

## DISTRIBUTION, CONSERVATION STATUS AND TAXONOMIC UPDATE OF THE CUBAN ENDEMIC WHIP-SPIDER *CHARINUS TOMASMICHELI* ARMAS, 2006 (AMBLYPYGI: CHARINIDAE)

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**Abstract:** The whip-spider *Charinus toasmicheli* Armas, 2006 (Amblypygi: Charinidae) was described, and was still known only from a single cave in the Guamuhaaya Massif, south-central Cuba; it was originally classified as a troglobite on the basis of the remarkable appendage attenuation of the type-specimens. Herein we report eight additional localities for *C. toasmicheli* (most of them scattered all over the Guamuhaaya Massif, but three on its western surrounding lowlands), which include its first records from Cienfuegos and Sancti Spiritus provinces and largely represent epigean habitats. Moreover, based on its current geographic range we make a preliminary assessment of its conservation status following the IUCN criteria. Finally, the abundant material now available (96 specimens: 27♂♂, 41♀♀, 28 juveniles) allowed us to reassess the validity of the species' original diagnostic characters and emend its taxonomic definition.

**Key words:** Amblypygi, Charinidae, threatened endemic species, Guamuhaaya Massif, Cuba.

### Distribución, estatus de conservación y actualización taxonómica del ambliopigio endémico cubano *Charinus toasmicheli* Armas, 2006 (Amblypygi: Charinidae)

**Resumen:** El ambliopigio *Charinus toasmicheli* Armas, 2006 (Amblypygi: Charinidae) se describió, y aún se conocía solo de una caverna del Macizo de Guamuhaaya, centro-sur de Cuba; fue clasificado originalmente como un troglobio sobre la base de la considerable atenuación apendicular de los ejemplares tipo. En el presente artículo se reportan ocho localidades más para *C. toasmicheli* (en su mayoría esparcidas por todo el Macizo de Guamuhaaya, pero tres de ellas en sus inmediaciones bajas occidentales), que incluyen sus primeros registros de las provincias de Cienfuegos y Sancti Spiritus y representan principalmente hábitats epigeos. Además, se hace una evaluación preliminar de su estado de conservación, basado en su actual rango de distribución y siguiendo los criterios de la UICN. Finalmente, el amplio material ahora disponible (96 ejemplares: 27♂♂, 41♀♀, 28 juveniles) permite reevaluar la validez de los caracteres dados originalmente como diagnósticos para la especie y enmendar su definición taxonómica.

**Palabras clave:** Amblypygi, Charinidae, especie endémica amenazada, Macizo de Guamuhaaya, Cuba.

## Introduction

The Cuban Archipelago holds the highest diversity and endemism within the order Amblypygi across the West Indies, with 16 species, 12 of them are endemic from the country; such a diversity accounts for 55% of all Antillean whip-spider species currently recognized as valid (Armas, 2006a, 2014; Teruel *et al.*, 2009; Teruel & Questel, 2015).

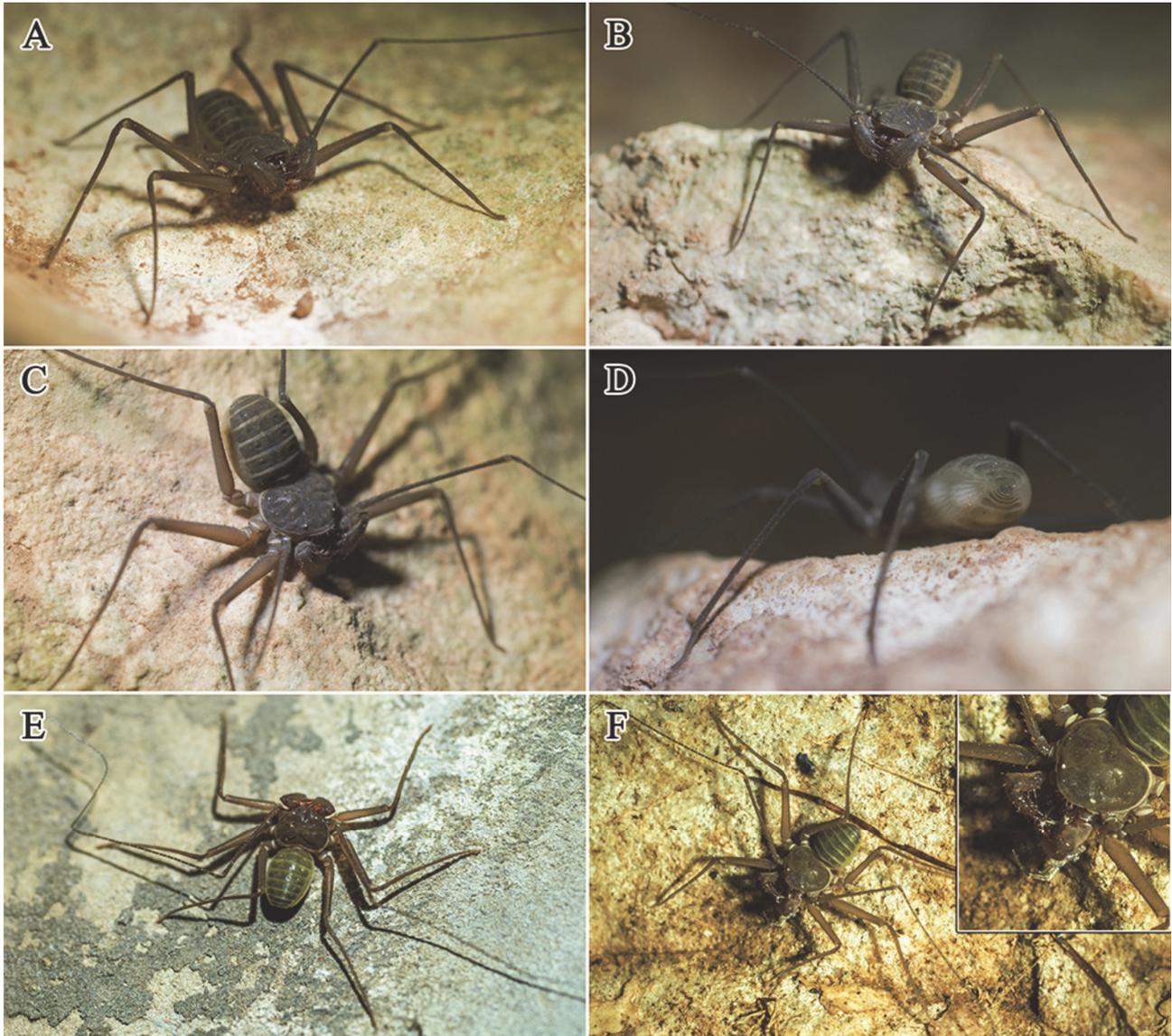
Within the Euamblypygi, the family Charinidae Quintero, 1986, constitutes the basalmost group and includes the smallest whip-spiders (Weygoldt, 1996, 2000). Its type genus *Charinus* Simon, 1892 is the most speciose of the entire order Amblypygi, with more than 50 currently accepted species (Jocque & Giupponi, 2012; Vasconcelos *et al.*, 2013, 2014; Silva de Miranda *et al.*, 2016a, b). It is represented in Cuba by six described and one undescribed species, all of which are considered island endemics (Quintero, 1983; Armas, 2014; Teruel & Questel, 2015).

With the exception of *C. acosta*, which is widespread, synantropic and parthenogenetic, the remaining five species have restricted distribution ranges, are habitat-specific and occur below 300 m a.s.l. (Armas, 2000, 2005, 2006a, b, 2012a, 2014; Teruel *et al.*, 2009; Teruel, 2011; Teruel & Rodríguez-Cabrera, 2016). Recently, Armas *et al.* (2012) and Viquez *et al.* (2012) referred some specimens from Colombia and Panama to *C. acosta*, but only tentatively.

On the other hand, the conservation status of this somewhat neglected arachnid order has received little atten-

tion. This is specially reflected in the IUCN Red List of Threatened Species, where only two species are listed: the charinid *Charinus seychellarum* Kraepelin, 1898 and the phrynichid *Phrynichus scaber* (Gervais, 1844), see Gerlach (2014a, b); this number represents only about 1% of the whole whip-spider fauna. In Cuba, Vales *et al.* (1998) categorized as Vulnerable only the phrynid *Phrynus noeli* Armas & Pérez, 1994, but this has undergone completely overlooked by the IUCN. Nevertheless, many endemic whip-spiders on this archipelago have restricted geographic ranges and are habitat-specific (Armas, 2014; Teruel *et al.*, 2009), thus, threats such as habitat loss/fragmentation/degradation and introduction of exotic species are expected to impact on them negatively. This suggest that an urgent assessment of their conservation status is desirable.

As the most recent addition to the genus in Cuba, Armas (2006) described *Charinus toasmicheli* (see fig. 1 herein) from a series of specimens collected by the present senior author inside a single cave near Manantiales, in the northern watershed of the Guamuhaaya Massif, Villa Clara Province, in south-central Cuba. Because of such habitat and the remarkable appendicular attenuation of the available specimens, Armas (2006b) and Armas *et al.* (2009) classified this species as a troglobite. However, these specimens were actually collected both in a dark chamber and the semi-darkness vestibular zone (Armas, 2006b; Armas *et al.*, 2009; TMRC, pers. obs.),



**Fig. 1.** Typical live habitus of adult *Charinus toasmicheli* from a subterranean habitat at Martín Infierno Cave (**A–D**), from an epigeal habitat at Cienfuegos Botanical Garden (**E–F**). Note the following details: **i**) the lack of macro-morphological distinction between cave and surface-dwelling specimens; **ii**) the eggs visible through the lateral pleura of the pregnant female at **D**; **iii**) a specimen preying upon an undetermined apterygote insect at **F**. Photographs courtesy of Raymundo López-Silvero.

which suggests a not-so-strict dependence on the subterranean lifestyle, as observed in true troglobites which are usually restricted to the deep dark zones far from the cave entrances (Galán, 1993). Later, Teruel & Rodríguez-Cabrera (*in Armas*, 2013) already mentioned that *C. toasmicheli* occurs in epigeal (surface) habitats, but gave no additional details.

Herein we report eight new localities for *C. toasmicheli* that extend over essentially all the Guamuhaya Massif and surroundings, most of which represent strictly epigeal habitats. The new information obtained on distribution combined with some natural history observations allowed us to make a preliminary assessment of its conservation status following the IUCN criteria. Finally, based on the wide new series of specimens obtained, we review the diagnostic characters given for the species on its original description and comment on their validity.

## Material and methods

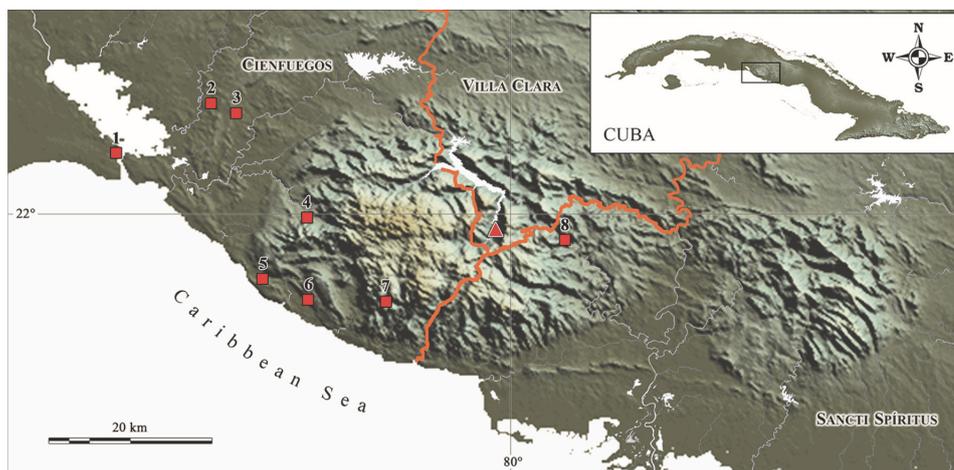
We collected the specimens by direct search, i.e., rock rolling

during daytime in epigeal habitats and visual detection with standard flashlights in caves. All samples were preserved in 80% ethanol and deposited in the following repositories: Instituto de Ecología y Sistemática, La Habana (IES), and personal collections of Rolando Teruel, Santiago de Cuba (RTO) and Michael Seiter, Vienna, Austria (MS).

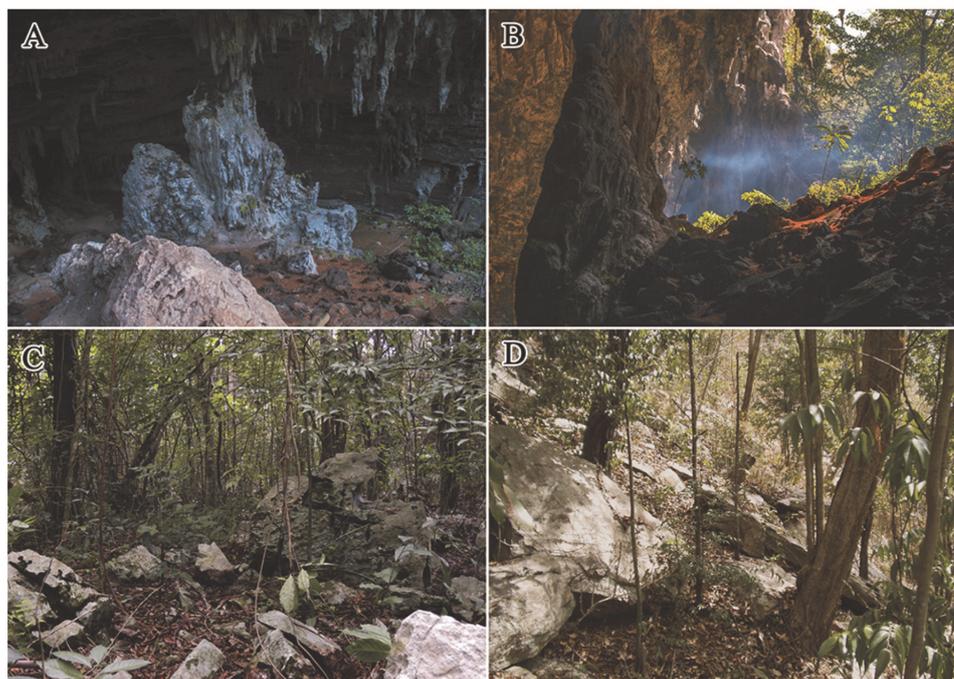
We took coordinates either directly *in situ* with a GPS or obtained *a posteriori* from 1:25,000 topographic maps with software MapInfo Professional ver. 10.5 (*datum* WGS 84). We pooled all individual records within a 1 km radius into a single location for mapping purposes, but gave the separate coordinates of every record in the Material Examined section, and produced the resulting distribution map in MapInfo Professional ver. 10.5 and Adobe Photoshop CS5.

We assessed the conservation status of *C. toasmicheli* based on its geographic range, i.e., criterion B of IUCN (2012) and IUCN Standards and Petitions Subcommittee (2014). We calculated both the Area of Occupancy (AOO) and the Extent of Occurrence (EOO) with MapInfo Professional ver. 10.5. For the AOO we used a reference scale grid

**Fig. 2.** Updated distribution of *Charinus toasmicheli*, depicting the type locality (triangle) and the new records (squares): Caletón de Don Bruno (1), Pepito Tey (2), Cienfuegos Botanical Garden (3), San Blas (4), Palma Sola (5), La Tatagua (6), Martín Infierno Cave (7), and resurgence of the Jibacoa river (8).



**Fig. 3.** Subterranean habitat of *Charinus toasmicheli* in semi-darkness vestibular zone of Martín Infierno Cave (A–B) and epigeal habitats with semideciduous forest at Cienfuegos Botanical Garden (C) and west of San Blas. Photographs A–B courtesy of Raimundo López-Silvero.



of 1 km<sup>2</sup> cells due to the small size, specific habitat requirements and poor dispersal ability of the target species. We calculated the EOO using the minimum convex polygon (IUCN, 2012; IUCN Standards and Petitions Subcommittee, 2014). We are aware of some bias toward underestimation of EOO because of the highly irregular vertical topography of the region, particularly in mountainous zones. Nevertheless, this compensates for all unsuitable habitats that according to our present data are actually or potentially unoccupied by *C. toasmicheli* and remained inside the polygons imposing an opposite bias toward overestimation: water bodies (sea, rivers and lagoons), bald terrains, open secondary grasslands, intensive agricultural crops, towns and villages.

## Results

### I. Distribution and natural history

The updated distribution of *C. toasmicheli* includes so far nine localities, four of them placed up on the mountains of the Guamuhaya Massif, two in its foothills and three along its surrounding lowland coastal to subcoastal areas (fig. 2), extending over an altitude range of 1–600 m a.s.l. Despite the somewhat wide distribution, the species habitat is conspicu-

ously restricted to karst areas where it is found under rocks both inside caves (mostly at the semi-darkness vestibular zone) and in the leaf litter of shaded forests with > 90% canopy coverage (fig. 3). Apparently, it can tolerate some levels of human disturbance, including partial replacement of the primary forest by second-growth forest, but it seems highly sensitive to complete deforestation.

The species lives sympatrically and syntopically with *Paraphrynus viridiceps* (Pocock, 1893) in most localities, both cave and epigeal. The single exception is Caletón de Don Bruno, where it coexists only with *Phrynus marginamaculatus* C. L. Koch, 1840. At La Tatagua and Palma Sola, it coexists also with *Phrynus decoratus* Teruel & Armas, 2005.

About its reproductive biology, we found pregnant and/or ovigerous females in all sampled dates and populations (fig. 1D).

In August 4, 2013, the junior author observed two subadults of *C. toasmicheli* consuming undetermined termites at night in the vestibular zone of Guajimico largest cave. On October 26, 2014, the senior author found one adult male consuming an undetermined apterygote insect during daytime at the Cienfuegos Botanical Garden (fig. 1F).

## II. Conservation status

The current geographic range of *C. tomasmicheli* represents a 9 km<sup>2</sup> AOO and a 509 km<sup>2</sup> EOO (fig. 4), which fulfills both criterion B2ab(iii) in the category of **Critically Endangered** and criterion B1 in the category of **Vulnerable**. Moreover, according to our observations *C. tomasmicheli* is a habitat-specific species that requires to survive an essentially closed forest cover (>90% canopy coverage) and the high relative humidity provided by cave environments and leaf litter (in epigeal habitats). The population of this species across its geographic range is severely fragmented into various subpopulations (criterion B2a). Most of them are isolated as metapopulations, with very low likelihood of genetic exchange; these are actually relict patches of native vegetation, surrounded by a heavily disturbed matrix of unsuitable habitats.

Moreover, because *C. tomasmicheli* does always occur in limestone karstic landscapes which are plenty of inaccessible refuges such as rock crevices and subterranean systems, accurate estimates on population density and general population size become very difficult. The main factor that seems critical for the species is the accelerated habitat loss and fragmentation due to both extensive and intensive deforestation derived from agriculture, inadequate use of soils and the continuous advance of human settlements. In addition, the exotic invasive species such as feral and domestic pigs have devastating effects on the forest ground where *C. tomasmicheli* inhabits, by heavily removing the soil and turning up the loose rocks.

To make things even worse, only two (22%) of the nine records of *C. tomasmicheli* fall within the National System of Protected Areas of Cuba (SNAP, its Spanish acronym) (fig. 5). One is the tiny (2.46 km<sup>2</sup>) "Área Protegida de Significación Nacional Cueva de Martín Infierno", the other is within the "Paisaje Natural Protegido Guajimico", still pending of official approval by the Cuban government (Centro Nacional de Áreas Protegidas, 2013). However, it is worth mentioning here the Cienfuegos Botanical Garden: despite this last locality does not fall within the SNAP, the preservation of the native forest patch where *C. tomasmicheli* occurs has been a priority for this institution since the mid-20<sup>th</sup> century. The remaining localities are currently under great anthropogenic pressure.

## III. Taxonomy

**EXAMINED MATERIAL** (96 specimens: 27♂♂, 41♀♀, 28 juveniles). CIENFUEGOS Province: Cienfuegos Municipality: Jagua: Caletón de Don Bruno [22°04'24"N - 80°28'03"W; 1 m a.s.l.]; under rocks in coastal semideciduous forest, about 6 m from tide line; 11/March/2013; T. M. Rodríguez; 2 juveniles (RTO). Belmonte, 1 km west of Pepito Tey village [22°07'39"N - 80°20'43"W; 50 m a.s.l.]; under rocks in secondary forest; 2/April/2014; T. M. Rodríguez; 2♂♂, 1♀, 1 juvenile (RTO). Cienfuegos Botanical Garden [22°07'15"N - 80°19'30"W; 60 m a.s.l.]; under rocks in semideciduous forest; 2/July/2012; T. M. Rodríguez; 1♂, 4♀♀, 1 juvenile (RTO). 8/March/2013; T. M. Rodríguez; 5♂♂, 5♀♀, 5 juveniles (RTO). Cumanayagua Municipality: 1.5 km west of San Blas [21°59'44"N - 80°14'27"W, 21°59'26"N - 80°14'14"W and 21°59'21"N - 80°14'30"W; 80–90 m a.s.l.]; under rocks in semideciduous forest and inside small cave; 15–18/March/2013; T. M. Rodríguez; 3♂♂, 5♀♀, 1 juvenile (RTO). 3/May/2013; T. M. Rodríguez; 1♂, 2♀♀, 1 juvenile (RTO).

Guajimico: Cueva Grande [21°55'45"N - 80°18'43"W; 35 m a.s.l.]; under rocks on moist humus at the vestibular zone of the cave; 4/August/2013; R. Teruel, M. Seiter, J. Nigl, F. Schramm; 1♂, 1♀, 2 juveniles (MS). Palma Sola, 1 km southeast of Guajimico village [21°55'22"N - 80°17'33"W; 80–90 m a.s.l.]; under rocks in secondary vegetation; 23/June/2009; T. M. Rodríguez, R. Teruel; 1♂, 2♀♀, 3 juveniles (RTO). La Tatagua waterfall, 2.5 km northwest of Camilo Cienfuegos village [21°54'06"N - 80°14'39"W and 21°53'54"N - 80°14'24"W; 80–100 m a.s.l.]; under rocks in riparian secondary forest; 10/March/2013; T. M. Rodríguez, L. Fernández; 4♂♂, 3♀♀ (RTO). Colorado: Cueva Martín Infierno [21°53'32"N - 80°08'47"W; 600 m a.s.l.]; under rocks inside the cave, semi-dark zone; 1–4/March/2013; T. M. Rodríguez; 6♂♂, 7♀♀, 2 juveniles (RTO). VILLA CLARA Province: Manicaragua Municipality: Los Manantiales, Cueva de Tito [21°58'51"N - 80°01'08"W; 400 m a.s.l.; type locality, herein corrected]; under rocks inside the cave, dark zone; 2♂♂, 1♀, 6 juveniles (IES). 1/March/2014; under rocks in semideciduous forest and inside the cave; T. M. Rodríguez, C. A. Martínez; 1♂, 2♀♀ (topotypes-RTO). SANCTI SPÍRITUS Province: Trinidad Municipality: Dos Arroyos: resurgence of Jibacoa river [21°58'13"N - 79°56'12"W; 250–300 m a.s.l.]; under rocks in evergreen forest and inside small caves; 27/July/2012; T. M. Rodríguez, C. A. Martínez; 8♀♀, 4 juveniles (RTO).

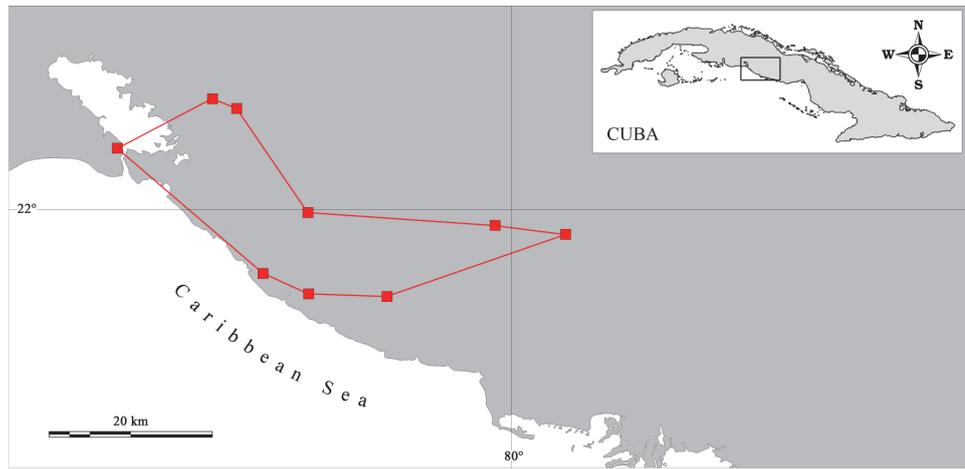
**DIAGNOSIS** (emended). Adult size medium to moderately large for the genus (males 4.2–5.8 mm, females 4.6–7.5 mm). Coloration almost uniformly light yellowish to reddish brown, immaculate overall; in life with shades of greenish (abdomen) and purplish (rest of the body). Carapace with lateral eyes well developed, median ocular tubercle and median eyes absent, underlying melanic pigment variable from entirely absent to present as a small blackish spot; frontal margin variable from narrowly conical to widely convex (usually slightly narrower in males). Tritosternum/tetrasternum/pentasternum with 4/1/1 pairs of spiniform setae, respectively; tritosternum bottle-shaped, remarkably longer than wide and with a pair of apical spiniform setae. Leg I flagellum with 21 tibial and 37 tarsal segments. Leg IV with trisegmented basitibia. Tarsomere II of legs II–IV with translucent membranous ring complete. Table I.

**Table I.** Measurements (mm) of four adults of *Charinus tomasmicheli* from Martín Infierno cave population. Abbreviations: length (L), width (W), depth (H).

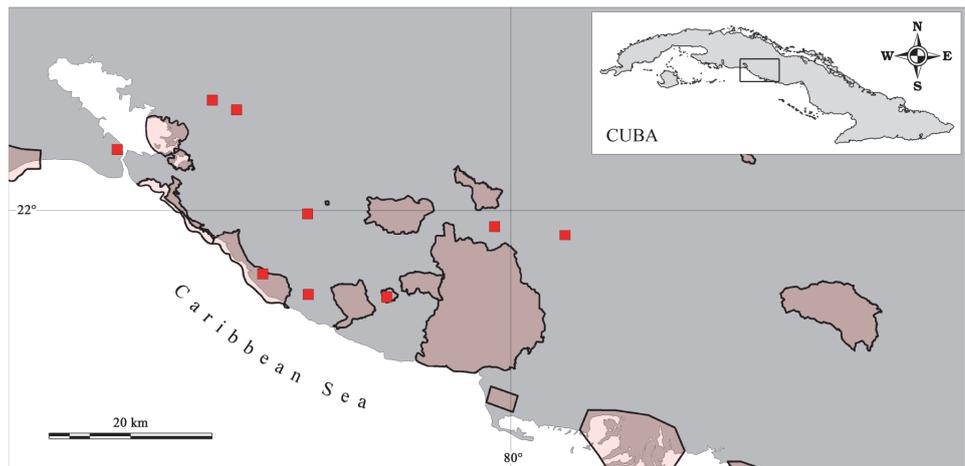
Dimensions	♂	♂	♀	♀
Carapace L/A	1.75/2.05	2.40/2.80	2.00/2.40	3.00/3.75
Abdomen L	2.50	3.40	2.60	4.50
Pedipalp L	3.30	4.60	3.70	6.81
Femur L/A	0.80/0.30	1.30/0.48	1.00/0.40	1.63/0.60
Patella L/A	1.10/0.32	1.40/0.45	1.10/0.30	2.20/0.70
Tibia L	0.60	0.80	0.60	1.18
Basitarsus L	0.40	0.55	0.50	0.90
Postarsus L	0.40	0.55	0.50	0.90
Leg I Femur L	3.50	5.15	3.50	7.00
Leg IV Femur L	2.20	3.25	2.30	5.20
<b>Total L</b>	<b>4.25</b>	<b>5.80</b>	<b>4.60</b>	<b>7.50</b>

**COMMENTS.** Armas (2006b) regarded *Charinus cubensis* (Quintero, 1983) as the sister-taxon of *C. tomasmicheli* and diagnosed both species on the basis of body size, leg attenuation, shape of anterior portion of carapace, presence/absence of ocular melanic pigment, trichobothrial pattern of leg IV basitibia, and arrangement of carapace setae. However, a

**Fig. 4.** Minimum convex polygon depicting the calculated Extent of Occurrence (EOO) for *Charinus toasmicheli*.



**Fig. 5.** Distribution of *Charinus toasmicheli* superimposed with the National System of Protected Areas of Cuba (south-central region depicted only).



thorough examination of the 96 additional specimens of *C. toasmicheli* herein recorded, plus their direct comparison to a similar number of newly collected specimens of *C. cubensis* (all of them obtained by the present authors and deposited in RTO collection), allowed us to conclude that most characters proposed as diagnostic in the species' original description (Armas, 2006) are no longer valid.

This is due to excessive variability both within and amongst populations, which is random (i.e., not geographically correlated) and more evident in epigean populations of *C. toasmicheli*. For instance, Martín Infierno cave sample (15 specimens) is remarkable for its degree of variability among adults, which equals the complete species' range. For example: **1)** the largest female is 39% larger than the smallest female and 23–43% larger than the largest and smallest male, respectively; **2)** despite being cave-dwellers, the largest females are the darkest specimens we studied, while most males and the smallest adult females are amongst the palest.

The anterior margin of carapace exhibits the complete range from wide to narrow and its shape varies from evenly convex to truncate or even subtly bilobed (fig. 6). Moreover, this character is difficult to apply, because slight differences in view angle result in dissimilar observations: the most frontal the carapace is observed, the rounder it looks and vice versa.

In addition, there is considerable allometric variability, with positive correlation between appendage attenuation and body size, i.e., the larger the specimen, the longer its legs and pedipalps and vice versa; this character seems habitat-related,

as the largest specimens were always collected in cave environments, but together with medium and even small adults identical in appendicular attenuation to epigean ones.

Coloration also varies in *C. toasmicheli*, from uniformly olive-yellowish to light yellowish-brown (fig. 1A-D) to bicolor, with the carapace and appendages light olive-yellowish and the tergites olive-greenish (fig. 1E-F). Intermediate conditions are common and both color patterns occur in epigean and subterranean populations, but in reverse proportions: bicolor, darker specimens are predominant in lowland epigean habitats, while uniformly pale individuals are more commonly found in caves.

Similarly, the underlying melanic pigment of the eyes is variable in both taxa, but with opposite trend in each one. It is almost always absent in *C. toasmicheli* (present and well-developed in only four specimens: a topotype adult female, one adult male from Cienfuegos Botanical Garden and one juvenile male from Jibacoa river), while it is generally present in *C. cubensis* (absent in some isolate individuals from different populations). Thus, this character is of limited value as species' diagnostic and must be used with caution.

On the other hand, a previously unnoticed character proved truly diagnostic for this species: the shape and setation of the tritosternum, tetrasternum and pentasternum. Actually, *C. toasmicheli* has one of the most divergent (= unique) sternal areas amongst all Cuban members of *Charinus*: a conical, bottle-shaped tritosternum, plus tetrasternum and pentasternum with two setae closely adjoining on a single larger central tubercle. As opposite, *C. cubensis* has the tritos-

ternum cylindrical and straight, and the two setae are widely separated each on its own very small, independent tubercle (fig. 7).

From a biogeographical point of view, *C. cubensis* and *C. toasmicheli* have strictly allopatric distributions, with about 600 km isolation between the nearest records. Further, each species occurs in its own mountain system that is entirely independent and has a very different paleogeographical history (Iturralde-Vinent & MacPhee, 1999; Iturralde-Vinent, 2003, 2005, 2006, 2012). For these small, habitat-specific species with highly limited dispersal abilities, geographical distribution indicates that we have two separate taxa, despite close morphological resemblance. Genetic studies of both metapopulations are highly desirable to investigate on their phylogenetic relationship, potential divergence timeframe and speciation model.

### General remarks

As previously advanced by R. Teruel & T. M. Rodríguez-Cabrera (*in Armas, 2013*), our fieldwork revealed that *C. toasmicheli* occurs and develops its entire life cycle in both subterranean and epigeal habitats indistinctly, thus, we reclassify this species herein as troglophile instead of troglobite as previously thought (Armas, 2006b; Armas *et al.*, 2009). An interesting point is that the population at Martín Infierno Cave represents the highest elevation reported both for the species and for the genus *Charinus* in Cuba/the West Indies (600 m a.s.l.).

On the other hand, recent estimates using remote sensing suggested that the coverage of primary forests in Cuba increased about 2.4% during the 1990-2010 period (FAO, 2007; González *et al.*, 2012). However, this number seems insignificant when compared to the long history of forest depletion during the last centuries (> 50% *sensu* González *et al.*, 2012), which we consider strong enough as to have long-lasting, negative effects on the native biota. Therefore, we assumed the criterion Bb(iii), referring to continuing decline in the effective "area extent and/or quality of habitat", as fully applicable to *C. toasmicheli*. Moreover, despite *C. toasmicheli* qualifies for more than one category, the IUCN states that "only the highest category of threat that the taxon qualifies for should be listed" (IUCN, 2012; IUCN Standards and Petitions Subcommittee, 2014). Therefore, according to our assessment *C. toasmicheli* can be evaluated as Critically Endangered, *i.e.*, facing an extremely high risk of extinction in the wild.

This is an alert for local and national wildlife conservation authorities of Cuba regarding the critical situation that some endemic and neglected groups of arthropods actually and currently face right under our nose. In particular, many other endemic whip-spider species suspected to be in a similar situation than *C. toasmicheli* require urgent assessment in order to take rapid actions to guarantee their long-term survival. In the meantime, it is mandatory to continue searching for *C. toasmicheli* in other areas with suitable habitats in the region, particularly within the SNAP. The study and management of *C. toasmicheli* in those areas with some kind of administration then has maximum priority. The more subpopulations we can discover within the SNAP, the more probabilities local wildlife conservation authorities will have to implement management actions to preserve the species. In addition, a detailed characterization of the specific habitat re-

quirements and demographic parameters of *C. toasmicheli* is crucial to gain an insight into its ecology, which will guarantee the accuracy of further management actions.

In natural ecosystems, every species is important, and predators are particularly vulnerable to human disturbance and stochastic events because of their usually low population densities (Begon *et al.*, 2006). We consider this work a first approach, and therefore still insufficient, to the conservation status of Cuban endemic whip-spiders. Our primary aim is that it serves as model to replicate in other threatened endemic species and as a first step to promote the implementation of other methodologies like ecological niche modeling to obtain more accurate assessments.

Last, despite essentially all characters given as diagnostic for *C. toasmicheli* in its original description proved to be too variable to be reliable, the shape and setation of the sternal area and wide geographic isolation both suggest that this species is valid and distinct from its closest relative *C. cubensis*. About this new morphological character, herein we propose to use the sternal area to distinguish species at least in West Indian *Charinus* spp. (Teruel & Questel, 2015; R. Teruel & T. M. Rodríguez-Cabrera, unpublished data). However, wider and deeper studies (including reproductive organs and genetic analyses) shall be helpful to set more accurate and feasible species boundaries within the genus *Charinus* in the region.

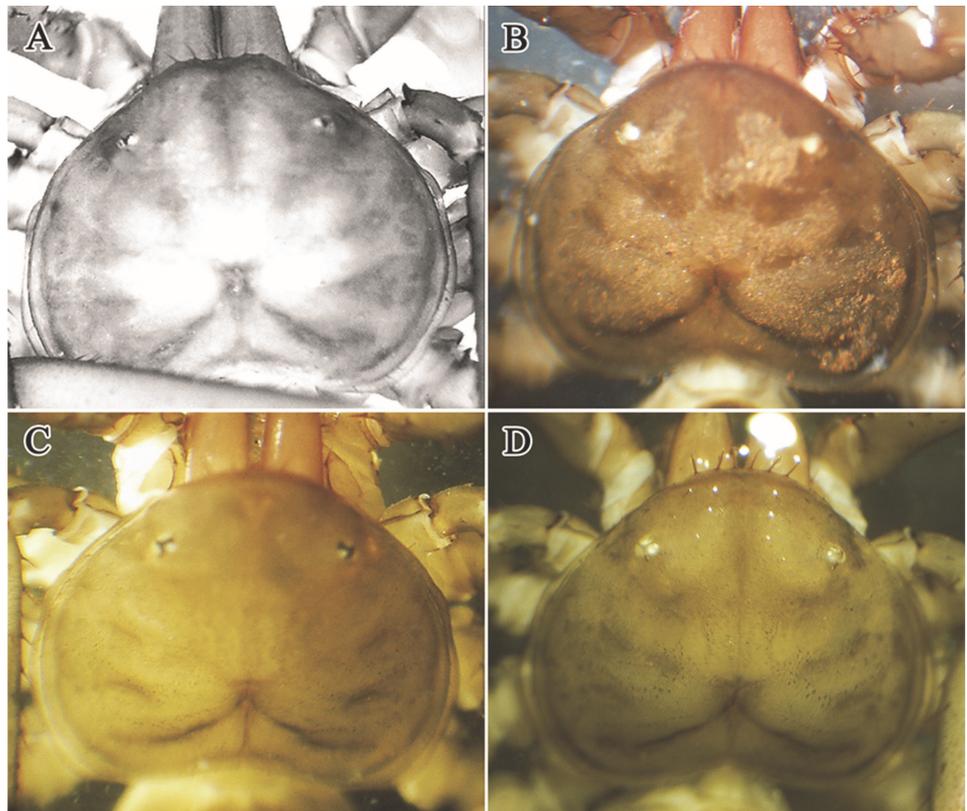
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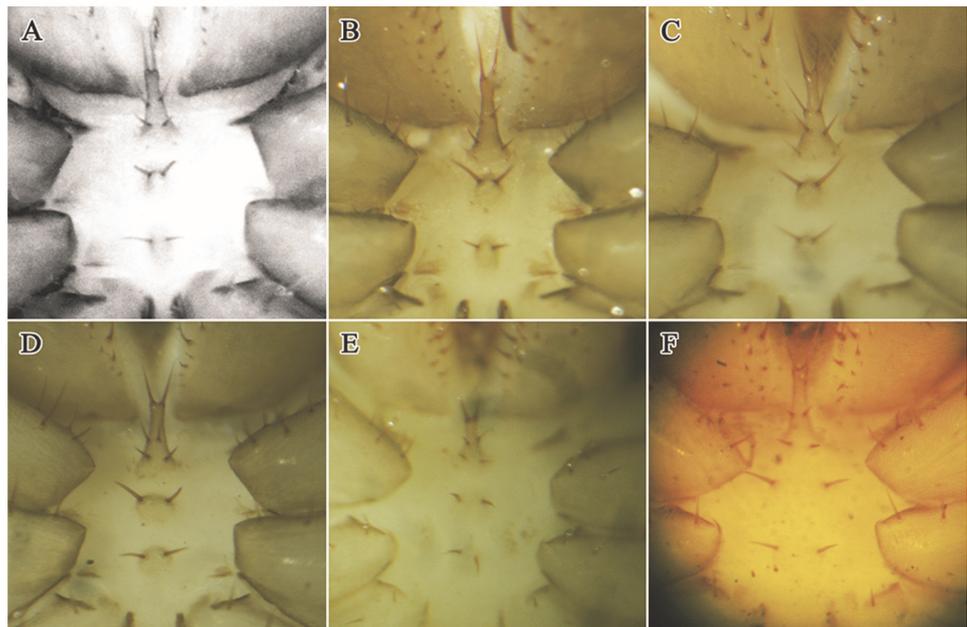
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**Fig. 6.** Variation of carapace shape in adult male *Charinus toasmicheli*: **A)** holotype (modified from Armas, 2006b); **B)** Martín Infierno Cave; **C)** west of San Blas; **D)** La Tatagua.



**Fig. 7.** Variation of sternal area of *Charinus toasmicheli*: **A)** holotype (modified from Armas, 2006b); **B)** Martín Infierno Cave; **C)** west of San Blas; **D)** La Tatagua; **E)** Caletón de Don Bruno. Topotype of *Charinus cubensis* included for comparison (**F**).



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