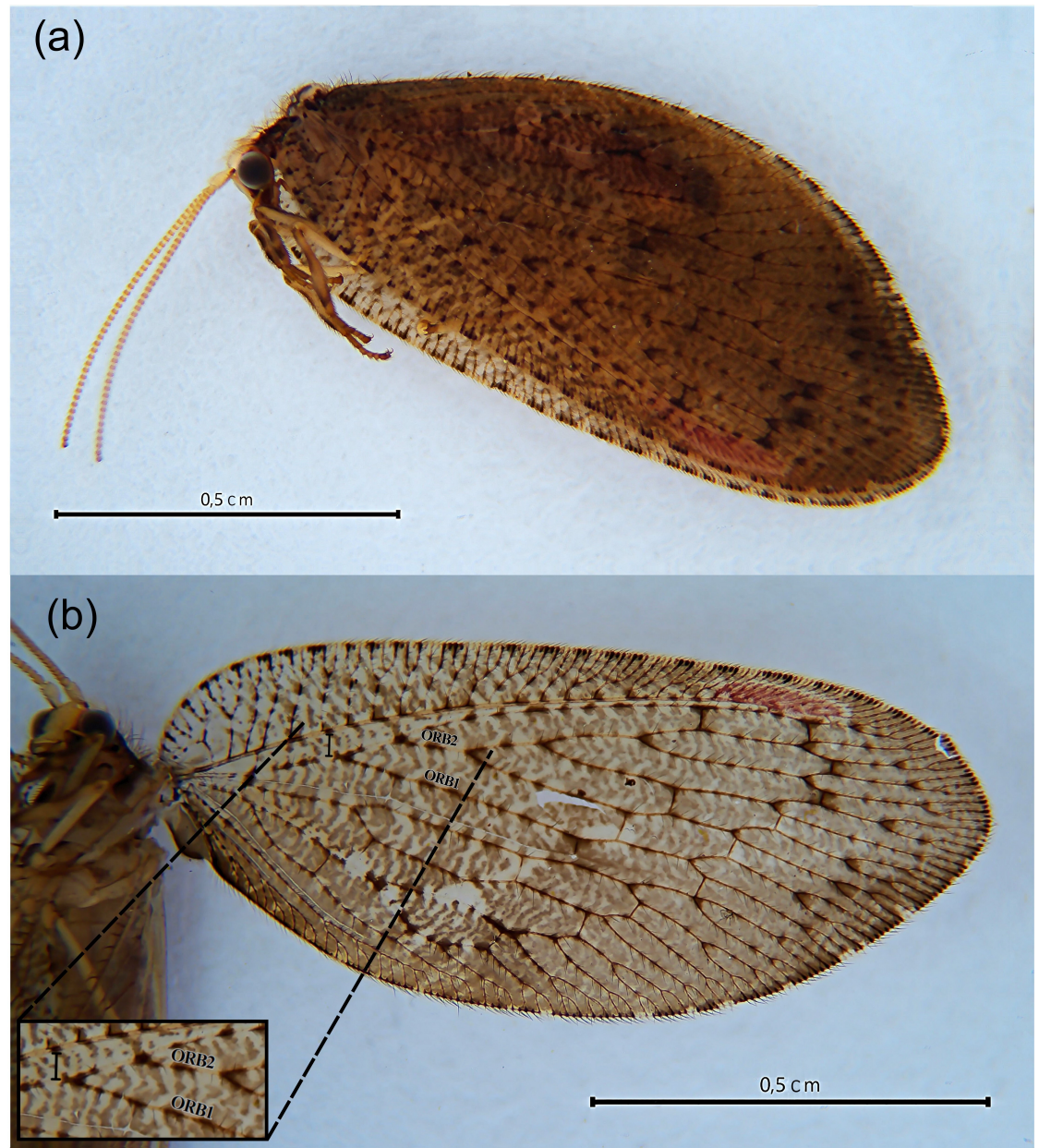


Figure 2. Female *Biramus* Oswald, 1993 (Neuroptera: Hemerobiidae) from an upper Andean tropical forest in Colombia (Guasca, Cundinamarca), showing (a) the habitus and (b) the left wing. ORB1 and ORB2 represent the Oblique Radial Branches (equivalent to "radial sectors").

The Colombian record of *Biramus* updates the current distribution of this genus in northern South America with the highest altitudinal record. Future fieldwork in other areas of Colombia should explore whether this genus is restricted to Bogotá's high-plateau region and whether it occurs in other biogeographical regions and even at higher elevations in the country.

4. Acknowledgments

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5. Conflict of interest

The authors have no conflicts of interest to declare.

References

- [1] Aspöck U, Plant JD, Nemeschkal HI. Cladistic analysis of Neuroptera and their systematic position within Neuropterida (Insecta: Holometabola: Neuropterida: Neuroptera), *Systematic Entomology*, 26(1): 73–86, 2001.
<https://doi.org/10.1046/j.1365-3113.2001.00136.x>
- [2] Oswald JD, Machado RJP. Biodiversity of the Neuropterida (Insecta: Neuroptera: Megaloptera, and Raphidioptera). In: Footitt, RG, Adler, PH (Eds.). *Insect Biodiversity: science and society*, John Wiley & Sons, 2: 627–671, New York, USA, 2018.
<https://doi.org/10.1002/9781118945582.ch21>
- [3] Engel MS, Winterton SL, Breitzkreuz LCV. Phylogeny and evolution of Neuropterida: where have wings of lace taken us? *Annual Review of Entomology*, 63: 531–551, 2018.
<https://doi.org/10.1146/annurev-ento-020117-043127>
- [4] Winterton SL, Lemmon AR, Gillung JP, Garzon IJ, Badano D, Bakkes DK, Breitzkreuz LCV, Engel MS, Lemmon EM, Liu X, Machado RJP, Skevington JH, Oswald JD. Evolution of lacewings and allied orders using anchored phylogenomics (Neuroptera, Megaloptera, Raphidioptera), *Systematic Entomology*, 43(2): 330–354, 2018.
<https://doi.org/10.1111/syen.12278>
- [5] Machado RJP, Gillung JP, Winterton SL, Garzón-Orduña IJ, Lemmon AR, Lemmon EM, Oswald JD. Owlflies are derived antlions: anchored phylogenomics supports a new phylogeny and classification of Myrmeleontidae (Neuroptera), *Systematic Entomology*, 44(2): 418–450, 2019.
<https://doi.org/10.1111/syen.12334>
- [6] Martins CC. Neuropterida from South America: large diversity, largely unknown. In: Weihrauch F, Frank O, Gruppe AV, Jepson JE, Kirschey L, Ohl M. (Eds.). *International Symposium of Neuropterology*, 13, 2019, Wolnzach (pp. 145–161). Proceedings. Wolnzach: Osmylus Scientific Publishers, 2019.

<https://doi.org/10.5281/zenodo.3569393>

- [7] Vasilikopoulos A, Misof B, Meusemann K, Lieberz D, Flouri T, Beutel RG, Niehuis O, Wappler T, Rust J, Peters RS, Donath A, Podsiadlowski L, Mayer C, Bartel D, Böhm A, Liu S, Kapli P, Greve C, Japson JE, Liu X, Zhou X, Aspöck H, Aspöck U. An integrative phylogenomic approach to elucidate the evolutionary history and divergence times of Neuropterida (Insecta: Holometabola), *BMC Evolutionary Biology*, 20(1): 64, 2020.
<https://doi.org/10.1186/s12862-020-01631-6>
- [8] Contreras-Ramos A, Rosas MV. Biodiversidad de Neuroptera en México, *Revista Mexicana de Biodiversidad*, 85(Supl. Ene): S264-S270, 2014.
<https://doi.org/10.7550/rmb.32677>
- [9] Ribera I, Melic A. Order Neuroptera (Planipennia), *Revista IDE@ - SEA*, 58: 1–12, 2015.
- [10] New TR. Planipennia, lacewings. In: Fischer, M. (Ed). *Handbuch der Zoologie. Band IV. Arthropoda: Insecta. Part 30* (pp. 129), Walter Gruyter, Berlin, Germany, 1989.
- [11] De Jong GD. Observations on the biology of *Polystoechotes punctatus* (Fabricius) (Neuroptera: Ithonidae): adult trophic status, description of the male reproductive system, and associations with mites, *Proceedings of the Entomological Society of Washington*, 113(3): 291–298, 2011.
<https://doi.org/10.4289/0013-8797.113.3.291>
- [12] Oswald JD. Review of the brown lacewing genus *Biramus* (Neuroptera: Hemerobiidae: Hemerobiinae), with the description of a new species from Costa Rica and Panama, *Tijdschrift voor Entomologie*, 147(1): 41–47, 2004.
<https://doi.org/10.1163/22119434-900000135>
- [13] Oswald JD. A new genus and species of brown lacewing from Venezuela (Neuroptera: Hemerobiidae), with comments on the evolution of the hemerobiid forewing radial vein, *Systematic Entomology*, 18(4): 363–370, 1993.
<https://doi.org/10.1111/j.1365-3113.1993.tb00672.x>
- [14] Oswald JD. A new phylogenetically basal subfamily of brown lacewings from Chile (Neuroptera: Hemerobiidae), *Entomologica scandinavica*, 25: 295–302, 1994.
- [15] Oswald JD. Lacewing digital library. Neuropterida species of the world. version 5.0.
URL: <http://lacewing.tamu.edu/speciesCatalog/Main>
- [16] McGugan BM, Coppel HC. Biological control of forest insects, 1910-1958. In: McLeod J, McGugan BM, Coppel HC. A review of the biological control attempts against insects and weeds in Canada (pp. 35–216), Common Wealth Agricultural Bureaux: UK, 1962.
- [17] Tauber CA, Tauber MJ, Albuquerque GS. Neuroptera (lacewings, antlions). In: Resh VH, Cardé RT. *Encyclopedia of insects* (pp. 695–707), Academic Press: San Diego, California, USA, 2009.

- [18] Lara RIR, Fernandes DRR, Sosa-Duque F, Antunes NTB, Freitas S, Perioto NW. Temporal variation of brown and green lacewings (Neuroptera: Hemerobiidae and Chrysopidae) collected with McPhail traps from a fruit orchard in Southeast Brazil, *Entomological Communications*, 2: ec02005, 2020.
<https://doi.org/10.37486/2675-1305.ec02005>
- [19] Lara RIR, Fernandes DRR, Perioto NW. Diversity and temporal variation of brown lacewings (Neuroptera, Hemerobiidae) from Atlantic rainforest areas in southeastern Brazil, *Revista Brasileira de Entomologia*, 66: e20220076, 2022.
<https://doi.org/10.1590/1806-9665-RBENT-2022-0076>
- [20] Aspöck U, Aspöck H, Gruppe A. Anchored between heaven and earth – a new flightless brown lacewing from Perú (Neuroptera, Hemerobiidae), *Deutsche Entomologische Zeitschrift*, 67(2): 141–149, 2020.
<https://doi.org/10.3897/dez.67.56008>
- [21] Cancino-López RJ, Martins CC, Contreras-Ramos A. Neuroptera diversity from Tacaná Volcano, Mexico: species composition, altitudinal and biogeographic pattern of the fauna, *Diversity*, 13(11): 537, 2021.
<https://doi.org/10.3390/d13110537>
- [22] Cancino-López RJ, Moreno CE, Contreras-Ramos A. Diversity of Lacewings (Neuroptera) in an altitudinal gradient of the Tacaná Volcano, Southern Mexico, *Insects*, 13(7): 652, 2022.
<https://doi.org/10.3390/insects13070652>
- [23] McEwen PK, New TR, Whittington AE. Lacewings in the crop environment, Cambridge University Press, Cambridge, UK, 2001.
- [24] Podlesnik J, Jakšič P, Nahirnič A, Janžeković F, Klenovšek T, Klokočovnik V, Devetak D. Fauna of the brown lacewings of Serbia (Insecta: Neuroptera: Hemerobiidae), *Acta Entomologica Slovenica*, 27:17–29, 2019.
- [25] Castillo-Figueroa D, González-Melo A, Posada JM. Wood density is related to aboveground biomass and productivity along a successional gradient in upper Andean tropical forests, *Frontiers in Plant Science*, 14: 1276424, 2023.
<https://doi.org/10.3389/fpls.2023.1276424>
- [26] Castillo-Figueroa D, Castillo-Avila C, Moreno-González JA, Posada JM. Habitat of two threatened short-tailed whip-scorpions (Arachnida: Schizomida) in the tropical Andes of Northern South America, *Journal of Insect Conservation*, 28: 503–509, 2024.
<https://doi.org/10.1007/s10841-024-00565-4>

Notable extensión del rango del género *Biramus* Oswald, 1993 (Neuroptera: Hemerobiidae) y primer registro en Colombia

Resumen: *Biramus* Oswald, 1993 es un género de hemeróbidos (Neuroptera) distinguido por los rasgos morfológicos de sus alas anteriores. Este género se distribuye en Venezuela, Panamá, Costa Rica y México. Aquí, detallamos el primer registro de *Biramus* en Colombia, basándonos en un solo espécimen hembra recolectado en un bosque altoandino, a una altitud superior a 3,000 m, en Guasca - Cundinamarca. Este nuevo registro extiende la distribución del género en 440 km hacia el noroeste de la región de América del Sur y representa su registro altitudinal más alto, expandiendo su distribución elevacional en 1373 m.

Palabras Clave: Distribución; Hemeróbidos; Insectos con alas reticuladas; Rango altitudinal; Taxonomía.

Notável extensão do alcance do gênero *Biramus* Oswald, 1993 (Neuroptera: Hemerobiidae) e primeiro registro na Colômbia

Resumo: *Biramus* Oswald, 1993 é um gênero de hemeróbídeos (Neuroptera) distinguido pelas características morfológicas de suas asas anteriores. Esse gênero é distribuído na Venezuela, Panamá, Costa Rica e México. Aqui, detalhamos o primeiro registro de *Biramus* na Colômbia, baseado em um único espécime fêmea coletado em uma floresta alto-andina, a uma altitude superior a 3.000 m, em Guasca - Cundinamarca. Este novo registro estende a distribuição do gênero em 440 km para o noroeste da região da América do Sul e representa o seu registro altitudinal mais alto, expandindo sua distribuição elevacional em 1373 m.

Palavras-chave: Alcance altitudinal; Distribuição; Hemeróbídeos; Insetos com asas reticuladas; Taxonomia.

Camilo Castillo-Avila

Biologist. Currently a master student in Forest Management, Utilization, and Conservation at Universidad Distrital Francisco José de Caldas (Bogotá, Colombia). Camilo conducts research in the Arthropod Research Group KUMANGUI at Universidad Distrital Francisco José de Caldas.

ORCID: 0000-0001-7973-5488

Dennis Castillo-Figueroa

Ecologist and Biologist. Currently a PhD candidate of Biological and Biomedical Sciences at the Universidad del Rosario (Bogotá, Colombia). Dennis' research focuses on functional ecology, biological conservation, and natural history of neotropical species, particularly in understanding the functional mechanisms by which anthropogenic pressures affect biodiversity and ecological processes.

ORCID: 0000-0002-4584-0762