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Article

The alien species Stenochrus portoricensis (Schizomida: Hubbardiidae): decreasing the Wallacean shortfall in the New World

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ABSTRACT. The widely distributed species, *Stenochrus portoricensis* Chamberlin, 1922, is recorded for the first time from Costa Rica and Venezuela, and new occurrences from Brazil and Colombia are presented. Morphology of spermathecae from 14 localities is compared and illustrated. The need for studies to evaluate the potential status as an invasive species of *S. portoricensis* is commented on and a distribution map of the species in southern Central America and South America is given.

KEYWORDS. Dry Tropical Forest; Hubbardiinae, invasive species; new records, neotropics.

RESUMEN. La especie exótica *Stenochrus portoricensis* Chamberlin, 1922 (Schizomida: Hubbardiidae): disminución del déficit de Wallace en el Nuevo Mundo. La especie de amplia distribución *Stenochrus portoricensis* Chamberlin, 1922 se registra por primera vez en Costa Rica y Venezuela, y se presentan nuevas ocurrencias en Brasil y Colombia. Se compara e ilustra la morfología de las espermatecas de especímenes provenientes de 14 localidades. Se comenta la necesidad de realizar estudios para evaluar el estatus potencial de *S. portoricensis* como especie invasora y se presenta un mapa de distribución de la especie en el sur de Centroamérica y Sudamérica.

PALABRAS CLAVE. Bosque Seco Tropical, Hubbardiine, especies invasoras, nuevos registros, neotrópico.

Schizomids constitute an order of small, endemic, and circuntropically distributed arachnids. Typically found in forests, mainly in leaf litters, caves, tree barks or under stones (Reddell & Cokendolpher, 2002), schizomids comprise an abundant group across tropical and subtropical areas. With >305 species distributed in two recent families, this order has shown considerable promise to the study of historical biogeography, given its geographic fidelity (Clouse *et al*., 2017). Most schizomid species exhibit very narrow distribution ranges and are therefore considered short-range endemic (SRE) taxa, a category dedicated to animal species that exhibit distributions of less than 10,000 km^2 in extension (Harvey, 2002; Harvey *et al*., 2011).

Despite this, there are a few schizomid species that exhibit exceptionally wide distributional ranges. For example, *Zomus bagnallii* (Jackson, 1908), native of Southeast Asia (Malaysia and Singapore), has been recorded from Cook Islands, Fiji, Mauritius, Samoa, Seychelles Islands, Sri Lanka, Indonesia (Krakatoa Island), and England (*e.g*., Reddell & Cokendolpher, 1995; Harvey, 2001; Villarreal, 2010; Armas & Rehfeldt, 2015). On the other hand, *Schizomus crassicaudatus* (Cambridge, 1872) described from Sri-Lanka was introduced to France (Millot, 1949) and Germany (Armas & Rehfeldt, 2015); *Bucinozomus hortuspalmarum* Armas & Rehfeldt, 2015 described from Germany was recently recorded in Singapore (Armas & Moreno-González, 2022; Monjaraz-Ruedas *et al*., 2022), and, finally, *Stenochrus portoricensis* Chamberlin, 1922 represents the most widely distributed species of the order (Reddell & Cokendolpher, 1995). However, there is still a huge knowledge gap on the distribution (a.k.a. Wallacean shortfall) for the vast majority of schizomid species.

The genus *Stenochrus* Chamberlin, 1922 comprises seven species distributed in Central America and the Caribbean islands, excluding records of presumably introduced populations (Monjaraz-Ruedas *et al*., 2020). As mentioned, one species with a particularly wide distribution is *S. portoricensis* (type-species of the genus), since it

presents populations across several countries in the Antilles (Cuba, Dominica Island, Jamaica, Puerto Rico, Haiti, the Dominican Republic, and Saint Barthélemy), Central America (Belize, Guatemala, Honduras, Nicaragua, and Panama), and North America (Bermuda, Mexico, and the USA (*i.e.*, Florida and the Virgin Islands) (Camilo & Cokendolpher, 1988; Reddell & Cokendolpher, 1995; Harvey, 2003, 2013; Teruel & Questel, 2019; World Schizomida Catalog, 2022). In natural habitats in Cuba, the Dominican Republic, Guatemala, Mexico, Nicaragua, and Puerto Rico *S. portoricensis* has sexual populations (Armas, 1977; Rowland & Reddell, 1977, 1980; Armas & Abud Antun, 1990) which may support the hypothesis of this species being native in any of these countries, as suggested by Monjaraz-Ruedas *et al*. (2019, 2022).

However, *S. portoricensis* is not restricted to Central America, North America, and the Antilles since it is also widely distributed across many countries in two additional continents: Europe and South America. In Europe, this species appears to be common among greenhouses, as reported from many countries (e.g., Czech Republic, England, Germany, Poland, Slovakia, Switzerland, and Spain) (Reddell & Cokendolpher, 1995; Blick, 2006; Christophoryová *et al*., 2013; Zawierucha *et al*., 2013; Barranco *et al*., 2014; Armas & Rehfeldt, 2015; Lauterbach *et al*., 2020; Krajčovičová *et al*., 2021). On the other hand, in South America, this species has been recorded from three countries: Ecuador (Galapagos Islands, Guayaquil in mainland Ecuador), Brazil, and Colombia (World Schizomida Catalog, 2022). In Brazil, the populations of *S. portoricensis* seem to be established in anthropized areas in the states of São Paulo, Rio de Janeiro, Bahia, Pernambuco, and Tocantins (Tourinho & Kury, 1999; Souza & Lira, 2015), and in hypogean habitats in the state of Goiás (Gallão *et al*., 2015). Likewise, in Colombia this species has been recorded in anthropized areas of cities, such as Armenia (Department of Quindío) and Cali (Department of Valle del Cauca) (Reddell & Cokendolpher, 1995; Armas & Delgado-Santa, 2012).

In the present contribution, the first records of *Stenochrus portoricensis* from Costa Rica (Guanacaste province) and Venezuela (Mérida state) are presented. Besides, we provide seven new records from Brazil (in the states of Bahia, Minas Gerais, Pará, Rio de Janeiro, and Pernambuco) and four new records from Colombia (departments of Valle del Cauca and Santander).

The morphology of the female spermathecae across 14 localities is presented and compared. Considering the dispersal capabilities and wide distribution exhibited by *Stenochrus portoricensis*, its status as an alien species is discussed.

MATERIALS AND METHODS

For the species identification, external morphology was examined under a Leica MZ75 or Zeiss Discovery V12 stereoscope. Spermathecae of specimens from Colombia and Venezuela were dissected and cleared with Lactic Acid (60%) at room temperature for about 3 h; then, washed with ethanol at 70% and mounted onto a temporal slide. Spermathecae slides were observed under a Zeiss Axio Scope A1 microscope. For the Colombian specimens, permanent slides were prepared using Hoyer's medium. Spermathecae of specimens from Brazil were dissected and cleared with a pancreatin solution, prepared as described by Álvarez-Padilla & Hormiga (2007), for about 12 h. Temporary slides containing the spermathecae of these specimens were mounted using 70% alcohol gel-only. After examining, the spermathecae were removed from the slides and stored in microtubes, along with the remaining body parts.

General morphology photographs (Figs 1-10) were taken with a Nikon DS-series camera attached to a Nikon SMZ1500 stereoscope with trinocular tube, integrated to the NIS-Elements software of Nikon. Spermathecae photographs were taken using a Zeiss AxioCam MR R3 adapted on a trinocular tube (photographs shown in Figs 13–17), a Canon Powershot SX510 manually adapted on a GS-10x stereoscope (photographs shown in Fig. 12), or a Zeiss AxioCam 105 Color adapted on Zeiss Primo Star microscope (photographs shown in Figs 18–24). The specimens were deposited in the Colección de Arácnidos of the Universidad de los Andes, Mérida, Venezuela (CAULA-SCH; curator Antonio de Ascenção); Colección de Insectos of the Universidad del Quindío, Armenia, Quindío, Colombia (CIUQ; curator Andrea Lorena García Hernandez); Instituto de Ciencias Naturales, Bogotá, Colombia (ICN-Sc; curator Eduardo Flórez); Museo de Entomología of the Universidad del Valle, Cali, Colombia (MUSENUV; curator Jimmy Cabra-García); Instituto Butantan, São Paulo, Brazil (IBSP; curator A. D. Brescovit); Coleção de História Natural of the Universidade Federal do Piauí, Floriano, Brazil (CHNUFPI, curator J. F. Vilela); Centro de Coleções Taxonômicas of the Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (UFMG, curator A. J. Santos); and collection of Subterranean Invertebrates of Lavras, Lavras, Brazil (ISLA; curator R. L. Ferreira). Cheliceral chaetotaxy indicated on the figures follows Villarreal *et al*. (2016) and spermathecae description follows Moreno-González *et al*. (2014). Only taxonomic references after 2016 were indicated. For a complete list, see World Schizomida Catalog (2022). Works merely citing the species as the type-species of the genus are not considered in logonymy.

RESULTS

Hubbardiidae

Stenochrus portoricensis Chamberlin, 1922

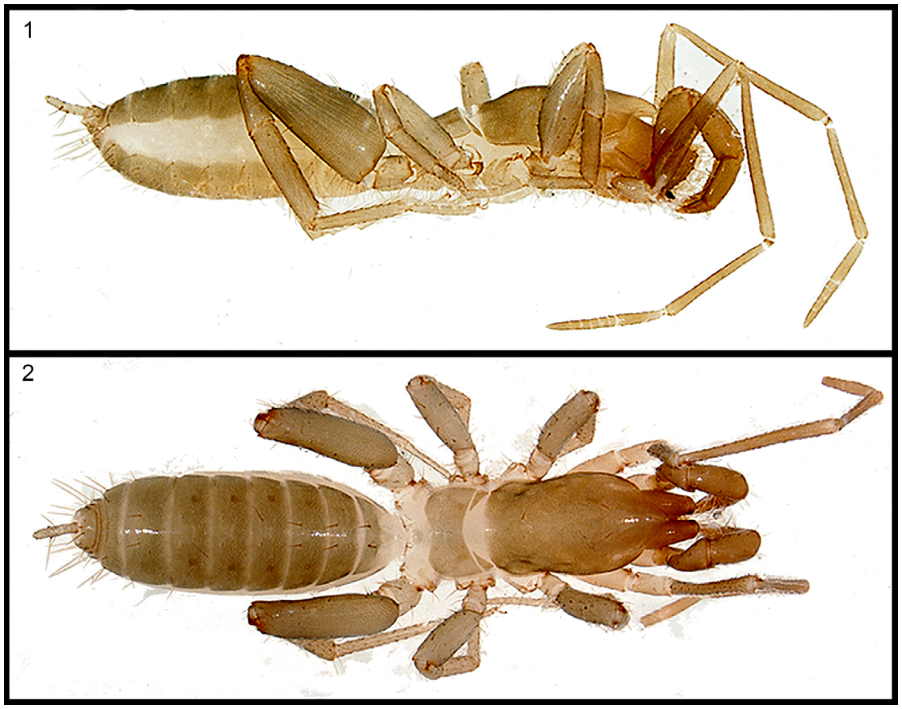
(Figs 1–34)

Stenochrus portoricensis – Monjaraz-Ruedas *et al*., 2019:69, figs 10C, 20B; Teruel & Questel, 2019:3, figs 1, 2; Lauterbach *et al*., 2020:51, figs 1A-E; Monjaraz-Ruedas *et al*., 2020:16; Teruel &

Hernández-Barroto, 2020:2, figs 2, 3; Hernández-Borroto *et al*., 2021:fig. 2; Krajčovičová *et al*., 2021:69, figs 1, 3; Monjaraz-Ruedas *et al*., 2022:2.

Distribution. NORTH AMERICA: Bermuda, Mexico, and the USA (Florida). THE ANTILLES: Cuba, Dominica, the Dominican Republic, Jamaica, Puerto Rico, Saint Barthélemy, and Virgin Islands. CENTRAL AMERICA: Belize, Costa Rica (new country record), Guatemala, Honduras, Nicaragua, and Panama. SOUTH AMERICA: Brazil, Colombia, Ecuador (Galapagos Islands and mainland: Guayaquil), and Venezuela (new country record). EUROPE: Czech Republic, Germany, Great Britain, Poland, Slovakia, Switzerland, and Spain (Canary Islands and mainland: Sevilla).

Material examined. COSTA RICA, **Guanacaste**: ♀ (11°03'15.7"N 85°21'27.2"W, 344 masl, collected on bromiliad on tree, between 1 and 3 meters), 15.vii.2017, R. Pierre leg. (CIUQ-020368) (new country record). VENEZUELA, **Mérida**: 4♀, Sucre, Lagunillas (Laguna de Urao Natural Monument, Yohama Park, 08°30'15.70"N 71°23'45,87"W, 1039 masl, under a dry trunk at the edge of a channel of water runoff towards the Laguna de Urao), 31.x.2012, N. Sánchez leg. (CAULA-SCH-0011) (new country record). COLOMBIA, **Santander** (new record): 2♀, Girón (07°04'14.86"N 73°10'23.11"W, 848 masl, collected in a human settlement), 10.xii.2012, S. García leg. (ICN-Sc); **Valle del Cauca**: 2♀, 1 juv., Buga (El Vínculo Natural Regional Park, 03°50'4.3"N 76°17'54.8"W, 1022 masl, collected in a dry tropical forest edge), 16.v.2010, J. A. Moreno leg. (ICN-Sc) (new record); ♀, Buga (El Vínculo Natural Regional Park, 03°50'4.3"N 76°17'54.8"W, 1022 masl, collected in a dry tropical forest edge), 12.i.2010, J. A. Moreno leg. (ICN-Sc) (new record); ♀, 1 juv., Buga (El Vínculo Natural Regional Park, 03°50'4.3"N 76°17'54.8"W, 1022 masl, collected in a dry tropical forest edge), 16.v.2010, J. A. Moreno leg. (ICN-Sc) (new record); ♀, Buga (El Vínculo Natural Regional Park, 03°50'4.3"N 76°17'54.8"W, 1022 masl, collected in a dry tropical forest edge), 16.v.2010, J. A. Moreno leg. (MUSENUV 24629) (new record); ♀, Buga (El Vínculo Natural Regional Park, 03°50'4.3"N 76°17'54.8"W, 1022 masl, collected in a dry tropical forest edge), 16.v.2010, J. A. Moreno, leg. (MUSENUV 24627) (new record); ♀, Buga (El Vínculo Natural Regional Park, 03°50'4.3"N 76°17'54.8"W, 1022 masl, collected in a dry tropical forest edge), 16.v.2010, J. A. Moreno leg. (MUSENUV 24630) (new record); 2♀, 4 juvs, Dagua, (El Naranjo, 03°46'45.47"N 76°43'15.69"W, 500 masl, collected in an anthropized forest, under rocks), 10.v.2012, J. A. Moreno leg. (ICN-Sc) (new record); ♀, Cerrito (El Hatico Farm, 03°38'34.48"N 76°19'40.52"W, 980 masl, collected in an anthropized dry tropical forest), 15.xii.2005, J. Cabra-García leg. (MUSENUV 24631) (new record); 1 juv, Cerrito, (El Hatico Farm, 03°38'34.48"N 76°19'40.52"W, 980 masl, collected in an anthropized dry tropical forest), 9.i.2009, C. Bermúdez leg. (ICN-Sc) (new record). BRAZIL, **Pará**: 6♀, Marabá (1º Grupo de Artilharia de Campanha de Selva, Regimento Floriano, 05°21'34.2"S 49°03'28.4"W, 118 masl, secondary *terra firme* forest), 10.x.2016, L. S. Carvalho leg. (CHNUFPI 2147) (new record); 3♀, 2 juvs, 11.x.2016, same locality and collector (CHNUFPI 2512); 6♀, 10.x.2016, same collector (UFMG 20291); ♀, same locality and collector (UFMG 21475); 3♀, 11.x.2016, same locality and collector (UFMG 21476); **Pernambuco**: ♂, ♀, Camaragibe, Road to Aldeia dos Camarás, Km 08, 07°59'8"S, 34°58'37"W, 105 masl, 7.xii.2014, P. Grossi leg. (CHNUFPI 4071) and 1 ♀ (CHNUFPI 4072) (new record); 8♀, São Vicente Ferrer, near road PE 089, 07°37'14.2"S, 35°27'47.3"W, 389 masl, secondary forest and banana plantation, 28.v.2015, L. S. Carvalho leg. (CHNUFPI 1640) (new record); **Minas Gerais**; 5♀, 2 juvs, Matozinhos, Mineração Belocal LTDA, Cave BM 157, 19° 32'12.36"S, 44°05'55.44"W, 878 masl, 17–21/IV/2020, F. O. Borges leg. (ISLA 82136) (new record); **Rio de Janeiro**: 2♀, 2 juvs, Paraty, Paraty Mirim, Trilha do Saco do Mamanguá, 23°15'48.41"S, 44°36'53.18'"W, 360 masl, 11.ii.2020, M. Pessoa-Silva & M. Teixeira leg. (IBSP 196) (new record); ♀, 4 juvs, Rio das Ostras, Reserva Biológica União, Estrada Buracão, 22°25'52.52"S, 42°02'1.05"W, 47 masl, 5.ii.2020, M. Pessoa-Silva & M. Teixeira leg. (IBSP 195) (new record); ♀, Reserva Biológica União (Estrada Três Pontes), 6.ii.2020, M. Pessoa-Silva & M. Teixeira leg. (IBSP 195) and ♀ (IBSP 200) (new record); 2♀, Rio de Janeiro, Monumento Natural dos Morros do Pão de Açúcar, Trilha da Urca, 22°57'9.11"S, 43°09'38.51"W, 2 amsl, 7.ii.2020, M. Pessoa-Silva & M. Teixeira leg. (IBSP 194); 2♀, Parque Nacional da Tijuca, 22°57'2.77"S, 43°17'9.92"W, 616 masl, E. S. S. Álvares leg. (UFMG 8838) (new record).

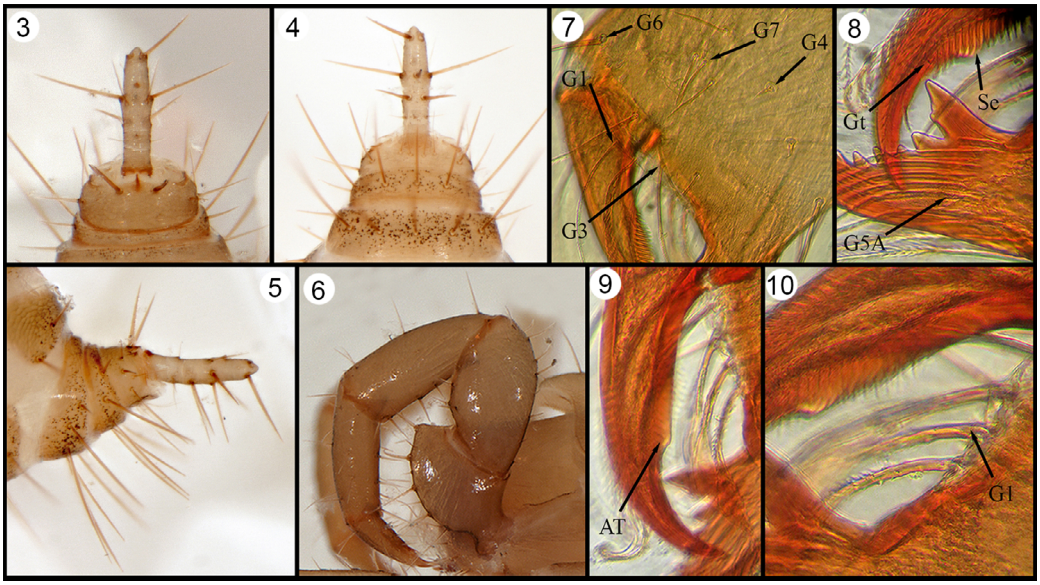


Figs 1, 2. *Stenochrus portoricensis* Chamberlin, 1922 (ICN-Sc), female habitus from Colombia (Girón, Santander department): 1, habitus, dorsal view; 2, habitus, lateral view.

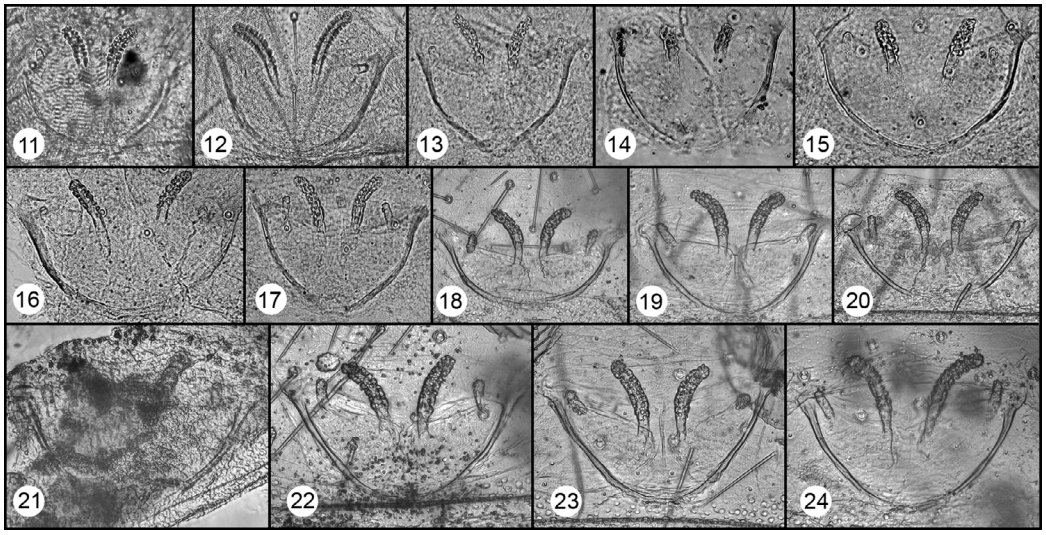
Additional material tentatively identified as *S. portoricensis*. BRAZIL, **Bahia**: 2 juv., Salvador, Parque Metropolitano de Pituaçu, 12°57'40.95"S, 38°25'19.08"W, 6 masl, 27.iii.2012, M. Martha and M. Peres leg. (IBSP 91, 92).

Remarks. The external morphology and genitalia did not differ from other populations of *S. portoricensis* from other countries (Figs 1, 2). Spermathecae from 14 localities were dissected, prepared and studied (Figs 11-24), but no relevant differences were found. The internal lobes in the Colombian populations from Dagua (Fig. 15) and El Vínculo (Fig. 14) and the Costa Rican specimen from Santa Cecília (Fig. 11) are straighter and shorter than the remaining populations (Figs 12, 13, 16–24). In the female studied from El Vínculo, the outer lobes have a slightly more anterior position compared to the chitinized arch and the internal lobes, and the shape of the arch is a bit longer and more opened in the anterior branch. However, as only one female was studied per location, it is impossible to know if these variations are constant in the populations, or even if it could be due to the effects of preparing the spermathecae for study. The populations studied presented a large variation in the shape of the chitinized arch. The Brazilian specimens from Marabá and São Vicente Ferrer have a shorter and wider arch (Figs 18–20), whereas the specimens from Mérida, Venezuela and some Colombian populations (Girón, El Vínculo, Cali) have a deeper arch (Figs 12-14, 17). Another variable aspect is the shape of the posterior branch of the chitinized arch, which is generally rounded (*e.g.*, Figs 11, 16, 22-24). However, in the Colombian specimens from Girón and Cali it is acute (Figs. 13, 17).

Natural history. *Stenochrus portoricensis* seems to have great ecological plasticity and apparent tolerance to disturbance (MONJARAZ-RUEDAS *et al.*, 2022), which could have allowed it to colonize and expand its populations. A great diversity of microhabitats has been recorded for this species, such as botanical gardens, greenhouses, anthropized areas, including gardens, houses or aqueducts, forests or even caves. In this work, specimens inhabiting bromeliads on trees, between 1 and 3 meters above the ground are recorded for the first time, as observed in *Surazomus arboreus* (COKENDOLPHER & REDDELL, 2000). Also, according to the brooding data available, from Germany, the Dominican Republic [mistake: referred to as Cuba by GIRIBET & MORENO-GONZÁLEZ, 2021: Table 1], and the U.S.A. populations, the females of *S. portoricensis* may carry on between 3–15 young and 1–16 eggs (GIRIBET & MORENO-GONZÁLEZ, 2021). On the other hand, *Stenochrus portoricensis* has been observed living in sympatry with at least other unidentified species of schizomid (*Surazomus* sp.) (ARMAS & DELGADO-SANTA, 2012); termites (*Prorhinotermes simplex* (Hagen, 1858) and *Cribetermes discolor* (Banks, 1919)); and ants (*Themnothorax canescens* (Santschi, 1908), *Pheidole megacephala* (Fabricius, 1793), *Monomorium pharaonis* (Linneaeus, 1758), and *Solenopsis saevissima* (Smith, 1855) (MIGLIORINI *et al.*, 2019)) (REDDELL & COKENDOLPHER, 1995). Whereas, the knowledge on the diet of *S. portoricensis* is restricted to laboratory conditions and includes preys such as *Drosophila melanogaster* (Meigen, 1830) (Diptera), small termites (Blattodea), Psocids (Psocoptera: Psocidae), and zorapterans (Zoraptera) (BRACH, 1976). Finally, little is known about the predators of *S. portoricensis*, there is a single record of an adult female being preyed upon by *Phrynus marginemaculatus* C. L. Koch, 1841 (ARMAS, 1989).



Figs 3-10. *Stenochrus portoricensis* Chamberlin, 1922 (ICN-Sc), female from Colombia (Santander): 3, flagellum, dorsal view; 4, flagellum, ventral view; 5, flagellum, lateral view; 6, left pedipalp, ectal view; 7-10, right chelicera, ectal view (AT, additional tooth; G1-7, cheliceral setae groups; Gt, guard tooth; Se, serrula). Figures not scaled.



Figs 11-24. *Stenochrus portoricensis* Chamberlin, 1922, spermathecae in dorsal view, from Costa Rica (11), Venezuela (12), Colombia (13-17), Brazil (18-24): 11, Guanacaste, Province of Guanacaste (CIUQ-020368); 12, Laguna de Urao Natural Monument, Lagunillas, Mérida, Mérida state (CAULA-SCH-0011); 13, Girón, department of Santander (ICN-Sc); 14, Regional Natural Park El Vínculo, Buga, department of Valle del Cauca (ICN-Sc); 15, Dagua, department of Valle del Cauca (ICN-Sc); 16, El Hatico farm, El Cerrito, department of Valle del Cauca (MUSENUV 24631); 17, Cali, department of Valle del Cauca; 18, Marabá, state of Pará (CHNUFPI 2147); 19, Camaragibe, state of Pernambuco (CHNUFPI 4072); 20, São Vicente Ferrer, state of Pernambuco (CHNUFPI 1640); 21, Matozinhos, Minas Gerais (ISLA 82136); 22, Paraty, state of Rio de Janeiro (IBSP 196); 23, Rio das Ostras, state of Rio de Janeiro (IBSP 195); 24, Tijuca National Park, Rio de Janeiro, state of Rio de Janeiro (UFMG 8838). Figures not scaled.

Figs 25-31. Habitats and live pictures of *Stenochrus portoricensis* Chamberlin, 1922: 25-27, Laguna de Urao, Mérida, Venezuela. The pink star indicates the collection site; 28, anthropized area, Los Limones Pathway, Cali, Colombia; 29-31, specimens from Los Limones Pathway, Cali, living under stones, sharing microhabitat with woodlice *Ethelum americanum* (Dollfus, 1896) (Isopoda: Oniscidea).

DISCUSSION

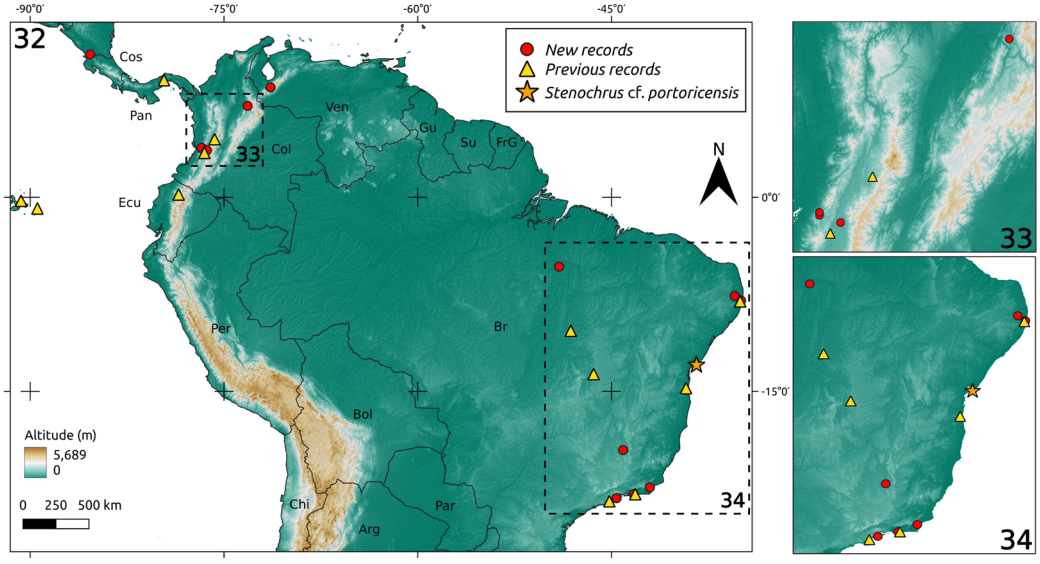
The presence of *Stenochrus portoricensis* in Costa Rica and Venezuela is not surprising due to the previous records in neighboring countries with similar ecological conditions (Figs 32-34). From Costa Rica, 15 species distributed in four genera have been recorded. The current main component of the short-tailed whip scorpions from this country is the genus *Surazomus*, which is the second-most diverse in America (behind *Rowlandius* Reddell & Cokendolpher, 1995), originally distributed in South America, but recently recorded from Mexico (MONJARAZ-RUEDAS *et al.*, 2020). The other genera present in Costa Rica are common elements in northern South America and the Antilles (ARMAS & VÍQUEZ, 2011, 2014). This is the first record of *Stenochrus* for this country.

The schizomid fauna of Venezuela has been poorly studied, but this seems to be potentially diverse, with 10 species and six genera - including *Stenochrus* - (HARVEY, 2003; ARMAS & COLMENARES-GARCÍA, 2006; VILLARREAL & TERUEL, 2006; VILLARREAL *et al.*, 2008, 2016; ARMAS *et al.*, 2009; ARMAS, 2010). This makes this country the third most-diverse in South America, behind Brazil (19 species in six genera) (PINTO-DA-ROCHA *et al.*, 2016; RUIZ & VALENTE, 2017; SALVATIERRA, 2018) and Colombia (16 species in six genera) (SEGOVIA-PACCINI *et al.*, 2018). Other South American countries occupy descendent positions in schizomid species richness and generic diversity: Ecuador (three genera and six species), Suriname (one genus and three species), Guyana (one genus and two species), and Bolivia and Peru (one genus and one species) (ROWLAND & REDDELL, 1979a,b; PINTO-DA-ROCHA, 1996; COKENDOLPHER & REDDELL, 2000; VILLARREAL *et al.*, 2016).

The new record from Venezuela is based on four females collected in an anthropized forest fragment in Lagunillas near Laguna de Urao (Mérida state) (Figs 25-27), which could correspond to the Thorn Shrub forest biome (ATAROFF & SARMIENTO, 2004). Although efforts have been made to collect within preserved Thorn Shrub forest fragments, no specimens of *S. portoricensis* or any other schizomid species were observed whatsoever. So, the distribution of *S. portoricensis* is apparently restricted to anthropized forest fragments.

The introduction of *S. portoricensis* in Lagunillas may be related to agricultural activities carried out in an experimental station near the anthropized forest fragment. Although this species has not been collected in other regions of the country, the heterogeneous sampling in Venezuela prevents ruling out its presence in areas adjacent to some cities, mainly in the coast and center of the country. However, further efforts are needed to detect this species in urban areas in Venezuela, given that most of the efforts to sample short-tailed whip scorpions have focused on pristine humid forests or cave environments (*e.g.*, GONZÁLEZ-SPONGA, 1997; ARMAS & COLMENARES-GARCÍA, 2006; VILLARREAL & TERUEL, 2006; ARMAS *et al.*, 2009; VILLARREAL *et al.*, 2014).

Moreover, one of the new records from Colombia represents a female population inside an urban area in Girón (department of Santander), similar to that recorded from other cities, such as Cali (department of Valle del Cauca) (Fig. 4D–G) and Armenia (department of Quindío) (*e.g.*, REDDELL & COKENDOLPHER, 1995; DELGADO-SANTA & ARMAS, 2012). However, the most interesting new records probably correspond to those from the seasonally dry tropical forest (SDTF) relics from Buga, Cerrito, and Dagua (department of Valle del Cauca). These records represent well-established populations of an alien species in a native and endangered Colombian ecosystem (GARCÍA *et al.*, 2014).



Figs 32-34. Geographical distribution of *Stenochrus portoricensis* Chamberlin, 1922 in South America and part of Central America (mainland and some islands): 32, South America and the southernmost portion of Central America; 33, Colombia; 34, Brazil.

The SDTF presents a wide and fragmented distribution ranging from Mexico to Argentina (including the Antilles) (Pennington *et al*., 2009). It comprises one of the most threatened tropical biomes in the world (Miles *et al*., 2006) with less than 10% of its original extent remaining in a few countries (Pennington *et al*., 2009). When compared with other humid counterparts, such as tropical rain forests, the remaining area and the conservation efforts to protect the SDTF seem to be smaller (Sánchez-Azofeifa *et al*., 2005; Miles *et al*., 2006). In Colombia, the SDTF do not represent an exception and have also been considered among the most threatened ecosystems due to human activities that have diminished to 46% of its original extension of 7,172 km^2 (García *et al*., 2014).

Records of schizomids from SDTF are scarce. In Colombia, *Piaroa turbacoensis* (Segovia-Paccini, Ahumada-C. & Moreno-González) was described from Turbaco in the Colombian Caribbean region (department of Bolívar) within that biome. In Brazil, four schizomid species are known from SDTF localities, with one epigean (*Surazomus algodoal* (Ruiz & Valente, 2017) and three hypogean taxa (*Rowlandius ubajara*) (Santos, Ferreira & Buzatto, 2013; *R. potiguar* Santos, Ferreira & Buzatto, 2013) and *R. pedrosoi* (Giupponi, Miranda & Villarreal, 2016) (Ruiz & Valente, 2017). Records of *S. portoricensis* in Brazil, however, are not located in the SDTF biome. Conversely, these records are from moist biomes, such as the Atlantic and the Amazon forests or from cave environments in the Cerrado, a savanna-like biome.

The presence of *S. portoricensis* may constitute a threat to native schizomids inhabiting the SDTF or moist biomes. For example, in the department of Valle del Cauca, eight protected SDTF fragments exist; all surrounded by massive sugar cane crops: Colindres (Jamundí), El Vínculo Natural Regional Park (Buga), Las Chatas (Buga), El Medio (Zarzal), Las Pilas (La Victoria), Juan María Céspedes Botanical Garden, El Hatico Farm (Cerrito), and El Tiber (San Pedro) (Alvarado-Solano & Ospina, 2015). According to personal field observations by the last author (JAMG), El Medio and the Juan María Céspedes Botanical Garden have native populations of two undescribed species of *Piaroa* Villarreal, Giupponi & Tourinho, 2008 each, and have no populations of *S. portoricensis*, yet. Other fragments, such as El Vínculo Natural Regional Park (Buga) and El Hatico Farm (Cerrito), have well-established populations of *S. portoricensis*, but not native schizomid populations.

In the Amazon forest, several species of short-tailed whip scorpions are known (see, Ruiz & Valente, 2017 for a list) and the low number of species described might be due to sampling bias, widely reported for Brazil (Oliveira *et al*., 2016). In the Atlantic Forest, however, only one endemic or native species is known, *Rowlandius linsduarte* Santos, Dias, Brescovit & Santos, 2008. This species was described from Mata do Buraquinho, a forest reserve in the state of Sergipe (Santos *et al*., 2008), located less than 100 km from at least three records of *S. portoricensis*, in the state of Pernambuco (see Souza & Lira, 2015 and records in the present study).

As well as other introduced populations of *S. portoricensis*, the new records presented here are composed only of female populations. It may be due to the presumably parthenogenetic abilities of this species (Ruiz & Valente, 2017; Teruel & Questel, 2019; Monjaraz-Ruedas *et al*., 2022). This particular reproduction strategy of *S. portoricensis* can facilitate a rapid and massive expansion abroad, in non-native biomes and anthropogenic areas. This hypothesis is also suggested for other taxa. For example, the goblin spiders *Triaeris stenaspis* Simon, 1891 and *Heteroonops spinimanus* (Simon, 1891) are considered parthenogenetic species with pantropical distribution, thus, raising concerns of the impact of these species on natural ecosystems (Brescovit *et al*., 2019). There is no study on competition nor interactions between *S. portoricensis* and local schizomid species, hampering further assessments of their impacts. An important question remains open as to whether this species could become a harmful invasive exotic species that competes for resources or even takes advantage of local species, affecting their populations, but until there are studies in this regard, any assumption would be merely speculative.

Stenochrus portoricensis is a widely distributed species in the New World, with populations introduced in the Old World. Although its presence in Costa Rica and Venezuela is not surprising, the occurrence of this species in both countries is confirmed for the first time. Additionally, new records are presented for Colombia and Brazil. New records from the Brazilian Amazon region help to fill some distributional gaps for the species. This wide distribution suggests a possible status as an invasive species, thus, future studies should evaluate the ecological role played by *S. portoricensis* in other biomes where it has been introduced, emphasizing its influence on native populations and the risk that this introduction would represent to the local fauna. Furthermore, spermathecal morphology was evaluated in some individuals over a wide geographic range and no substantial differences were detected. Small variations were observed in the shape of the chitinized arch and the length of the lobes, however, the low number of samples studied per locality, as well as the differences in the preparation methods of the spermathecae, do not allow assessing whether they are population variations or an artifact of preparation. The species is reported for the first time in a bromeliad on a tree, a fact that – together with previous reports in heavily antropized places, forest litter or caves – allows evidence of ecological plasticity in the species.

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