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Resurrection of the erigonine spider *Ceratinopsis tybeensis* (Araneae: Linyphiidae) with the first description of the male

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Abstract

The erigonine linyphiid spider *Ceratinopsis tybeensis* Chamberlin & Ivie, 1944 was described from a single female collected in Savannah Beach, Georgia, USA. Subsequently, it was declared a junior synonym of *Masonetta floridana* (Ivie & Barrows, 1935) by Ivie (1967). However, recent multiple collections of females of *M. floridana* with specimens of an undescribed erigonine male has thrown this synonymy into question. Recent new research using morphological and molecular evidence supports our hypotheses that the synonymy proposed by Ivie is erroneous and the new male is the previously undescribed male of *C. tybeensis*. Herein, we resurrect *C. tybeensis*, provide the first description of the male, redescribe the female, and document increases to the known ranges of *C. tybeensis* and *M. floridana*.

Keywords: COI • eastern North America • Erigoninae • sheetweb spider • taxonomy

Introduction

The description of the erigonine spider *Caseola floridana* Ivie & Barrows, 1935 (Araneae: Linyphiidae: Erigoninae) was based on a single male and female collected by William M. Barrows in Fort Myers, Florida in February 1933. Subsequently the species was transferred to *Masonetta* Chamberlin & Ivie, 1939 by Chamberlin & Ivie (1939). The description of another erigonine spider, *Ceratinopsis tybeensis* Chamberlin & Ivie, 1944, was based on a single female collected by Chamberlin and Ivie in Savannah Beach, Georgia in 1943. Later, based on the morphological similarity of the single known female of each of the two species, Ivie (1967) synonymized *Ceratinopsis tybeensis* under *M. floridana*. The single male and two females comprise all of the published records of *M. floridana* and there are no online collection records of this species other than ours (GBIF 2026). Thus *M. floridana* has been considered a long-lost species: one not seen or collected in over 50 years (Long & Rodriguez 2022).

We compared the allotype female of *M. floridana* and the holotype female of *C. tybeensis* and it is clear that they are conspecific. Therefore, the synonymy proposed by Ivie (1967) is logical. However, as the male of *C. tybeensis* had not then been discovered, Ivie's synonymy of *C. tybeensis* with *M. floridana* was based only on female morphology and the assumption that the original male/female pairing established by Ivie and Barrows (1935) was correct. Because we and colleagues recently collected females of *M. floridana* with males of a previously undescribed erigonine species at multiple locations in various American states, we believe this assumption is incorrect. Thus, the holotype male of *M. floridana* originally described by Ivie & Barrows (1935) remains as the name bearer for *M. floridana*, but *C. tybeensis* is removed from synonymy with *M. floridana* and resurrected for the (misidentified) allotype female of *C. tybeensis*. Moreover, under this taxonomic hypothesis, the female of *M. floridana* remains unknown.

Here, we provide morphological and molecular evidence for our hypotheses that the male holotype and female allotype of *M. floridana* are incorrectly paired and that our recently discovered undescribed male is the correct pair with the current *M. floridana* female and, together, they represent the true male and female of *C. tybeensis*. Therefore, based on this evidence, we reject Ivie's (1967) synonymy and recognize a resurrected *C. tybeensis* with the female holotype as designated by Chamberlin & Ivie (1944) (the current allotype of *M. floridana*). We describe the previously unknown male, redescribe the female of *C. tybeensis*, and update the known ranges of both species. The true female of *M. floridana* is thus rendered unknown, remaining to be discovered and described.

Material and methods

Specimens

Specimens were obtained from collections made in Ohio, North Carolina, and Virginia. Sampled habitats in which this species was found included bogs, pine savannahs, and prairies. Almost half of all specimens were collected at Cherry Orchard Bog (VA) as part of an American Arachnological Society-funded collecting trip that sought to replicate part of a collecting trip by C. Crosby and S. Bishop 100 years prior. Collecting was done using several methods. At Cherry Orchard Bog (VA), Cedar Bog (OH), and Penny's Bend (NC), an electric leaf blower (Black & Decker model LSWV36, Type 2, 40V) flipped in reverse to function as a vacuum and equipped with a fine-mesh suction bag (Watkins & Doncaster product E668) was used to collect specimens. The vacuum was either pushed against the ground or into patches of moss within habitats. At Joseph Pines Preserve (VA), pitfall traps were used, which consisted of 147.9 ml (5 oz) cups half-filled with soapy water. Each pitfall trap was placed into the ground, flush with the ground, and left in place for one week before being removed, its contents poured into a plastic vial and returned to the lab for sorting and identification. At Joseph Pines Preserve (VA), spiders were also collected from the water within leaves (pitchers) of purple pitcher plants (*Sarracenia purpurea* Linnaeus). These spiders were found dead (presumably drowned) in the pitchers.

Description and images

Specimens from the American Museum of Natural History and Florida State Collection of Arthropods were exam-

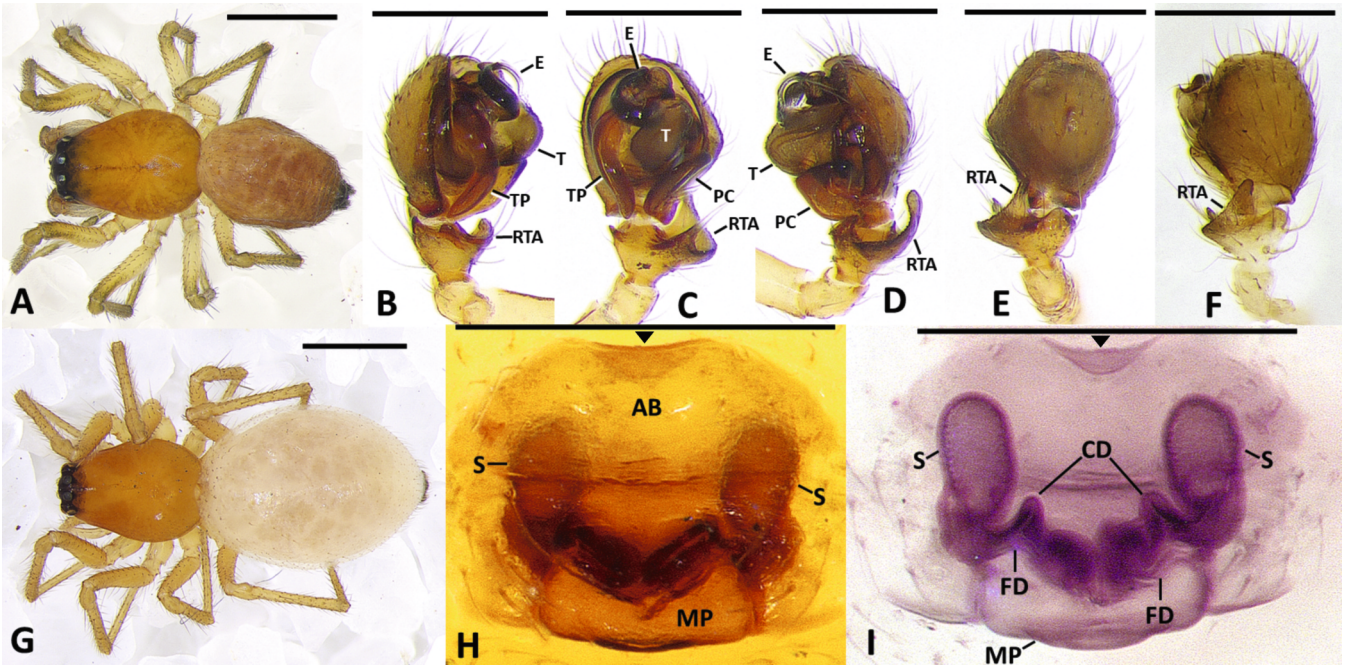

Fig. 1: *Ceratinopsis tybeensis*, male, UISC 18A18, Ohio: Champaign Co. (A–F) and female, UISC VA8A12 Virginia, Prince George Co. (G–I). **A** habitus; **B** pedipalp, prolateral view; **C** same, ventral view; **D**: same, retrolateral view; **E** same, dorsal view, specimen 1; **F** same, dorsal view, specimen 2; **G** habitus; **H** epigynum, ventral view; **I** same, cleared, dorsal view. AB = anterior bulge, CD = copulatory ducts, E = embolus, FD = fertilization ducts, MP = median plate, PC = paracymbium, RTA = retrolateral tibial apophysis, S = spermathecae, T = tegulum, TP = radical tailpiece. Black triangles denote anterior rounded notch. Scale bars = 0.5 mm (A, G), 0.25 mm (B–F, H–I).

ined and compared to our specimens in the University of Indianapolis Spider Collection. Spiders were examined in 95% ethanol using a Leica M165C stereomicroscope. Epigyna were dissected from female abdomens using forceps and temporarily cleared for photography using clove oil. Carapace width was measured at the widest part of the carapace. All images and descriptions of male pedipalps are of the left palp. Measurements and photographs were taken using the same stereomicroscope and a Leica DMC2900 attached digital camera with the associated Leica Application Software (LAS X Ver. 5.3.0.29166, Leica Microsystems, Switzerland) at the University of Indianapolis. All measurements are in millimetres (mm). Photographs were taken with specimens placed in glass dishes containing white sand and 95% ethanol. Morphological nomenclature follows Hormiga (2000).

Molecular analysis

Mitochondrial DNA from a segment of COI was extracted from the full bodies of the following specimens using the Qiagen DNeasy Blood & Tissue Kit (Qiagen Cat. No. 69504). The concentration of the extracted DNA was then quantified using a Qubit 3 Fluorometer (Invitrogen Q33216). Extracted DNA was then amplified using the following primers: C1-J-1718 (5′ GGN GGA TTT GGA AAT TGR TTR GTT CC 3′) and C1-N-2191 (5′ CCC GGT AAA ATT AAA ATA TAA ACT TC 3′). The PCR conditions were 94°C for 2 minutes before cycling the following 34 times: 94°C for 20 seconds, 49°C for 35 seconds, and 65°C for 30 seconds; 72°C for 3 minutes. PCR results were visualized and confirmed for successful amplification on a 1% agarose gel. Amplified DNA was then purified using antarctic phosphatase and exonuclease I. Purified amplified DNA was then sent to the Keck DNA Sequencing Facility (https://research.yale.edu/cores/keck-dna) for sequencing.

Successful sequences were then aligned with sequences taken from National Institute of Health's National Center for Biotechnology Information (NCBI: https://www.ncbi.nlm.nih.gov) using Molecular Evolutionary Genetics Analysis (MEGA) v. 11.0.13 using default values. NCBI sequences included other erigonine spiders that were hypothesized to be closely related to the target species (*Ceratinopsis labradorensis* Emerton, 1925 (accession # MG509187.1), *Ceratinella brunnea* Emerton, 1882 (accession # MF816074.1), *Ceratinops inflatus* (Emerton, 1923) (accession # MF813129.1), *Erigone autumnalis* Emerton, 1882 (accession # MF813679.1), *Ceratinopsis laticeps* Emerton, 1882 (accession # MG047581.1), and *Ceratinopsis nigriceps* Emerton, 1882 (accession # MF816145.1) as well as an outgroup linyphiid spider that is not an erigonine: *Bathyphantes pallidus* (Banks, 1892) (accession # MF817036.1). A maximum likelihood phylogeny with a Tamura-Nei substitution model was then created from the aligned sequences using MEGA with 500 bootstraps.

Collections

AMNH = American Museum of Natural History, New York; FSCA = Florida State Collection of Arthropods, Gainesville; UISC = University of Indianapolis Spider Collection, Indianapolis.

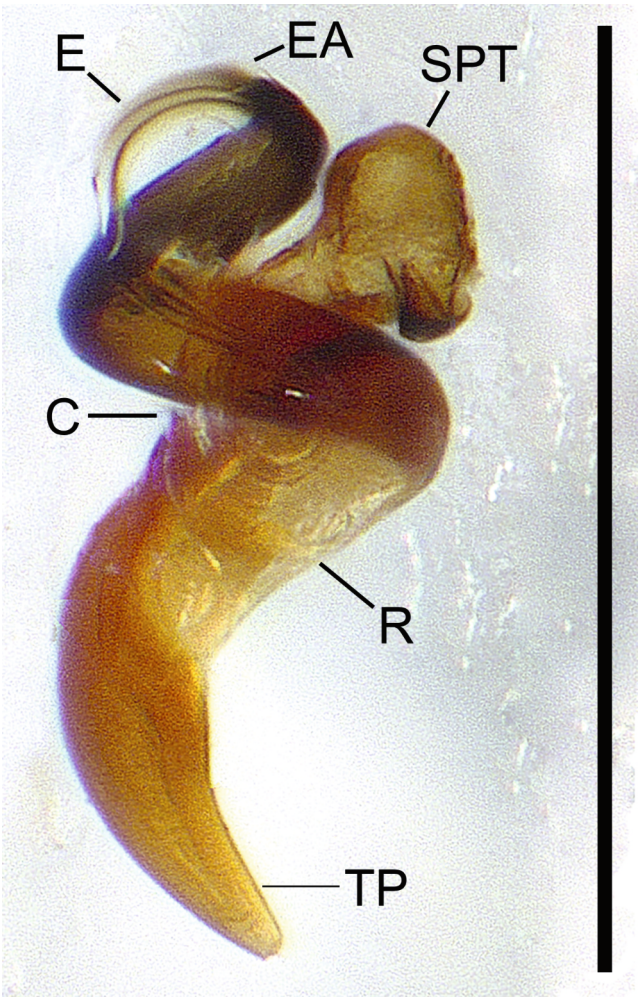

Fig. 2: *Ceratinopsis tybeensis*. Retrolateral view of embolic division of left male palpal organ. C = column, E = free part of embolus, EA = embolic apophysis, R = radix, SPT = suprategulum, TP = radical tail-piece. Scale bar = 0.25 mm.

Fig. 3: Map with red dots representing *Ceratinopsis tybeensis* collection localities. The Virginia location has two localities.

Linyphiidae Blackwall, 1859

Ceratinopsis Emerton, 1882

Ceratinopsis tybeensis Chamberlin & Ivie, 1944 Figs. 1–3

Ceratinopsis tybeensis Chamberlin & Ivie, 1944: 67, fig. 119 (described female)

Masonetta floridana Ivie, 1967: 129 (misidentified; synonymy rejected)

Type: Holotype female. USA: Georgia: Savannah Beach, 32.0 -80.85, 04 May 1943, 1♀, W. Ivie (AMNH_IZC#00171471).

Other material examined: USA: Ohio: Champaign Co., Cedar Bog, 40.05861 -83.79417, 17 May 2023, vacuum of *Sphagnum* moss patches, 2♀♀, M. A. Milne, R. Bradley, A. Tovar, C. M. Harris (UISC 18A18). North Carolina: Durham Co., Penny's Bend Nature Preserve, prairie remnant, 36.0719 -78.8679, 03 November 2024, vacuum of prairie soil, 2♀♀, M. A. Milne and B. Bockhahn (UISC 25B13). Virginia: Prince George Co., Cherry Orchard Bog, fire-maintained fen under power line break, 37.04590 -77.28986, 03 July 2023, vacuum of ground and moss patches, 4♂♂ 10♀♀, M. A. Milne, M. L. Draney, and N. Sandlin (UISC 20A17); Joseph Pines Preserve, found dead in pitcher of *Sarracenia purpurea*, 17 May 2008, hand collected, 1♂, M. A. Milne (UISC VA8B4); 12 April 2008, 2♀♀ (UISC VA7D17); 23 July 2008, 2♀♀ (UISC VA8A12); 12 September 2008, 1♀ (UISC VA9A4); pitfall trap, 12 April 2008, 2♂♂ 1♀ (UISC VA7E17); 15 May 2008, 1♀ (UISC VA5A2); 23 July 2008, 3♂♂ 1♀ (UISC VA8B12); 19 September 2008, 1♀ (UISC VA9E6).

Diagnosis: *Ceratinopsis tybeensis* males may easily be distinguished from all other North American *Ceratinopsis* species by the distinctly triangular palpal retrolateral tibial apophysis (Fig. 1E–F). Females may be distinguished from most other North American *Ceratinopsis* by their epigynum, which possesses the following unique combination of characters: a bulge anterior to the epigynum proper, a rectangular median plate, and paired, elongated, anteriorly-directed spermathecae (Fig. 1H–I). Females may be confused with other members of the genus that possess an epigynum with a prominent rectangular median plate such as *Ceratinopsis atolma* Chamberlin, 1925 or *C. labradorensis* Emerton, 1925, but these species lack the anterior bulge present in *C. tybeensis*.

Description of male (VA: Cherry Orchard Bog, UISC 20A17): Cephalothorax: eyes eight, approximately equal in size, posterior eye row straight when viewed dorsally (Fig. 1A), anterior eye row slightly recurved when viewed anteriorly; eyes ringed with black (Fig. 1A). Chelicera with 6 promarginal teeth, 5 retromarginal teeth, ~20 intermediately and equally spaced, clearly visible striae. Carapace burnt orange, oval, ¾ as wide as long, with 3 medial setae along midline behind PME, ~6 small setae between PER and AER, one between each PME and PLE, one behind each PLE, one on clypeus below AME; anterior portion of carapace 5× as high as section near pedicel, anterior portion of carapace unmodified and lacking pits (Fig. 1A), sternum burnt orange, only slightly longer than wide, bluntly pointed

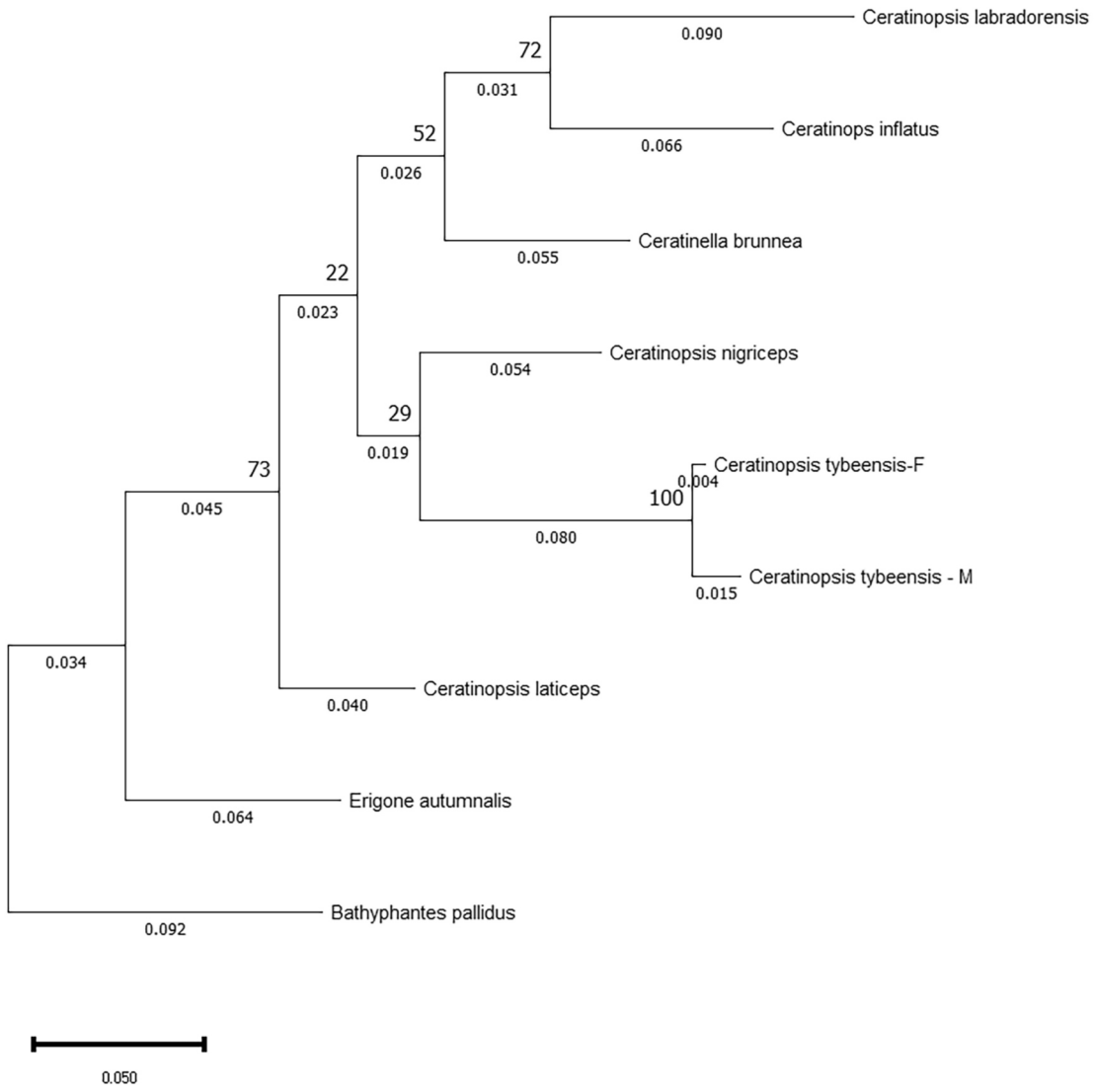

Fig. 4: Maximum-likelihood phylogenetic tree showing relationships between a *Ceratinopsis tybeensis* male (*Ceratinopsis tybeensis* - M) and female (*Ceratinopsis tybeensis* - F), various other erigonine species, and a single linyphiine (*Bathyphantes pallidus*) species based on p-distances derived from cytochrome c oxidase subunit I sequences. Bootstrap values (from 500 replicates) are indicated at the nodes. Branch lengths are indicated by the values along the internodes.

posteriorly between coxae of leg IV. Abdomen oval, cream-coloured to light brown; epiandrous fusules absent; spinnerets black, colulus twice as long as wide; anterior spinnerets wider, slightly longer than posterior spinnerets, cone shaped. Tracheal system desmitracheate (*sensu* Millidge 1984). Legs dusky yellow, often with diffuse black shading; relative lengths 1243; metatarsi I–IV each with a single trichobothrium; tibia I–III each with 4–5 trichobothria, tibia IV with 6 trichobothria; paired tarsal claws and median claw lacking teeth. Trichobothrium on metatarsus IV present. TmI at 0.53. Tibial spines 1111. Palp complex (Fig. 1B–F), tibia with retrolateral tibial apophysis triangular in dorsal view, with two points directed anteriorly and retrolaterally, slight prolateral lobe present (Fig. 1E–F). Palpal tibia with antero-prolaterally-pointed ventral apophysis with two long setae placed distally and small pointed apophysis directed prolaterally (Fig. 1C). Tegulum oval, lacking prominent protegulum and subtegulum (Fig. 1B–D). Embolic division sinuous, twisted counterclockwise in left palp with a prominent, elongated radical tailpiece that projects posteriorly, typical of the genus (Fig. 2). Free part of embolus sinuous, curling upon itself prolaterally and dorsally (Figs. 1B–D, 2) and possessing a minute embolic apophysis at the anterior curl of the distal part of the embolus (Fig. 2).

Description of holotype female (AMNH_IZC#00171471): Cephalothorax: eyes as in male (Fig. 1G). Chelicera as in male except for having ~11 intermediately and equally spaced, faint striae located midway on the chelicerae. Carapace colour as in male, ¾ as wide as long, with one medial seta along midline behind PME, ~6 small setae between PER and AER, one between each PME and PLE, one behind each PLE, one on clypeus below AME; carapace otherwise unmodified; sternum as in male. Abdomen and tracheal system as in male. Legs, spines, and trichobothria as in male. Epigynum with anterior bulge that sometimes possesses a rounded notch (Fig. 1H–I). Dorsally, vulva possesses dual spermathecae anterolateral to a median posterior rectangular plate (Fig. 1H–I). Spermathecae oval and elon-

gated along the anterior-posterior axis, separated by approximately 2.5× their narrowest width, fertilization ducts directed medially, copulatory ducts coiled, directed medially to dual copulatory openings just anterior of median plate (Fig. 1H–I).

Variation: Males (n = 8): total length 1.47–1.60 (mean = 1.54); carapace length 0.72–0.77 (mean = 0.74); carapace width 0.50–0.55 (mean = 0.52); femur I length 0.63–0.72 (mean = 0.66); TmI at 0.43–0.53. Females (n = 11): total length 1.57–2.01 (mean = 1.79); carapace length 0.75–0.82 (mean = 0.78); carapace width 0.52–0.58 (mean = 0.56); femur I length 0.71–0.84 (mean = 0.77); TmI at 0.45–0.54.

Distribution: Ranges from Ohio south to Florida. Likely distributed throughout most of the southeastern United States (Fig. 3).

Natural history: Specimens have been collected from April through November throughout most of its range. Additionally, the holotype was collected in Florida in February in 1933. This species has been collected in periodically-flooded areas of pine savannahs, bogs, fens, and remnant prairies. Specimens have been collected in webs built within the pitchers of the purple pitcher plant *Sarracenia purpurea* (Milne, 2010). This species is also regularly collected using a vacuum pushed against the ground in these aforementioned habitats. This species, like most erigonine spiders, appears to build webs close to the ground and probably feeds on springtails and other small arthropods.

Remarks: In the initial assessment of the male-female pairing of *Caseola* (later *Masonetta*) *floridana*, Ivie & Barrows (1935: 6) noted that the male is "in general similar to the female, but differing considerably in a number of details…". They then described differences in the cephalothorax morphology, eye pattern, clypeal width, cheliceral shape, and number of teeth on both cheliceral margins. When our previously undescribed males are compared to the female allotype of *M. floridana*, these morphological characters no longer differ between the sexes. Moreover, our simple molecular phylogeny based on COI reveals that these males are indeed conspecific with the female originally described as *Masonetta floridana* (Fig. 4). The actual female of *M. floridana* remains unknown. Because the phylogeny created here is solely based on COI, we have made no hypotheses about circumscription of genera and have left *C. tybeensis* within *Ceratinopsis* until a robust revision of the genus or subfamily can be undertaken.

Masonetta Chamberlin & Ivie, 1939

Masonetta floridana (Ivie & Barrows, 1935)

Type: Holotype male: USA: Florida: Lee County, Fort Myers, 81°52′W 26°37′N, February 1933, 1♂, W. M. Barrows (AMNH_IZC 00171472; HOLOTYPE).

Female unknown.

Additional record: Florida: Highlands County, Highlands Hammock State Park, sweeping swamp foliage, 26 October 1956, 1♂, M.H.M (FSCA).

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