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Couverture / *Cover*:
Live specimen of *Vesubia jugorum* (Simon, 1881). Photo: Emanuele Biggi.

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ABSTRACT

The genus *Vesubia* Simon, 1909 currently comprises two species, *Vesubia jugorum* (Simon, 1881) from the French and Italian SW Alps and *V. caduca* (Karsch, 1880) from Maoui, Hawaii. The position of *V. caduca* has been previously questioned, but both species are still clssified in the genus. In this paper we redescribe *V. jugorum*, update the diagnosis of the genus after examination of the type specimens and propose the transference of *V. caduca* to *Hogna* Simon, 1885 leading to the genus *Vesubia* being solely represented by *V. jugorum*, thus monotypic. In addition, we explore the relationships of the genus within a broader phylogenetic context in which *Vesubia* emerges in a clade together with *Alopecosa* Simon, 1885 representatives.

KEY WORDS
Wolf Spiders,
Araneae,
Alps,
phylogeny,
new combination.

RÉSUMÉ

Démeler la monotypie de Vesubia *Simon, 1909 et ses relations avec* Alopecosa *Simon, 1885 (Araneae, Lycosidae).*

Le genre *Vesubia* Simon, 1909 comprend actuellement deux espèces, *Vesubia jugorum* (Simon, 1881) des Alpes sud occidentales françaises et italiennes et *V. caduca* (Karsch, 1880) de Maoui, Hawaii. La position de *V. caduca* avait été précédemment remise en question, mais les espèces sont toujours classées dans le genre. Dans cet article nous redécrivons *V. jugorum*, actualisons la diagnose du genre après examen des spécimens types et proposons le transfert de *V. caduca* à *Hogna* Simon, 1885 : le genre *Vesubia* est seulement représenté par *V. jugorum*, et devient donc monotypique. En outre, nous avons exploré les relations du genre dans un contexte phylogénétique plus large dans lequel *Vesubia* émerge dans un clade avec les représentants d'*Alopecosa* Simon, 1885.

MOTS CLÉS
Araignées-loups,
Araneae,
Alpes,
phylogénie,
combinaison nouvelle.

INTRODUCTION

Vesubia Simon, 1909 is a small wolf spider genus currently comprising two species: the type species, *Vesubia jugorum* Simon (1881) (Fig. 1) from the French and Italian SW-Alps and *V. caduca* (Karsch, 1880) from Olinda in the island of Maoui, Hawaii (WSC 2024). Of these species, only *V. jugorum* has been revised and illustrated (Tongiorgi 1968,1969; Maurer & Thaler 1988). Although much is known about its life history (Tongiorgi 1969; Maurer & Thaler 1988; Mammola *et al.* 2016, 2019; Milano *et al.* 2023), from a taxonomic and systematic point of view, *Vesubia* is one of the least known wolf spider genera in Europe. Only recently, in their phylogenetic study of the family Lycosidae Sundevall, 1833, Piacentini & Ramírez (2019) placed *V. jugorum* within the subfamily Lycosinae Sundevall, 1833, as sister to *Arctosa ebicha* Yaginuma, 1960, and close to *Trochosa* C. L. Koch, 1847 and *Pardosa* C. L. Koch, 1847, but these relationships were poorly supported.

The aim of this work is to update the diagnosis of *Vesubia* using genital morphological characters. In addition, we revise the position of the genus within the Lycosinae.

MATERIAL AND METHODS

Specimens and figures

Specimens are deposited in the following arachnological collections (curators and acronyms in parenthesis): Department of Life Sciences and Systems Biology, University of Torino, Italy (Marco Isaia, MI), Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Science, Berlin (Jason Dunlop, ZMB), Germany and Muséum national d'Histoire naturelle, Paris (Christine Rollard, MNHN). Illustrations were prepared by Alessandro Infuso directly from specimens observed under the stereomicroscope and from multifocal Z-stack images taken with the same instrument. The expansion of the male copulatory bulb was made by placing the palp in a 10% KOH solution, and then in distilled water, cycling until the bulb was fully expanded. Photographs of the preserved specimens were taken with a Leica DFC 290 digital camera mounted on a Leica M165 C stereoscopic microscope. The focal planes were combined with Helicon focus 4.62 Pro (www.heliconsoft.com). Before examination on a JEOL JSM-5200 scanning electron microscope (SEM) at the Zoological Museum of the University of Turku, body parts were subjected to ultrasonic cleaning, critical point drying and coated with gold using a sputter coater.

Abbreviations and terminology

The nomenclature of the copulatory organs follows Dondale & Redner (1978), except for the term "synembolus" which was proposed by Zyuzin (1993), the macrosetae notation follows Ramírez (2003) and the measurements follows Framenau (2002).

Morphology

CD	copulatory ducts;
E	embolus;
HS	head of spermathecae;
PA	palea;
Pp	pars pendula;
PP	palea projection;
SS	stalk of the spermathecae;
ST	subtegulum;
Sy	synembolus;
T	tegulum.

Repository

Coll. MI	coll. Marco Isaia, Department of Life Sciences and Systems Biology, University of Torino;
MNHN	Muséum national d'Histoire naturelle, Paris.
ZMB	Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Science, Berlin.

Phylogenetic analyses

For the matrix construction, we employed all Lycosinae representatives from Piacentini & Ramírez (2019) and Murphy *et al.* (2006) plus one or two terminals from each of the other subfamilies as outgroups (see Appendix 1 for details). Given the history of *V. jugorum* relationships (see 'Composition and history' in Results), *Alopecosa* Simon, 1885 sequences from the studies of Astrin et al. (2016), Blagoev & Dondale (2014), Akpınar (2017), Just *et al.* (2019) and Macías-Hernández *et al.* (2020) were also utilized to evaluate the relationships between *Alopecosa* and *Vesubia*. The list of terminals and GenBank accession numbers are detailed in Appendix 1. The alignment of the COI, NADH and H3 sequences was trivial since no insertions/deletions were observed. The sequences of 12S and 28S were aligned using the online version MAFFT (Katoh *et al.* 2002) using the G-INS-i algorithm and the Gblocks (Castresana 2000) was used to remove positions of ambiguous homology from the output alignment. The default settings were used, and all gap positions were allowed.

We use the W-IQ-TREE webserver (Trifinopoulos *et al.* 2016) to infer the phylogenetic relationships were under a maximum likelihood approach and to select the best substitution model to our data. The trees were visualized with the program Figtree v1.4.4. (Rambaut 2014).

Two characters were recorded, "Chelicera retromarginal teeth" with the states: two (0), three (1) and four (2), and "Synembolus" with the states: absent (0), reduced (1) and present (2). In cases where the material was not available to the authors, we use bibliographic references and indicate in a comment on the cell that the matrix file with the comments is provided as supplementary material (Supplementary Material 1). We traced the character history using the parsimony ancestral state reconstruction method as implemented in Mesquite 3.81 (Maddison & Maddison 2023).

RESULTS

Samples and sequences analyzed

The aligned DNA data matrices used for phylogenetic inferences contained 520, 255, 554, 654 and 302 characters for the 28S, 12S,

Fig. 1. — Live specimens of *Vesubia jugorum* (Simon, 1881): **A**, female carrying spiderlings, in the nearby of Refugio Remondino, Valdieri (Alpi Marittime, Province of Cuneo, Italy); **B**, female and habitat, Passo Tesina, Sant'Anna di Vinadio (Alpi Marittime, Province of Cuneo, Italy). Photos: A, Francesco Tomasinelli; B, Emanuele Biggi.

NADH, COI and H3 gene fragments, respectively, after removal of hypervariable regions (Supplementary material 1). The best scheme found by IQ-TREE for each partition is in Appendix 2.

Phylogenetic analysis

The obtained tree (Figs 8; 9) are similar to those of Piacentini & Ramírez (2019), with minor node differences that lack statistical support (see Supplementary material 2). The inclusion of marker 28s in *Alopecosa farinosa* (Herman, 1879) (MH758549) and *Alopecosa kochi* (Keyserling, 1877) (KM225035) places these two species in a clade distant from the rest of *Alopecosa* and as a sister group to a clade composed of *Tasmanicosa* Roewer, 1959, *Rabidosa* Roewer, 1960 and some representatives of Pardosinae (Supplementary material 3). Given the characteristics of the somatic and genital morphology of these species this position seems unlikely. Moreover given that similar situations have already been reported for Lycosidae (Murphy et al. 2006; Piacentini & Ramírez 2019), we decided to exclude these sequences from the analysis.

The reconstruction of the ancestral state of the character "cheliceral retromargin teeth" shows the presence of three teeth as the ancestral state, which changes four times to two teeth in *Alopecosa nigricans*, the representatives of the genus *Trochosa*, the clade formed by *Vesubia* + *Alopecosa sensu stricto* and the clade containing *Evippomma* Roewer, 1959 and *Xerolycosa* Dahl, 1908, and only once from three to four teeth in *Birabenia birabenae* Mello-Leitão, 1941 (Fig. 9).The presence of the synembolus would be the ancestral state lost twice, once in *Aglaoctenus lagotis* (Holmberg, 1876) and once in a clade of *Alopecosa* formed by representatives of the fabrilis and cursor groups, with an ambiguous resolution in the clade formed by *Vesubia* and *Alopecosa*, which could lead to two possible scenarios, the reduction of the synembolus in this clade, with subsequent recovery in the clade containing the *exasperans* and *solivaga* groups, or the presence of the synembolus with two subsequent reductions, one in *Vesubia* and the other in the clade formed by the representatives of *pulverulenta* and *fabrilis* (Fig. 9).

Taxonomy

Family Lycosidae Sundevall, 1833
Subfamily Lycosinae Sundevall, 1833

Genus *Vesubia* Simon, 1909

Vesubia Simon, 1909: 402.

Type species by monotypy. — *Trabea jugorum* Simon, 1881.

Composition and history. — *Vesubia jugorum* (Simon, 1881) was described based on a female specimen collected in high alpine habitat near Saint-Martin-Vésubie (France, Provence-Alpes-Côte d'Azur).

The species was described in the genus *Trabea* Simon, 1876 and later transferred by the same author to *Lycosa* Latreille, 1804, in the second section of Lycoseae together with other species bearing two retromarginal teeth, a character shared with representatives of the genus *Alopecosa* (Simon 1898). The genus *Vesubia* was later described by Simon (1909) based on the presence of two retromarginal teeth, spination pattern and the eye configuration. It remained monotypic until, without specific justification, Roewer (1955) added *Arctosa gertschii* Fox, 1935, *Tarentula vivax* Thorell, 1875, *Lycosa ligata* O. Pickard-Cambridge, 1869, *L. magallanica* Karsch, 1880 and *L. caduca* Karsch, 1880, merely by mentioning them in his catalogue. Subsequent nomenclatural revisions (Roewer 1960; Tongiorgi 1977; Yu & Song 1988; Logunov 2023) have led to the current assignment of two species to the genus *Vesubia*: *V. caduca* of which only the female type specimen is known from Olinda in the Maui Island on Hawaii and *V. jugorum*, the type species of the genus. The last author who discussed the composition of the genus *Vesubia* was Tongiorgi (1969), who also described the male of *V. jugorum* for the first time. Tongiorgi provided observational data about the natural history of the species and discussed several hypotheses about its evolutive origins. Additionally, he provided a diagnosis for the genus based on a combination of somatic morphology characters and concluded that *Lycosa caduca* and *Tarentula vivax* were not congeneric with *V. jugorum*. However, no formal nomenclatural act was proposed. Recently, Logunov (2023) analyzed the type specimen of *Tarentula vivax* and concluded that this species belongs to the genus *Alopecosa* and proposed its transfer.

Diagnosis. — *Vesubia* differs from all other Lycosinae genera by the combination of the following characters: presence of two retromarginal teeth, a posterior epigynal pocket, a wide embolus, an apical projection of the palea and the shape of the median apophysis, with a dorsal concavity but without a dorsal channel as in other Lycosinae (see Kronestedt 1990: Fig. 4).

Description

Medium-sized wolf spiders (11-18 mm), carapace uniform dark brown, in live specimens a distinguishable paler median band, formed by setae (Fig. 1). Sternum, labium and maxillae reddish brown. Chelicerae dark brown with three promarginal and two retromarginal teeth. Abdomen uniform dark brown in fixed specimens, in live specimens a distinguishable cardiac mark followed by a series of paler marks (Fig. 1B), venter brownish yellow. Legs dark brown with a paler annulation at the middle of the femur (Fig. 1B), leg formula 4123. Palp of male with tibia as long as wide (Fig. 4F). Cymbium with several distal macrosetae (Fig. 4F) and a patch of strong setae dorsally (Fig. 4F); subtegulum not visible in ventral view, tegulum strongly sclerotized, with rounded conductor (Fig. 5A); median apophysis transverse with apical spur, directed anterodorsally (Fig. 6E), and a dorsal concavity but without a dorsal channel (Figs 5C, 6E); palea region projected apically (Figs 4B; 6E), synembolus reduced (Fig. 6D). Embolus wide, C-shaped with pars pendula (Figs 4D; 6D). Epigyne with two anterior semicircular atria, divided by a septum, leading to a pair of anterior hood (Figs 2C; 3A). Internal genitalia composed of a tri-partite spermatheca with a rounded head, that connects to the base of spermatheca by a thinner stalk (Fig. 2D).

Vesubia jugorum (Simon, 1881)
(Figs 1-6)

Trabea jugorum Simon, 1881: 83.

Lycosa jugorum – Simon 1898: 338 (transferred from *Trabea*).

Vesubia jugorum – Simon 1909: 402; 1937: 1122, 1141, fig. 1775 (female). — Tongiorgi 1968: 111, fig. 2, plate I, fig. 5-6 (female); 1969: 257, figs 1-3 (male and female). — Maurer & Thaler 1988: 331, fig. 14 (male). — Trotta 2005: 169, fig. 344-347 (male and female).

Type material. — **Syntypes**. **France** • 2 ♀; Saint-Martin-Vésubie; MNHN 4131 (Fig. 3A) and MNHN-AR-AR21647 (Fig. 3B).

Other material examined. — **France** • ♀; Col du Trem, Vallée de Merveilles, Saorge; 5.IX.2019; M. Isaia leg.; coloration and genitalia as per genus; coll. MI.
Italy • ♂; Bocchin dell'Aseo, Mongioie; 18.IX.2019; Isaia leg.; coloration and genitalia as per genus; coll. MI.

Diagnosis. — Same as per genus.

Distribution. — The known distribution range covers an area of approximately 2500 km^2, centred in South Western Alps (Italy and France). The current updated distribution of *Vesubia jugorum* (fig. 1 in Milano *et al.* 2023) encompasses the Province of Cuneo in north-western Italy (66 localities), the Département des Alpes-Maritimes (24 localities) and the département des Alpes-de-Haute-Provence (20 localities), in south-eastern France.

Description

Female (specimen from Col du Trem)

Spination pattern. Femur I p 0-d1-d1 d 1-1-0 r 0-d1-d1, **II** p 0-d1-d1, d 1-1-0 r 0-d1-0, **III** p d1-0-0, d 1-1-0, r d1-d1-d1, **IV** p d1-0-d1 d 1-1-1 r 0-0-d1; **patella I** 0, **II** 0, **III** p 1 r 1, **IV** p 1 r 1; **tibia I** p 1-1-0 v 2-2-2ap, r 1-v1-0; **II** p 1-1-0, v 2-2-2ap, r 1-v1-0, **III** p d1-1 d d1-1-0 r 1-1-0 v 2-2-2ap, **IV** p 1-0-1 d 1-0-1 r 1-0-1 v 2-2-2ap; **metatarsus I** p 0-1-1ap r 0-1-0 v 2-2-2ap, **II** p 1-1-1ap, r 0-1-1ap v 2-2-1ap, **III** p 1-1-2ap r 1-1-2ap v 2-2-1ap, **IV** p 1-1-2ap r 1-1-2ap v 2-2-1ap. Leg formula: 4123

Measurements. TL 14.76, CL 8.38, CW 6.12, CH 2.53. Eyes: AME 0.20, ALE 0.20, PME 0.67, PLE 0.40. Row of eyes: AER 1.53, PME 1.92, PLE 2.47. Legs: length of segments (femur + patella/tibia + metatarsus + tarsus = total length): **I** 5.99 + 8.25 + 5.32 + 2.93 = 22.49, **II** 5.99 + 7.98 + 4.52 + 2.39 = 20.88, **III** 5.72 + 7.32 + 4.92 + 2.39 = 20.35, **IV** 6.65 + 8.91 + 7.85 + 3.46 = 26.87. Leg formula 4123.

Male (specimen from Bocchin dell'Aseo)

Spination pattern. Femur I p 0-0-d1 d 1-1-1 r 0-d1-d1, **II** p 0-d1-d1, d 1-1, r d1-d1, **III** p 0-d1-d1, d 1-1-1 r d1-d1-d1, **IV** p d1-d1 d 1-1-0 r 0-0-d1; **patella I** p 1, **II** p 1 r 1, **III** p 1 r 1, **IV** p 1 r 1; **tibia I** p 1, v 2-2-2-2ap, r 1, **II** p 1-0-0 v 2-2-2-2ap, r -1-0-0, **III** p 1-1, d 1-1, r 1-1, v 2-2-0-2ap, **IV** p 1-1 d 1-1 r 1-1 v 2-2-0-2ap; **metatarsus I** p d1-d1-1ap, v 2-2-0-2ap, r 1-1-1ap, **II** p 1-1-1ap, r 1-1-1ap, v 2-2-2ap, **III** p 1-1-2ap, r 1-1-2ap, v 2-2-1ap, **IV** p 1-1-2ap r 1-1-2ap v 2-2-1ap. Leg formula 4123.

Measurements. TL 11.70, CL 6.65, CW 5.32, CH 2.79. Eyes: AME 0.20, ALE 0.20, PME 0.67, PLE 0.53. Row of eyes: AER 1.27, PME 1.67, PLE 2.13. Legs: length of segments (femur + patella/tibia + metatarsus + tarsus = total length): **I** 5.99 + 7.98 + 5.32 + 2.53 = 21.82, **II** 5.59 + 7.71 + 4.66 + 2.39 = 20.35, **III** 5.45 + 7.71 + 4.39 + 2.39 = 19.94, **IV** 6.78 + 8.11 + 8.11 + 3.33 = 26.33. Leg formula 4123.

Natural history

Life history information was reported through recent research focusing on the conservation of this species (Mammola *et al.* 2016; 2019; Milano *et al.* 2023). Due to its tight ecological requirements and its sensitivity to temperature increase due to global warming, in 2018 the species was assessed as Endangered in the IUCN Redlist (Isaia & Mammola 2018).

Conservation status

Endangered B1ab (see Mammola *et al.* 2016; Isaia & Mammola 2018).

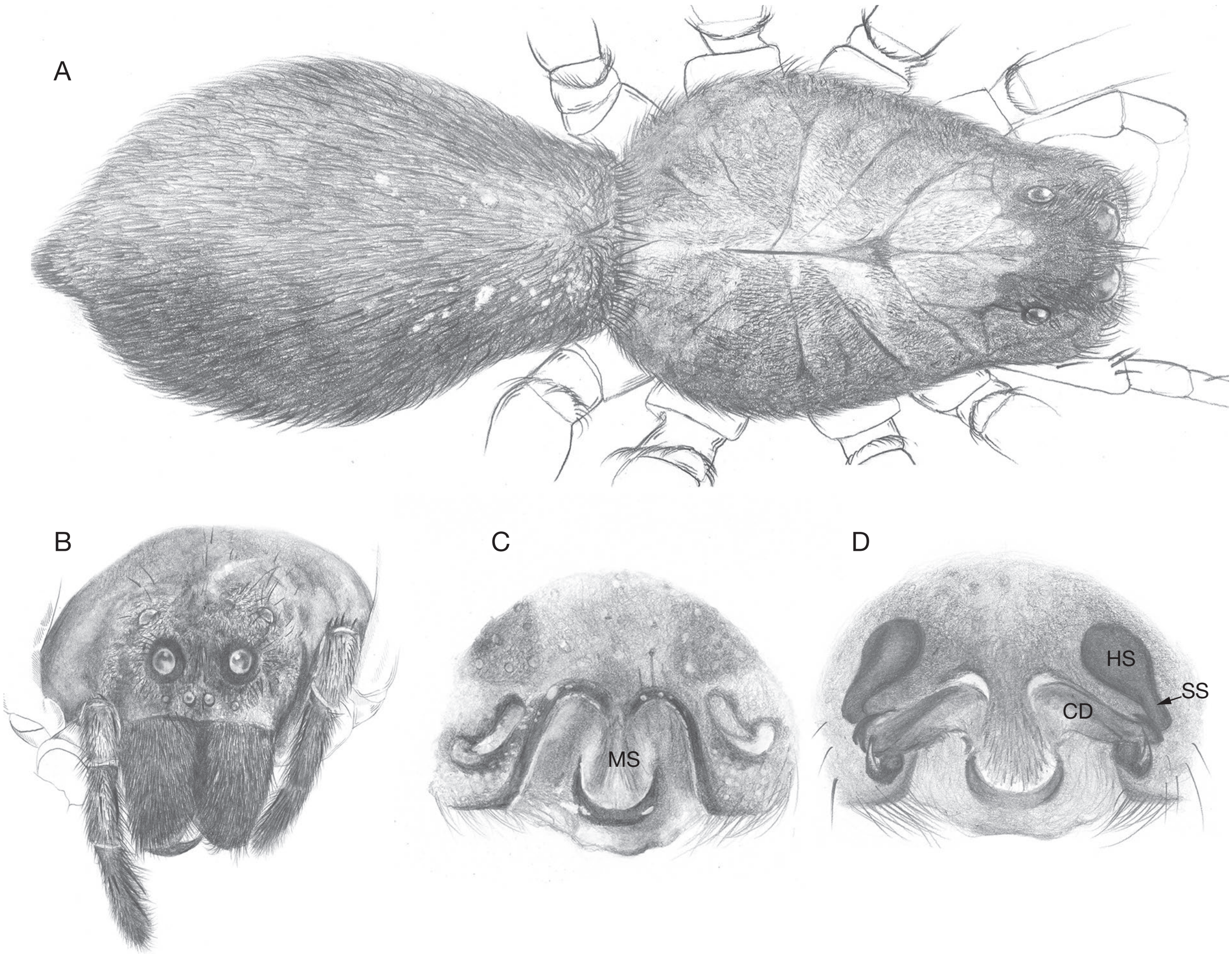

Fig. 2. — Drawings of *Vesubia jugorum* (Simon, 1881): **A**, **B**, habitus, dorsal (**A**), anterior (**B**); **C**, **D**, female genitalia: epigyne ventral view (**C**); vulva (**D**). Not to scale.

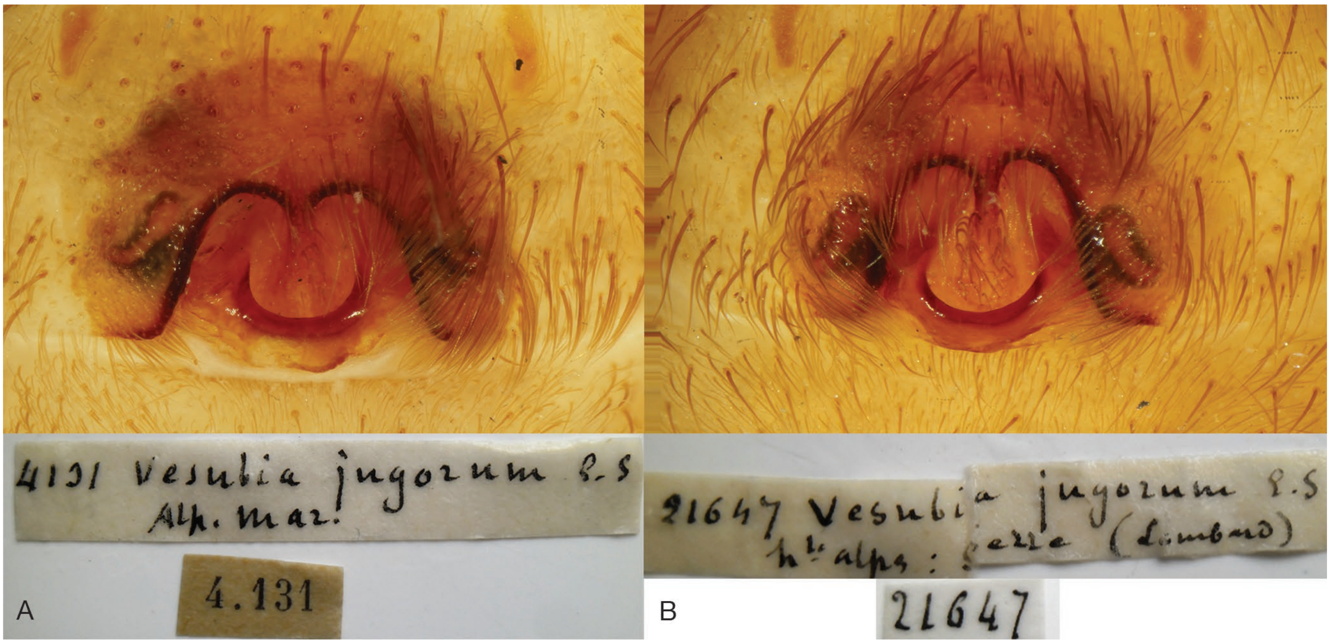

Fig. 3. — Type material of *Vesubia jugorum* (Simon, 1881) from Simon's collection (MNHN): **A**, ventral view of the lectotype with its original label; **B**, ventral view of the epigyne from additional material accompanied by the original label. Not to scale.

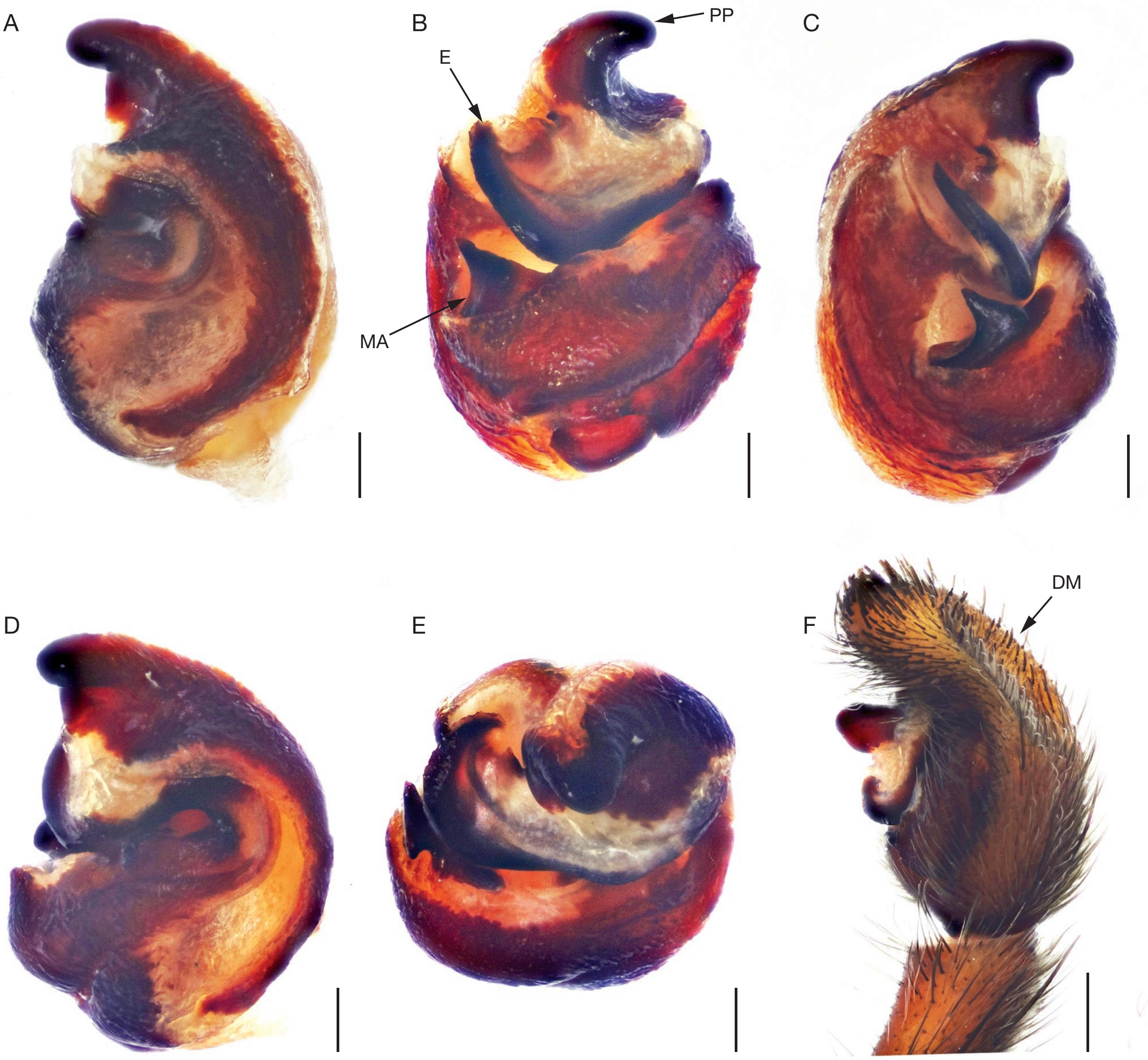

Fig. 4. — *Vesubia jugorum* (Simon, 1881) male genitalia, bulb of the right pedipalp: **A**, prolateral; **B**, ventral; **C**, retrolateral; **D**, dorsal; **E**, apical; **F**, entire pedipalp prolateral. Abbreviations: **E**, embolus; **MA**, median apophysis; **PP**, palear projection. Scale bar: A-E, 0.20 mm; F, 0.50 mm.

Fig. 5. — *Vesubia jugorum* (Simon, 1881), expanded pedipalp bulb: **A**, ventral view; **B**, anterior view; **C**, detail of median apophysis. Abbreviations: **C**, conductor; **E**, embolus; **MA**, median apophysis. Scale bar: A, B, 0.50 mm; C, 0.20 mm.

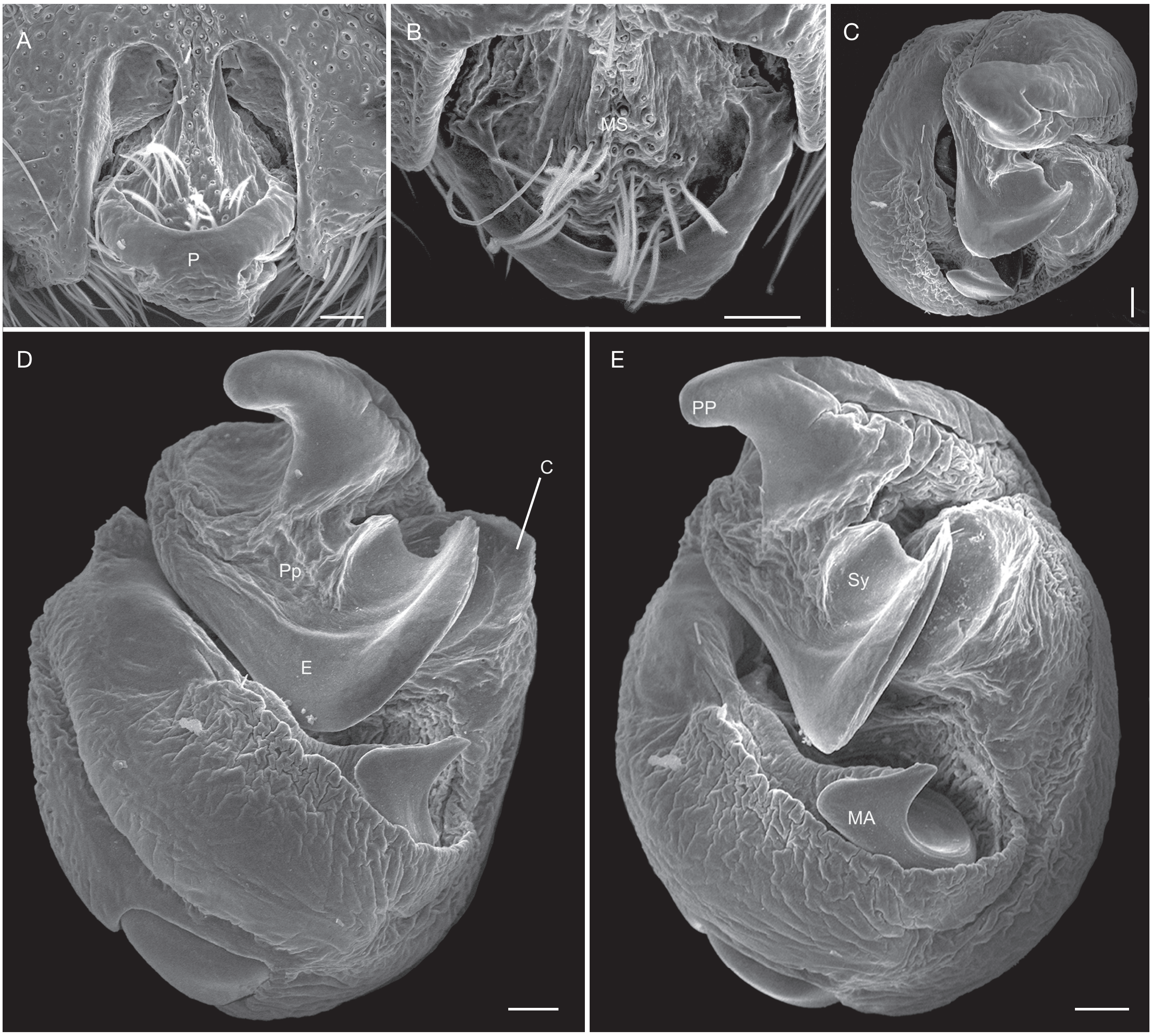

Fig. 6. — *Vesubia jugorum* (Simon, 1881), SEM images: **A**, epigyne ventral view; **B**, epigyne anterior view; **C**, bulb, apical view; **D**, bulb, ventral view; **E**, bulb retrolateral view. Abbreviations: **C**, conductor; **E**, embolus; **MA**, median apophysis; **MS**, median septum; **P**, epyginal pocket; **Pp**, pars pendula; **PP**, palear projection; **Sy**, synembolus. Scale bar: A-E, 0.10 mm.

Genus *Hogna* Simon, 1885

Hogna caduca Karsch, 1880 n. comb. (Fig. 7)

Lycosa caduca Karsch, 1880: 82.

Trochosa caduca – Roewer 1955: 301.

Vesubia caduca – Roewer 1960: 746.

Type material. — **Holotype. Hawaii** • ♀; Olinda on the island of Maui; ZMB.

Remark

Examining the type specimen of *V. caduca* (Fig. 7) revealed that it lacks the diagnostic characters of *Vesubia*. The epigynum with a straight, inverted T-shaped septum, along with the anterior pockets, unquestionably place this species within the Lycosinae, although none of the existing genera can be assigned to it with confidence. Accordingly, we propose to transfer *V. caduca* to to the genus *Hogna*, as *Hogna caduca* n. comb. *Hogna* is a paraphyletic genus that has not been reviewed, but in which many species with genital characters similar to this species are placed (Crespo *et al.* 2022). The World Spider Catalog (2024) indicates that this species is distributed in Polynesia, as indicated in the title of the Karsch's (1880) publication, although material was collected in Olinda, on the Maui Island in Hawaii.

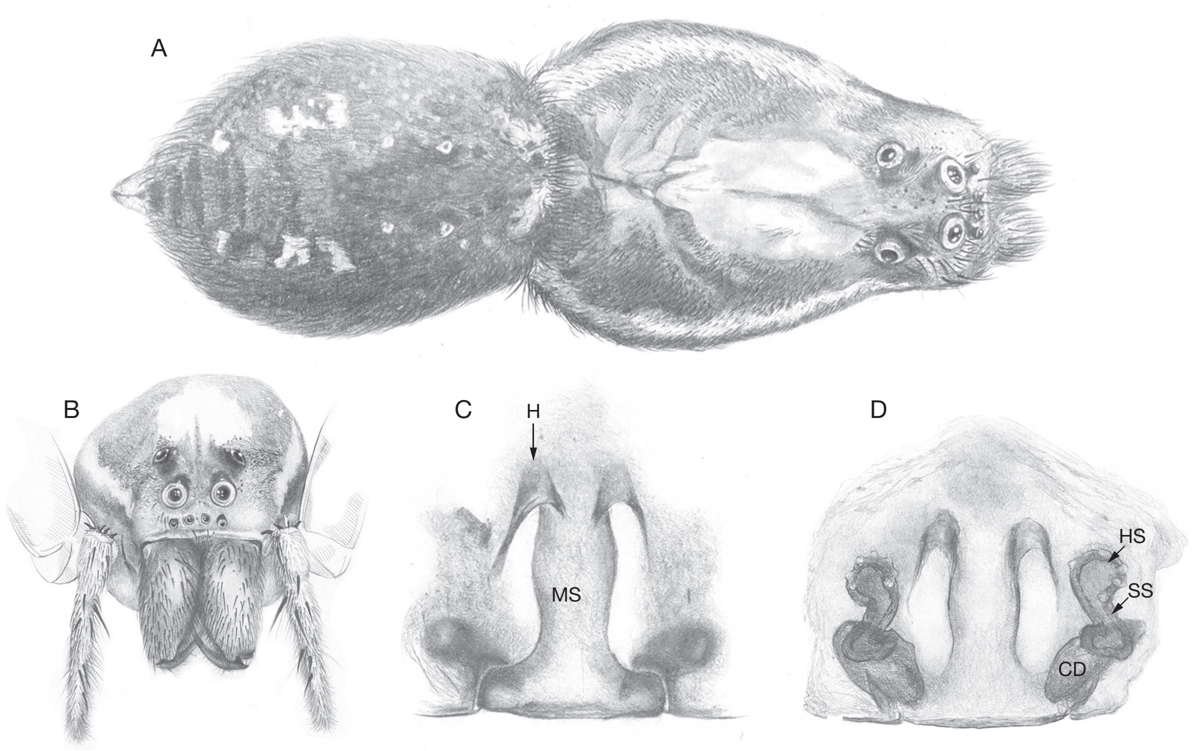

Fig. 7. — Drawings of *Lycosa caduca* Karsch, 1880, holotype: **A**, **B**, habitus: dorsal (**A**); anterior (**B**); **C**, **D**, female genitalia: epigyne ventral view (**C**), vulva (**D**). Not to scale.

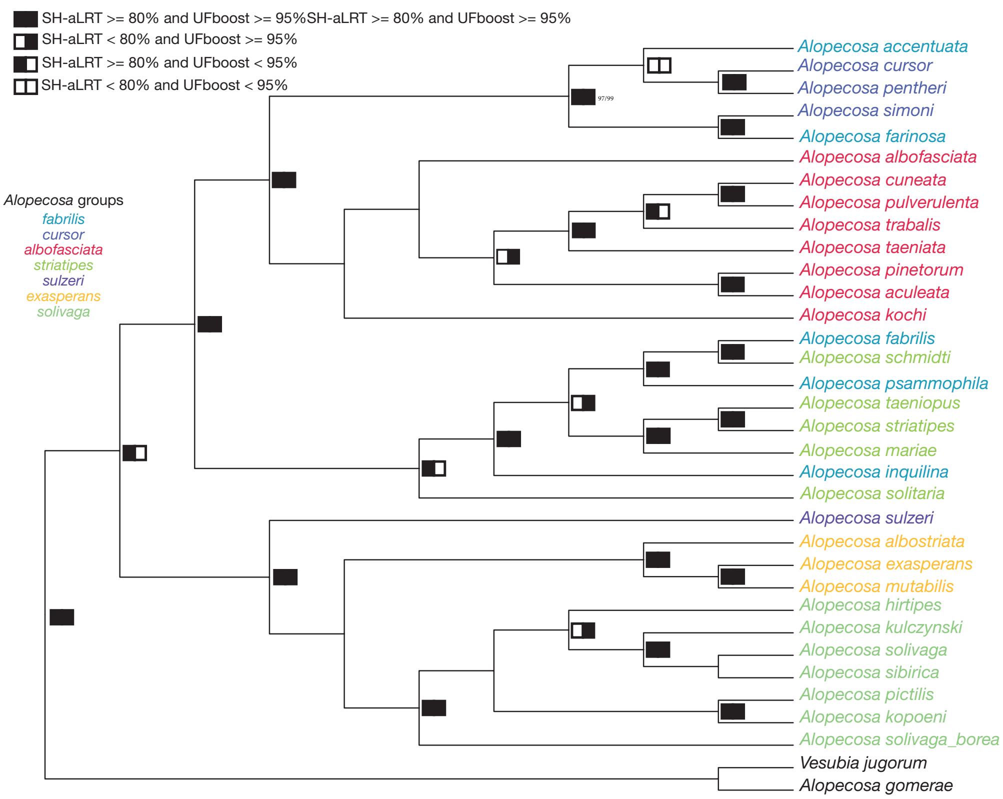

Fig. 8. — Phylogenetic relationships between *Vesubia* Simon, 1909 and *Alopecosa* inferred under maximum likelihood. The terminals of the genus *Alopecosa* Simon, 1885 are coloured according to the group of species to which they belong. Support values are summarized at each node: SH-aLRT support (%) / ultrafast bootstrap support (%).

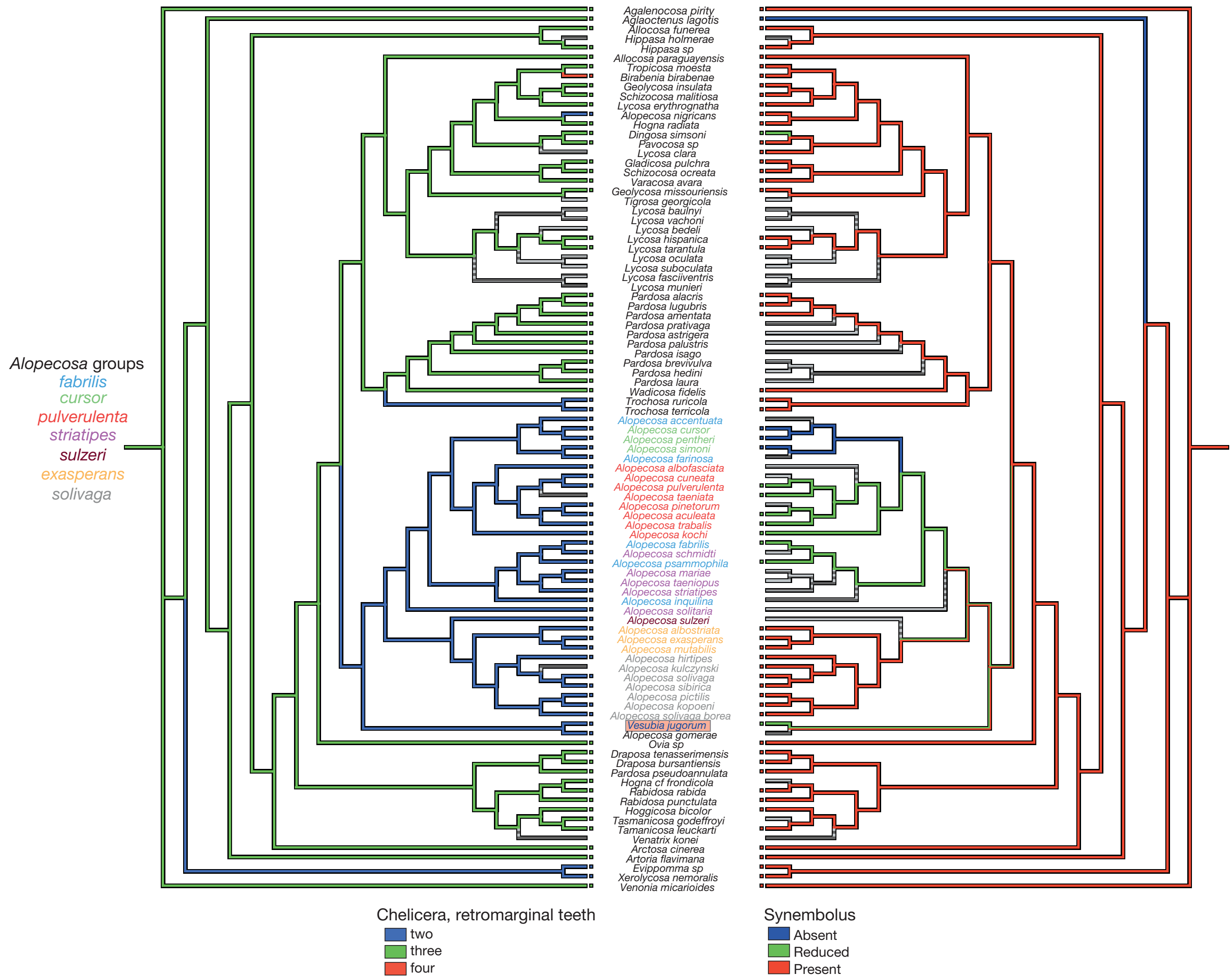

FIG. 9. — Ancestral state reconstruction of the number of teeth on the retromargin of the chelicera and the synembolus based on the maximum parsimony analysis. The terminals of the genus *Alopecosa* Simon, 1885 are colored according to the group of species to which they belong.

DISCUSSION

The placement of *V. jugorum* in a clade together with the representatives of *Alopecosa* restores the idea of Simon (1898) who classified it among the group of species with two teeth on the retromargin of the chelicerae, a character that appears as homoplastic in our results, emerging three times in Lycosinae (Fig. 9). Another morphological character that support this clade is the reduction of the synembolus, something that in Lycosinae only occurs in the *fabrilis*, *pulverulenta*, *striatipes* and *cursor* groups within *Alopecosa* (Lugetti & Tongiorgi 1969; Dondale & Redner 1979) (Fig. 9), which were recovered in this work forming a well-supported clade (Fig. 8). In our results, *V. jugorum* appears to form a poorly supported clade with *A. gomerae* (Fig. 8), a position that would suggest the inclusion of *A. gomerae* in *Vesubia* or the synonymy of *Vesubia* as junior synonym of *Alopecosa*, both options unlikely considering the morphological evidence. This situation could be clarified by extending the taxonomic coverage and/or genetic data in future work. An additional interesting result is that we recovered a second well-supported clade within *Alopecosa* containing the species representing the groups *exasperans*, *sulzeri* and *solivaga* (Dondale & Redner 1979; Esyunin & Tuneva 2012; Marusik 2018), which have the synembolus developed as the rest of the Lycosinae (Fig. 8). This supports Marusik's (2018) view on the paraphyly of *Alopecosa*, which suggests that representatives of the *albostriata* group do not belong to the genus *Alopecosa*. Marusik (2018) suggests that they are cogeneric with *Mustelicosa dimidiata* (Thorell, 1875); given the similarity in genital morphology of the *albostriata* group and the *solivaga* group, it is likely that species of both groups belong to *Mustelicosa* Roewer, 1960.

In this work, we recovered *A. kochi* and *A. farinosa* forming a monophyletic clade with the remaining *Alopecosa*, except *A. gomerae* (Fig. 8), contrary to that published by Just *et al.* (2019), where those species clustered in a separate clade. This difference could be explained by the effect of the 28s marker, which divides these two species into a distinct clade.

As mentioned in previous works the use of the 28s, one of the markers of great application in arachnology "the usual suspects" according to Dimitrov *et al.* (2017), should be considered with care, since it can lead to unlikely topologies (Murphy *et al.* 2006; Piacentini & Ramírez 2019). In this case, running the 28s marker separately, lead to the split of the genus into two distant groups. The same happened with the genus *Pardosa* in the analyses performed by Piacentini & Ramírez (2019).

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APPENDICES

APPENDIX 1. — List of terminals and GenBank accession numbers.

Species	28s	12s	NADH	COI	H3
Agalenocosa_pirity	MK496221	MK524583	MK524667	SPDAR245-13	MK524668
Aglaoctenus_lagotis	KY190291	DQ019753	DQ019640	–	MK524669
Allocosa_funerea	MK524604	–	–	SPDAR1405-16	MK524671
Allocosa_paraguayensis	MK524605	MK524584	MK524639	SPDAR929-15	MK524672
Alopecosa_accentuata	MT652049	–	–	MT607656	–
Alopecosa_aculeata	–	–	–	MH763777	–
Alopecosa_albofasciata	MH758550	–	–	MH763780	MH763802
Alopecosa_albostriata	–	DQ019757	DQ019643	SPIRU020-10	–
Alopecosa_cuneata	MH758554	–	–	MH763784	MH763806
Alopecosa_cursor	–	–	–	KM254113	–
Alopecosa_exasperans	–	–	–	KM254140	–
Alopecosa_fabrilis	MH758559	–	–	MH763790	MH763811
Alopecosa_farinosa	–	–	–	MH763776	MH763799
Alopecosa_gomerae	–	–	–	MT738761	–
Alopecosa_hirtipes	–	–	–	KM254125	–
Alopecosa_inquilina	MH758556	–	–	MH763786	–
Alopecosa_kochi	–	DQ019755	DQ019645	KM225089	–
Alopecosa_kulczynski	–	–	–	KM254105	–
Alopecosa_mariae	MH758558	–	–	MH763788	MH763809
Alopecosa_mutabilis	–	–	–	KM254127	–
Alopecosa_nigricans	MK524607	–	MK524640	SPDAR285-13	–
Alopecosa_pentheri	–	–	–	KM254154	–
Alopecosa_pictilis	–	–	–	HM384667	–
Alopecosa_pinetorum	MH758551	–	–	MH763781	MH763803
Alopecosa_psammophila	MH758557	–	–	MH763787	MH763808
Alopecosa_pulverulenta	MH758553	DQ019756	DQ019648	MH763783	–
Alopecosa_schmidti	MH758560	–	–	MH763789	MH763810
Alopecosa_simoni	MT651730	–	–	MT607660	–
Alopecosa_solitaria	MH758555	–	–	MH763785	MH763807
Alopecosa_solivaga	–	–	–	KM254146	–
Alopecosa_solivaga_borea	–	–	–	KM254151	–
Alopecosa_striatipes	–	–	–	KY270139	–
Alopecosa_sulzeri	MH758548	–	–	MH763775	MH763798
Alopecosa_taeniata	–	–	–	MH763778	MH763800
Alopecosa_taeniopus	–	–	–	KM254137	–
Alopecosa_trabalis	MH758552	–	–	MH763782	MH763804
Arctosa_cinerea	–	DQ019763	DQ019651	GBBSP1285-15	–
Artoria_flavimana	DQ019712	DQ019771	DQ019657	AY059992	–
Birabenia_birabenae	MK524611	–	MK524647	–	MK524680
Dingosa_simsoni	MK524612	–	MK524648	MK524716	MK524681
Draposa_burasantiensis	–	–	MK524649	SPDAR1369-16	MK524682
Draposa_tenasserimensis	KM225054	–	–	KM225107	KM225207
*Evippomma*_sp.	MK524613	MK524588	MK524650	SPDAR1379-16	MK524683
Geolycosa_insulata	MK524620	MK524592	MK524656	SPDAR251-13	MK524688
Geolycosa_missouriensis	DQ019727	DQ019775	–	BBUSU647-15	–
Gladicosa_pulchra	MK524614	MK524589	MK524651	SPDAR1397-16	–
Hippasa_holmerae	DQ019728	DQ019776	DQ019663	–	–
*Hippasa*_sp.	MK524615	–	MK524652	SPDAR1378-16	MK524684
Hoggicosa_bicolor	DQ019713	DQ019777	DQ019668	–	–
Hogna_cf_frondicola	KY017166	–	–	KY017782	KY018283
Hogna_radiata	KC550823	KC551070	MK524654	KC550817	MK524686
Lycosa_baulnyi	KC550848	KC550960	–	KC550802	–
Lycosa_bedeli	KC550831	KC551047	–	KC550713	–
Lycosa_erythrognatha	DQ019729	DQ019782	DQ019670	SPDAR393-14	MK524689
Lycosa_fasciiventris	KC550820	KC551079	–	KC550722	–
Lycosa_hispanica	KC550845	KC550969	–	KC550661	–
Lycosa_munieri	KC550830	KC550945	–	KC550749	–
Lycosa_oculata	KC550829	–	–	KC550670	–
Lycosa_suboculata	KC550862	KC551000	–	KC550696	–
Lycosa_tarantula	KC550842	KC551085	DQ019666	KC550669	–
Lycosa_vachoni	KC550833	KC551088	–	KC550775	–
*Ovia*_sp.	MK524622	–	MK524659	SPDAR1383-16	MK524694
Pardosa_alacris	MK524623	MK524596	–	SPDAR1298-15	MK524695
Pardosa_amentata	MK524624	–	–	SPDAR1281-15	MK524696
Pardosa_astrigera	–	DQ019792	DQ019685	–	–
Pardosa_brevivulva	–	DQ019793	DQ019686	–	–

Appendix 1. — Continuation.

Species	28s	12s	NADH	COI	H3
Pardosa_hedini	–	DQ019795	DQ019690	–	–
Pardosa_isago	–	DQ019796	DQ019691	–	–
Pardosa_laura	–	DQ019797	DQ019692	KY467121	–
Pardosa_lugubris	MK524625	MK524598	DQ019693	SPDAR1279-15	MK524697
Pardosa_palustris	–	DQ019799	DQ019694	–	–
Pardosa_prativaga	–	KY190235	KY199549	KY190313	KY190284
Pardosa_pseudoannulata	MK524626	MK524599	MK524662	SPDAR1376-16|	–
Pavocosa_gallopavo	DQ019735	DQ019800	DQ019695	SPDAR365-14	–
Rabidosa_punctulata	DQ019736	DQ019806	DQ019700	–	–
Rabidosa_rabida	KY017171	DQ019807	DQ019701	SPDAR1404-16	MK524699
Schizocosa_malitiosa	–	–	KY199543	KY190307	KY190277
Schizocosa_ocreata	KY017172	KY015465	AF223242	KY017784	–
Tasmanicosa_godeffroyi	DQ019716	DQ019809	DQ019671	–	–
Tasmanicosa_leuckarti	DQ019717	DQ019810	DQ019672	–	MK524690
Tigrosa_georgicola	MK524631	MK524601	–	SPDAR1400-16	MK524703
Trochosa_ruricola	JN816972	DQ019814	DQ019704	GBCNC087-09	–
Trochosa_terricola	DQ019739	DQ019813	DQ019705	SPDAR1277-15	MK524705
Tropicosa_moesta	MK524608	–	MK524641	CORAR050-13	MK524674
Varacosa_avara	DQ019740	DQ019817	DQ019707	SPDAR1398-16	MK524706
Venatrix_konei	DQ019742	DQ019820	DQ019708	–	–
Venonia_micarioides	DQ019738	DQ019819	DQ019709	SPDAR1393-16	–
Vesubia_jugorum	MK524634	–	–	MK524717	MK524707
Wadicosa_fidelis	MK524635	KP100666	KP100666	KP100666	MK524708
Xerolycosa_nemoralis	MK524636	DQ019821	DQ019710	SPDAR1291-15	MK524709

Appendix 2. — Best scheme founded by IQ-TREE for each partition.

Partition name	model	
28s	GTR+F+G4	1-520
12s	TIM2+F+I+G4	521-775
NADH_1	TIM2+F+I+G4	776-1329\3
NADH_2	TPM3u+F+I+G4	775-1329\3
NADH_3	TPM2u+F+G4	776-1329\3
COI_1	TPM2u+F+I+G4	1330-1983\3
COI_2	TIM3+F+I+G4	1331-1983\3
COI_3	TN+F+G4	1332-1983\3
H_1	TIM2e+I	1984-2285\3
H_2	K2P+G4	1985-2285\3
H_3	TIM2e+G4	1986-2285\3

SUPPLEMENTARY MATERIALS

Supplementary material 1. — Matrix containing the molecular and morphological characters used in this work. https://doi.org/10.5852/zoosystema/2024v46a25_s1

Supplementary material 2. — Maximum likelihood tree obtained from the analysis of the molecular data matrix containing the 28s, 12s, NADH, COI and H3 fragments. https://doi.org/10.5852/zoosystema/2024v46a25_s2

Supplementary material 3. — Maximum likelihood tree obtained from the analysis of the molecular data matrix containing the molecular marker 28s. https://doi.org/10.5852/zoosystema/2024v46a25_s3