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Gamelia bennetti sp. nov., a new Saturniidae species from Trinidad and Tobago (Lepidoptera: Bombycoidea)

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Abstract

Gamelia bennetti **sp. nov.** is described from Trinidad, Trinidad and Tobago, West Indies, and compared with members of the *Gamelia abas* species group: *G. abas* (Cramer, [1775]), *G. berliozi* Lemaire, 1967, *G. lichyi* Lemaire, 1973, *G. rubriluna* (Walker, 1862) and *G. septentrionalis* (Bouvier, 1936). A photographic record suggests *G. bennetti* **sp. nov.** may also occur in Tobago.

Key words: Hemileucinae, Neotropical Region, taxonomy, DNA barcoding

Résumé

Gamelia bennetti **sp. nov.** est décrite de Trinidad, Trinidad and Tobago, Indes Occidentales, et est comparée aux membres du groupe d'espèces de *Gamelia abas* : *G. abas* (Cramer, [1775]), *G. berliozi* Lemaire, 1967, *G. lichyi* Lemaire, 1973, *G. rubriluna* (Walker, 1862) et *G. septentrionalis* (Bouvier, 1936). Une donnée photographique suggère que *G. bennetti* **sp. nov.** pourrait également être présente sur l'île de Tobago.

Mots clefs: Hemileucinae, région néotropicale, taxonomie, codes-barres ADN

Resumen

Gamelia bennetti **sp. nov.** se describe de Trinidad, Trinidad and Tobago, Antillas Menores, y compara con especies del grupo de *Gamelia abas*: *G. abas* (Cramer, [1775]), *G. berliozi* Lemaire, 1967, *G. lichyi* Lemaire, 1973, *G. rubriluna* (Walker, 1862) y *G. septentrionalis* (Bouvier, 1936). Un registro fotográfico indica que *G. bennetti* **sp. nov.** podría también estar presente en Tobago.

Palabras claves: Hemileucinae, Región Neotropical, taxonomía, código de barras de ADN

Introduction

The two main islands of Trinidad and Tobago are continental islands off the coast of Venezuela (Starr 2009). Trinidad has an area of 4,828 km^2, and the south-west peninsula comes to within 11km from Venezuela. Tobago, on the other hand, has an area of about 300 km^2, and is separated from Trinidad by 36 km, and from the mainland by about 125 km. Trinidad's Northern Range and Tobago's Main Ridge are extensions of Venezuela's coastal range; Trinidad was probably last joined to the mainland 10,000 years ago, and Tobago 14,000 years ago (Starr 2009). This combination of land area, distance from the mainland, and time since the land masses were last joined, means that Trinidad's biodiversity is a subset of that of the mainland, and in turn, Tobago biodiversity is almost entirely a subset of Trinidad's.

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The moths of Trinidad were last catalogued by Kaye and Lamont (1927) when 27 species of Saturniidae were listed. Today, 57 species of Saturniidae are known from Trinidad (M.J.W. Cock unpublished). The moths of Tobago are not well known and only in 2017 was the first checklist published (Cock 2017b), which included eight species of Saturniidae. In preparation for publishing a general account of the Saturniidae of Trinidad and Tobago, several taxonomic issues need to be addressed. One of these is the description of this new species of the genus *Gamelia* Hübner, [1819] from Trinidad, which may also occur in Tobago.

Materials and methods

Morphological analyses. The following collections were examined in person or through the assistance of curatorial staff.

MJWC	Research collection of M.J.W. Cock, Dolgellau, Wales, UK
MGCL	The McGuire Center for Lepidoptera and Biodiversity, Gainesville, Florida, USA
MNHN	Muséum national d'Histoire naturelle, Paris, France
NHMUK	The Natural History Museum, London, UK
NMSE	National Museums of Scotland, Edinburgh, UK
OUNHM	Oxford University Natural History Museum, Oxford, UK
USNM	National Museum of Natural History (formerly United States National Museum), Washington D.C., USA
UWIZM	University of the West Indies Zoological Museum, St. Augustine, Trinidad and Tobago

Kaye and Lamont (1927) recorded *Gamelia abas* (Cramer, [1775]) from Trinidad based on a specimen in the Admiral Bourke Collection in OUNHM. Unfortunately, this and other specimens on which Kaye and Lamont (1927) based other new island records are missing from the Admiral Bourke Collection, and each replaced by a small square of paper with a single letter code in their place. Although the drawers of the Admiral Bourke collection are labelled and there is an explanatory card for each drawer, the individual specimens are not labelled. Hence, assuming it was W.J. Kaye who borrowed this material, unless data labels were added it will be difficult to locate them again, if they still exist. The first author (MJWC) failed to find this material in the OUNHM accessions drawers when he checked them in the 1990s, and Ryan St Laurent (pers. comm. 2020) failed to locate any *Gamelia* spp. from the W.J. Kaye holdings in the MGCL.

MJWC collected moths in Trinidad from 1978 to 1981 without finding any *Gamelia* spp. Attempting to confirm the identity of Kaye & Lamont's (1927) record from Trinidad, he examined the collections of NHMUK, NMSE, OUNHM, USNM and UWIZM without finding any *Gamelia* specimen from Trinidad or Tobago. It was only in 2003 and 2004 on return visits to Trinidad that MJWC obtained two representatives of the genus, both collected at the security lights of the Brigand Hill lighthouse, at an elevation of 212 m in eastern Central Trinidad. Cock (2017b) knew of no records from Tobago. Subsequent search for specimens at MNHN by the second author (RR) failed to locate any specimen of *Gamelia* from Trinidad or Tobago in the Lemaire collection hosted there. Because they closely resemble *G. abas* in both habitus and male terminalia (genitalia and adjacent abdominal sclerites) morphology, these specimens were compared to species in the *G. abas* species-group (*sensu* Lemaire, 2002), both with respect to their morphology and to variations of the DNA barcode genetic marker. Other species of the genus *Gamelia* described after Lemaire's (2002) revision, and whose affinities to species-groups were not discussed, were also considered on the basis of their original descriptions (Brechlin et al., 2012; Brechlin, 2018) and public DNA barcodes of their type specimens.

Material examined for morphological comparisons of male genitalia: MNHN: *Gamelia berliozi*, male holotype, Guyana, Orenoque and New River confluent, genitalia prep. C. Lemaire #351, BOLD DNA barcode BC-MNHN0628; *G. septentrionalis*, 1 male, Costa Rica, Sixola River, genitalia prep. C. Lemaire #364, MNHN acc. EL28483; 3 males, Costa Rica, Turrialba, genitalia prep. C. Lemaire #3270 to 3272, MNHN acc. EL28484 to EL28486; *G. rubriluna*, 1 male, Brazil, Amazonas, São Paulo de Olivença, genitalia prep. C. Lemaire #720, MNHN acc. EL28407, 3 males, Brazil, Amazonas, Uypiranga (Iranduba), genitalia prep. C. Lemaire #363, #849, #901, MNHN acc. EL28403 to EL28405, 1 male, Peru, Loreto region, Mishana, Rio Nanay, 25km South of Iquitos, elev.

120m, genitalia prep. C. Lemaire #4117, MNHN acc. EL28406, 1 male, Ecuador, Morona-Santiago, Road Gualaceo Mendez, 16km East of Limon, elev. 900m, genitalia prep. C. Lemaire #2999, MNHN acc. EL28409, 1 male, Ecuador, Upano, Rio Upano, elev. 900m, genitalia prep. C. Lemaire #2671, MNHN acc. EL28410; *G. lichyi*, 3 males, Venezuela, Aragua, Henry Pittier National Park, Rancho Grande, genitalia prep. C. Lemaire #1019, #1012, #1020, MNHN acc. EL28415, EL28425, EL28426 (paratype), 1 male, Venezuela, Carabobo, Santa Clara, genitalia prep. C. Lemaire #1223, MNHN acc. EL28432, 1 male, Venezuela, Táchira, San Juan de Navay, elev. 450m, genitalia prep. C. Lemaire #2524, MNHN acc. EL28431, 2 males, Venezuela, Miranda, El Guapo, genitalia prep. C. Lemaire #1224, #1225, MNHN acc. EL28418 (paratype), EL28428, 1 male, Venezuela, Miranda, Guatopo National Park, 9km South Los Alpes, elev. 700m, genitalia prep. C. Lemaire #2515, MNHN acc. EL28419 (paratype).

DNA barcode analysis. Standard DNA barcodes (5' end of COI mtDNA gene, Hebert *et al*. (2003)) of the two Trinidad *Gamelia* specimens and of the holotype of *G. berliozi* were generated at MNHN in the Molecular Systematics Services laboratory (UMS2700, Paris, France) following the high-throughput protocol described in Sire *et al*. (2019), except for primer pairs used being LCO1490/MLepR1 and MLepF1/HCO2198 (Folmer *et al*. 1994; Hajibabaei *et al*. 2006). This approach uses a dual-indexing multiplexing strategy for library construction and sequencing on the Illumina MiSeq platform. Other DNA barcodes of relevant *Gamelia* species were selected from results of the global DNA barcoding campaign for saturniid moths (*G. abas, G. berliozi,* and *G. lichyi*) and of the Lepidoptera inventory program in Area de Conservación Guanacaste (ACG) in northwestern Costa Rica (*G. septentrionalis* (Janzen & Hallwachs 2018)); these were generated at the Canadian Centre for DNA Barcoding (CCDB, Centre for Biodiversity Genomics, University of Guelph, Ontario, Canada) following standard protocols (deWaard *et al*. 2008). All 44 records used are listed in Table 1 and are publicly available in BOLD (www.boldsystems.org; Ratnasingham & Hebert 2007) dataset DS-TTGAM01 (dx.doi.org/10.5883/DS-TTGAM01). Each record includes both specimen (including images) and sequence data (including electropherograms of DNA barcodes produced with Sanger sequencing); all sequences are also publicly available in GenBank.

The 44 DNA barcode sequences were downloaded from BOLD, aligned in AliView v1.26 (Larsson 2014) and used in MEGA X (Kumar *et al*. 2018) with default settings to calculate pairwise distances (uncorrected p-distances) and to build a neighbour-joining (NJ) tree used to visualize genetic distances between the records.

TABLE 1. Specimen information for the 44 records used in the DNA barcode analysis. All records are publicly accessible in BOLD (www.boldsystems.org) in dataset DS-TTGAM01. (BIN=Barcode Index Number, see Ratnasingham & Hebert (2007)).

BOLD SampleID	GenBank Acc.	Species	BIN	Barcode length (bp)	Geographical origin
BC-EvS 1529	JN273283	Gamelia abas	BOLD:ACE7313	658	French Guiana
barcode SNB 3604	MW128631	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
NS-RR1891	JN272796	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
CLV4747	MW128637	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
NS-RR1592	JN272776	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
NS-RR1077	JN272754	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
NS-RR1075	JN272752	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
NS-RR0161	JN272722	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
KLM Lep 10540	MW128627	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
NS-RR0137	JN272716	*Gamelia abas*	BOLD:ACE7313	658	French Guiana
MJWC-249	MW128625	*Gamelia bennetti* **sp. nov.** (paratype)	BOLD:ADW6987	658	Trinidad and Tobago, Trinidad
MJWC-248	MW128630	*Gamelia bennetti* **sp. nov.** (holotype)	BOLD:ADW6987	658	Trinidad and Tobago, Trinidad
BC-RBP 8214	MW128628	*Gamelia berliozi*	BOLD:AAD3150	658	French Guiana
CO1-AF5	MW128633	*Gamelia berliozi*	BOLD:AAD3150	658	French Guiana
BC-Her2526	GU703604	*Gamelia berliozi*	BOLD:AAD3150	658	French Guiana

.....continued on the next page

TABLE 1. (Continued)

BOLD SampleID	GenBank Acc.	Species	BIN	Barcode length (bp)	Geographical origin
BC-Her2522	MW128634	*Gamelia berliozi*	BOLD:AAD3150	658	French Guiana
BC-Her2516	MW128624	*Gamelia berliozi*	BOLD:AAD3150	658	French Guiana
BC-MNHN0628	MW128642	*Gamelia berliozi* (holotype)	(sequence too short)	407	Guyana
BC-FMP-1311	MW128636	*Gamelia lichyi*	BOLD:AAD3066	624	Venezuela, Bolivar
BC-EvS 0161	JN273230	*Gamelia lichyi*	BOLD:AAD3066	658	Venezuela, Carabobo
BC-EvS 0160	JN273221	*Gamelia lichyi*	BOLD:AAD3066	658	Venezuela, Carabobo
BC-Her3017	MW128632	*Gamelia lichyi*	BOLD:AAD3066	630	Venezuela, Carabobo
BC-Her3016	MW128641	*Gamelia lichyi*	BOLD:AAD3066	630	Venezuela, Carabobo
BC-RBP 4829	JF861112	*Gamelia lichyi*	BOLD:AAD3066	658	Venezuela, Merida
BC-RBP 4828	JF861111	*Gamelia lichyi*	BOLD:AAD3066	658	Venezuela, Merida
BC-Dec0562	MW128640	*Gamelia rubriluna*	BOLD:AAB1487	658	Colombia, Meta
BC-Dec1432	MW128639	*Gamelia rubriluna*	BOLD:AAB1487	658	Colombia, Casanare
BC-Dec1433	MW128626	*Gamelia rubriluna*	BOLD:AAB1487	658	Colombia, Casanare
BC-Roug0683	MW128635	*Gamelia rubriluna*	BOLD:AAB1487	658	Ecuador, Loja
BC-FMP-1634	GU663309	*Gamelia rubriluna*	BOLD:AAB1487	658	Ecuador, Napo
BC-FMP-1635	GU663308	*Gamelia rubriluna*	BOLD:AAB1487	658	Ecuador, Pastaza
BC-FMP-1636	GU663311	*Gamelia rubriluna*	BOLD:AAB1487	658	Ecuador, Pastaza
BC-RBP 6895	MW128629	*Gamelia rubriluna*	BOLD:AAB1487	658	Peru, Loreto
BC-RBP 6896	MW128638	*Gamelia rubriluna*	BOLD:AAB1487	658	Peru, Loreto
08-SRNP-5188	GU652115	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Alajuela
08-SRNP-5187	GU652114	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Alajuela
06-SRNP-36137	GU146528	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-35142	JF777961	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-35144	GU666385	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-35131	GU666387	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-35132	GU666392	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-36809	GU652113	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-36810	GU652112	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste
08-SRNP-36837	GU652120	*Gamelia septentrionalis*	BOLD:AAA8280	658	Costa Rica, Guanacaste

Results

The two males from Brigand Hill resemble *G. abas*, and are the only specimens of *Gamelia* known to us from Trinidad. It is assumed that they represent the species collected by Admiral Bourke and treated as *G. abas* by Kaye and Lamont (1927). Wing patterns are of little use in characterizing species of genus *Gamelia* (Lemaire, 2002), but the comparative morphology of male terminalia and the analysis of DNA barcodes (Fig. 5 and Table 1) indicate that these specimens do not match any known species of *Gamelia* (Brechlin et al. 2012; Brechlin, 2018; Lemaire 2002; Kitching *et al*. 2018), and therefore form the basis of the description of a new species. Additional unvouchered photographic records were obtained from a local naturalist (K. Sookdeo pers. comm.) and by monitoring observations on iNaturalist (www.inaturalist.org) and flickr (https://www.flickr.com/).

Gamelia bennetti Cock and Rougerie sp. nov.

urn:lsid:zoobank.org:act:B890CE4B-A62A-4730-8BEC-6A823791DA08
Barcode Index Number (BIN): BOLD:ADW6987; Figs. 1–3, 6.

Type material. Holotype ♂: **TRINIDAD**: TRINIDAD, W.I., Brigand Hill lighthouse, at MV security lights by 22.00h, 17.i.2004, M.J.W. Cock [leg.]/ DNA sampleID MJWC-248, M.J.W. Cock 2018 / Holotype, *Gamelia bennetti* Cock & Rougerie (to be deposited in NHMUK, ex MJWC).

Paratype, 1♂. TRINIDAD: TRINIDAD, W.I., Brigand Hill lighthouse, attracted to lights the previous night, 24.iii.2003, M.J.W. Cock [leg.]/ DNA sampleID MJWC-249, M.J.W. Cock 2018 / M.J.W. Cock genitalia 1015 / Paratype, *Gamelia bennetti* Cock & Rougerie. (to be deposited in NHMUK, ex MJWC).
Both types will be deposited in NHMUK once it is open following the closure for the covid-19 pandemic.

Diagnosis. There are several similar *Gamelia* species from the Amazon-Guiana-Venezuela area with which this species can be confused, including *G. abas*, *G. rubriluna* (Walker, 1862), *G. lichyi* Lemaire, 1973 and *G. berliozi* Lemaire, 1967. Given the variability noted between the holotype, paratype and female photo of *G. bennetti* **sp. nov.**, it is not really possible to point to reliable diagnostic characters of wing markings. The male genitalia are very similar to species in the *Gamelia abas* group (Lemaire 2002), particularly *G. rubriluna* and *G. lichyi*, and to a lesser extent *G. septentrionalis* (Bouvier, 1936) and *G. berliozi* (Lemaire 2002, Brechlin & Meister 2012), so we consider *G. bennetti* **sp. nov.** to be an additional species of the *Gamelia abas* group. The genital structure (Fig. 3 A, D) is more elongate than that of *G. rubriluna*, but less so than in the other three species. The saccus (Fig. 3 D–F) is longer than that of *G. rubriluna*, but shorter than that of *G. lichyi*. The long slender lobes of the succus ('lobes of the vinculum' in Lemaire (2002)) curl back over the saccus before arching back to emerge under the uncus; it is difficult to compare this curvature with the other species of the group as Lemaire only provides ventral views, and images in Brechlin & Meister (2012) are from microscope slides, whereas lateral or partial lateral views (Fig. 3 F–I) are needed to observe this character. The saccus lobes of *G. rubriluna* and *G. lichyi* joined in their basal half (see figures in Lemaire (2002) and Brechlin & Meister (2012)), but are completely separate throughout in *G. bennetti* **sp. nov.** The aedeagus of *G. bennetti* **sp. nov.** has a ventral spike (Fig. 3 N) as do *G. rubriluna* and *G. lichyi*, but not *G. septentrionalis* and *G. berliozi* (Lemaire 2002). The aedeagus caecum in *G. bennetti* **sp. nov.** is a quadrate flange with the distal margin concave (Fig. 3 L–N), whereas this flange is basally rounded in *G. lichyi*, *G. rubriluna* and *G. berliozi* and the distal margin is concave in *G. lichyi*, but straight or rounded in *G. rubriluna* and *G. berliozi* (Lemaire 2002; Brechlin & Meister 2012). The sternite of abdominal segment 8 (A8) (Fig. 3 J) resembles that of *G. rubriluna*. The tergite of abdominal segment 7 (A7) (Fig. 3 K) resembles that of *G. lichyi*, and does not have the bottleneck shape of *G. rubriluna*. At this time, *G. bennetti* **sp. nov.** is the only species of the genus *Gamelia* known from Trinidad, and is only known from the eastern part of the island of Trinidad and perhaps eastern Tobago (see Distribution paragraph). Hence location will give a good pointer as to its identity, although there is no reason to think *G. bennetti* **sp. nov.** will not be found to occur more widely in Trinidad or on the mainland in north-eastern Venezuela and/or Guyana. It is therefore fortunate that both the male genitalia and the DNA barcodes can be reliably used to separate *G. bennetti* **sp. nov.** from other *Gamelia* species.

Description. Male. Wingspan of 48–55 mm, and forewing length of 28–30 mm. **Head**. Dorsal and ventral colour match adjacent forewing ground colour (Fig. 1). Antennae brown (matching dorsal forewing ground colour of paratype), quadri-pectinate, dorsal rami reaching two-thirds the width of ventral rami (Fig. 1 D); just over one-fifth of forewing length. **Thorax.** Dorsally matching forewing ground colour; ventrally reddish brown in holotype,

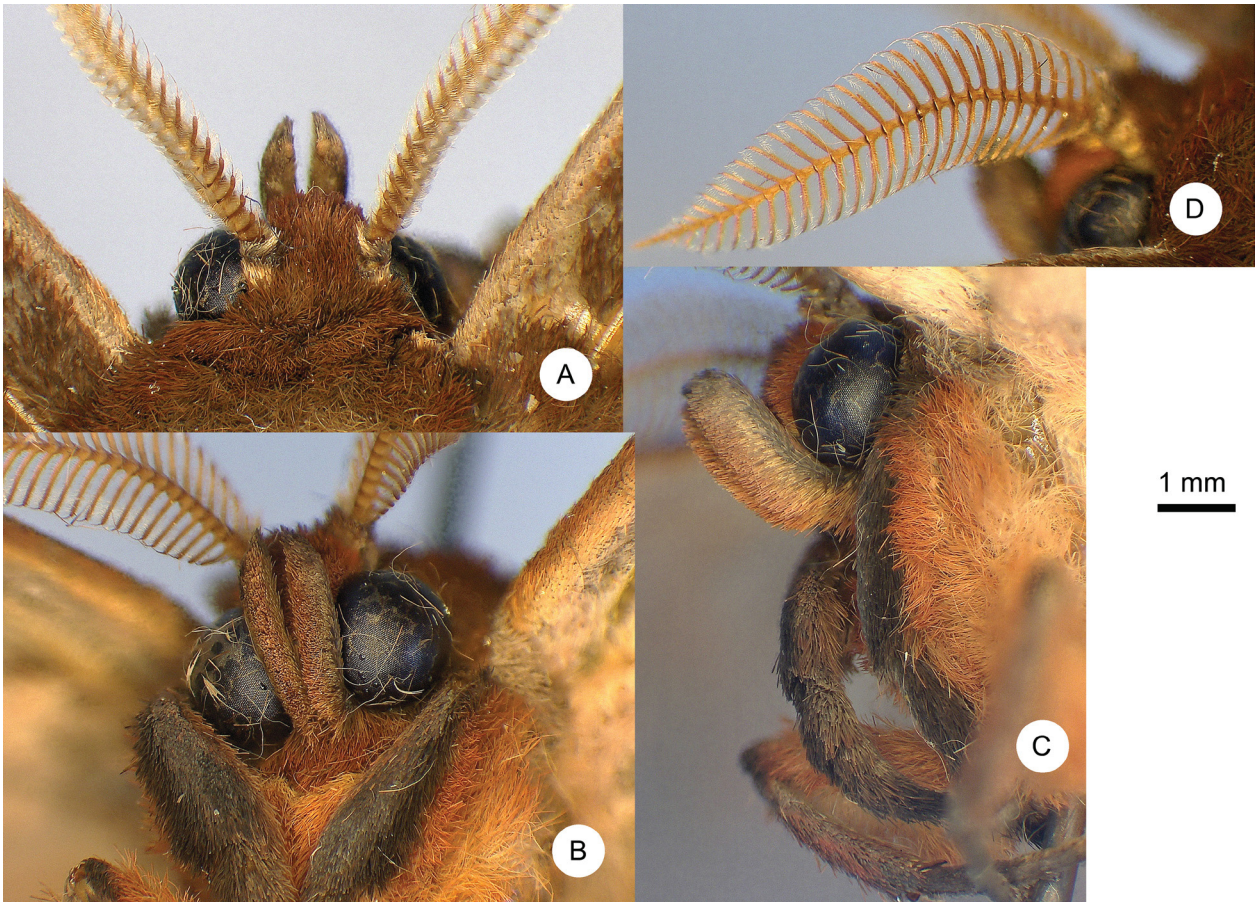

FIGURE 1. Details of the head of *Gamelia bennetti* **sp. nov.** holotype. A, head and anterior thorax, dorsal view. B, head and anterior thorax, ventral view. C, head and forelegs, lateral view. D, left antenna, dorsal view. All to scale as shown (x10).

FIGURE 2. *Gamelia bennetti* **sp. nov.** Trinidad and Tobago, Trinidad, Brigand Hill, M.J.W. Cock. Left, holotype male, 17 January 2004. Right, paratype male, 24 March 2003.

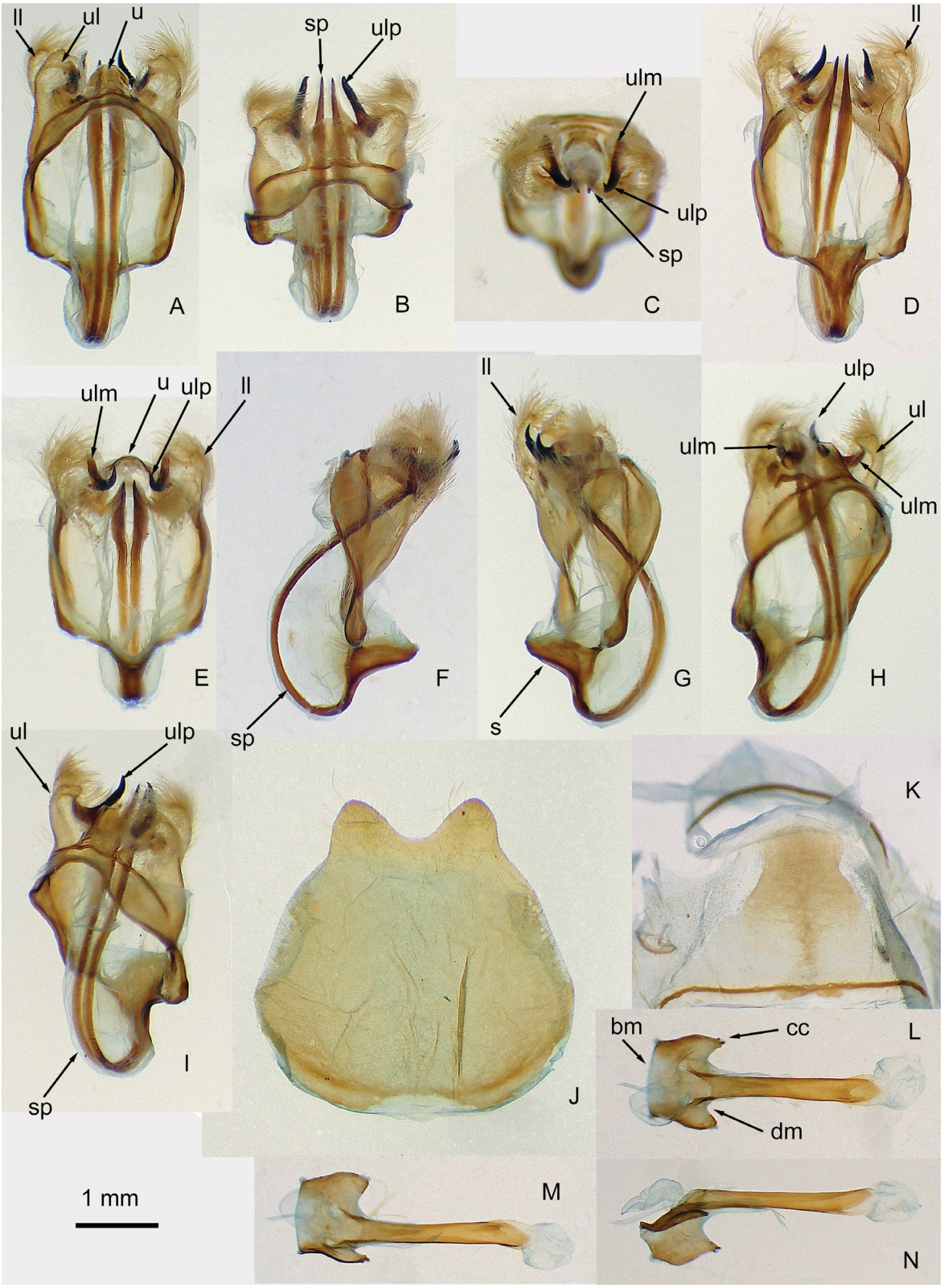

FIGURE 3. Male terminalia of paratype of *Gamelia bennetti* **sp. nov. A–I,** genitalia with aedeagus removed; A, dorsal view. B, dorso-posterior view. C, posterior view. D, ventral view. E, ventro-posterior view. F, lateral view. G, latero-posterior view. **H–I**, latero-dorsal-anterior views; J–K abdominal sclerites; J, A8 sternite (flattened). K, A7 tergite; **L–N** aedeagus; L, dorsal view. M, slightly lateral of ventral view. N, slightly ventral of lateral view. Key: bm = straight basal margin of caecum; cc = toothed right distal corner of caecum; dm = concave distal margin of caecum; ll = lower lobe of valve; s = saccus; sp = process arising from the base of the saccus; u = uncus; ul = upper lobe of valve; ulm = inner margin of upper lobe of valve; ulp = sclerotised projection of upper lobe of valve. All to scale as shown (x 15).

orange-brown in paratype. **Dorsal forewing** dark blackish brown in holotype (Fig. 2 left) and live photograph (Fig. 6), or brown in paratype (Fig. 2 right), in all cases darker in basal third which is well covered with dense hair-like setae, especially towards dorsum. An irregular antemedian line and a small dark brown discal spot apparent in paratype, but not in dark brown holotype (although discal spot obvious on ventral forewing). A postmedian line runs from near tornus on anal margin to apex, although hardly visible towards apex; narrow and dark brown with a distal pale margin and then a very narrow dark brown border; much more obvious in brown paratype. Broad marginal band very slightly paler. **Dorsal hindwing** predominantly grey brown in holotype, but with yellow-brown tone in paratype. A curved, double, postmedian line of dark grey (holotype) or grey (paratype), running from anal margin before tornus to apex; inner line fairly even in width, but outer line broadens considerably in lower half of wing approaching anal margin. Distal to this double line, holotype is uniformly grey-brown, whereas paratype is yellow-grey-brown. Basal to double line, ground colour is paler, with anal area darker and overlaid with hair-like cells. Eyespot displaced inward from postdiscal lines; red with small white centre and broad black border; size variable (compare Figs. 2 and 6). **Ventral forewing**. Holotype dark grey-brown, suffused with russet in basal half, and paler towards anal margin. Antemedian line absent and postmedian line only visible as a slight shadow. Discal spot small, round, and black at the distal end of cell. Paratype similarly marked but ground colour yellow-brown. **Ventral hindwing**. Ground colour as ventral forewing; eyespot faintly visible through the wing. A straight postmedian line runs from two-thirds on anal margin to external margin just below apex, nearly touching eyespot edge. **Abdomen**. Dorsally, colour matches marginal band of dorsal hindwing; distally and dorso-laterally it matches basal ground colour of dorsal hindwing; ventrally reddish brown at base, fading to brown distally in holotype; orange-brown basally and yellow brown distally in paratype. **Male terminalia** (paratype; Fig. 3). Central part of posterior margin of A7 tergite flattened; constricted to each side of this before dilating (Fig. 3 K). A8 sternite smoothly bilobed on posterior margin (Fig. 3 J). Genitalia symmetrical, except as indicated for aedeagus; 3.2 mm from anterior margin of saccus to posterior margin of uncus. Uncus (Fig. 3 u) very short (0.35 mm), rounded posteriorly. A long (4.8 mm), thin, pointed process arising from the base of the saccus (Fig. 3 sp) curves anteriorly, then dorsally and finally posteriorly to finish projecting beyond uncus; processes from each side fused in the basal portion but separate for most of their length. Saccus (Fig. 3 s) projects posteriorly, but not anteriorly. Valva bilobed; lower lobe (Fig. 3 ll) elongate, arching dorsally; upper lobe (Fig. 3 ul) rounded and partly sclerotised (Fig. 3 upm) with a strong, curved, sclerotised projection (Fig. 3 ulp). Aedeagus 2.96 mm long; straight, pointed on dorsal distal margin; vesica simple; caecum of aedeagus a lateral flange each side of base, basal margin (Fig. 3 bm) straight, lateral margin dilating distally to a point and then concave on distal margin (Fig. 3 dm); right distal lateral corner with two small teeth (Fig. 3 cc) (Fig. 3 L–N).

FIGURE 4. Left, putative living *Gamelia bennetti* **sp. nov.** female, Trinidad and Tobago, Trinidad, East of Cunaripa, Bedes Buxoo Trace, by night, 30 May 2020, R. Deo [iNaturalist observation 48063102]. © R. Deo, with permission. Right, a possible living *G. bennetti* **sp. nov.** female, Trinidad and Tobago, Tobago, near Speyside, +11.301, -60.534, at light, 29 November 2014, P. Davis. © P. Davis, with permission.

Provisional description of female. No female specimens were available to us. However, Fig. 4 (left) shows a dorsal view of a living specimen that was not collected, but that is assumed to be the female of *G. bennetti* **sp. nov.** as it differs from the male in similar ways to other species of the genus (Lemaire 2002), although it is not impossible that it represents a second otherwise unknown species from Trinidad. Dorsal **head and thorax** same colour as basal forewing. **Dorsal forewing**. Compared to holotype male, wing of female more falcate and paler. Antemedian

line strongly marked with a pale inner border, most pronounced on costa. Postmedian line strongly marked, double, black and runs all the way to apex. Discal area pale pinkish brown; no discal spot, although there are 2–3 discal dots, and a diffuse pale patch on costa towards apex. Postmedian area grey brown, with distinct border on external margin, similar in colour to discal area. **Dorsal hindwing**. Similar to male holotype, but generally paler. Eye spot larger, and distally overlies innermost postmedian line; black border proportionally narrower, and white pupil has a black mark in it. Dorsal **abdomen** matches thorax at base, but remainder matches basal ground colour of dorsal hindwing.

DNA barcodes. The barcodes of the two specimens are almost identical (p-distance of 0.16%); *G. lichyi*, from Venezuela, is the nearest neighbour to *G. bennetti* **sp. nov.**, with a minimum p-distance of 3.37% (Fig. 5). *Gamelia bennetti* **sp. nov.** is segregated as BIN BOLD:ADW6987.

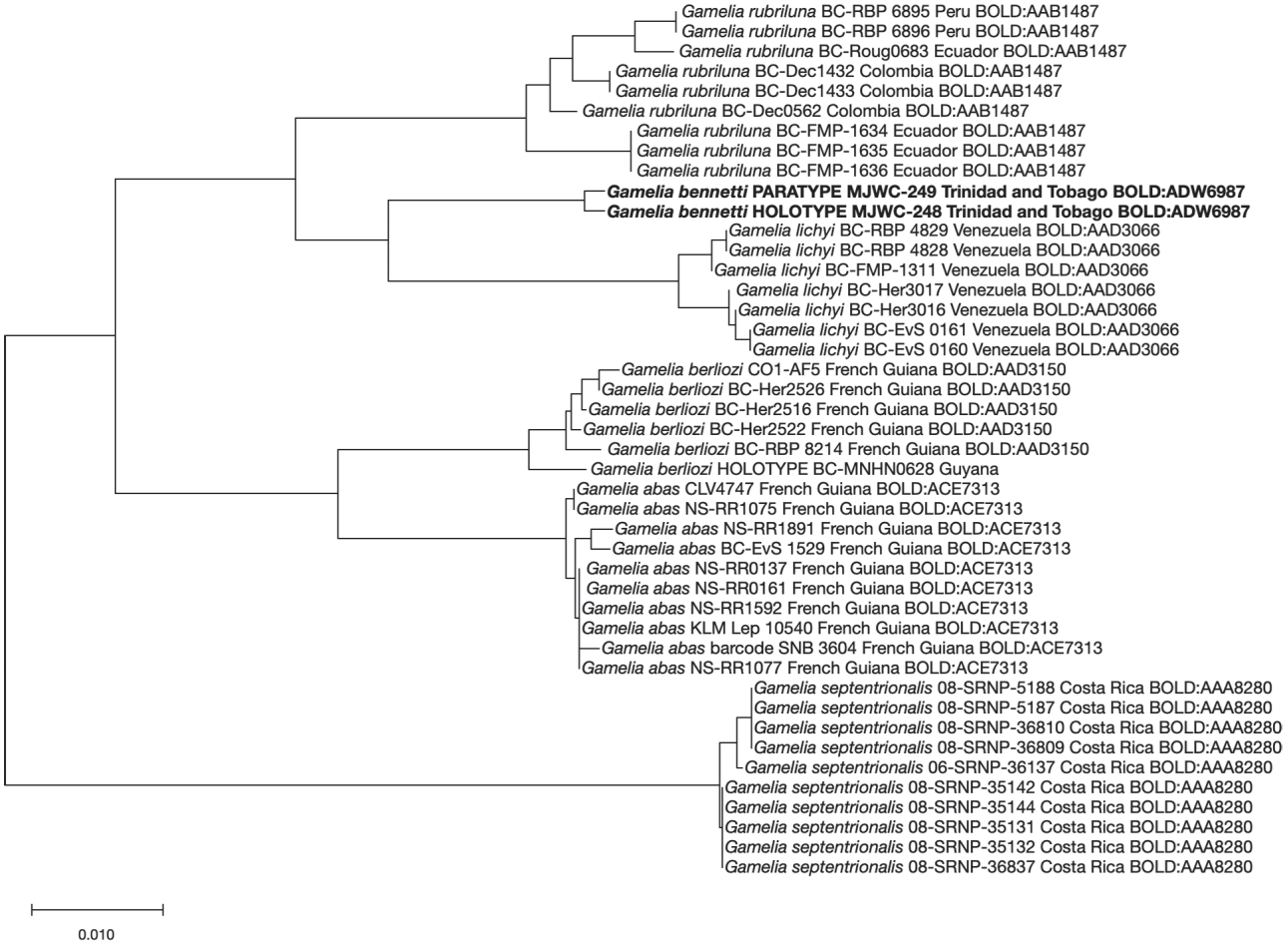

FIGURE 5. Neighbour joining tree (uncorrected p-distances) built using MEGA X from the 44 DNA barcodes of *Gamelia* in BOLD dataset DS-TTGAM01. Specimens of the new species *G. bennetti* **sp. nov.** are highlighted in bold characters. BOLD SampleID codes are given after species names in terminal labels, followed by the country of origin of the record and Barcode Index Numbers (BINs).

Variability. Based on the limited observations from Trinidad (two specimens and two photographic records), the male seems to be rather variable with regard to the ground colour, or it occurs in two colour forms, the holotype (Fig. 2 left) being of a dark blackish brown form and the paratype (Fig. 2 right) a paler brown form. The dark blackish brown form is seen in the unvouchered images of living males (e.g. Fig. 6), and so the specimen of this form was chosen as the holotype. The image of putative females from Trinidad (e.g. Fig. 4 left) indicates a degree of sexual dimorphism in addition. More observations are needed to assess the variation in this species. Lemaire (2002) states that *G. lichyi* is more variable than *G. rubriluna* and notes that the lightest males have a bright yellow underside, so it seems likely that *G. bennetti* **sp. nov.** will prove to be continuously variable.

An additional photograph of a female from Tobago was located (Davis 2014, Fig. 4 right). This individual is dark blackish brown, there is a single distinct discal spot, the inner margin of the post median line is pale, and there

is a distinct pale subapical patch on the costa. This is likely to be *G. bennetti* **sp. nov.**, suggesting that the female is also variable, but without a specimen from Tobago to examine, we do not make this assumption. Nevertheless, in almost all cases, the Lepidoptera of Tobago are a subset of the species found in Trinidad, and there are just a few examples of species found in Tobago but not yet in Trinidad, or where Trinidad and Tobago have different subspecies of the same species (Cock 2017a, 2017b).

FIGURE 6. Living *Gamelia bennetti* **sp. nov.,** Trinidad and Tobago, Trinidad, Bush Bush, 18 October 2014, K. Sookdeo. © K. Sookdeo, with permission.

Distribution (Fig. 7). Trinidad and Tobago, Trinidad: W.I., Brigand Hill lighthouse (type series), Bush Bush, Cunaripa, Inniss Field, Rampanalgas (unvouchered photographic records as listed below).
TRINIDAD: Bush Bush: ♂ 18 October 2014 (K. Sookdeo photo) (Fig. 6), ♂ 18 October 2014 (R. Rutherford photo) [iNaturalist observation 38318126] (these two observations are of the same individual); East of Cunaripa, Bedes Buxoo Trace, by night: ♀ 30 May 2020 (R. Deo photo) [iNaturalist observation 48063102] (Fig. 4 left); Inniss Field, 10.17N 61.27W, by night: ♀ 24 December 2020 (R. Deo photo) [iNaturalist observation 67114868] (not shown); NE of Rampanalgas on Toco Main Road, at light ♂ 26 October 2019 (laurababoolal photo) [iNaturalist observation 34905707] (not shown). The single photographic record from Tobago (Davis 2014) probably represents this species, but this needs confirmation: TOBAGO: Near Speyside, +11.301N, -60.534W, at light: ♀ 29 November 2014 (P. Davis photo) (Fig. 4 right).

Etymology. This species is named with thanks and appreciation after Dr Fred D. Bennett (Frank 2019), who was director of the Commonwealth Institute of Biological Control (now integrated within CABI) in Trinidad, during the five years that the first author was based there. Fred's support, encouragement and help with the study the insects of Trinidad has contributed to the first author's subsequent four decades long interest in the Lepidoptera of Trinidad and Tobago.

Remarks. This is a rarely seen species in Trinidad, with two collection records and three photographic records, all from the less collected eastern side of the island. The months of capture or observation are January, March, May, October (2) and December in Trinidad, i.e. in both the dry season (January to early May) and the wet season (mid-May to December, often with a short break mid-September to mid-October).

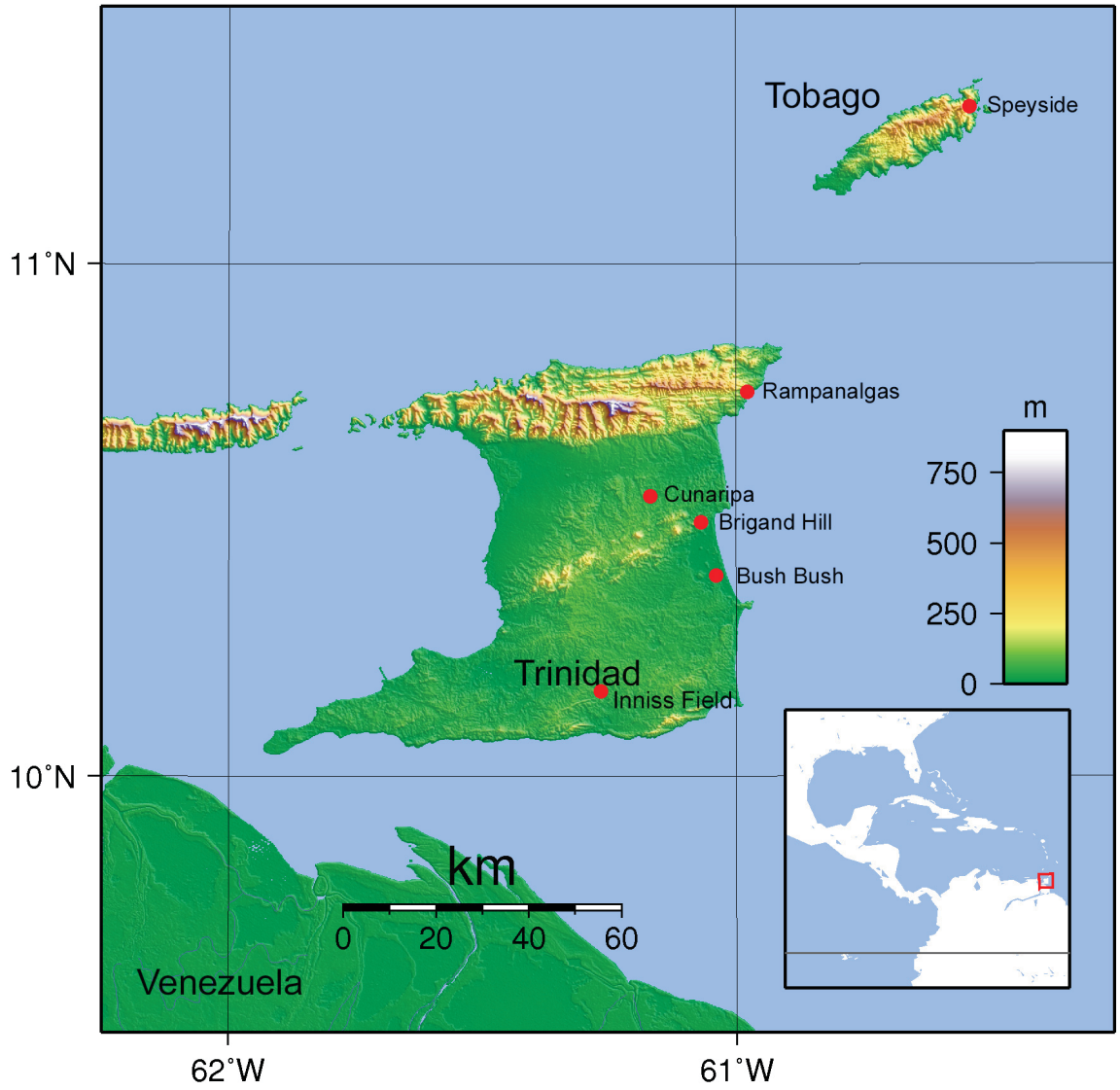

FIGURE 7. Map of Trinidad and Tobago, showing the known localities for *Gamelia bennetti* **sp. nov.** (modified from a map created by Sadalmelik, https://commons.wikimedia.org/wiki/File:Trinidad_Topography.png under GNU Free Documentation License and Creative Commons License BY-SA 3.0).

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