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A new species of *Notomastus* (Annelida, Capitellidae) from southern China, with remarks on its morphology and distribution

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Abstract

The genus *Notomastus* is frequently encountered in Chinese waters. However, its species richness is poorly understood. In this study, a *Notomastus* species obtained from Xiamen Bay, southern China, was described and illustrated as a new species (*N. sunae* **sp. nov.**), based on morphological and molecular analyses. The new species is characterized by having uniramous chaetiger 1, the presence of palpode and eyespots on prostomium, chaetiger 11 with notopodial capillaries and neuropodial hooded hooks, and notopodial lobes with simple epithelial extensions on far posterior abdomen. With additional specimens collected from several localities along the southern coasts of China, the morphology and geographical distribution of the new species are discussed. A key is also provided for *Notomastus* species with neuropodial hooks in thoracic chaetiger 11.

Keywords

coastal waters, Polychaeta, sequences analysis, southern China, systematics

Introduction

Polychaetes of the family Capitellidae, which is among the most common families in marine surveys, are distributed at depths from the intertidal to abyssal zones (Hernández-Alcántara and Solís-Weiss 1998; Blake 2000). Of the 43 known genera, *Notomastus* is the most species-rich genus in the family Capitellidae and includes 43 described species worldwide (García-Garza et al. 2019). *Notomastus* was initially erected by Sars (1851) for the type species *N. latericeus* from Norway, a capitellid bearing an achaetous peristomium, 11 thoracic chaetigers with only capillaries, and an abdomen having only chaetigers with hooded hooks. However, newly described species have added morphological variability to the genus and the generic diagnosis became increasingly obscure. For instance, Hartman (1960) described a *Notomastus* species with neuropodial hooks in last thoracic chaetiger, which is not found in most members of the genus. To clarify the taxonomic boundary of the genus, an emended generic diagnosis was proposed over time by several authors. Ewing (1982) and later Blake (2000) proposed a broader definition to include species from morphologically similar genera, such as *Paraleiocapitella*, *Dodecaseta*, and *Rashgua*. However, Green (2002) preferred to include species of *Paraleiocapitella* and exclude species of *Dodecaseta* and *Rashgua*. García-Garza and León-González (2015) suggested a more strict definition that only species with biramous chaetiger 1 were included in the genus. The latest definition proposed by Magalhães and Blake (2017) is in agreement with Green (2002). Under the current scheme, six *Notomastus* species (at species level) were reported to have neuropodial hooded hooks in the last thoracic chaetiger, i.e., *N. americanus* from North Carolina, USA (Day 1973; now synonymous with *N. hemipodus* Hartman, 1945), *N. angelicae* from the Gulf of California (Hernández-Alcántara and Solís-Weiss 1998), *N. daueri* from the Gulf of Mexico (Ewing 1982), *N. mossambicus* from Madagascar (Thomassin 1970), *N. precocis* from California, USA (Hartman 1960), and *N. teres* from waters off New England, USA (Hartman 1965). Ewing (1984) also reported an unnamed species (labelled as *Notomastus* sp. A) with this character.

Notomastus species are frequently encountered in Chinese coastal waters. Among the six recorded species to date (Liu 2008), only two species have brief taxonomic descriptions (Sun and Yang 1988), whereas the rest are reported in ecological publications, where only species names are mentioned without any taxonomic descriptions and illustrations. Besides, most of the recorded species have type localities that are distant from China. Therefore, the knowledge of Chinese *Notomastus* species is still poorly understood, and the known records require further examination. Currently, *Notomastus mossambicus* (formerly known as *Paraleiocapitella mossambicus*) is the only species in Chinese waters known to have the last thoracic chaetiger with notopodial capillaries and neuropodial hooded hooks. In this study, a new *Notomastus* species with the same structure of the last thoracic chaetiger was collected from intertidal to shallow subtidal habitats in Xiamen Bay, Fujian Province, China. In addition to the structure of chaetiger 11, the new species resembles *N. mossambicus* in having prostomial eyespots and uniramous chaetiger 1, but it differs from the latter in the structure of the

prostomium and epithelial texture. The new species is distinguished from other closely related species by morphological characters and gene sequences. With specimens collected from the identical site in different months and from other localities along the southern coasts of China, the morphology and geographical distribution of the new species are also discussed. A identification key is provided for worldwide *Notomastus* species having the last thoracic chaetiger transitional.

Materials and methods

Field sampling

A collection of over 90 specimens from eight localities along southern China (Fig. 1) was examined in this study. Sediment samples were collected from intertidal or shallow subtidal coastal waters during surveys conducted from 2016 to 2019 using either a grab sampler (subtidal stations) or a sampling frame (intertidal). Sediment samples were washed through a 0.5 mm sieve in the field. Specimens retained were fixed with either 8% diluted formalin in seawater, and later transferred to 70% ethanol, or directly preserved in 95% ethanol.

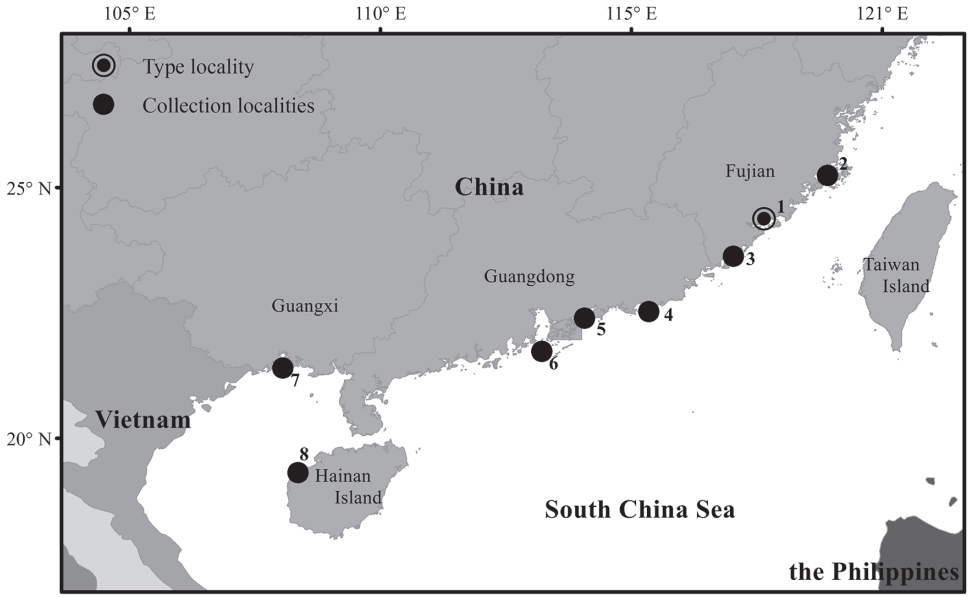

Figure 1. Type locality and collection localities of *Notomastus sunae* sp. nov., **1** Xiamen Bay (Fujian Province) **2** Xinghua Bay (Fujian Province) **3** Dongshan Bay (Fujian Province) **4** Jieshi Bay (Guangdong Province) **5** Daya Bay (Guangdong Province) **6** outside Pearl River estuary (Guangdong Province) **7** Qinzhou Bay (Guangxi Province) **8** water off western Hainan Island.

Morphological analysis

Specimens were examined using a Leica MZ95 optical stereoscope. Light photographs were taken under a Leica M205A stereoscope equipped with DFC 550 digital camera. The structure of abdominal hooks was observed under Axio Imager Z2 (Carl Zeiss Inc., Oberkochen, Germany) using oil emersion. SEM observations were carried out on a scanning electron microscope (ZEISS SUPRA 55 SAPPHIRE) at Xiamen University, and methyl green staining pattern (MGSP) was used to identify the distribution of glandular areas, both as delineated by Lin et al. (2019). The type material and additional material examined in this study were deposited in the Third Institute of Oceanography, Ministry of Natural Resources, Xiamen, China.

Molecular analysis

The total genomic DNA was extracted from organisms using Transgen Micro Genomic DNA EE 181 Kit (Transgen, Beijing, China) following the protocol provided by the manufacturer. The PCR reactions were conducted to amplify partial sequences of mitochondrial (COI) and nuclear (18S, H3) genes using primer sets as shown in Table 1. The PCRs (100 μL) contained 73.5 μL of deionized water, 10 μL of TakaRa 10× Ex Taq buffer, 8 μL of dNTP mixture (2.5 mM), 2 μL of each primer (10 μM), 0.5 μL of TakaRa Ex Taq (5 U/μL) and 4 μL DNA template. The thermal cycling conditions were as follows: 95 °C for 240 s; 35 cycles of 95 °C for 45 s, 41 °C (COI) or 43 °C (18S1, 18S2, 18S3, H3) for 60 s, and 72 °C for 80 s; and 72 °C for 7 mins. 5 μL of the resulting PCR products were checked using 1% agarose gel electrophoresis, and the remaining products were purified using a Transgen Quick Gel Extraction EG 101 Kit (Transgen, Beijing, China) following the manufacturer's protocol. Sequencing of the purified DNA samples was performed at Biosune company (Xiamen, China) with an ABI 3730XL DNA analyzer (Applied Biosystems).

Obtained sequences were manually checked and assembled into a consensus sequence using the software DNAMAN 8 (Lynnon Biosoft, Quebec, Canada). Eventually, about 650 bp of COI, 1637 bp of 18S, and 316 bp of H3 were successfully amplified in this study. The available sequences of related genera of Capitellidae in GenBank were used in phylogenetic analysis (Table 2). Alignments of the sequences

Table 1. List of primer sets used for PCR and sequencing in this study.

Gene	Primer name	Sequence (5' to 3')	Reference
COI	LCO 1490	GGTCAACAAATCATAAAGATATTGG	Folmer et al. (1994)
	HCO 2198	TAAACTTCAGGGTGACCAAAAAATCA	Folmer et al. (1994)
H3	aF	ATGGCTCGTACCAAGCAGAC	Colgan et al. (1998)
	aR	ATATCCTTRGGCATRATRGTGAC	Colgan et al. (1998)
18S1	F	GCTGTATGTACTGTGAAACTGCG	Song et al. (2018)
	R	GGAATTACCGCGGCTGCTGGCACC	Song et al. (2018)
18S2	F	GTTCGATTCCGGAGAGGGAGCCT	Song et al. (2018)
	R	GTTTCGGCCTTGCGACTATACTT	Song et al. (2018)
18S3	F	ACTGCGAAAGCATTTGCCAAGAGT	Song et al. (2018)
	R	CACCTACGGAAACCTTGTTACGAC	Song et al. (2018)

Table 2. DNA sequences with GenBank accession numbers used in phylogenetic analysis.

Species name	Origin	18S	H3
Ingroup			
Barantolla lepte Hutchings, 1974	Australia	AB106265	N/A
Capitella teleta Blake et al., 2009	Ehime, Japan	LC208027	LC208089
Dasybranchus caducus (Grube, 1846)	N/A	AF448153	N/A
Heteromastus filiformis (Claparède, 1864)	N/A	DQ790081	N/A
Mediomastus opertaculeus Hiruta & Kajihara, 2013	Hokkaido, Japan	LC208046	LC208107
Notomastus hemipodus Hartman, 1945	Bamfeld, Canada	HM746728	HM746759
Notomastus koreanus, Jeong et al. 2018	Busan, Korea	N/A	MG748699
Notomastus latericeus Sars, 1851	Bohuslän, Sweden	AY040697	DQ779747
Notomastus sp. 1 ST2018	Tokyo, Japan	LC208047	LC208108
Notomastus sp. 2 ST2018	Okinawa, Japan	LC208048	LC208109
Notomastus sp. 3 ST2018	off Owase, Japan	LC208049	LC208110
Notomastus sp. 4 ST2018	Suou-Nada, Japan	LC208050	LC208111
Notomastus sp. 5 ST2018	Okayama, Japan	LC208051	LC208112
Notomastus sp. 6 ST2018	Okayama, Japan	LC208052	LC208113
Notomastus sp. 7 ST2018	Kagoshima, Japan	LC208053	LC208114
Notomastus sp. SIO BIC	Friday Harbor, WA, USA	KF511859	KF511880
Notomastus sunae sp. nov.	Xiamen, China	MT055861	MT055862
Notomastus tenuis Moore, 1909	N/A	DQ790084	N/A
Notomastus torquatus Hutchings & Rainer, 1979	Australia	N/A	AF185258
Outgroup			
Arenicola marina (Linnaeus, 1758)	Arcachon, France	AF508116	DQ779718
Nicomache personata Johnson, 1901	Hokkaido, Japan	LC006051	LC005496

were performed using the MUSCLE algorithm (Edgar 2004) implemented in the software MEGA X (Kumar et al. 2018) under default settings. The unaligned sequences and highly divergent regions were removed using Gblocks (Castresana 2000). A maximum likelihood (ML) analysis was conducted in RAxMLGUI 1.5 beta (Silvestro and Michalak 2012) on the concatenated sequence of 18S and H3 genes, using the model GTR+G+I and 1000 thorough bootstrap pseudoreplicates. The tree was edited using FigTree v. 1.4 (Rambaut 2012) and Adobe Photoshop CS5. The aligned and trimmed sequences were used as data sets to generate the interspecific genetic distance using the Kimura's two-parameter (K2P) model (Kimura 1980) implemented in MEGA X.

Systematics

Class Polychaeta Grube, 1850
Family Capitellidae Grube, 1862

Genus *Notomastus* Sars, 1851

Type species. *Notomastus latericeus* Sars, 1851

Generic diagnosis (after Magalhães and Blake 2017). Prostomium conical, with or without palpode; eyespots present or absent. Thorax consisted of an achaetous peristomium and 11 chaetigers. First chaetiger uniramous or biramous. Chaetigers 1–11

with only capillaries in both rami or last thoracic chaetiger transitional with notopodial capillaries and neuropodial hooded hooks. Abdominal chaetigers with hooded hooks only. Branchiae present or absent. Genital pores present or absent. Lateral organs present on thorax and abdomen.

***Notomastus sunae* sp. nov.**
http://zoobank.org/1E60348C-F682-457C-862C-D7BED5215024
Figures 2A–F, 3A–F, 4A–G

Type material examined. ***Holotype:*** TIO-BTS-Poly-114 (sta. XM12)–Xiamen Bay, Fujian Province, [24°33'54"N, 118°10'00"E], 6 m, mud, complete, 25 August 2018, coll. Junhui Lin. ***Paratypes:*** TIO-BTS-Poly-115–6 specimens, same information as holotype, one mounted on SEM stub; TIO-BTS-Poly-116 (sta. QPW1-4)–9 specimens, Xiamen Bay, [24°27'16"N, 118°10'20"E], intertidal, muddy sand, 23 January 2019; TIO-BTS-Poly-117–9 specimens, 4 April 2019; TIO-BTS-Poly-118–23 specimens, 24 July 2019; TIO-BTS-Poly-119–4 specimens, 13 September 2019; TIO-BTS-Poly-120–16 specimens, 30 October 2019. Specimens (from TIO-BTS-Poly-116 to TIO-BTS-Poly-120) collected from the identical site (QPW1-4) by Junhui Lin.

Additional material examined. TIO-BTS-Poly-121 (sta. XHW04)–3 specimens, Xinghua Bay (Fujian Province), [25°25'55"N, 119°24'16"E], 7 m, mud, 17 April 2019, coll. Zhong Li; TIO-BTS-Poly-122 (sta. DS06)–1 specimen, Dongshan Bay (Fujian Province), [23°48'57"N, 117°31'41"E], 5 m, mud, 26 February 2019, coll. Heshan Lin; TIO-BTS-Poly-123–2 specimens, same location as TIO-BTS-Poly-122, 17 June 2019, coll. Heshan Lin; TIO-BTS-Poly-124–6 specimens, Jieshi Bay (Guangdong Province), [22°45'22"N, 115°47'09"E], 8 m, mud, 19 August 2019, coll. Zhizhong Huang; TIO-BTS-Poly-125–2 specimens, [22°42'40"N, 115°48'10"E], 21 m, muddy sand, 19 August 2019, coll. Zhizhong Huang; TIO-BTS-Poly-126–1 specimen, Daya Bay (Guangdong Province), [22°34'42"N, 114°33'30"E], 12.5 m, mud, 20 February 2016, coll. Junhui Lin; TIO-BTS-Poly-127–2 specimens, outside Pearl River estuary (Guangdong Province), [21°54'49"N, 113°42'15"E], 23 m, muddy sand, 24 October 2019, coll. Zhizhong Huang; TIO-BTS-Poly-128 (sta. GFC-S23)–4 specimens, Qinzhou Bay (Guangxi Province), [21°35'04"N, 108°32'07"E], 7 m, muddy sand, 28 October 2017, coll. Zhong Li; TIO-BTS-Poly-129 (sta. GFC-S11)–1 specimen, [21°37'34"N, 108°38'15"E], 9.5 m, muddy sand, 20 April 2018, coll. Zhong Li; TIO-BTS-Poly-130 (sta. GFC-S23)–1 specimen, same location as TIO-BTS-Poly-128, 19 April 2018, coll. Zhong Li; TIO-BTS-Poly-131 (sta. GFC-S33)–1 specimen, [21°34'31"N, 108°52'42"E], 7 m, muddy sand, 21 April 2018, coll. Zhong Li; TIO-BTS-Poly-132 (sta. GFC-S02)–2 specimens, [21°37'32"N, 108°34'57"E], 12 m, mud, 17 August 2018, coll. Zhong Li; TIO-BTS-Poly-133 (sta. GFC-S19)–2 specimens, [21°31'55"N, 108°34'29"E], 12 m, sand with shell fragment, 17 August 2018, coll. Zhong Li; TIO-BTS-Poly-134 (sta. GFC-S48)–1 specimen, [21°39'29"N, 108°36'47"E], 14 m, mud, 17 August 2018, coll. Zhong Li; TIO-BTS-Poly-135 (sta.

CJ03)–2 specimens, off western Hainan Island**,** [19°27'56"N, 108°49'40"E], 20 m, muddy sand, 22 May 2019, coll. Zhong Li; TIO-BTS-Poly-136 (sta. CJ07)–2 specimens, [19°29'46"N, 108°50'24"E], 18 m, muddy sand, 22 May 2019, coll. Zhong Li.

Comparative type material. *Notomastus hemipodus* Hartman, 1945, holotype: LACM-AHF Poly-414–North Carolina, Bogue Sound, dredged in a few feet of water, 15 June 1940; paratypes: LACM-AHF Poly-415–North Carolina, Bogue Sound, June 1940; LACM-AHF Poly 2667–muddy sand at low tide, June 1940; LACM-AHF Poly 2668–incomplete, muddy sand flats at low water, June 1940; LACM-AHF Poly-2669–incomplete, outer end of Bird Shoal, 18 June 1940, coll. O. Hartman. *Notomastus americanus* Day, 1973, Holotype: USNM 43118–North Carolina, Beaufort, 4 June 1965; Paratype: USNM 43119–North Carolina, Beaufort, 4 June 1965 coll. J. Day.

Sequence. MT055861 (18S, 1637 bp), MT055862 (H3, 316 bp), MT055863 (COI, 650 bp), determined from paratype (TIO-BTS-Poly-118).

Description. Holotype complete with over 100 chaetigers (Fig. 3A), measuring 33.74 mm long by 0.8 mm wide. Paratypes complete or incomplete, ranging from 6.81–43.02 mm long, 0.57–0.90 mm wide for 19–103 chaetigers. Color in alcohol tan (Fig. 3B). Thorax dorsally rounded, ventrally flattened, widest at chaetiger 3. Prostomium conical, with narrow palpode (Figs 2A–C, 3B, 4A, B). Everted proboscis globular, with numerous minute papillae (Fig. 2A–C). Eyespots present on lateral sides of prostomium (Figs 2A, C, 3B). Peristomium achaetous, wider than long, as wide as first chaetiger, but longer (Fig. 2A). Thorax slightly areolated in anterior 4–5 chaetigers, remaining chaetigers smooth.

Thorax consisted of an achaetous peristomium and 11 chaetigers (Fig. 2A, B). Chaetiger 1 uniramous (Figs 2A, C, 4A, B), with capillaries in notopodia only. Chaetigers 2–10 with only capillaries in both rami (Figs 2A, B, 4A, D). All capillaries bilimbate. Chaetiger 11 transitional with notopodial capillaries and neuropodial hooded hooks (Figs 2A, D, 4A, C). Chaetigers 1–4 slightly expanded. Chaetigers 6–10 biannulated with intra- and inter-segmental grooves (more evident in lateral view), wider than long (Fig. 2A, B). Notopodia inserted dorsolaterally in first five thoracic chaetgiers, then notopodia inserted dorsally from chaetiger 6 to posterior thorax (Fig. 2B). Neuropodia ventrolateral. Chaetal fascicles inserted just posterior to midline of thoracic segments (Figs 2A, B, 4A). Notopodia of chaetigers 1–11 and neuropodia of chaetigers 2–10 each with 10–25 capillaries per fascicle; neuropodia of chaetigers 11 with approximately 16 hooks per fascicle. Thoracic hooks of similar shape to abdominal hooks, but shaft markedly longer. Lateral organs conspicuous in thorax and anterior abdomen, located between noto- and neuropodia, closer to notopodia, as small rounded pores (Fig. 2A–C). Genital pores present on intersegmental grooves of between chaetigers 7/8, 8/9, 9/10, and 10/11 on holotype.

Transition between thorax and abdomen marked by change in chaetal arrangement and methyl green staining pattern (Figs 2A, B, D, 3C, D, 4A). First abdominal segment as wide as last thoracic chaetiger, but slightly shorter (Fig. 2A, B, 3C, D). Parapodial lobes reduced in anterior abdomen, well separated (Fig. 2A, B). Notopodial lobes located dorsally (Fig. 2B), close together in anterior abdomen, becoming dorsolateral in posterior abdomen. Neuropodial lobes lateral, separated ventrally. Chaetal fascicles po-

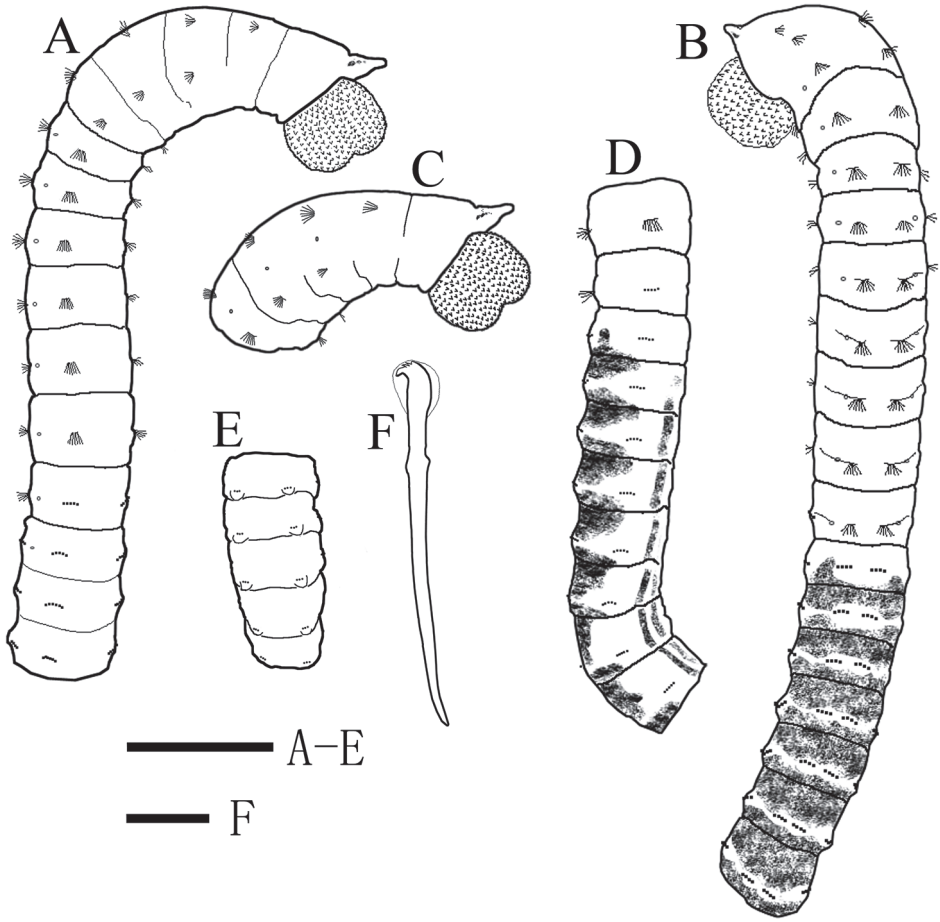

Figure 2. *Notomastus sunae* sp. nov., holotype. **A** thorax and anterior abdomen (14 chaetigers) in ventrolateral view **B** thorax and anterior abdomen (18 chaetigers) in dorsal view **C** anterior end in lateral view, showing eyespots and papillae **D** chaetigers 10–19 in ventrolateral view, showing transition between thorax and abdomen **E** far posterior abdomen in dorsal view, showing notopodia with simple epithelial extensions **F** abdominal hooded hooks. Shading on **B** and **D** indicates methyl green staining. Scale bars: 1 mm (**A–E**); 20 μm (**F**).

sitioned posterior to midsegment in anterior abdomen (Fig. 2B, D), and near posterior edge of segment toward the pygidium (Fig. 2E). In the far posterior, notopodial lobes with a simple epithelial extension (Figs 2E, 3E), broadly-based and rounded-tipped. In anterior abdomen, chaetal fascicles with approximately 10 hooks in notopodia and 16 hooks in neuropodia, decreasing to 6 hooks in notopodia and 10 hooks in neuropodia in posterior abdomen, and to 1–2 hooks in segments near pygidium. Notopodial and neuropodial abdominal hooded hooks of similar shape, with angled node, evident constriction, developed shoulder, posterior shaft longer than anterior one, attenuated to terminal end (Fig. 2F). Hood smooth, slightly longer than wide (Fig. 2F). Abdominal

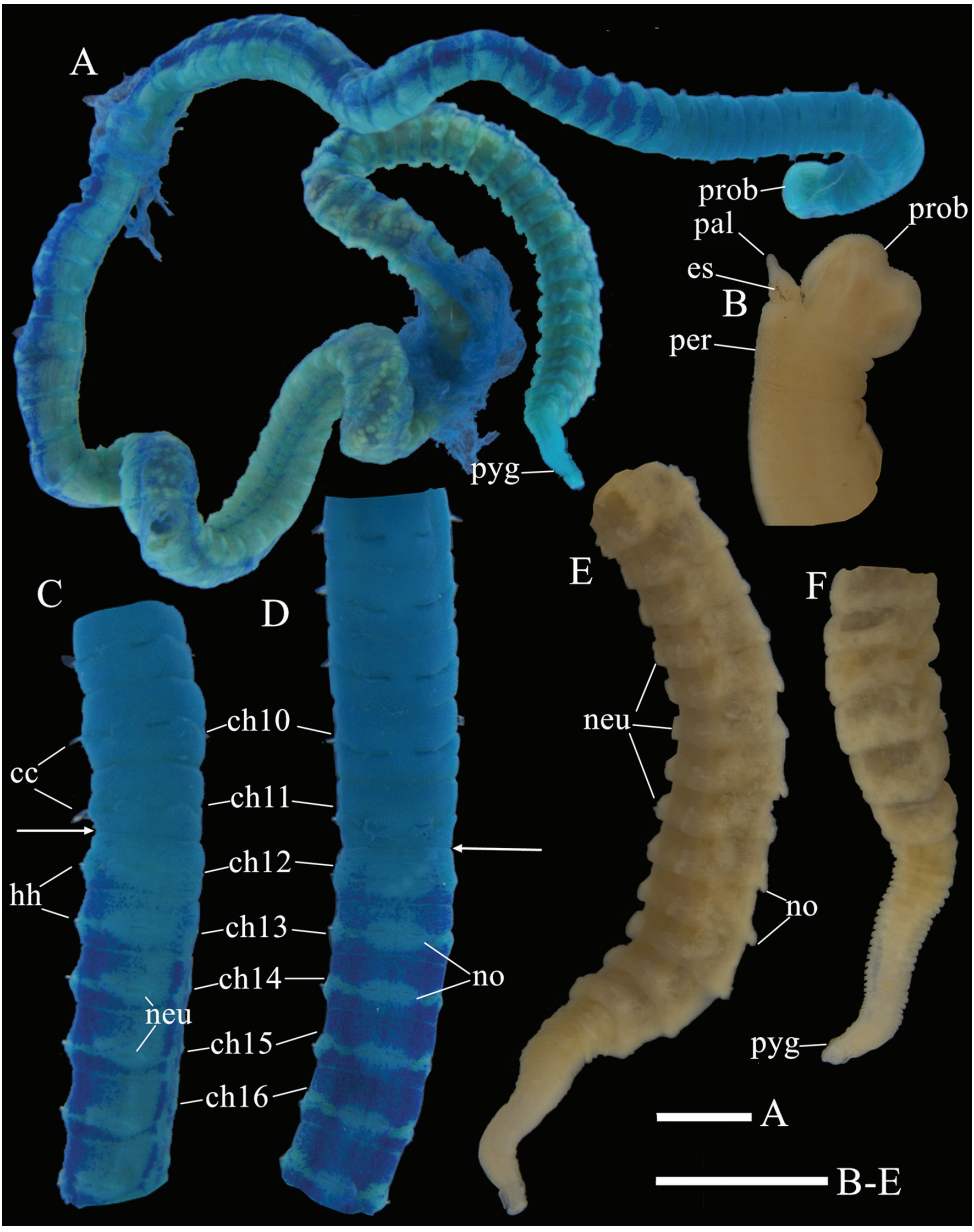

Figure 3. *Notomastus sunae* sp. nov., holotype. **A** MGSP of whole body **B** anterior end in lateral view **C** MGSP of transitional segments (chaetigers 9–17) between thorax and abdomen in ventrolateral view **D** MGSP of transitional segments (chaetigers 7–17) between thorax and abdomen in dorsal view **E** posterior end in ventrolateral view **F** posterior segments near pygidium in dorsal view. Abbreviations: cc, capillary chaetae; ch, chaetiger; hh, hooded hooks; neu, neuropodia; no, notopodia; pal, palpode; per, peristomium; prob, proboscis; pyg, pygidium. Scale bars: 1 mm (**A**); 1 mm (**B–E**).

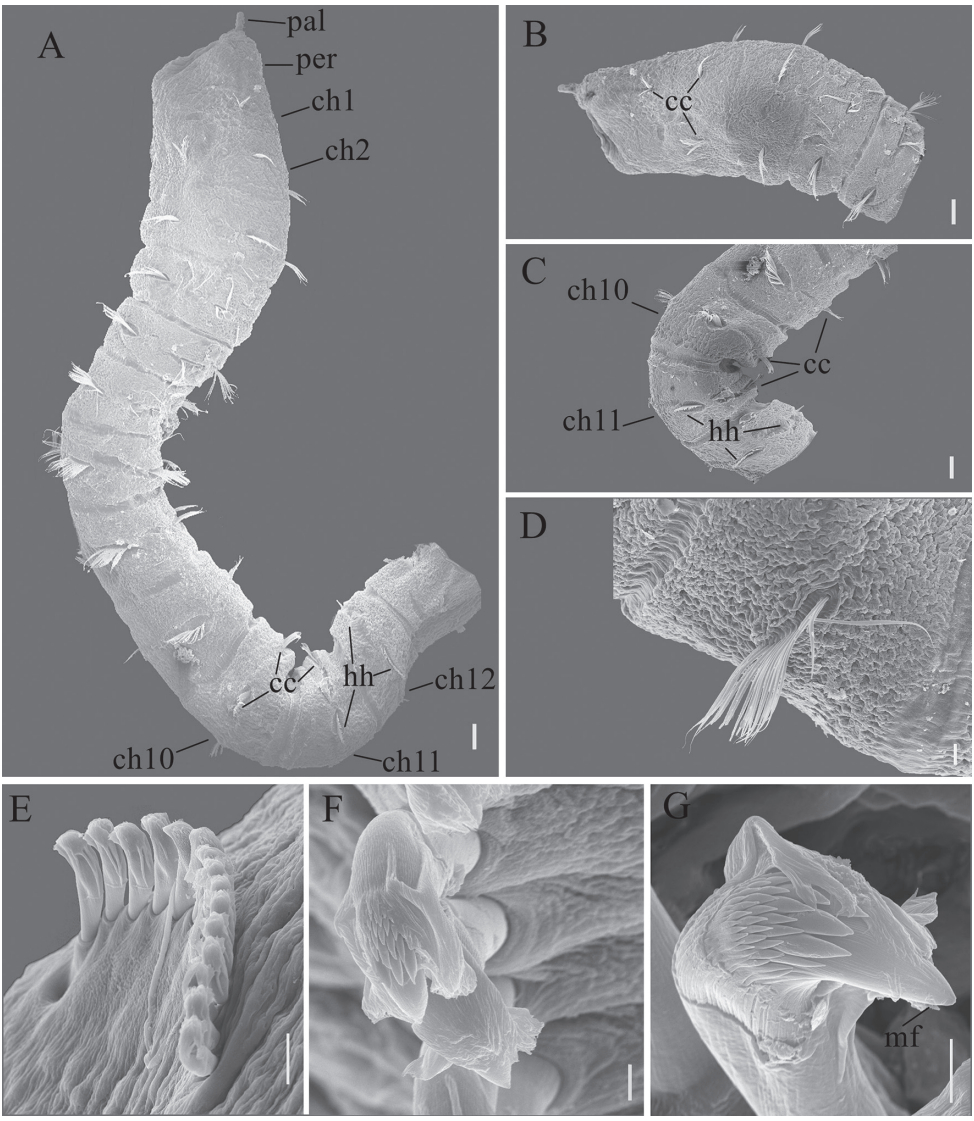

Figure 4. SEM photos of *Notomastus sunae* sp. nov., paratype (TIO-BTS-Poly-115) **A** anterior body in lateral view **B** anterior end in dorsolateral view **C** chaetigers 8–12 in lateral view **D** capillary chaetae **E–G** hooded hooks. Abbreviation: cc, capillary chaetae; ch, chaetiger; hh, hooded hooks; mf, main fang; pal, palpode; per, peristomium. Scale bars: 100 μm (**A–C**); 20 μm (**D**); 10 μm (**E**); 2 μm (**F, G**).

hooded hooks (Fig. 4E–G) with multiple rows of teeth above main fang: 4–5 teeth in basal row, 6–8 teeth in second row, and at least 6 teeth in superior row.

No branchiae observed in abdomen. Regenerated pygidium simple, without anal cirri (Fig. 3E, F)

Methyl green staining pattern (Figs 2B, D, 3A, C, D)**.** Thorax stained with blue with slightly different intensity whereas abdomen stained with very dark blue. From postchaetal area of chaetiger 12, abdominal segments dorsally stained with dark blue,

extending ventrallaterally, interrupted by parapodial lobes and lateral organs. Toward posterior abdomen, blue stain on abdominal dorsum faded gradually. From chaetiger 13, abdominal segments with paired stripes of ventral stain with darker intensity, interrupted by intersegmental rings.

Distribution. The new species is widely distributed along the southern coasts of China, from Fujian Province westward to Guangxi Province, and southward to Hainan Province (Fig. 1).

Ecology. The examined specimens were collected from intertidal to shallow subtidal coastal waters (~23 m). Sediment was mainly characterized by mud or muddy sand. The new species is especially abundant in nearshore waters off eastern Xiamen Island, Fujian Province.

Etymology. The species is named after Professor Ruiping Sun, in recognition of her contribution to the study of polychaetes from China Seas.

Variation. Eyespots on prostomium were indistinct in several specimens due to preservation in alcohol. MGSP on chaetigers 11–12 may be different among individuals. Some specimens have darker stain on post-chaetal area of chaetiger 11.

Remarks. As the most species-rich genus of Capitellidae, *Notomastus* has more morphological variability, including variation in the structure of the last thoracic chaetigers. Although it is known that hooks may be replaced by capillaries in the middle-posterior thorax of capitellids during ontogeny (Blake 2000), such as the example of *Heteromastus* (Warren and Hutchings 1994), several authors have confirmed the presence of neuropodial hooks in posterior thorax of some *Notomastus* species even when in adulthood (Ewing 1982; Blake 2000; Green 2002, Magalhães and Blake 2017). For instance, among the 44 examined specimens of *N. angelicae*, Hernández-Alcántara and Solís-Weiss (1998) found that 43 specimens possessed only hooks in the neuropodium of chaetiger 11. Nevertheless, less efforts have been devoted to detecting whether this character change during the development of the specimens. In this study, *Notomastus sunae* sp. nov. specimens were collected from the identical site (sta. QPW1-4) in different months (January, April, July, September, and October). All the 61 specimens uniformly have the last thoracic chaetiger (chaetiger 11) transitional with notopodial capillaries and neuropodial hooded hooks, regardless of body size. Additional specimens from other localities also confirm the similar chaetal structure of chaetiger 11 to the type material. These indicate the stability of this character and that it could be used as an identification tool at the species level.

Notomastus sunae sp. nov. is readily distinguished from most congeners by the presence of neuropodial hooks in last thoracic chaetiger. Among the known *Notomastus* species with neuropodial hooks in chaetiger 11, *N. sunae* sp. nov. closely resembles *N. mossambicus* by the presence of uniramous chaetiger 1 and prostomial eyespots, but differs from the latter in that the new species has prostomial palpode and slightly areolated epithelium in anterior thorax, whereas *N. mossambicus* has prostomium without palpode and strongly areolated epithelium in anterior thorax as stated by Thomassin (1970) and Cinar (2005). The new species differs from the geographically close Korean species *Notomastus koreanus* described by Jeong et al. (2018) in that the new species bears eyespots on prostomium, reduced parapodial lobes in anterior abdomen, as well as neuropodial hooks in the last thoracic chaetiger. In terms of

the MGSP, *N. sunae* sp. nov. has paired stripes of ventral stain, the feature shared by *N. hemipodus* and *N. koreanus*. However, *N. sunae* sp. nov. has very dark blue stain on abdominal dorsum and extending dorsolaterally, which is distinct from other *Notomastus* species.

Based on morphological description and illustration provided by Green (2002), a *Notomastus* species (labelled as *N.* near *hemipodus*) reported from Andaman Sea is closely similar to *N. sunae* sp. nov. in a number of characters: presence of palpode and eyespots on prostomium, uniramous chaetiger 1, slightly areolated epithelium on anterior 4–5 chaetigers, and the MGSP on abdomen which has very dark blue stain on dorsum and paired stripes of ventral stain. Green (2002) mentioned that some specimens had chaetiger 11 transitional with notopodial capillaries and neuropodial hooks, which also agreed with *N. sunae* sp. nov. As the specimens examined by Green (2002) only had anterior fragments (23–37 chaetigers) and lacked ultrastructure of hooded hooks and gene sequences, further comparison is hindered. According to the redescription of *N. hemipodus* by García-Garza et al. (2012), the specimens identified as *N.* near *hemipodus* could not belong to *N. hemipodus* in that: 1) they had slightly areolated epithelium on anterior thorax instead of strongly tessellated epithelium as in *N. hemipodus*; 2) they had reduced neuropodial lobes in the anterior abdomen instead of expanded neuropodial lobes as in *N. hemipodus*; 3) they had very dark blue stain on abdominal dorsum instead of moderate green stain as in *N. hemipodus*.

Notomastus sunae sp. nov. is commonly collected and abundant in Xiamen Bay, Fujian Province, widely distributed westward to Qinzhou Bay, Guangxi Province, and southward to western Hainan Island, based on the examined material obtained from several localities along southern China. Its specimens are found in great geographical ranges at latitude from 19.5N to 25.5N and at longitude from 108.8E to 119.5E. They prefer to inhabit soft sediments, like mud or muddy sand. So far, this species is found in shallow coastal waters less than 30 m deep.

Sequences analysis

No identical matches are found for mtCOI, 18S, or H3 of this new species when conducting a GenBank BLAST search. In this study, the maximum likelihood tree (Fig. 5) showed that the new species is sister to *Barantolla lepte* known from Australia with low support value (bootstrap value = 62). The situation might be due to the limited gene sequences included in the analysis, which need further verification. The K2P genetic distances between *N. sunae* sp. nov. and related *Notomastus* species ranged from 20.55% to 74.73% for mtCOI, from 4.107% to 4.109% for 18S rRNA, and from 3.29% to 9.87% for histone H3 (Table 3). For polychaete species, the K2P genetic distance was reported to be 12.3–23.7% among capitellid species (Jeong et al. 2017) and 19.4–26.5% among *Timarete* species (Magalhães et al. 2014) for mtCOI, and 2–9% among cryptic species of *Nereis denhamensis* (Glasby et al. 2013) for histone H3. Therefore, the genetic distance for mtCOI and histone H3 reported in this study, together with distinct morphological characters, indicates that *N. sunae* can be recognized as a new species.

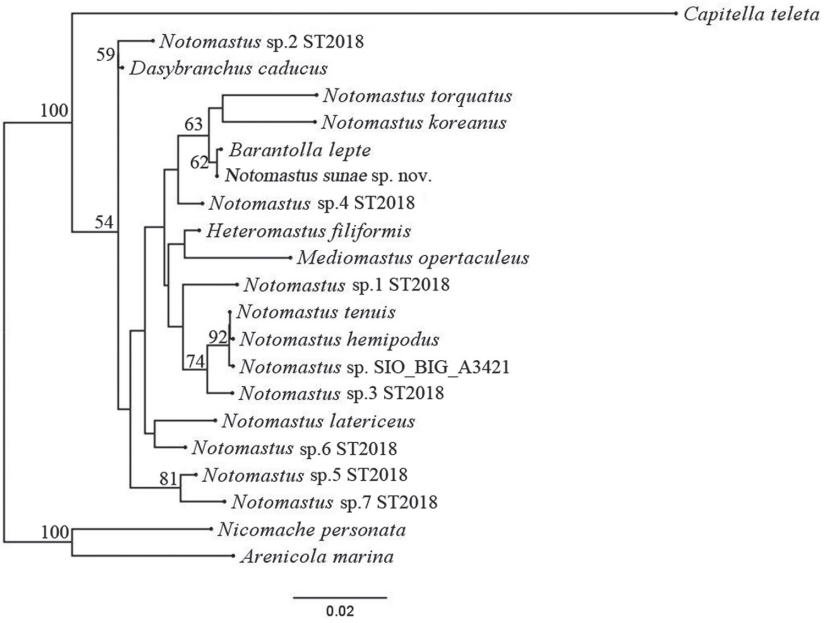

Figure 5. Maximum likelihood tree constructed using the concatenated sequences of *18S rRNA* and *H3*. Only bootstrap support values greater than 50 are shown for each branch. Scale bar represents 0.02 nucleotide substitutions per sequence position.

Key to *Notomastus* species with neuropodial hooks in thoracic chaetiger 11

1 Chaetiger 1 biramous.....**2**
– Chaetiger 1 uniramous, with only notopodium **3**
2 Prostomium with palpode and eyespots .... ***N. angelicae*** **Hernández-Alcantára & Solís-Weiss, 1998**
– Prostomium without palpode and eyespots.....***N. daueri*** **Ewing, 1982**
3 Prostomium with narrow palpode and eyespots ..... ***N. sunae*** **sp. nov.**
– Prostomium without palpode; eyespots present or absent **4**
4 Prostomium with eyespots; neuropodia of last thoracic chaetiger with hooded hooks.....**5**
– Prostomium without eyespots; neuropodia of posterior two or three thoracic chaetigers with hooded hooks **6**
5 Epithelium areolated in anterior thorax .... ***N. mossambicus*** **(Thomassin, 1970)**
– Epithelium smooth throughout thorax ..... ***N. americanus**** **(Day, 1973)**
6 Neuropodial hooks present in thoracic chaetigers 10–11 .... ***N. teres*** **Hartman, 1965**
– Neuropodial hooks present in thoracic chaetigers 9–11 .... ***N. precocis*** **Hartman, 1960**

Table 3. Pairwise genetic distance (%) base on the K2P model.

	mtCOI	**1**	**2**	**3**		
1	*Notomastus sunae* sp. nov. (MT055863; China)	–				
2	*Notomastus profundus* (KR916899; Porgugal)	74.73	–			
3	*Notomastus koreanus* (MG437148; Korea)	20.55	73.01	–		
	18S rRNA	**1**	**2**	**3**	**4**	
1	*Notomastus sunae* sp. nov. (MT055861; China)	–				
2	*Notomastus latericeus* (AY040697; Sweden)	4.11	–			
3	*Notomastus hemipodus* (HM746728; Canada)	4.11	2.03	–		
4	*Notomastus tenuis* (DQ790084; –)	4.11	2.03	0.00	–	
	Histone H3	**1**	**2**	**3**	**4**	**5**
1	*Notomastus sunae* sp. nov. (MT055862; China)	–				
2	*Notomastus koreanus* (MG748699; Korea)	3.29	–			
3	*Notomastus torquatus* (AF185258; Australia)	3.72	4.19	–		
4	*Notomastus hemipodus* (HM746759; Canada)	9.87	9.85	9.84	–	
5	*Notomastus latericeus* (DQ779747; Sweden)	9.31	7.83	9.32	7.89	–

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References

Blake JA (2000) Family Capitellidae Grube, 1862. In: Blake JA, Hilbig B, Scott PV (Eds) Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and the Western Santa Barbara Channel. Vol. 7. The Annelida, Part 4, Polychaeta: Flabelligeridae to Sternaspidae. Santa Barbara Museum of Natural History, California, 47–96.

Castresana J (2000) Selection of conserved blocks from multiple alignments for their use in phylogenetic analysis. Molecular Biology and Evolution 17: 540–552. https://doi.org/10.1093/oxfordjournals.molbev.a026334

Cinar ME (2005) Polychaetes from the coast of northern Cyprus (eastern Mediterranean Sea. Cahiers De Biologie Marine 46(2): 143–159.

Colgan DJ, McLauchlan A, Wilson GDF, Livingston SP, Edgecombe GD, Macaranas J, Cassis G, Gray MR (1998) Histone H3 and U2 snRNA DNA sequences and arthropod molecular evolution. Australian Journal of Zoology 46: 419–437. https://doi.org/10.1071/ZO98048

Day JH (1973) New Polychaeta from Beaufort, with a key to all species recorded from North Carolina. National Marine Fisheries Service Circular 375: 1–140. https://doi.org/10.5962/bhl.title.62852

Edgar RC (2004) MUSCLE: multiple sequence alignment with high accuracy and high throughput. Nucleic Acids Research 32(5): 1792–1797. https://doi.org/10.1093/nar/gkh340

Ewing RM (1982) A partial revision of the genus *Notomastus* (Polychaeta: Capitellidae) with a description of a new species from the Gulf of Mexico. Proceedings of the Biological Society of Washington 95(2): 232–237.

Ewing RM (1984) Chapter 14. Family Capitellidae Grube, 1862. In: Uebelacker JM, Johnson PG (Eds) Taxonomic Guide to the Polychaetes of the Northern Gulf of Mexico. Barry A. Vittor & Associates, Mobile, Alabama, 47 pp.

Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R (1994) DNA primers for amplification of mitochondrial cytochrome *c* oxidase subunit I from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology 3(5): 294–299.

García-Garza ME, de León-González JA (2015) The genus *Notomastus* (Polychaeta: Capitellidae) in the Gulf of California, Mexico, with the description of three new species. Proceedings of the Biological Society of Washington 128(2): 176–189. https://doi.org/10.2988/0006-324X-128.2.176

García-Garza ME, de León-González JA, Tovar-Hernández MA (2019) Catalogue of *Notomastus* M. Sars, 1851 (Annelida, Capitellidae) and the description of a new species from the Gulf of California. Zootaxa 4577(2): 249–273. https://doi.org/10.11646/zootaxa.4577.2.2

García-Garza ME, Harris LH, de León-González JA (2012) Redescription of *Notomastus hemipodus* Hartman 1945 and *N. tenuis* Moore, 1909 (Polychaeta: Capitellidae). Proceedings of the Biological Society of Washington 125(1): 1–11. https://doi.org/10.2988/11-28.1

Glasby CJ, Wei NV, Gibb KS (2013) Cryptic species of Nereididae (Annelida: Polychaeta) on Australian coral reefs. Inverebrate Systematics 27: 245–264. https://doi.org/10.1071/IS12031

Green KD (2002) Capitellidae (Polychaeta) from the Andaman Sea. In: Eibye-Jacobsen D (Ed.) Proceedings of the International Workshop on the Polychaetes of the Andaman Sea. Phuket Marine Biological Center Special Publication 24: 249–344.

Hartman O (1960) Systematic account of some marine invertebrate animals from the deep basins off southern California. Allan Hancock Pacific Expeditions 22(2): 69–176.

Hartman O (1965) Deep-water benthic polychaetous annelids off New England to Bermuda and other North Atlantic areas. Allan Hancock Found Occasional Papers 28: 1–384.

Hernández-Alcántara P, Solís-Weiss V (1998) Capitellids (Polychaeta: Capitellidae) from the continental shelf of the Gulf of California, with the description of a new species, *Notomastus angelicae*. Proceedings of the Biological Society of Washington 111: 708–719.

Jeong M-K, Soh HY, Wi JH, Suh H-L (2018) A new *Notomastus* (Annelida, Capitellidae) species from Korean waters, with genetic comparison based on three gene markers. ZooKeys 754: 141–155. https://doi.org/10.3897/zookeys.754.23655

Jeong M-K, Wi JH, Suh H-L (2017) A reassessment of *Capitella* species (Polychaeta: Capitellidae) from Korean coastal waters, with morphological and molecular evidence. Marine Biodiversity 1–10. https://doi.org/10.1007/s12526-017-0707-2

Kimura M (1980) A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. Journal of molecular evolution 16: 111–120. https://doi.org/10.1007/BF01731581

Kumar S, Stecher G, Li M, Knyaz C, Tamura K (2018) MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. Molecular Biology and Evolution 35: 1547–1549. https://doi.org/10.1093/molbev/msy096

Lin J, García-Garza ME, Arbi UY, Wang J (2019) Two new species of *Notodasus* Fauchald, 1972 (Annelida: Capitellidae) from the Central Indo-Pacific region. PeerJ 7: e7638. https://doi.org/10.7717/peerj.7638

Liu JY [Ruiyu] (2008) Checklist of marine biota of China seas. China Science Press, Beijing, 1267 pp.

Magalhães WF, Blake JA (2017) Capitellidae Grube, 1862. In: Westheide W, Purschke G (Eds) Handbook of Zoology Online, a Natural History of the Phyla of the Animal Kingdom–Annelida, Polychaetes. De Gruyter, Boston/Berlin. https://www.degruyter.com/view/Zoology/bp_029147-6_76 [Accessed on: 2017-6-28]

Magalhães WF, Seixas VC, Paiva PC, Elias R (2014) The multitentaculated Cirratulidae of the Genera *Cirriformia* and *Timarete* (Annelida: Polychaeta) from Shallow Waters of Brazil. Plos ONE 9(11): e112727. https://doi.org/10.1371/journal.pone.0112727

Rambaut A (2012) FigTree v1.4. Molecular evolution, phylogenetics and epidemiology. University of Edinburgh, Institute of Evolutionary Biology, Edinburgh.

Sars M (1851) Beretning om en i Sommeren 1849 foretagen zoologisk Reise i Lofoten og Finmarken. Nyt Magazin for Naturvidenskaberne, Oslo, 211 pp.

Silvestro D, Michalak I (2012) RaxmlGUI: a graphical front-end for RAxML. Organisms Diversity & Evolution 12: 335–337. https://doi.org/10.1007/s13127-011-0056-0

Song X, Gravili C, Ruthensteiner B, Lyu M, Wang J (2018) Incongruent cladistics reveal a new hydrozoan genus (Cnidaria:Sertularellidae) endemic to the eastern and western coasts of the North Pacific Ocean. Invertebrate Systematics 32(5): 1083–1101. https://doi.org/10.1071/IS17070

Thomassin BA (1970) Contribution a l'étude des polychètes de la région de Tuléar (S.W. de Madagascar) II. quelques Aphroditidae des sables coralliens. Recueil des Travaux de la Station Marine d'Endoume 10 (Supplement): 47–69.

Warren LM, Hutchings PA, Doyle S (1994) A revision of the genus *Mediomastus* Hartman, 1944 (Polychaeta: Capitellidae). Records of the Australian Museum 46(3): 227–256. https://doi.org/10.3853/j.0067-1975.46.1994.6

Yang D, Sun R (1988) Polychaetous Annelids Commonly seen from the Chinese Waters. China Agriculture Press, Beijing, 352 pp. [in Chinese]

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RESEARCH ARTICLE

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A new species of the cave-fish genus *Lucifuga* (Ophidiiformes, Bythitidae), from eastern Cuba

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Abstract

Recently, a barcoding study and a molecular phylogenetic analysis of the Cuban species of the cave-fish genus *Lucifuga* Poey, 1858 revealed the existence of different evolutionary lineages that were previously unknown or passed unnoticed by morphological scrutiny (i.e., cryptic candidate species). In the present study, *Lucifuga gibarensis* is described as a new species restricted to anchialine caves in the northeastern karst region of the main island. The species was earlier described as a variety of *Lucifuga dentata*, but since the name was introduced as a variety after 1960, it is deemed to be infrasubspecific and unavailable according to the International Code of Zoological Nomenclature Art. 15.2. The new species differs from *L. dentata* by pigmented eyes vs. eyes absent and lack of palatine teeth vs. present. *Lucifuga gibarensis* seems to be most similar to the Bahamian species *L. lucayana* by showing pigmented eyes, 13 or 14 precaudal vertebrae and ten caudal fin rays. However, differs from it by a larger size of the pigmented eye (1.1–1.9 vs. 0.9–1.0% SL) and number of posterior lateral line neuromasts (30–33 vs. 34–35).

Keywords

Anchialine caves, Gibara, Holguin, speleology, taxonomy, viviparous brotulas

Introduction

Lucifuga Poey, 1858 is a conspicuous genus of obligate cave-dwelling fishes, currently recognised with six species distributed in Cuba and Bahamas (Nielsen et al. 1999; Møller et al. 2006, 2016; see comparative material). Another nominal species, *Lucifuga inopinata* Cohen and McCosker, 1998, from off Galapagos Archipelago belongs to another, yet undescribed, genus (Møller unpublished data).

Because of the characteristics of the habitats of *Lucifuga* species (caves, sinkholes and crevices) and the morphological modifications that they show in the evolutionary adaptations to the environment, the genus represents an iconic part of the fish fauna in Cuba. The scientific interest in these fishes, however, has been sporadic. Since the description of the genus and the two first Cuban species by Felipe Poey (1858), the studies dealing with the genus are very few and have mainly been dedicated to the discussions of morphological characters of taxonomic interest for the genus and species and the descriptions of new species (Gill 1863; Nalbant 1981; Díaz-Pérez et al. 1987a, 1987b; Díaz-Pérez 1988); some aspects of feeding and reproductive system (Lane 1903; Eigenmann 1909; Thinès and Piquemal 1978; García-Debrás and Pérez 1999) and two studies that constituted the first approximation to the evolutionary relationships of the group based on a comparison of several morphological characters of the three species known at that time (Vergara 1980, 1981).

Møller et al. (2006) found evidence for all Cuban and all Bahamian species representing two separate evolutionary lineages, but recently García-Machado et al. (2011) made a phylogenetic analysis of the Cuban species using mitochondrial and nuclear genes finding several new evolutionary lineages not identified previously by morphological analyses. It was also indicated that the separation in Cuban and Bahamian species as suggested by Møller et al. (2006) is no longer correct, since some of the new Cuban species are more closely related to Bahamian species than to other Cuban species. Their results also questioned the specific status of *Lucifuga teresinarum* Diaz, 1988, showing no difference to *L. subterranea* Poey, 1858 (see also Lara et al. 2010).

A controversial taxon has been *Lucifuga dentatus* var. *holguinensis* Díaz-Pérez, Nieto and Abio, 1987 from the Holguin province in eastern Cuba. It was suggested as a valid species name by Proudlove (2019), but the name has now been decided to be infrasubspecific and unavailable according to ICZN Art. 15.2, since it was introduced as a variety after 1960 (Fricke et al. 2019). In the present study, based on the molecular results of García-Machado et al. (2011) and from revisiting the morphological characters recently used to define species in the genus (Møller et al. 2006), we present a new formal description of the species as *Lucifuga gibarensis* sp. nov.

Materials and methods

The morphological study of the Cuban *Lucifuga* species was based on the analysis of 214 individuals sampled from several localities covering most of its known distribu-

tion areas (Fig. 1). Nine morphometric measurements were taken using a Vernier caliper (precision 0.05 mm) and eleven meristic counts (e.g., fin ray numbers, scales, etc.) were carried out using a Novel stereomicroscope (magnification 40 x maximum) and/ or radiographs. All morphometric measurements were weighted according to the standard length (SL) to avoid allometric effects. The number of vertebrae was counted using X-ray radiographs.

Abbreviations include:

ANSP Academy of Natural Sciences of Drexel University, Philadelphia, Pennsylvania, U.S.A;
FMNH Division of Fishes, Department of Zoology, Field Museum of Natural History, Chicago, Illinois, U.S.A.;
MCZ Museum of Comparative Zoology, Harvard University, Ichthyology Department, Cambridge, Massachusetts, U.S.A;
MFP Felipe Poey Museum of Havana University, Cuba;
UMMZ University of Michigan Museum of Zoology, Ann Arbor, Michigan, U.S.A.;
ZMB Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany;
ZMUC Natural History Museum of Denmark, University of Copenhagen, Denmark.

Taxomomy

Family Bythitidae

Genus *Lucifuga* Poey, 1858

Type species. *Lucifuga subterranea* Poey, 1858 by subsequent designation of Jordan and Evermann, 1896, type locality: El Cajio cave, but not precisely stated for *L. subterranea*, which was referred originally from caves of San Antonio, middle-south Havana province, Cuba.

Diagnosis. Body moderately elongated and compressed mainly from the abdomen to the caudal end. Snout with two nostrils: anterior nostril tube-shape and smaller, placed near to the upper lip; posterior nostril is a larger hole, placed ca. midway between snout and eyes cavity. The mouth is subterminal with the lower jaw only slightly shorter than the upper. Opercular spines absent. Seven branchiostegal rays.

The entire body is covered with small, rounded cycloid scales; fins naked except for scales on pectoral fin basis. Predorsal area and operculum scaled. Branchiostegal membranes, entire underside of the head, snout, interorbital areas and entire course of the cavernous cephalic system are naked. Origin of dorsal fin approximately above the tip of pectoral fins. Pelvic fin is subjugular with a single ray reaching ca. 1/3 to halfway to the anus. Pectoral fin behind the operculum, peduncle short and narrow. Lateral line

with two series of sensory neuromasts: upper and anterior series extends from the head to a point ca. midway between dorsal and anal fin origins; and lower and posterior series extends from a point under and slightly in advance of the end of the upper series to the mid side from the caudal base.

There are three symmetric sensory canal series on each side of the head: supraorbital series with three pores (two anterior and one posterior): the anteriormost is at the snout rim, the second open between and above the nasal openings, and the posterior single pore is at the end of the lateral canal above the operculum. The infraorbital series with six pores (three anterior and three posterior): first pore is slightly below the anterior nasal opening, the other five pores (two anterior and three posterior) are along the edge of infraorbital rim. Finally, the mandibular series with six pores (three anterior and three posterior). The first pore is in the fold of skin between the lip and canal series, the second is at the side of the jaw tip on the lower lip, the third is at the anterior end of the mandibular series, the fourth to sixth posterior pores open ventrally along the mandibular series. There is also a large preopercular pore. Teeth are present on the premaxillae, dentaries and vomer; but are present or absent in palatines.

Sexual dimorphism. The male copulatory organ is completely integrated into a fleshy genital hood which projects posteriorly beyond the anus, the lateral end of the hood could be from broad to conical. A fleshy small conical papillae project from the middle of the distal margin of the hood and is enclosed by lateral earlike lobes. Penis is placed underneath the hood.

***Lucifuga gibarensis* sp. nov.**

http://zoobank.org/4D8B142C-4CAE-49CB-B93D-42FA40B266A9

Figures 1–3; Tables 1, 2

Common name: Gibara cave brotula (English)

Lucifuga dentatus variety *holguinensis* Díaz-Pérez et al., 1987b: 44.

Lucifuga dentatus var. *holguinensis* Hernández 2005: 15; García-Machado et al. 2011: 471.

Lucifuga holguinensis Proudlove 2019.

Holotype. MFP 18.000420, 89.3 mm SL, female, Aguada de Macigo cave, ca. 21°09'42"N, 76°14'55"W, near Gibara municipality, Northern Holguin province, Cuba, collected by Eduardo Nieto, in 1986, designated as *Lucifuga dentatus* variety *holguinensis* by Díaz-Pérez et al. (1987b).

Paratypes. MFP 18.000399, 69.3 mm SL, male, Tanque Azul cave, ca. 21°12'6"N, 76°13'59"W, near Gibara municipality, Northern Holguin province, Cuba, collected by Alfredo García-Debrás, 2 June 1997; MFP 18.000278, 89.2 mm SL, male, Aguada de Macigo cave, Gibara municipality, Northern Holguin province, Cuba, collected by Arturo Rojas, 21 November 2014; ZMUC P771732, 45.0 mm SL, male, Cueva El Baga, ca. 21°11'51"N, 76°14'3"W, near Gibara municipality, northern Holguin province, Cuba, collected by Katrine Worsaae and Peter Rask Møller, 27 November 2014.

Diagnosis. Dorsal fin rays 72–90; anal fin rays 58–72; pectoral fin rays 15–17, caudal fin rays 10; palatine teeth absent; rakers on anterior gill arch 17–19 (long gill-rakers 3); occiput and area between lateral canal and preopercular canal scaled; diameter of pigmented eyes 1.1–1.9% SL; total vertebrae 50–53.

Description. Meristic and morphometric characters are given in Tables 1, 2. Body moderately elevated behind the head, with a slight depression in the interorbital region (Figs 2, 3). Eyes pigmented (similar to the condition present in *L. spelaeotes* and *L. lucayana* (Møller et al. 2006)). Anterior gill arch with three elongate rakers and 14–16 low dentigerous pads. The areas between lateral canal and preopercular canal, and the occiput are scaled (Fig. 2). Caudal fin free (not fused with dorsal and anal fins). In the lateral line series of sensory neuromasts, the upper and anterior count with 13–15, the lower and posterior with 30–35. Teeth are present on the premaxillae (5–7 rows), dentaries (6 or 7 rows) and vomer (2 or 3 rows in two separate patches). Palatines without teeth.

Coloration. Uniformly brown or light brown, with lighter fins and naked parts on the head. Nevertheless, one juvenile specimen (ZMUC P771732) was very pale, but still with tiny dark pigment dots (Fig. 3b).

Distribution and habitat. *Lucifuga gibarensis* shows a very restricted known distribution, in a lithographically isolate karst patch of caves at the north of Gibara municipality, Holguín province, without any overlap with other Cuban species of the genus (Fig 1; García-Machado et al. 2011; Hernández et al. 2016). It is ca. 800 km away from the nearest *L. dentata*, *L. subterranea* and *L. simile* distribution areas. The distance to the Bahamian species on Little Bahama Bank (*L. lucayana*) and Great Bahama Bank (*L. spelaeotes*) is ca. 650 km and 240 km, respectively. The location area is composed by three caves (Aguada de Macigo, Tanque Azul and Cueva El Baga) located near to the shore ca. 3–15 km from each other (Corella et al. 2000, Dietz 2015). The Aguada de Macigo cave is the type-locality with an emergent large doline, ca. 22 m deep and salinity of 16 ppt. According to Díaz-Pérez et al. (1987b), the individual designated as holotype was caught at 12 m depth.

Etymology. The specific epithet refers to the village of Gibara, where the three caves inhabited by this species are located. We do not follow variety epithet used by Díaz-Pérez et al. (1987b), since the *L. gibarensis* better describes the narrow distribution of the species near the village Gibara instead of the entire region Holguin.

Genetic distances. Among Cuban species, García-Machado et al. (2011) have demonstrated that *L. gibarensis* [at that time as *L. dentata* var. *holguinensis*] is not phylogenetically close to *L. dentata* by showing a large mitochondrial DNA divergence of 30.5% (16.5% with cytochrome *b* gene) as well as several diagnostic nucleotide variations at nuclear genes. In contrast, *L. gibarensis* is phylogenetically closely related to other two lineages of undescribed species of *Lucifuga* from Cuba (named *Lucifuga* sp. 3 and *L.* sp. 4) (García-Machado et al. 2011). However, genetic distance to both Bahamian species is not yet known.

Comparisons. Based on external appearance, *Lucifuga gibarensis* sp. nov. resembles the Cuban species *L. dentata* (from which it was designated as variety, see Díaz et al.

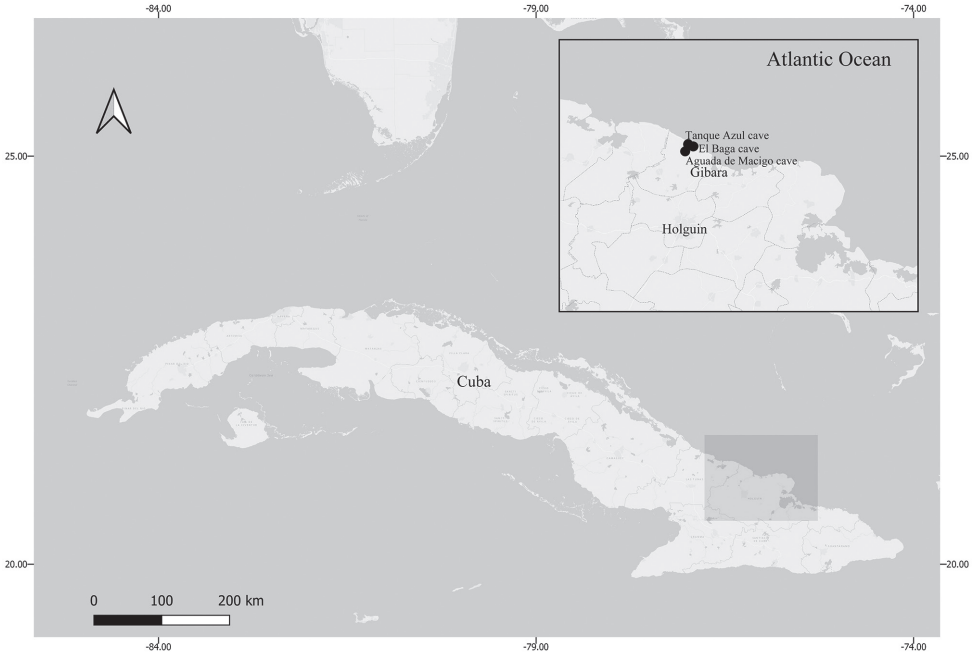

Figure 1. Sample sites of *Lucifuga gibarensis* sp. nov. in eastern Cuba.

1987b) and *L. simile*. Nonetheless, it differs in several characters: e.g., number of caudal fin rays (10 vs. 8), diameter of the pigmented eyes (1.1–1.9 vs. 0.0–0.2% SL), lack of palatine teeth vs. present and scaled occiput vs. naked or weakly scaled occiput. It also differs in dorsal and anal fin rays mean number (fewer than *L. dentata* and more than *L. simile*) (Table 1).

Lucifuga gibarensis sp. nov. also resembles *L. subterranea* in the lack of palatine teeth and the scaled occiput, but it differs in the body moderately elevate behind the head vs. little elevated (see maximum height in Table 1), number of pectoral fin rays (15–17 vs. 10–13), number of caudal fin rays (10 vs. 8), the diameter of the pigmented eyes (1.1–1.9 vs. 0.0–0.3% SL) and in the number of rakers on the anterior gill arch 17–19 vs. 12–17 (Table 1).

Finally, *Lucifuga gibarensis* resembles both Bahamian species in the head profile, the number of caudal fin rays (10), the occiput scales (similar to *L. spelaeotes* and less scaled than *L. lucayana*) and in the presence of relatively large pigmented eyes (Table 1). With *L. lucayana* it also shares the lack of palatine teeth. It differs in the number of pectoral fin rays (15–17 vs. 17–18 in *L. lucayana* and 17–20 in *L. spelaeotes*); and diameter of pigmented eye is larger than in *L. lucayana* (1.1–1.9 vs. 0.9–1.0% SL).

Remarks. It has been demonstrated that *L. gibarensis* is not phylogenetically close to *L. dentata*. The estimate of mtDNA genetic divergence between these two lineages is huge (P = 30.5%) and several diagnostic nucleotide changes at the intron 4 of calmoduline gene and intron 1 of the homeodomain EVX gene were described

Figure 2. *Lucifuga gibarensis* sp. nov. Holotype, MFP 18.000420, 89.3 mm SL, female, Aguada de Macigo cave, Gibara municipality, Northern Holguin province, Cuba.

(García-Machado et al. 2011). Designation as a variety of *L. dentata*, was wrong as judgment, given the sharp differences observed at three major morphological characters: palatine teeth; number of caudal fin rays; and degree of pigmentation in the eyes. Particularly, the number of caudal fin rays (10) and pigmented eyes were realised in *L. spelaeotes* description (Cohen and Robins 1970), and recognised as diagnostic characters to distinguish the Cuban and Bahamian species at that time (Cohen and Robins 1970; Møller et al. 2006).

As a result of the present study, we describe a new species, *Lucifuga gibarensis*, which is supported by morphology and molecular phylogenetic analysis (García-Machado et al. 2011). We found unique diagnostic characters that distinguish this species from all the species described so far. Díaz-Pérez et al. (1987b) identified this *taxon* as a variety of *Lucifuga dentata* (*L. dentata* var. *holguinensis*), and recognised the presence of 10 caudal fin rays and pigmented eyes (characters distinguished by Cohen and Robins (1970) as important to separate *L. spelaeotes* from the two Cuban species known at that time), but underestimated the taxonomic relevance of these characters and avoid them. They also underrated the absence of palatine teeth vs. present in *L. dentata*, a

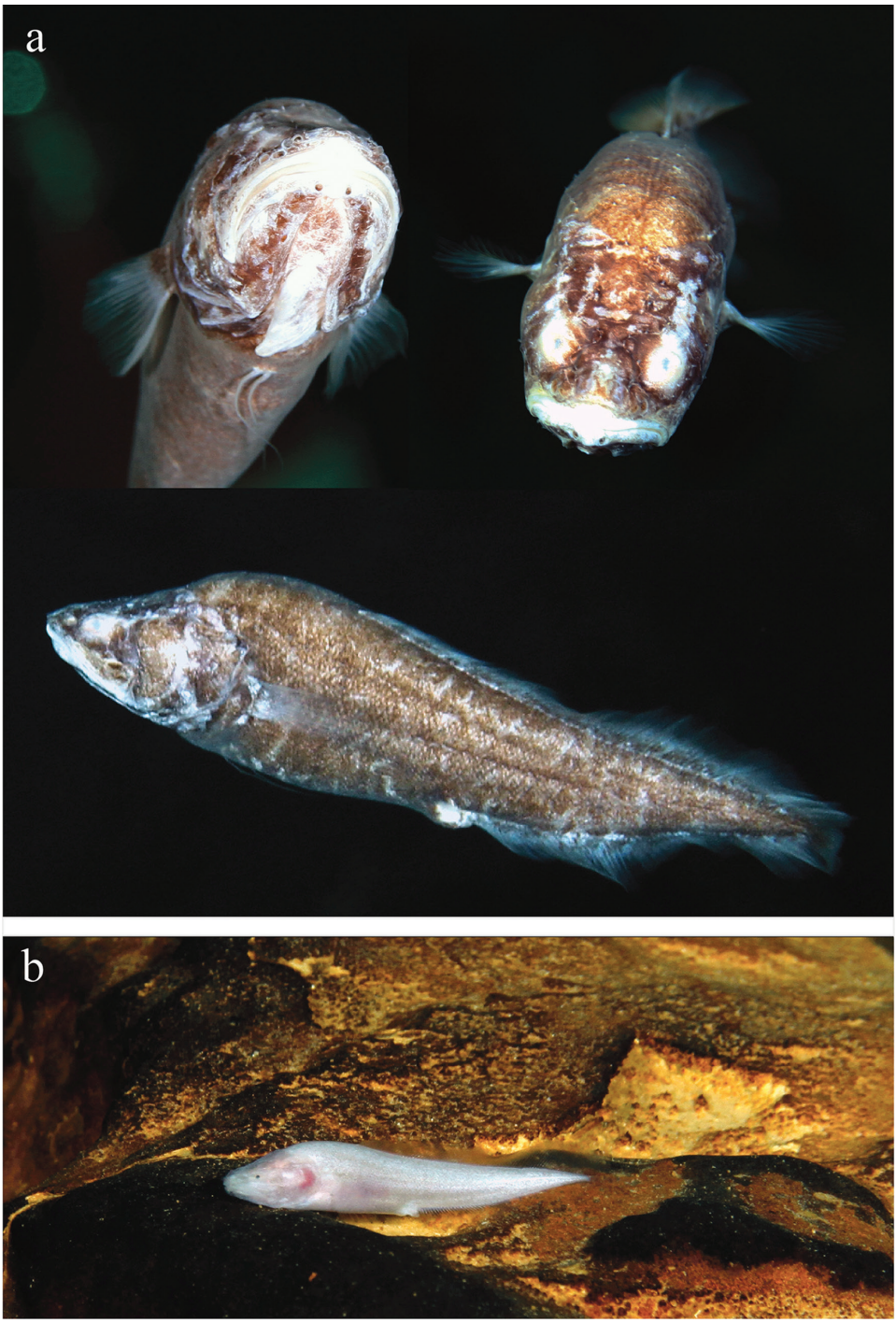

Figure 3. *Lucifuga gibarensis* sp. nov. in Cueva El Baga, Gibara municipality, northern Holguin province, Cuba, **a** unsampled specimen, 27 November 2014 **b** ZMUC P771732, 45.0 mm SL, male, photo taken immediately prior to collection.

Table 1. Morphometric and meristic characters of *Lucifuga* spp. (HT: holotype; PT: paratype; ST: syntype).

	L. gibarensis sp. nov.		*L. dentata*		*L. simile*	*L. subterranea*		*L. lucayana*		*L. spelaeotes*	
	HT	HT and 3 PT	ST, MCZ 32329	2 ST and 126 nontypes	22 nontypes	HT	HT and 42 nontypes	HT	HT and 5 PTs	HT	HT, PT and 40 nontypes
		Mean and range		Mean and range	Mean and range		Mean and range		Mean and range		Mean and range
SL (mm)	89.3	73.2 (45.0–89.3)	85.0	91.0 (45–124)	74.5 (57.5–103)	69.0	66.1 (39.7–89.5)	99.0	74.3 (44–99)	110	106.3 (42–166)
Morphometric characters (% SL)											
Head length	26.0	27.5 (26.0–28.4)	28.5	26.7 (18.4–31.5)	24.0 (17.1–31.2)	28.7	26.3 (18.8–28.9)	28.8	28.4 (27.1–29.3)	29.1	28.8 (26.2–31.3)
Jaw length	13.4	14.5 (13.4–15.3)	14.9	14.3 (11.7–20.2)	14.7 (11.2–17.0)	13.3	12.0 (9.6–14.4)	14.9	14.2 (13.2–14.9)	16.2	14.7 (12.4–16.8)
Maximum height	20.4	19.1 (17.8–20.4)	–	19.8 (13.1–24.5)	20.8 (14.4–26.0)	–	16.9 (13.2–21.7)	–	–	–	–
Diameter of pigmented eye	1.5	1.4 (1.1–1.9)	0.0	0.02 (0.0–0.2)	0.0	0.0	0.1 (0.0–0.3)	1.0	1.0 (0.9–1.0)	1.3	1.3 (0.7–1.8)
Predorsal length	39.1	37.6 (35.9–39.1)	39.6	40.1 (31.5–50.7)	40.2 (32.9–45.3)	40.8	39.9 (36.3–44.0)	37.0	36.4 (35.5–37.0)	39.9	38.1 (34.7–41.1)
Preanal length	58.2	55.7 (52.6–58.3)	53.7	54.6 (50.0–65.8)	54.7 (44.0–61.3)	55.4	54.0 (48.2–59.4)	55.6	55.0 (51.7–57.6)	54.1	54.2 (48.2–60.5)
Pectoral fin length	11.2	13.7 (11.2–15.3)	11.4	10.6 (7.5–15.7)	10.2 (8.0–12.5)	10.3	8.9 (7.8–12.0)	13.3	12.6 (11.3–13.3)	12.5	12.7 (11.1–14.4)
Base of pelvic fin to anal fin origin	35.9	35.6 (32.2–38.7)	31.5	31.5 (23.0–38.1)	28.9 (20.3–33.8)	31.6	31.6 (26.9–35.5)	34.9	33.7 (29.4–36.9)	31.3	31.2 (27.0–36.9)
Dorsal fin origin to anal fin origin	17.8	18.2 (17.8–18.9)	–	14.3 (9.4–18.4)	14.6 (12.3–16.9)	–	14.2 (9.3–18.8)	–	–	–	–
Meristic characters											
Dorsal fin rays	72	82.3 (72–90)	–	90.5 (82–102)	72.9 (67–80)	87	82.8 (70–87)	91	89.2 (84–91)	92	97.5 (86–109)
Anal fin rays	58	65.5 (58–72)	–	72.4 (66–80)	58.4 (54–70)	71	64.2 (53–70)	67	66.2 (63–69)	71	73.8 (66–82)
Caudal fin rays	10	10	–	8	8	8	8	10	10	10	10
Pectoral fin rays	16	16.0 (15–17)	15	16.1 (15–17)	14.4 (13–17)	13	11.9 (10–13)	17	17.2 (17–18)	18	18.5 (17–20)
Precaudal vertebrae	14	13.5 (13–14)	–	11.1(11–12)	11	11	11.3 (11–12)	13	12.8 (12–13)	13	13.2 (13–14)
Caudal vertebrae	36	36.5 (36–37)	–	35.9(34–37)	34–35	37	35.8 (34–37)	39	38.6 (37–39)	39	39.5 (38–42)
Total vertebrae	50	51.0 (50–53)	–	47.0(46–48)	46	48	46.9 (46–48)	52	51.3 (50–52)	52	52.7 (51–55)
Rakers on anterior gill arch	18	18.0 (17–19)	20	18.4 (15–22)	17.6 (15–20)	16	14.2 (12–17)	16	15.3 (13–17)	21	18.8 (15–23)
Premaxillary teeth rows	5	6.0 (5–7)	6	4.3 (3–6)	3.9 (3–5)	8	4.0 (3–8)	7	6.0 (5–7)	8	6.8 (4–10)
Palatine teeth rows	0	0	3	2.1 (1–4)	2.2 (1–4)	0	0	0	0	5	3.7 (1–7)
Lateral line neuromasts	15/30	13–15/30–33	–	12–18/22–33	12–15/24–27	–	12–19/26–33	13/35	12–13/34–35	14/38	12–19/30–47
Occiput squamation	Yes	Yes	–	No 79%/Yes 21%	No		Yes		Yes		Yes

Table 2. Frequency of meristic characters in *Lucifuga* spp.

Number of dorsal fin rays

	67	69	70	71	72	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	109	N
L. dentata														1	3	1	1	2	6	5	5	5	5	6	5	7	3	2	1					1						61
L. gibarensis sp. nov.					1										1	1						1																		4
L. simile	1	2	2	2	1	2	2	3	2			1																												18
L. subterranea			1					1	5	4	5	7	3	3	7	2	2	1																						41
L. lucayana																1					1		4																	6
L. spelaeotes																		1			1		2	2	1	6	2	3	2	5	2	6	1	2	1	1	2	1	1	42

Number of anal fin rays

	53	54	55	56	57	58	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	N
L. dentata													4	3	3	4	5	6	6	7	4	4	4	3	3	2	3			61
L. gibarensis sp. nov.						1						1		1					1											4
L. simile		2	2	3	3	3	1	1		1	1						1													18
L. subterranea	1						2	6		7	8	4	6	3	3		1													41
L. lucayana										1			2	1		1														5
L. spelaeotes													1	1	1	1	2	7	6	4	4	2	2	2	2	4	1	1	1	42

Number of pectoral fin rays

	10	11	12	13	14	15	16	17	18	19	20	N
L. dentata						22	48	24				94
L. gibarensis sp. nov.						1	1	1				3
L. simile				5	8	4	3	1				21
L. subterranea	3	7	25	10								45
L. lucayana								5	1			6
L. spelaeotes								2	18	20	2	42

Number of posterior lateral line neuromasts

	20	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	N
L. dentata		1	1	1	3	5	7	1	4	3			1															27
L. gibarensis sp. nov.										2			1															3
L. simile				2		2	2																					6
L. subterranea							1	7	4	8	2	4	3															29
L. lucayana														1	1													2
L. spelaeotes										1					2	1	1	2	5	6	1	2				1	1	23

Number of rakers on anterior gill arch

	12	13	14	15	16	17	18	19	20	21	22	23	N
L. dentata				2	3	6	11	10	7	2	1		42
L. gibarensis sp. nov.						1	1	1					3
L. simile				1	1	3	2	2	1				10
L. subterranea	3	9	10	9	2	1							36
L. lucayana		1			1	1							3
L. spelaeotes				3	3	6	3	9	5	8	1	1	39

useful taxonomic character to distinguish *Lucifuga* species (see Poey 1858; Møller et al. 2006). Furthermore, Møller et al. (2006) pointing out that the Bahamian species differing from all four Cuban species formerly known by having higher caudal fin rays number (10 vs. 8), larger pigmented eyes diameter (0.7–1.8 vs. 0.0–0.3% SL), higher vertebrae number (50–55 vs. 45–48), and higher pectoral fin rays number (17–20 vs. 10–17) supporting the hypothesis that Bahamas and Cuba are represented by two different evolutionary lineages (see also Vergara 1980, 1981). However, the new Cuban species *L. gibarensis*, shared a similar combination of these characters with Bahamian

species apart from low number of pectoral fin rays in *L. gibarensis*. Based on these characters, our results do not support that lineages are confined to only one Archipelago. With the available knowledge, species with reduced or completely absence of eyes and 8 fin rays are only found in western Cuba; but species having pigmented eyes and 10 caudal fin rays are found in both archipelagos. Detailed phylogenetic studies including all Atlantic *Lucifuga* spp. will be crucial to clarify the phylogeographic relationships between the Cuban and Bahamian members of this genus.

Identification key to species of *Lucifuga*

The current key is based on a small number of samples. Measures that overlapping in range were only used when it helps distinguishing between two species.

1	Diameter of pigmented eyes 0.0–0.3% SL, caudal fin rays 8, number of vertebrae < 50 ..... **2**
–	Diameter of pigmented eyes > 0.7% SL, caudal fin rays 10, number of vertebrae ≥ 50 ..... **4**
2	Palatine teeth present, pectoral fin rays 13–17 ..... **3**
–	Palatine teeth absent, pectoral fin rays 10–13 ..... ***L. subterranea***
3	Dorsal fin rays < 80 ..... ***L. simile***
–	Dorsal fin rays ≥ 80 ..... ***L. dentata***
4	Palatine teeth present, lateral occipital area naked ..... ***L. spelaeotes***
–	Palatine teeth absent, lateral occipital area scaled **5**
5	Pigmented eye diameter 0.9–1.0% SL, number of posterior lateral line neuromasts 34–35 ..... ***L. lucayana***
–	Pigmented eye diameter 1.1–1.9% SL, number of posterior lateral line neuromasts 30–33 ..... ***L. gibarensis* sp. nov.**

Comparative material

Lucifuga subterranea Poey, 1858

Material examined. (38 specimens: 18 females, 20 males).

Holotype: ZMB 6314, 69 mm SL, female, Cueva de Cajio, potrero de Torres, dos leguas, Sur de Guira de Melena, Habana province, Cuba, collected by Felipe Poey (see discussion about type status in Proudlove (2019)).

Additional specimens. ANSP 37111, 70 mm SL, female, Canas, Cuba, collected by C.H. Eigenmann, exact location unknown, 10 March 1903; FMNH 3934, 67 mm SL, male, Canas Cuba, exact location and date unknown; FMNH 33090-91, 67–74 mm SL, females, Cuba, exact location and date unknown; FMNH 52631, 77 mm SL, male, 80 mm SL, female, Cuba, exact location and date unknown; MFP 18.000199, 39.7 mm SL, male, Paredones cave, La Salud locality, Caimito municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 March 2004;

MFP 18.000371 (7 specimens), 41.45–67.5 mm SL, Juanelo Piedra cave, Quibicán municipality, collected by A. Sosa, date unknown; MFP 18.000372, 80.2 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000373, 76.2 mm SL female, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000374, 71.85 mm SL male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000198, 74.55 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000375 (10 specimens), 27.65–75.6 mm SL, Luis Piedra cave, Quibicán municipality, collected by Alfredo Garcia-Debrás, July 1993; MFP 18.000376 (2 specimens), 52.0–79.4 mm SL, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Antonio Nuñez Jimenez, 7 November 1943; MFP 18.000377 (4 specimens), 70.5–89.55 mm SL, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Armando Montoto and Gonzalo Abio, 5 May 1984; MFP 18.000378, 75.0 mm SL, male, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier, Armando Montoto and Lisset Gómez, 25 October 2000; MFP 18.000379, 78.25 mm SL, female, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Damir Hernández and Didier Casane, 15 December 2008; MFP 18.000380 (3 specimens), 47.3–78.1 mm SL, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Gonzalo Abio, Erik García-Machado and Armando Montoto, 20 October 1984; MFP 18.000381, 60.25mm SL, female, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 25 September 2005; MFP 18.000382, 62.3 mm SL, male, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 25 September 2005; MFP 18.000383 68.7 mm SL, male, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier, Armando Montoto and Lisset Gómez, 25 October 2000; MFP 18.000200, 69.3 mm SL, female, Lechuza cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 7 November 2002; MFP 18.000384, 62.0 mm SL, female, El Sitio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by José Martínez and Gonzalo Abio, 20 October 1984; MFP 18.000385 (Holotype of *Lucifuga teresinarum*) 71.9 mm SL, male, Lechuza cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado and Armando Montoto, 20 October 1986; MFP 18.000386 (Paratype of *Lucifuga teresinarum*) 78.5 mm SL, male, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado and Armando Montoto, 20 October 1986; MFP 18.000387, 77.3 mm SL, female, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and

Damir Hernández, 7 November 2002; MFP 18.000388, 57.3 mm SL, female, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 7 November 2002; UMMZ 157178 (5 specimens), 52–60 mm SL, Cuba, no further data.

Remarks. Díaz-Pérez (1988) distinguished *L. teresinarum* from *L. subterranea* by the relationships among the dorsal, anal and caudal fins (i.e., independent in the first vs. broadly joined in the second), as well as by the shape of the hood of the male copulatory organ (i.e., broad distal lateral ends in *L. teresinarum* vs. conical in *L. subterranea*); and pointed out that *L. teresinarum* shares both characters states with *L. dentata*. Evidence from molecular data (García-Machado et al. 2011) and morphological considerations indicate that this species is invalid and will be regarded as a synonymy of *L. subterranea*. All measures from the four specimens examined were included within *L. subterranea*. Previous descriptions have indicated that *L. subterranea* has a caudal fin broadly joined to dorsal and anal fins (Poey 1858; Cohen and Robins 1970; Nalbant 1981; Nielsen et al. 1999; Møller et al. 2006). However, as noticed previously by García-Machado et al. (2011) four individuals collected at Baño II cave have the caudal fin joined to the anal but free from the dorsal, a variant previously observed in *L. simile* (Díaz-Pérez et al. 1987a; Díaz-Pérez 1988). The redefinition of *L. teresinarum* as a synonymy of *L. subterranea* increase the morphological variation in this species, only paralleled by *L. simile* (Díaz-Pérez et al. 1987a).

Lucifuga dentata Poey, 1858

Material examined. (126 specimens: 63 females, 63 males).

Syntypes and/or Poey specimens. MCZ 12415, 32329, 85–90 mm SL, females, Cave of Cajio, Cuba.

Additional specimens. MFP 18.000312, 93.6 mm SL, female, El Judio cave, Guanahacabibes peninsula, Sandino municipality, collected by José Luis Ponce de León, October 2006; MFP 18.000048, 97.35 mm SL, female, El Judio cave, Guanahacabibes peninsula, Sandino municipality, collected by José Luis Ponce de León, October 2006; MFP 18.000195, 107.1 mm SL, male, El Judio cave, Guanahacabibes peninsula, Sandino municipality, collected by Niurka Hernández, 11 September 2006; MFP 18.000313 100.1 mm SL, female, El Judio cave, Guanahacabibes peninsula, Sandino municipality, collected by José Ponce de León, April 2007; MFP 18.000314 95.1 mm SL, female, El Judio cave, Guanahacabibes peninsula, Sandino municipality, collected by José Ponce de León, April 2007; MFP 18.000315 78.5 mm SL, female, El Judio cave, Guanahacabibes peninsula, Sandino municipality, collected by José Ponce de León, April 2007; MFP 18.000316, 79.95 mm SL, female, El Grillo cave, El Valle locality, Sandino municipality, collected by Yosvani Medina and Damir Hernández, 7 May 2003; MFP 18.000317 (2 specimens), 75.95–100.9 mm SL, La Raja cave, La Jarreta locality, Sandino municipality, collected by Yosvani Medina and Damir Hernández, 6 May 2003; MFP 18.000318 (3 specimens), 93.0–93.5 mm SL, El Jagüey cave,

Majin locality, Sandino municipality, collected by Yosvani Medina and Damir Hernández, 30 April 2003; MFP 18.000319 (3 specimens), 75.6–104.3 mm SL, El Patrón cave, Majin locality, Sandino municipality, collected by Yosvani Medina and Damir Hernández, 30 April 2003; MFP 18.000320 (4 specimens), 77.25–97.25 mm SL, Felipe cave, Cayuco locality, Sandino municipality, collected by Erik García-Machado and Pedro Chevalier, 1 March 2001; MFP 18.000321, 81.05 mm SL, female, Pozo Azul sinkhole, Cayuco locality, Sandino municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 September 2007; MFP 18.000322, 92.5 mm SL, female, Pozo Azul sinkhole, Cayuco locality, Sandino municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 September 2007; MFP 18.000323, 90.15 mm SL, male, Pozo Azul sinkhole, Cayuco locality, Sandino municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 September 2007; MFP 18.000324, 82.9 mm SL, female, Pozo Azul sinkhole, Cayuco locality, Sandino municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 September 2007. South of Havana Province: MFP 18.000325 (2 specimens), 100.0–103.4 mm SL, Paredones cave, La Salud locality, Caimito municipality, collected by Antonio Nuñez Jimenez, date unknown; MFP 18.000326, 105.0 mm SL, female, Paredones cave, La Salud locality, Caimito municipality, collected by José Álvarez Lemus, date unknown; MFP 18.000327, 52.5 mm SL, female, Paredones cave, La Salud locality, Caimito municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 March 2004; MFP 18.000328, 82.55 mm SL, female, Paredones cave, La Salud locality, Caimito municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 March 2004; MFP 18.000329, 86.61 mm SL, female, Paredones cave, La Salud locality, Caimito municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 March 2004; MFP 18.000330, 104.0 mm SL, male, Paredones cave, La Salud locality, Caimito municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 18 March 2004; MFP 18.000331, 103.5 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by José R. Martínez and Gonzalo Abio, date unknown; MFP 18.000332, 120.0 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000333, 102.15 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000334, 97.4 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000335, 92.5 mm SL, male, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000336, 90.9 mm SL, female, Juanelo Piedra cave, Quibicán municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 1 July 2005; MFP 18.000368 (20 specimens), 75.9–121.2 mm SL, Luis Piedra cave, Quibicán municipality, collected by Alfredo Garcia-Debrás and Abel Ramirez, July 1993; MFP 18.000337 119.0 mm SL, male, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, col-

lected by Erik García-Machado, 20 October 1984; MFP 18.000338, 115.0 mm SL, male, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Armando Montoto, Javier Vazquez, Erik García-Machado and Pedro A. Díaz, 26 January 1985; MFP 18.000339 (2 specimens), 96.0–99.1 mm SL, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Armando Montoto and Gonzalo Abio, 5 May 1984; MFP 18.000340 (4 specimens), 84.5–101.9 mm SL, Emilio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier, Armando Montoto and Lisset Gómez, 25 October 2000; MFP 18.000342, 86.1 mm SL, male, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Gonzalo Abio, 20 October 1984; MFP 18.000343 (4 specimens), 67.15–90.25 mm SL, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier, Armando Montoto and Lisset Gómez, 25 October 2000; MFP 18.000196, 82.15 mm SL, female, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 11 July 2002; MFP 18.000341 (2 specimens), 67.15–90.25 mm SL, Baño II cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 11 July 2002; MFP 18.000345 (5 specimens), 74.3–95.25 mm SL, Lechuza cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by Erik García-Machado, Pedro Chevalier, Armando Montoto and Lisset Gómez, 25 October 2000; MFP 18.000344, 81.0 mm SL, female, El Sitio cave, Ashton formation, Las Cañas locality, Artemisa municipality, collected by José R. Martínez and Gonzalo Abio, 20 October 1984; MFP 18.000346, 85.0 mm SL, male, El Sitio cave, Ashton formation, Las Cañas locality, Artemisa municipality (collection data unknown). South of Matanzas Province: MFP 18.000347, 81.5 mm SL, male, Chicharrones cave, Bolondrón municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 28 April 2005; MFP 18.000348, 78.35 mm SL, male, Chicharrones cave, Bolondrón municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 28 April 2005; MFP 18.000349, 73.1 mm SL, female, Chicharrones cave, Bolondrón municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 28 April 2005; MFP 18.000350, 74.1 mm SL, female, Chicharrones cave, Bolondrón municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 28 April 2005; MFP 18.000351, 79.9 mm SL, female, Chicharrones cave, Bolondrón municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 28 April 2005; MFP 18.000352, 77.15 mm SL, male, Chicharrones cave, Bolondrón municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, September 2008; MFP 18.000369 (11 specimens), 69.0–114.15 mm SL, Chicharrones cave, Bolondrón municipality, collected by Alfredo Garcia-Debrás, October 1996; MFP 18.000370 (3 specimens), 74.0–104.0 mm SL, Los Chivos cave, Bolondrón municipality, collected by Alfredo Garcia-Debrás, October 1996; MFP 18.000367 (12 specimens), 65.25–120.1 mm SL, Los Chivos cave, Bolondrón municipality, collected by Alfredo Garcia-Debrás, October 1996;

MFP 18.000197, 78.95 mm SL, male, Perico Sánchez cave, Jagüey Grande municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000353, 69.05 mm SL, female, Perico Sánchez cave, Jagüey Grande municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000354, 67.45 mm SL, male, Perico Sánchez cave, Jagüey Grande municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000355, 71.55 mm SL, female, Perico Sánchez cave, Jagüey Grande municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000356, 72.9 mm SL, female, El Pozo cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000357, 72.95 mm SL, female, El Pozo cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000358, 79.5 mm SL, female, El Pozo cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000359, 66.95 mm SL, female, El Pozo cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000360, 87.05 mm SL, male, El Pozo cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000361, 82.6 mm SL, female, El Pozo cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier and Damir Hernández, 27 April 2005; MFP 18.000362, 114.15 mm SL, male, La Carreta cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier, Didier Casane and Damir Hernández, 26 July 2005; MFP 18.000363, 91.6 mm SL, male, La Carreta cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier, Didier Casane and Damir Hernández, 26 July 2005; MFP 18.000364, 106.9 mm SL, male, La Ratonera cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier, Didier Casane and Damir Hernández, 26 July 2005; MFP 18.000365, 105.2 mm SL, male, La Ratonera cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier, Didier Casane and Damir Hernández, 26 July 2005; MFP 18.000366, 99.2 mm SL, male, La Ratonera cave, Agramonte municipality, collected by Erik García-Machado, Pedro Chevalier, Didier Casane and Damir Hernández, 26 July 2005.

Remarks. *Lucifuga dentata* has been described as having the caudal fin free from dorsal and anal fins and the occiput naked (Poey, 1858; Cohen and Robins, 1970; Vergara, 1980; Nalbant, 1981; Nielsen et al., 1999; Møller et al. 2006). However, we have found that in 60% of the specimens the caudal fin is partially joined to the dorsal and anal fins by tiny basal membranes. Additionally, two individuals, from Luis Piedra caves, have the caudal fin broadly joined to the anal fin. These two conditions were previously assigned as diagnostic for *L. simile* (Díaz et al. 1987a; Díaz 1988). We also found that around 14% of the specimens have the occiput with different degrees of squamation as described for *L. spelaeotes*.

As mention previously for *L. subterranea*, the sampling at localities near to those mentioned in Poey's original description of the species, applied exactly for *L. dentata*.

We also use several exemplars from Juanelo Piedra and Luis Piedra caves which are near to El Cajio cave (ca. 2 km) the type-locality referred by Poey (1858). *Lucifuga dentata* is the most abundant and widely distributed *Lucifuga* species in Cuba. It is found in caves from median-southern karts from central (Matanzas province) to the western part of the island (Guanahacabibes Peninsula). Its distribution is not continuous, with the most important gap between western Havana and Guanahacabibes, Pinar del Río (Hernández et al. 2016).

Lucifuga simile Nalbant, 1981

Material examined. (22 specimens: 8 females, 14 males).

Additional specimens. MFP 18.000406, (4 specimens), 57.5–100.5 mm SL, Grieta Punta de Guana crevice, Matanzas municipality, North of Matanzas province, Cuba, collected by Gonzalo Abio, Armando Montoto and Erik García-Machado, 6 October 1984; MFP 18.000407, 62.55 mm SL, male, Grieta Punta de Guana crevice, Matanzas municipality, North of Matanzas province, Cuba, collected by Gonzalo Abio, November 1984; MFP 18.000408, 66.65 mm SL, female, Grieta Punta de Guana crevice, Matanzas municipality, North of Matanzas province, Cuba, collected by Alfredo García-Debrás, 8 June 1995; MFP 18.000410, 73.55 mm SL, female, Grieta Punta de Guana crevice, Matanzas municipality, North of Matanzas province, Cuba, collected by Gonzalo Abio, Armando Montoto and Erik García-Machado, 9 September 1984; MFP 18.000409, 84.5 mm SL, female, La Pluma cave, Matanzas municipality, North of Matanzas province, Cuba, collected by Gonzalo Abio, 3 October 1986; MFP 18.000411 (2 specimens), 60.95–92.05 mm SL, La Pluma cave, Matanzas municipality, North of Matanzas province, Cuba, collected by Lazaro Joo, José Alvarez and Ignacio Hernández, 25 March 1984; not catalogued (12 specimens), 66.0–103.0 mm SL, Grieta Punta de Guana crevice, Matanzas municipality, North of Matanzas province, Cuba, (collection data unknown).

Remarks. We examined specimens of *L. simile* from the two known localities: the type-locality Grieta Punta de Guana cave (Nalbant, 1981) and La Pluma Cave (Díaz-Pérez et al. 1987a). This species was also reported from El Tunel cave in Quivican, southern Havana, living in sympatry with *L. dentata* (Díaz-Pérez et al. 1987a). However, this later report need verification.

Lucifuga lucayana Møller, Schwarzhans, Iliffe & Nielsen, 2006

see Møller et al. (2006).

Lucifuga spelaeotes Cohen & Robins, 1970

see Møller et al. (2006).

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References

Cohen DM, Robins CR (1970) A New Ophidioid Fish (genus *Lucifuga*) from a Limestone sink, New Providence Island, Bahamas. Proceeding of the Biological Society of Washington 83: 133–144.

Cohen DM, McKosker JE (1998) A new species of Bythitid Fish, genus *Lucifuga*, from the Galapagos Island. Bulletin of Marine Science 63: 179–187.

Corella JE, Echtinger H, Guarch JJ (2000) Caracter Sticas Espeleológicas del kast de la region de Gibara (Cuba). Endins, no. 23. Palma de Mallorca.

Díaz-Pérez PA (1988) *Lucifuga teresinarum* sp. n., Nueva Especie Cubana de Peces Troglobios. (Ophidiiformes, Bythitidae). Revista Biología 2: 37–43.

Díaz-Pérez PA, Lima AM, García E (1987a) Morfología Externa de Ejemplares Machos de *Lucifuga simile* Nalbant, 1981 (Ophidiiformes, Bythitidae). Revista Biología 1: 77–84.

Díaz-Pérez PA, Nieto E, Abio G (1987b) Peces Ciegos del Género *Lucifuga* (Ophidiiformes, Bythitidae) en dos Casimbas Cubanas. Revista Investigaciones Marinas 8: 41–47.

Dietz P (2015) Höhlentauchführer Kuba. Tauch-Info und Verlag, Berlin, 148 pp.

Echtinger H (2000) Die caverna de Tanque Azul ein subaqutisches hohlensystem bei Gibara (Cuba). ENDINS no 23. Palma de Mallorca.

Eigenmann CH (1909) Cave vertebrates of America; a study in degenerative evolution. Carnegie Institution, Washington, D.C., 241 pp. https://doi.org/10.5962/bhl.title.11955

Fricke R, Eschmeyer WN, Van der Laan R (2019) ESCHMEYER'S Catalog of Fishes: Genera, Species, References. http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp [Electronic version accessed 16 May 2019]

García-Debrás A, Pérez A (1999). Estudio sobre la dieta de peces ciegos cubanos (Ophidiiformes: Bythitidae). Troglobio 4: 2–3.

García-Machado E, Hernández D, García-Debrás A, Chevalier-Monteagudo P, Bernatchez L, Casane D (2011) Molecular phylogeny and phylogeography of the Cuban cave-fishes of the genus *Lucifuga*: Evidence for cryptic allopatric diversity. Molecular Phylogenetic and Evolution 61: 470–483. https://doi.org/10.1016/j.ympev.2011.06.015

Gill TN (1863) Descriptions of the genera of gadoid and brotuloid fishes of western North America. Proceedings of the Academy of Natural Sciences of Philadelphia 15: 242–254.

Hernández D (2005) Relaciones evolutivas de las especies del genéro *Lucifuga* (Ophidiiformes: Bythitidae) en Cuba. Centro de Investigaciones Marinas Universidad de la Habana [Master's Thesis].

Hernández D, Casane D, Chevalier-Monteagudo P, Bernatchez L, García-Machado E (2016) Go West: A One Way Stepping–Stone Dispersion Model for the Cavefish *Lucifuga dentata* in Western Cuba. PLOS ONE 11(4): e0153545. https://doi.org/10.1371/journal.pone.0153545

Jordan DC, Evermann BF (1896) A check-list of the fishes and fish-like vertebrates of North and Middle America. Report U.S. Fish. Commission for 1895, 584 pp.

Lane HH (1903) The ovarian structures of the viviparous blind fishes, *Lucifuga* and *Stygicola*. The Biological Bulletin 6: 38–54. https://doi.org/10.2307/1535811

Lara A, Ponce de León JL, Rodríguez R, Casane D, Côté G, Bernatchez L, García-Machado E (2010) DNA barcoding of Cuban freshwater fishes: evidence for cryptic species and taxonomic conflicts. Molecular Ecological Resources 10: 421–430. https://doi.org/10.1111/j.1755-0998.2009.02785.x

Møller PR, Schwarzhans W, Nielsen JG (2004) *Tuamotuichthys bispinosus*, a new genus and species from off Tuamotu Islands, South Pacific Ocean (Ophidiiformes, Bythitidae). Ichthyological Research 51: 146–152. https://doi.org/10.1007/s10228-004-0210-1

Møller PR, Schwarzhans W, Iliffe TM, Nielsen JG (2006) Revision of the Bahamian cavefishes of the genus *Lucifuga* (Ophidiiformes, Bythitidae), with description of a new species from islands on the Little Bahama Bank. Zootaxa 1223: 23–46. https://doi.org/10.11646/zootaxa.1223.1.3

Møller PR, Knudsen SW, Schwarzhans W, Nielsen JG (2016) A new classification of viviparous brotulas (Bythitidae) – with family status for Dinematichthyidae – based on molecular, morphological and fossil data. Molecular Phylogenetics and Evolution 100: 391–408. https://doi.org/10.1016/j.ympev.2016.04.008

Nalbant TT (1981) A Study of the Subterranean Species of *Lucifuga* from Cuba, with the Description of *Lucifuga simile* sp. n. (Pices, Ophidiiformes, Bythitidae). Résultats des expéditions bio-spéologiques cubano-roumanianes à Cuba, Bucarest, Romania, 185–190.

Nielsen JG, Cohen DM, Markle DF, Robins CR (1999) Ophidiiform Fishes of the World (Order Ophidiiformes). FAO Species Catalogue 18: I–XI + 1–178.

Poey F (1858) Memorias Sobre la Historia Natural de la Isla de Cuba, Acompañadas de Sumarios Latinos y Frases en Francés, Imprenta de Barcina, Habana, 442 pp.

Proudlove G (2019) Subterranean Fishes of the World. An account of the subterranean (hypogean) fishes with a bibliography from 1436. V1.0 Tuesday 25th June 2019. https://cavefishes.org.uk/

Thinès G, Piquemal (1978) Observations sur les comportements de *Lucifuga subterranea* Poey (Pisces, Ophidiidae), poisson cavernicole de Cuba. International Journal of Speleology 10: 195–203. https://doi.org/10.5038/1827-806X.10.2.6

Vergara R (1980) Estudio filogenético de los peces ciegos del género *Lucifuga* (Pisces: Ophidiidae). I. Sistemática Filogenética. Revista CENIC 11: 311–323.

Vergara R (1981) Estudio filogenético de los peces ciegos del género *Lucifuga* (Pisces: Ophidiidae). II. Bibliografía Filogenética. Revista Ciencias Biológicas, 12: 99–107.

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RESEARCH ARTICLE

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Tatupa grafei, a new genus and species of Cylapinae (Heteroptera, Miridae) from Brunei Darussalam

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Abstract

A new genus and species, *Tatupa grafei* Tyts, Namyatova & Konstantinov, **gen. et sp. nov.** (Heteroptera, Miridae, Cylapinae, Fulviini), is described from Brunei Darussalam. A diagnosis, photographs of the dorsal habitus, scanning micrographs of selected morphological structures, and illustrations of male and female genitalia are provided for this new species. Its taxonomic placement within the subfamily Cylapinae is briefly discussed. A comparison with the morphologically most similar genus, *Proamblia* Bergroth, 1910, is made, and scanning micrographs of *Proamblia* are also provided.

Keywords

Borneo, dipterocarp forest, morphology, *Rhinocylapus*-complex, taxonomy

Introduction

Borneo is mostly covered with highly diverse tropical rainforests (e.g. Ashton 2010) and recognized as one of the biodiversity hotspots (e.g. Myers et al. 2000; de Bruyn et al. 2014). The major lowland forest formation of this island is dipterocarp forest, which is the most diverse ecosystem in the world (Davies and Becker 1996; Hédl et al. 2009). Borneo harbors a great number of arthropods, including numerous endemic species, many of them undescribed and at risk of extinction because of the intensive logging (Hédl et al. 2009; Ashton 2010; Berry et al. 2010; Giam et al. 2010). Brunei Darussalam is important for biodiversity conservation as it is least affected by the conversion of rainforests into palm oil plantations in comparison with Indonesia and Malaysia (Damken et al. 2017).

Although the area of Brunei Darussalam is relatively small, occupying only around 1% of Borneo, its insect fauna remains understudied. An important glimpse into the biodiversity of Brunei's rainforests was provided by the canopy fogging study conducted by Nigel Stork in the early 1980s (Stork 1991); his study yielded more than 3000 insect species from just 10 trees. The construction in 1990 of the Kuala Belalong Field Studies Centre in the southern part of Temburong District, within the Batu Apoi Forest Reserve (later declared as Ulu Temburong National Park) provided the much needed permanent logistics to conduct fieldwork in a near-pristine lowland mixed dipterocarp forest and Kuala Belalong. The forest reserve has since become the type locality for many of the invertebrates recorded or described from the Sultanate (e.g. Damken et al. 2017; Gnezdilov 2015; Heiss 2011; Kočárek et al. 2017; Pfeifer et al. 2011; Ševčík et al. 2014; Tan et al. 2017; Wolski and Gorczyca 2012).

From 2013 to 2015, the third author conducted systematic field sampling of Heteroptera (Hemiptera) in various locations and forest types across the Sultanate. A regional (i.e. Borneo) reference collection was established for pristine forests for a group of tropical insects with both a moderate species diversity and moderate specimen abundance. The collection can be used to conduct future ecological studies, such as the impact of land-use change on tropical insect diversity. During this field survey, more than 400 species of Heteroptera were collected, including many hitherto undescribed species.

The hyperdiverse family Miridae, in the order Hemiptera, is well represented in Brunei, as most of its suprageneric groupings are most diverse in the tropics (e.g. Schuh and Slater 1995; Cassis and Schuh 2012). However, apart from the mirine *Kosmiomiris carvalhoi* Kim & Jung, 2019 (Kim et al. 2019), only taxa from the less species-rich subfamilies, Cylapinae (Gorczyca 1999, 2006; Wolski 2008; Wolski and Gorczyca 2006, 2007, 2012; Wolski et al. 2018) and Isometopinae (Akingbohungbe 2013; Taszakowski et al. 2020), have been recently recorded or described from Brunei Darussalam.

We describe here a new cylapine genus and species from the dipterocarp forest of Brunei Darussalam. Species of the subfamily Cylapinae live in litter or under bark, presumably are mycetophagous or some may be predacious, and are most abundant in subtropical and tropical forests (e.g. Gossner and Damken 2018; Namyatova et al. 2018; Namyatova and Cassis 2019; Wheeler 2001; Wolski and Gorczyca 2011; Yasunaga 2000; Yasunaga and Miyamoto 2006). This is one of the least diverse mirid subfamilies, as currently known, but many tropical taxa still await description.

Material and methods

Specimens

The holotype and six paratypes of the new species described in this paper will be deposited in the Universiti Brunei Darussalam Museum (UBDM), but are currently retained on loan in the private research collection of Claas Damken, Dunedin, New Zealand. Two paratypes of the new species are deposited in the Zoological Institute, Russian Academy of Sciences (ZISP). Each specimen was associated with a unique specimen identifier or USI (see Material examined section), and was entered into the Arthropod Easy Capture Specimen database (https://research.amnh.org/pbi/locality/). Additional information such as photographs of habitus and scanning electron micrographs of selected structures, georeferenced coordinates of each locality, specimens dissected and notes are accessible through the interface of the Heteroptera Species Pages (http://research.amnh.org/pbi/heteropteraspeciespage).

Microscopy and illustrations

Observations, measurements, and digital dorsal color images were made with a Nikon SMZ 1500 stereomicroscope equipped with a Nikon D700 digital SLR camera. Drawings and images of the male and female genitalic structures were taken with a Leica DM2500 microscope equipped with a drawing attachment and a Leica DFC450 digital camera. Partially focused images of each specimen or structure were stacked using the HELICON FOCUS 7.5.4 software. Scanning electron micrographs of selected structures were taken using Tescan MIRA3 LMU, Quanta 3D DualBeam and Hitachi TM 3000 scanning microscopes. Specimens were uncoated, except Figures 2D, F, J, where legs were covered with 28 nm gold using a Leica EM SCD500 high vacuum film deposition system.

Dissections

The genitalia were macerated in 10% KOH solution prior to dissection, cleared in distilled water, and then transferred to glycerin jelly for proper orientation. The aedeagus is described in repose.

Terminology

The terminology used for male genitalia follows Konstantinov (2003), and, for females, follows Davis (1955).

Measurements

The measurements were completed using a graticule and 10× eyepiece. All measurements are in millimeters (Table 1). Scale bars for genitalia equal 0.1 mm, scale bar for habitus equals 0.5 mm.

Table 1. Measurements (mm). Abbreviations: Cun–Clyp – distance between apex of clypeus and apex of cuneus in dorsal view, Head Length – distance between apex of clypeus and the highest point of vertex, AntSeg1 and AntSeg2 – length of antennal segments I and II, InterOcDi – width of vertex between inner margins of eyes in dorsal view.

		Length						Width				
	Body	Cun–Clyp	Pronotum	Head	AntSeg1	AntSeg2	Scutellum	Head	Pronotum	InterOcDi	Scutellum	Hemelytron
♂ Mean	4.58	3.94	0.73	0.84	0,87	1.72	0,52	1,04	1,28	0,49	0,60	1,45
SD	0,14	0,15	0,05	0,06	0,05	0,07	0,03	0,03	0,10	0,01	0,03	0,08
Range	0,27	0,35	0,13	0,13	0,13	0,23	0,08	0,08	0,25	0,03	0,08	0,20
Min	4,45	3,75	0,65	0,78	0,80	1,60	0,48	1,00	1,13	0,48	0,55	1,35
Max	4,73	4,10	0,78	0,90	0,93	1,83	0,55	1,08	1,38	0,50	0,63	1,55
N	4	4	5	4	6	6	5	6	5	5	5	5
♀ Mean	4,98	4,35	0,80	0,95	0,94	1,82	0,59	1,12	1,44	0,55	0,71	1,71
Min	4,93	4,33	0,80	0,93	0,90	1,70	0,55	1,10	1,43	0,55	0,70	1,65
Max	5,03	4,38	0,80	0,98	0,98	1,95	0,63	1,13	1,45	0,55	0,73	1,83
N	3	2	2	2	3	3	2	3	2	2	2	3

Taxonomy

Tatupa Tyts, Namyatova & Konstantinov, gen. nov.

http://zoobank.org/E7C59542-A3C8-4948-8D5C-2D1A72E75F5F

Type species. *Tatupa grafei* Tyts, Namyatova & Konstantinov, sp. nov.

Diagnosis. The new genus is recognized by the following combination of characters: head yellow to brownish yellow, sometimes with slightly darkened clypeus and usually with V-shaped dark marking on frons running from antennal fossa to midline (Fig. 1); head short in dorsal view (Fig. 2G), with ventrally directed apex of clypeus; portion of head anterior to eyes equal to eye length (Fig. 2C); labial segment I and II not subdivided (Fig. 2A–C); labrum without spines in both sexes; antennal fossa not adjoining to eye, separated from inferior eye margin by distance less than antennal fossa diameter and located at distance subequal to one-third of eye height from ventral margin of eye (Fig. 2C); antenna twice as long as body; antennal segment I distinctly longer than head width; pronotum entirely brownish yellow with slightly paler posterior angles (Fig. 1) and more sparsely punctured than hemelytron (Fig 2G); calli weakly delimited and only slightly raised, occupying about half of pronotum, confluent at midline (Fig. 2G); pleura with round shallow punctures; peritreme of scent gland evaporative area twice as long as wide (Fig. 2E); scutellum flattened, not convex; aedeagus thin, C-shaped; vesica obvolute, with strongly sclerotized basal part and less sclerotized apically (Fig. 4C, D); posterior wall of bursa copulatrix with large, roughly triangular, keeled interramal sclerites (Fig. 3G).

Description. Male. ***Coloration.*** (Fig. 1A) Head yellow to brownish yellow, sometimes with darkened, pale-brown to brown clypeus; frons usually with V-shaped dark marking running from antennal fossa to midline. Pronotum brownish yellow with slightly paler posterior angles.

Surface and vestiture. Dorsum with whitish, scarce, short, adpressed simple setae (Fig. 2G–I); appendages and abdomen with similar but longer setae; antennal segment I covered with sparse, decumbent setae (Fig. 2C); segment II with dense adpressed

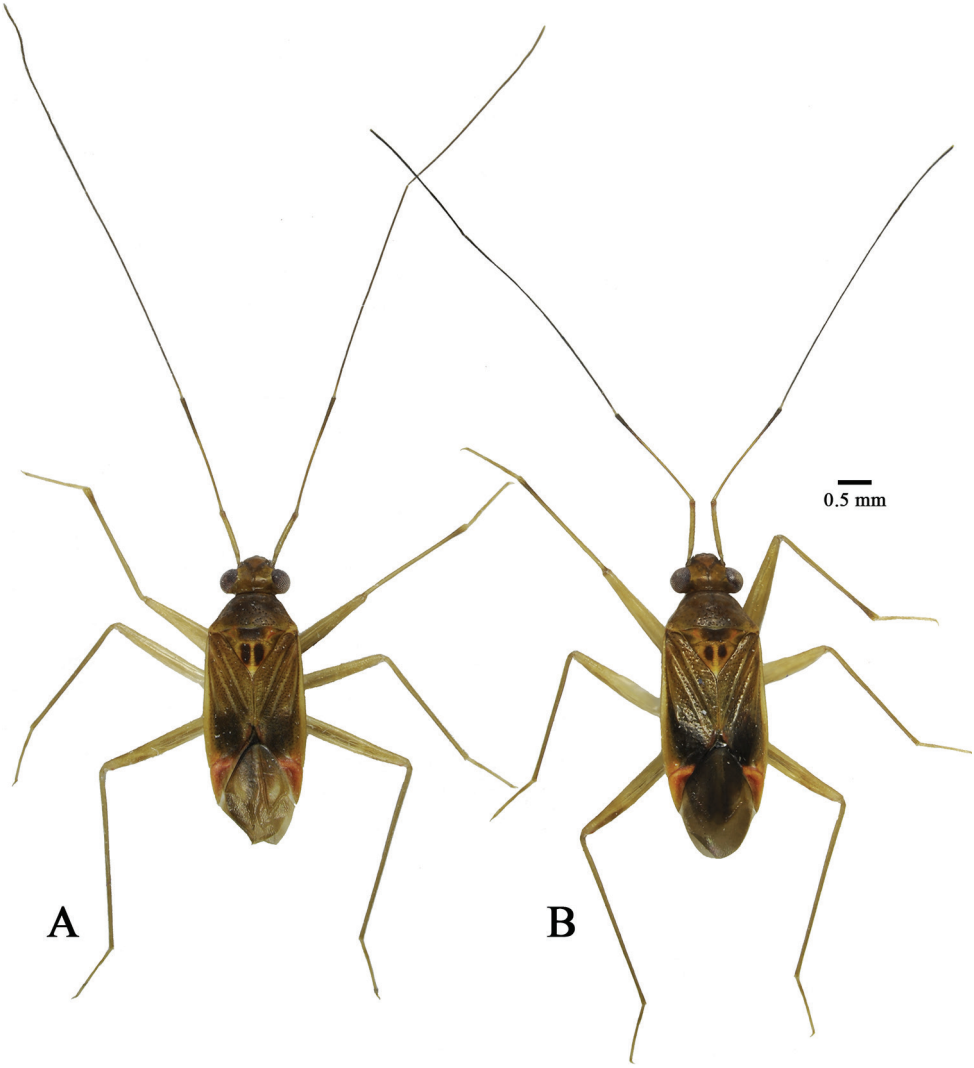

Figure 1. Habitus, dorsal view, *Tatupa grafei*. **A** male AMNH_PBI 00342925 **B** female AMNH_PBI 00342928.

setae on apical third and very sparse setae basally; pleura without setae (Fig. 2G). Dorsum moderately shiny; vertex distinctly shiny (Fig. 1); mesopleuron slightly rugose (Fig. 2E); scutellum rugose (Fig. 2G); evaporative scent gland area and scutellum matt; posterior part of pronotum, mesopleuron, clavus, and corium with distinct deep often pale punctures, some specimens with darkened punctures on hemelytron; pronotum more sparsely punctured than hemelytron; head, anterior part of pronotum, propleuron, scutellum and abdomen with round shallow punctures (Fig. 2E, G–I).

Structure. Body elongate, more than three times as long as width across hemelytron.

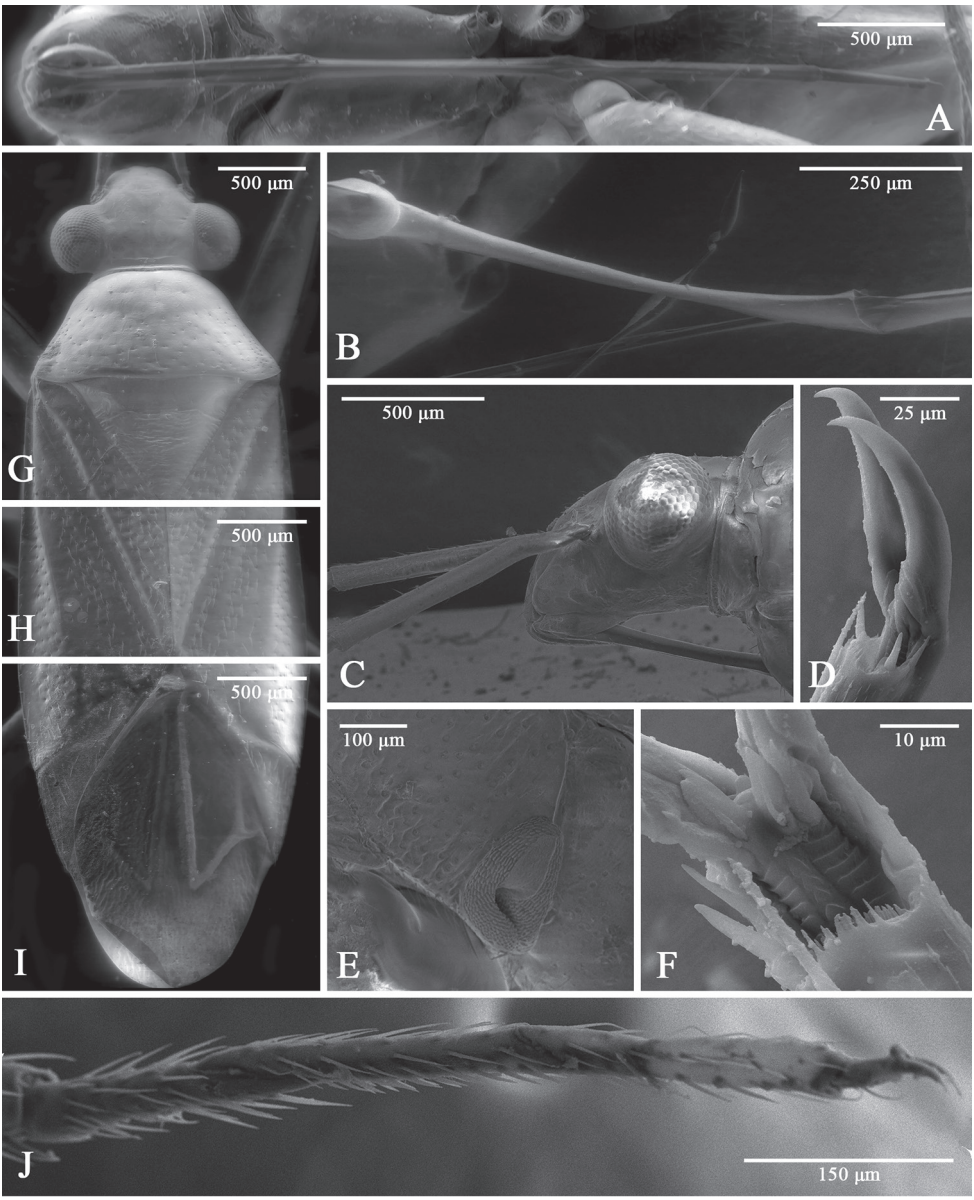

Figure 2. SEM images of *Tatupa grafei*. **A** labium and ventral view, female AMNH_PBI 00342926 **B** labial II segment, male AMNH_PBI 00342929 **C** head, lateral view, female AMNH_PBI 00343423 **D** hind pretarsus, lateral view **E** thoracic pleura, female AMNH_PBI 00342926 **F** hind pretarsus, ventral view, parempodia shown **G** head, pronotum, and scutellum, dorsal view, female AMNH_PBI 00342928 **H** clavus and corium, dorsal view, female AMNH_PBI 00342928 **I** corium, cuneus, and membrane, dorsal view, female AMNH_PBI 00342928 **J** fore tarsus.

Head. Sloping, wider than long in dorsal view (Fig. 2C), short as seen from above; eye contiguous with pronotum; vertex wider than eye diameter (Fig. 2G); in lateral view head distinctly longer than high; portion of head anterior to eyes equals to eye diameter;

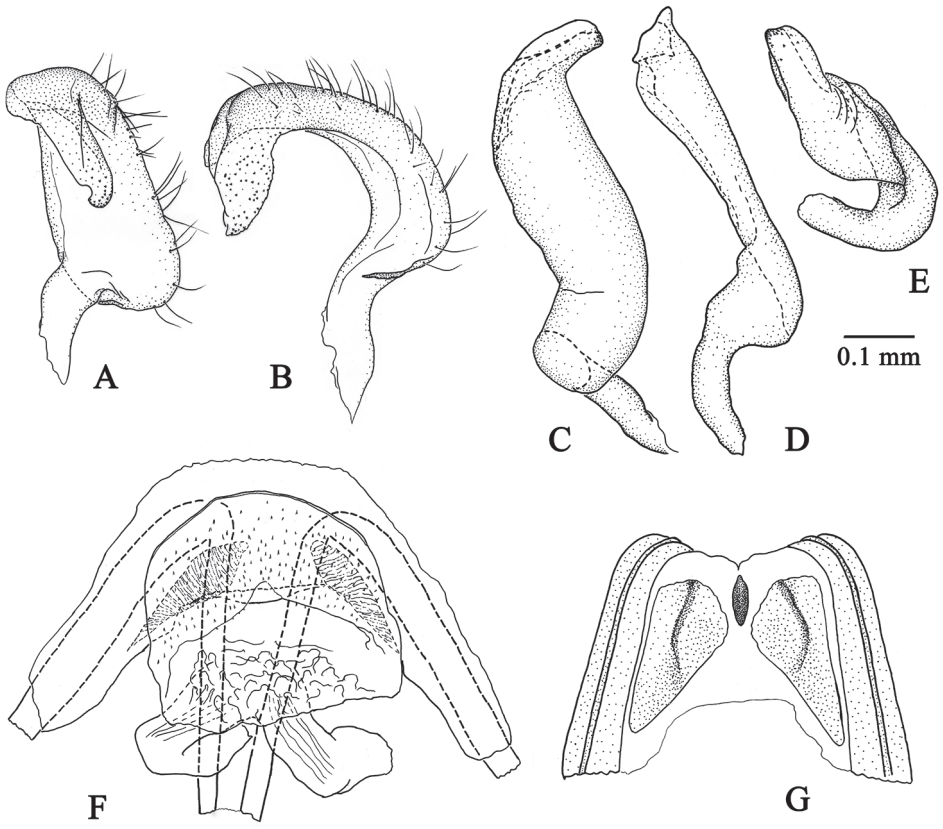

Figure 3. Male and female genitalia of *Tatupa grafei*. **A** left paramere, lateral view, AMNH_PBI 00342929 **B** left paramere, ventral view, AMNH_PBI 00342929 **C** right paramere, lateral view, AMNH_PBI 00342925 **D** right paramere, dorsal view, AMNH_PBI 00342925 **E** right paramere, caudal view, AMNH_PBI 00342925 **F** dorsal labiate plate, AMNH_PBI 00342926 **G** posterior wall of bursa copulatrix, AMNH_PBI 00342928.

clypeus moderately extending forward; apical part of clypeus directed ventrally; eyes relatively large, occupying slightly less than two-thirds of head height; antennal fossa removed from eye at distance less than antennal fossa diameter; distance between antennal fossa and ventral margin of eye subequal to one-third of eye height; buccula slightly shorter than distance between pronotum and buccula, gradually diminishing posteriorly and reaching just behind antennal fossa (Fig. 2C); labium thin and long, surpassing abdominal segment VIII and nearly reaching apex of abdomen; segments I and II not subdivided (Fig. 2A, C); segment I surpassing posterior margin of head, reaching or almost reaching forecoxae; segments I, II, and III subequal in length, each of them twice as long as segment IV (Fig. 2A–C); antenna twice as long as body; segment I and II cylindrical; segment I slightly incrassate towards apex, subequal to half of segment II; segments III and IV filiform (Fig. 1A).

Thorax. Collar narrow, delimited with shallow suture laterally, suture distinct dorsally; lateral margins of pronotum slightly carinate on basal part; posterior margin bisinuate; calli

mostly fused and slightly raised, occupying slightly less than half of pronotum, confluent at midline, with shallow furrow; mesoscutum exposed, with ridges laterally; scutellum with acute apex, flattened (Fig. 2G); mesepimeral apodeme arcuate, slit-like; metathoracic spiracle slit-like narrow, not surrounded with microsculpture; metathoracic scent gland evaporative area oval; peritreme twice as long as wide, flattened (Fig. 2E); metepimeron narrow.

Hemelytron. Claval commissure 1.5 times as long as scutellum; clavus with distinct projecting claval vein, forming ridge; medial fracture distinct, surpassing middle of corium; R+M distinct; embolium clearly delimited only on basal half; cuneal fracture not incised (Fig. 2G–I). Membrane with two cells; outer cell surpassing apex of cuneus, longer than half of membrane, with acute angle; inner cell small, near middle of cuneus (Fig. 2I).

Legs. Coxae slightly elongate; forecoxa longer than others; hind coxa wider than others; femora narrow; forefemur wider than hind and middle femora; hind femur longer than others; tarsus three-segmented; length of segments of hind tarsus subequal (Fig. 2J); pretarsus with three rows of lamellae on unguitractor close to each other and with acute lamellae on medial row (Fig. 2F); claws slightly curved, without tooth apically (Fig. 2D).

Genitalia. Genital capsule distinctly wider than long, apically asymmetric, with shallow longitudinal sutures at sides, clothed with almost evenly distributed short setae; ventral wall of genital capsule distinctly longer than dorsal, hoodlike in posterior view (Fig. 4A, B); aperture of genital capsule wide, without supragenital bridge; right paramere oblong, with long scarce setae on dorsal side, basally curved, apically beakshaped, flattened and covered with minute denticles (Fig. 3C–E); left paramere slightly wider but shorter than right paramere, hook-shaped, covered with long erect setae on dorsal side, basally widened, apically tapering, with small excision and minute denticles at apex (Fig. 3A, B); aedeagus thin, C-shaped, phallotheca moderately sclerotized, narrow, tightly adjoining to vesica along entire length; vesica C-shaped, long and narrow, obvolute, apically tapering, with strongly sclerotized basal part and somewhat weaker sclerotized apically; basal part of ductus seminis running from phallobase to base of vesica equipped with sclerotized ribs; apical part of ductus seminis inside vesica membranous, hardly visible; secondary gonopore subapical, indistinct, without any sculpturing (Fig. 4C, D).

Female. ***Coloration.*** As in male, generally darker.

Surface and vestiture. As in male.

Genitalia. Dorsal labiate plate entirely membranous, very thin, covered with tiny spinules, lateral oviducts thick (Fig. 3F); posterior wall of bursa copulatrix with large, roughly triangular, keeled interramal sclerites at sides and small elongate sclerite located on midline (Fig. 3G); vestibulum membranous, without sclerites encircling vulva; ventral wall membranous, without sclerotizations.

Etymology. The name of the new genus is a random combination of letters. The gender is feminine.

Remarks. Morphological examination of the new genus indicates that it belongs to the *Rhinocylapus*-complex of the tribe Fulviini sensu Namyatova and Cassis (2019). It has been demonstrated, using molecular and morphological data, that the *Rhinocylapus*-complex is a distinct group, differing from other representatives of the Cylapinae in the structure of the pleura, shape of the parameres, and sclerotization of the

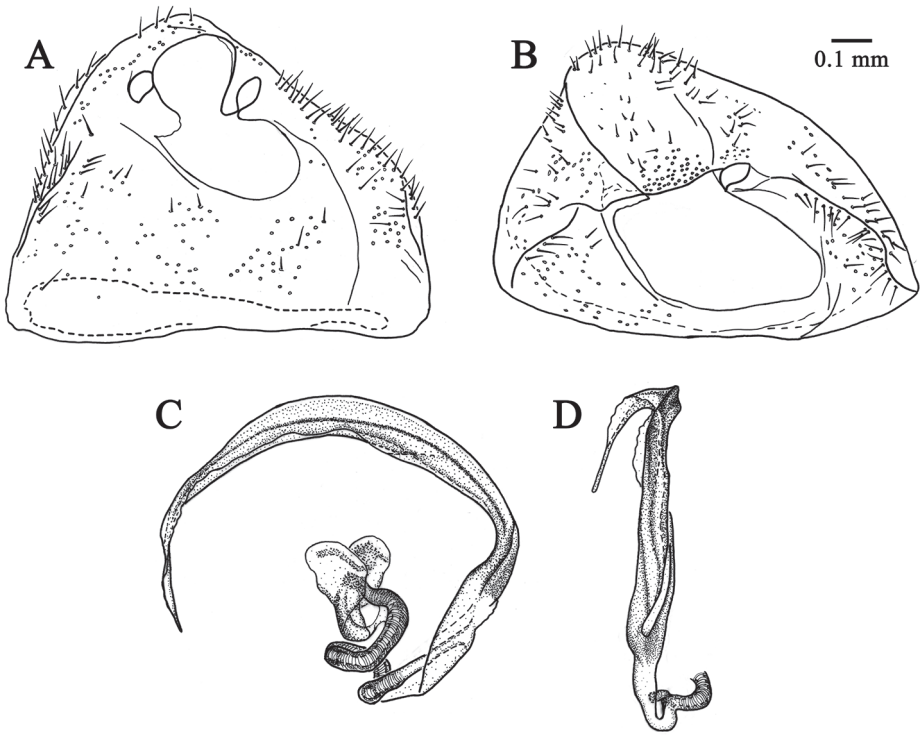

Figure 4. Male genitalia of *Tatupa grafei*. **A** genital capsule, dorsal view, AMNH_PBI 00342925 **B** genital capsule, caudal view, AMNH_PBI 00342925 **C** vesica, lateral view, AMNH_PBI 00342925 **D** vesica, ventral view, AMNH_PBI 00342924.

posterior wall of the bursa copulatrix (Namyatova and Cassis 2019). In particular, the *Rhinocylapus*-complex has reduced metathoracic evaporative area not reaching the base of the hind coxa (Fig. 2G) with a flattened peritreme and the metathoracic spiracle without microsculpturing. The right paramere in this group is almost straight, widened medially, and with a cone-shaped outgrowth subapically. The left paramere is hook-like with the apical part elongate dorsally, and the posterior wall of the bursa copulatrix has two large symmetrical sclerites (see Namyatova and Cassis 2019 for details). *Tatupa* possesses all the diagnostic characters of the *Rhinocylapus*-complex.

The new genus differs from other genera of the *Rhinocylapus*-complex by the characters given in the diagnosis. It differs from most of the genera of this group in the shape of the head, which is declivous in males and females (Fig. 2C) and short as seen from above (Fig. 2G), and in having the labrum without spines. *Tatupa* also is unique within this group in having a C-shaped aedeagus with a strongly sclerotized obvolute vesica that is even more sclerotized basally and without any separate sclerites (Fig. 4C, D). A similar head is present in *Mycetocylapus* (Namyatova and Cassis 2019: figs 6F, 9A, D), but *Tatupa* differs from this genus in having calli that are far less raised and occupy only about a half of pronotum (Namyatova and Cassis 2019: compare fig. 2G

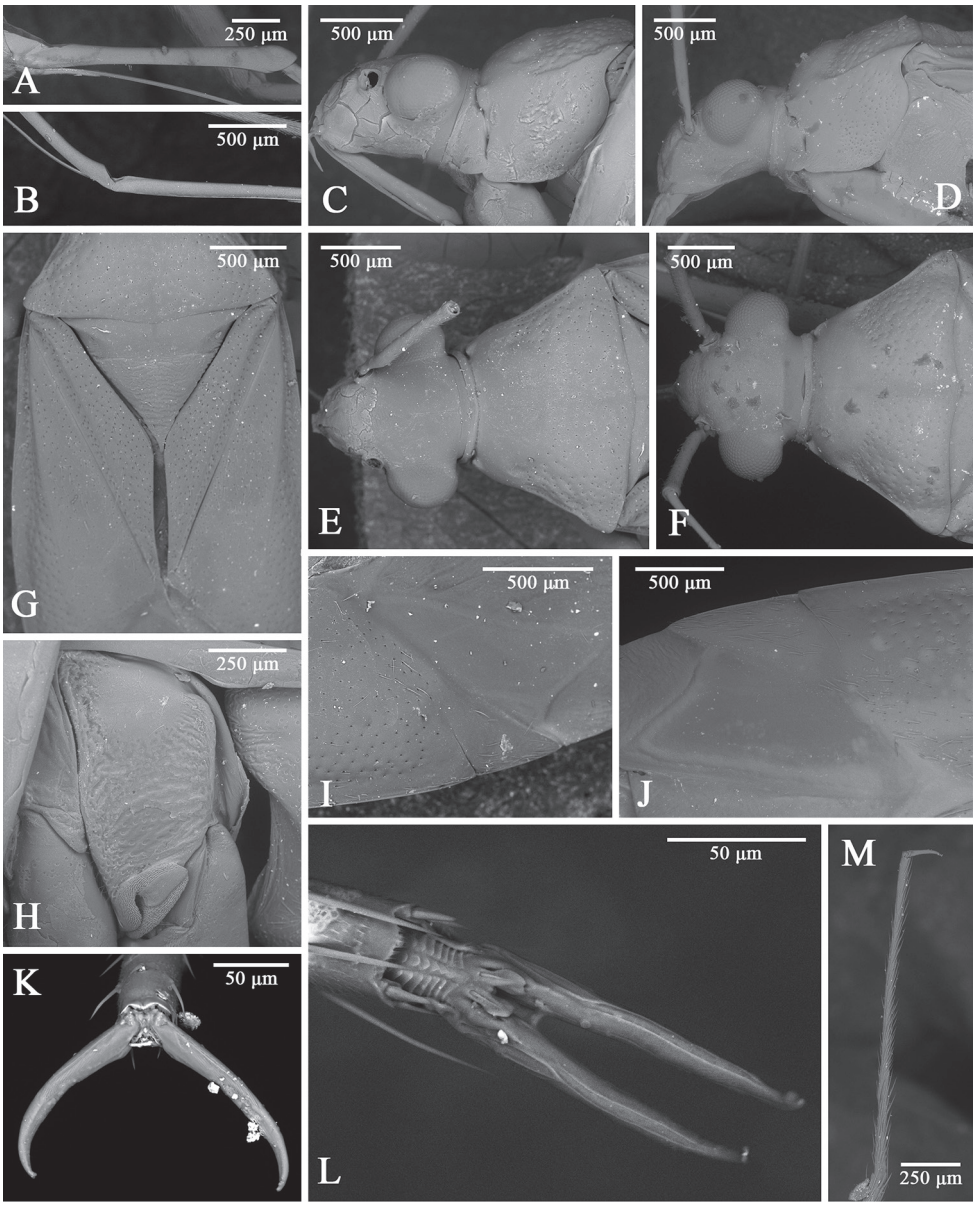

Figure 5. SEM images of *Proamblia sp.* **A** labial I segment, female UNSW_ENT 00045352 **B** labial II segment, female UNSW_ENT 00045352 **C, D** head and pronotum, lateral view, female UNSW_ENT 00045447, female UNSW_ENT 00045352 **E, F** head and pronotum, dorsal view, female UNSW_ENT 00045447, female UNSW_ENT 00045352 **G** scutellum, clavus, and corium, dorsal view, female UNSW_ENT 00045447 **H** thoracic pleura, female UNSW_ENT 00045447 **I, J** cuneus and membrane, dorsal view, female UNSW_ENT 00045447, female UNSW_ENT 00045352 **K** pretarsus, dorsal view, male UNSW_ENT 00045339 **L** pretarsus, ventral view, parempodia shown, male UNSW_ENT 00045339 **M** hind tarsus, male UNSW_ENT 00045351.

and figs 6A, B, 9B, E), and an oval and more elongate peritreme (Fig. 2E); in *Mycetocylapus* a peritreme is small and rounded (Namyatova and Cassis 2019: fig. 6R). Additionally, the vesica in *Mycetocylapus* is membranous and only slightly sclerotized at its base (Namyatova and Cassis 2019: fig. 7A–C, H).

Tatupa presumably is most closely related to *Proamblia*, as these two genera cannot be differentiated from each other in head shape, as well as body size and proportions. Both genera also have similar punctation, and in particular, the posterior part of pronotum, mesopleuron, clavus, and corium are covered with distinct deep punctures, whereas the anterior part of pronotum, propleuron, scutellum, and abdomen have round shallow punctures (Figs 2G–I, 5C–J). *Tatupa* differs from *Proamblia* in the flattened, not convex scutellum and pronotum that is more sparsely punctured than the hemelytron (Fig. 2G), whereas in *Proamblia* the scutellum is distinctly convex and the pronotum usually is as densely punctured as the hemelytron, with punctures sometimes dense only along posterior margin of calli (Fig. 5E–G). Moreover, *Tatupa* clearly differs from *Proamblia* in the structure of strongly sclerotized, C-shaped aedeagus (see above) (Fig. 4C, D), whereas in *Proamblia* the aedeagus is slightly curved, elongate, distinctly membranous, and the vesica has single endosomal sclerite and a relatively long sclerotized portion of ductus seminis (Wolski 2010: fig. 8A, B, G, F). The new genus also has almost triangular sclerites on the posterior wall of bursa copulatrix, each having a ridge (Fig. 3G), whereas in *Proamblia* those sclerites are more elongate and without ridges (Namyatova and Cassis 2019: fig. 15C).

In most cases, *Tatupa* and *Proamblia* can be differentiated using color pattern. The new genus possesses a yellow to brownish-yellow head, sometimes with a slightly darkened clypeus and with a V-shaped dark marking running from the antennal fossa to the midline of the frons (Fig. 1), whereas head color in *Proamblia* varies from brownish to almost entirely dark brown, sometimes with paler areas on the gula, the vertex or near the eye margin, and without a V-shaped dark marking on the frons. Additionally, *Tatupa* has a more or less uniform brownish-yellow pronotum with slightly paler posterior angles (Fig. 1), whereas the pronotum in *Proamblia* varies from brownish to dark brown and typically has a yellow posterior margin and/or yellow stripes on the pronotum and/or yellow markings on the calli.

***Tatupa grafei* Tyts, Namyatova & Konstantinov, sp. nov.**
http://zoobank.org/C571F541-BFE1-4816-A36C-E7BB301A6B4A

Material examined. ***Holotype.*** Brunei Darussalam • 1♂; Temburong District, Temburong National Park; 4.5178N, 115.1778E; 13 Nov. 2013; C. Damken leg.; mixed dipterocarp forest, bark with fungi, dead tree; DBH 110 cm; 2000–2200 hours; AMNH_PBI 00342925, belalong.02143; UBDM.

Paratypes. Brunei Darussalam • 3 ♀; same data as for holotype; AMNH_PBI 00342928, belalong.02135; ZISP; AMNH_PBI 00342926, belalong.02261; AMNH_PBI 00343423, belalong.02144; UBDM • 2 ♂; same data as for holotype; AMNH_PBI 00342927, belalong.02263; AMNH_PBI 00342924, belalong.02262;

UBDM • 3 ♂; Temburong District, Temburong National Park, Ashton trail; 4.5333N, 115.15E; 15 Jan. 2014; C. Damken leg.; mixed dipterocarp forest, under bracket fungi, hand collected; 2000–2200 hours; AMNH_PBI 00342929, belalong.02264; UBDM; AMNH_PBI 00342930, belalong.02265; ZISP.

Diagnosis. As in generic diagnosis.

Description. Male. ***Coloration*** (Fig. 1A). Head yellow to brownish yellow, sometimes with darkened, pale-brown to brown clypeus; frons usually with V-shaped dark marking running from antennal fossa to midline; eye dark brown with reddish tinge; labium yellow, with mostly dark-brown segment IV; antennal segment I dirty yellow, with darkened base and reddish or brownish tinge apically; segment II yellow, gradually darkened to dark brown towards apex; segment III brown to dark brown with pale yellow base; segment IV brown to dark brown.

Thorax. Pronotum brownish yellow with slightly paler posterior angles; exposed part of mesonotum yellow, somewhat darkened at middle, usually with reddish tinge at sides; scutellum yellow with paired brown longitudinal markings, sometimes with reddish tinge near anterior angles; thoracic pleura brownish yellow, sometimes with red tinge; hemelytron yellow to pale brown; clavus with whitish stripe along claval vein; corium with whitish stripes along medial fracture and R+M vein, and darker pale brown to brown large marking medioapically; embolium whitish; cuneus yellow with reddish tinge, sometimes indistinct; membrane brown, larger cell sometimes pale brown apically.

Legs. Coxae whitish; femora, tibiae, and tarsi yellow to pale brown.

Abdomen. Yellow with reddish tinge, brown laterally.

Structure and vestiture. As in generic description.

Ratios. Body 3.0–3.3× as long as wide, 3.4–4.0× as long as pronotum width, head 1.2–1.3× as wide as long, vertex 1.7–1.9× as wide as eye, antennal segment I. 1.7–1.9× as long as vertex, segment II 1.9–2.1× as long as segment I, 3.4–3.7× as long as vertex, 1.6–1.7× as long as head width, 1.3–1.4× as long as pronotum base width; pronotum 1.7–1.8× as wide as long, 1.1–1.3× as wide as head, scutellum 0.8–0.9× as long as wide.

Female. ***Coloration.*** As in male, generally darker.

Surface and vestiture. As in generic description.

Ratios. Similar to male, but body generally larger and head longer in lateral view. Body 2.7–3.0× as long as wide, 3.4–3.5× as long as pronotum width, head 1.2× as wide as long, vertex 1.9× as wide as eye, antennal segment I 1.7–1.8× as long as vertex, segment II 1.8–2.2× as long as segment I, 3.1–3.3× as long as vertex, 1.5–1.8× as long as head width, 1.2× as long as pronotum base width, pronotum 1.8× as wide as long, 1.3× as wide as head, scutellum 0.8–0.9× as long as wide.

Distribution. Known only from the type locality, Brunei Darussalam, Temburong National Park.

Natural history. Collected from dipterocarp forest, under bracket fungi and bark with fungi from dead trees.

Etymology. The new species is named after Professor Ulmar Grafe of the Universiti Brunei Darussalam for his generous help and advice during the field work of the third author and for his continuous and invaluable support of ecological research in Brunei Darussalam in general.

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We thank Thomas J. Henry (USNM) and Jacek Gorczyca (Department of Zoology, University of Silesia, Katowice, Poland) for reviewing the manuscript and offering suggestions for its improvement. This research was supported by the Russian Foundation for Basic Research (grant 19-04-00662 A). The Heteroptera collection of the Zoological Institute, Russian Academy of Sciences also used in this study is financially supported by the state research project AAAA-A19-119020690101-6. We acknowledge resource centers 'Chromas', 'Molecular and Cell Technologies', 'Centre of Microscopy and Microanalysis' (Saint Petersburg State University) for access to the experimental equipment and technical assistance. The SEM images of *Proamblia* were taken using equipment in the Cassis' Lab, University of New South Wales, Australia. We thank Mikhail Valuyskiy (Saint Petersburg State University) for his help with scanning micrographs and Alexandra Tokareva (Saint Petersburg State University) for the general assistance during the study. Claas Damken gratefully acknowledges the support of the KBFSC field crew and the many volunteers during the fieldwork around the Kuala Belalong Field Studies Centre. Fieldwork and research on the Heteroptera of Brunei Darussalam were strongly supported by and conducted in close collaboration with Ulmar Grafe (Universiti Brunei Darussalam) and funded through an UBD postdoctoral fellowship awarded to Claas Damken (Research and export permit file no: UBD/CAN–387(b)(SAA); UBD/ADM/R3(z)Pt.; UBD/PNC2/2/RG/1(293)). The authors also thank Brunei Forestry Department and the Ministry of Primary Resources and Tourism for permission to conduct field work in Brunei Darussalam. The Biodiversity Research and Innovation Centre provided export permits.

References

Akingbohungbe AE (2013) A note on *Gigantometopus* Schwartz and Schuh (Heteroptera: Miridae: Isometopinae) with the description of a new species from Borneo. Entomologica Americana 118(1): 130–133. https://doi.org/10.1664/12-RA-015.1

Ashton PS (2010) Conservation of Borneo biodiversity: do small lowland parks have a role, or are big inland sanctuaries sufficient? Brunei as an example. Biodiversity and Conservation 19(2): 343–356. https://doi.org/10.1007/s10531-009-9717-0

Berry NJ, Phillips OL, Lewis SL, Hill JK, Edwards DP, Tawatao NB, Ahmad N, Magintan D, Khen CV, Maryati M, Ong RC, Hamer KC (2010) The high value of logged tropical forests: lessons from northern Borneo. Biodiversity and Conservation 19(4): 985–997. https://doi.org/10.1007/s10531-010-9779-z

Cassis G, Schuh RT (2012) Systematics, biodiversity, biogeography, and host associations of the Miridae (Insecta: Hemiptera: Heteroptera: Cimicomorpha). Annual Review of Entomology 57: 377–404. https://doi.org/10.1146/annurev-ento-121510-133533

Damken C, Wiesner J, Wahab RA (2017) Notes on the tiger beetles (Coleoptera: Carabidae: Cicindelinae) of Brunei Darussalam. 137. Contribution towards the knowledge of Cicindelinae. Insecta Mundi 0552: 1–15. https://digitalcommons.unl.edu/insectamundi/1043/

Davies SJ, Becker P (1996) Floristic composition and stand structure of mixed dipterocarp and heath forests in Brunei Darussalam. Journal of Tropical Forest Science 8: 542–569. http://www.jstor.org/stable/43582177

Davis NT (1955) Morphology of the female organs of reproduction in the Miridae (Hemiptera). Annals of the Entomological Society of America 48(3): 132–150. https://doi.org/10.1093/aesa/48.3.132

De Bruyn M, Stelbrink B, Morley RJ, Hall R, Carvalho GR, Cannon CH, van den Bergh G, Meijaard E, Metcalfe I, Boitani L, Maiorano L (2014) Borneo and Indochina are major evolutionary hotspots for Southeast Asian biodiversity. Systematic Biology 63(6): 879–901. https://doi.org/10.1093/sysbio/syu047

Giam X, Ng TH, Yap VB, Tan HT (2010) The extent of undiscovered species in Southeast Asia. Biodiversity and Conservation 19(4): 943–954. https://doi.org/10.1007/s10531-010-9792-2

Gnezdilov VM (2015) Description of a new genus and species of Hemisphaeriini from Brunei with an identification key to the Bornean species of the tribe (Hemiptera: Fulgoroidea: Issidae). Acta Entomologica Musei Nationalis Pragae 55(1): 9–18. https://www.biotaxa.org/AEMNP/article/view/12425

Gorczyca J (1999) On the *Euchilofulvius*-complex (Heteroptera: Miridae: Cylapinae). Genus 10(1): 1–12.

Gorczyca J (2006) A revision of the genus *Peritropis* Uhler 1891 from the Oriental Region (Hemiptera, Miridae, Cylapinae). Denisia 19: 401–422. https://www.zobodat.at/pdf/DENISIA_0019_0401-0422.pdf

Gossner MM, Damken C (2018) Diversity and ecology of saproxylic Hemiptera. In: Ulyshen M (Ed.) Saproxylic Insects. Springer, 263–317. https://doi.org/10.1007/978-3-319-75937-1_9

Hédl R, Svátek M, Dančák M, Rodzay AW, Salleh AB, Kamariah AS (2009) A new technique for inventory of permanent plots in tropical forests: a case study from lowland dipterocarp forest in Kuala Belalong, Brunei Darussalam. Blumea-Biodiversity, Evolution and Biogeography of Plants 54(1–2): 124–130. https://doi.org/10.3767/000651909X475482

Heiss E (2011) *Bruneiaptera tarmanni* nov. gen., nov. sp., a new apterous Carventinae from Brunei Darussalam (Hemiptera: Heteroptera: Aradidae). Linzer Biologische Beiträge 43(1): 331–336. https://www.zobodat.at/pdf/LBB_0043_1_0331-0336.pdf

Kim J, Damken C, Sah HHA, Jung S (2019) Notes on the genus *Kosmiomiris* Kirkaldy (Hemiptera: Miridae: Hyalopeplini) with description of a new species. Zootaxa 4657: 377–384. https://doi.org/10.11646/zootaxa.4657.2.10

Kočárek P, Wahab RA, Abdul Kahar SR (2017) *Zorotypus asymmetricus* sp. nov. from Brunei Darussalam, Borneo (Insecta: Zoraptera). Zootaxa 4286(2): 285–290. https://doi.org/10.11646/zootaxa.4286.2.11

Konstantinov FV (2003) Male genitalia in Miridae (Heteroptera) and their significance for suprageneric classification of the family. Part I: general review, Isometopinae and Psallopinae. Belgian Journal of Entomology 5: 3–36. http://www.srbe-kbve.be/cm/sites/default/files/publications/BJE/BJE%202003/BJE%202003%20vol%205%20%281-2%29%20Konstantinov.pdf

Myers N, Mittermeier RA, Mittermeier CG, Da Fonseca GA, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403(6772): 853–858. https://doi.org/10.1038/35002501

Namyatova AA, Cassis G (2019) Total-evidence phylogeny of the Rhinomirini, taxonomic review of its subgroupings (Insecta: Heteroptera: Miridae: Cylapinae) and description of new Australian taxa. Zoological Journal of the Linnean Society 187(4): 1196–1252. https://doi.org/10.1093/zoolinnean/zlz058

Namyatova AA, Contos P, Cassis G (2018) New species, taxonomy, phylogeny, and distribution of the tropical tribe Bothriomirini (Insecta: Heteroptera: Miridae: Cylapinae). Insect Systematics & Evolution 50(1): 83–146. https://doi.org/10.1163/1876312X-00002179

Pfeiffer M, Mezger D, Hosoishi S, Bakhtiar EY, Kohout RJ (2011) The Formicidae of Borneo (Insecta: Hymenoptera): a preliminary species list. Asian Myrmecology 4(1): 9–58. http://www.asian-myrmecology.org/publications/am04_9-58_pfeiffer_etal_2011.pdf

Schuh RT, Slater JA (1995) True Bugs of the World (Hemiptera: Heteroptera): Classification And Natural History. Cornell University Press, Ithaca, NY, 336 pp.

Ševčík J, Hippa H, Wahab RA (2014) Diversity of *Manota* Williston (Diptera, Mycetophilidae) in Ulu Temburong National Park, Brunei. ZooKeys 428: 57–77. https://doi.org/10.3897/zookeys.428.7912

Stork NE (1991) The composition of the arthropod fauna of Bornean lowland rain-forest trees. Journal of Tropical Ecology 7: 161–180. https://doi.org/10.1017/S0266467400005319

Tan MK, Gorochov AV, Wahab RA (2017) New taxa and notes of katydids from the tribe Meconematini (Orthoptera: Meconematinae) from Brunei Darussalam. Zootaxa 4337: 390–402. https://doi.org/10.11646/zootaxa.4337.3.4

Taszakowski A, Kim J, Damken C, Wahab RA, Herczek A, Jung S (2020) Two new genera and species of the Gigantometopini (Hemiptera, Heteroptera, Miridae, Isometopinae) from Borneo with remarks on the distribution of the tribe. ZooKeys 941: 71–89. https://doi.org/10.3897/zookeys.941.47432

Wolski A (2008) A new genus and two new species of Cylapinae from the Oriental Region (Heteroptera: Miridae). Polish Taxonomical Monographs 15: 155–162.

Wolski A (2010) Revision of the *Rhinocylapus*-group (Hemiptera: Heteroptera: Miridae: Cylapinae). Zootaxa 2653 (1): 1–36. https://doi.org/10.11646/zootaxa.2653.1.1

Wolski A, Gorczyca J (2006) A new species of the genus *Dashymenia* Poppius from Indonesia (Hemiptera: Miridae: Cylapinae). Polskie Pismo Entomologiczne 75(2): 329–332.

Wolski A, Gorczyca J (2007) A new species of the genus *Peritropis* from Brunei (Heteroptera: Miridae: Cylapinae). Genus 14: 71–75.

Wolski A, Gorczyca J (2011) *Rhinocylapoides brachypterus*, a new cylapine genus and species from Malaysia (Hemiptera: Heteroptera: Miridae). Zootaxa 3040(1): 19–24. https://doi.org/10.11646/zootaxa.3040.1.2

Wolski A, Gorczyca J (2012) Plant bugs of the tribe Bothriomirini (Hemiptera: Heteroptera: Miridae: Cylapinae) from the Oriental Region: descriptions of eight new species and keys to Oriental genera and species of *Bothriomiris* Kirkaldy, *Dashymenia* Poppius, and *Dashymeniella* Poppius. Zootaxa 3412(1): 1–41. https://doi.org/10.11646/zootaxa.3412.1.1

Wolski A, Gorczyca J, Yasunaga T (2018) Taxonomic review of the *bifenestratus* species group of the genus *Fulvius* Stål with descriptions of two new species (Hemiptera, Heteroptera, Miridae, Cylapinae). ZooKeys (796): 107–129. https://doi.org/10.3897/zookeys.796.21293

Yasunaga T (2000) The mirid subfamily Cylapinae (Heteroptera: Miridae), or fungal inhabiting plant bugs in Japan. Tijdschrift voor Entomologie 143(1–2): 183–209. https://doi.org/10.1163/22119434-99900044

Yasunaga T, Miyamoto S (2006) Second report on the Japanese cylapine plant bugs (Heteroptera, Miridae, Cylapinae), with descriptions of five new species. Denisia 19: 721–735. https://www.zobodat.at/pdf/DENISIA_0019_0721-0735.pdf

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New Coleoptera records from eastern Canada, with additions to the fauna of Manitoba, British Columbia, and Yukon Territory

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Abstract

One-hundred-eleven new provincial and territorial Coleoptera records are reported from New Brunswick (64), Nova Scotia (20), Prince Edward Island (5), Quebec (14), Manitoba (3), British Columbia (3), and Yukon Territory (2) for the 26 following families: Carabidae, Dytiscidae, Histeridae, Staphylinidae, Scarabaeidae, Buprestidae, Eucnemidae, Elateridae, Cantharidae, Erotylidae, Monotomidae, Cryptophagidae, Passandridae (first record of this family from New Brunswick), Laemophloeidae, Nitidulidae, Anamorphidae, Coccinellidae, Latridiidae, Mordellidae, Tenebrionidae, Cerambycidae, Chrysomelidae, Anthribidae, Brentidae, Dryophthoridae, and Curculionidae. Among these are ten new Canadian records: *Heterosternuta oppositus* (Say, 1823) (Dytiscidae) (New Brunswick), *Gyrophaena blatchleyi* Seevers, 1951 (Staphylinidae) (Quebec), *Acropteroxys lecontei* Crotch, 1873 (Erotylidae) (Manitoba), *Placonotus falinorum* Thomas, 2011 (Laemophloeidae) (Quebec), *Adelina pallida* (Say, 1824) (Tenebrionidae) (Quebec),

Poecilocera harrisii (J.L. LeConte, 1851) (Chrysomelidae) (New Brunswick), *Plesiobaris albilata* (LeConte, 1876) (Curculionidae) (Quebec, New Brunswick), *Pseudopityophthorus asperulus* (LeConte, 1868) (Curculionidae) (Nova Scotia), *Hylurgops palliatus* (Gyllenhal, 1813) (Curculionidae) (New Brunswick), and *Heteroborips seriatus* (Blandford, 1894) (Curculionidae) (Nova Scotia). *Plesiobaris disjuncta* Casey reported as new for Canada in New Brunswick and Quebec by Webster et al. (2012a) is actually *P. albilata* (LeConte) and thus *P. disjuncta* is removed from the faunal list of Canada. Eleven species from New Brunswick not previously reported in literature were found on the online platforms BugGuide.Net and iNaturalist and are reported in this publication. This highlights the importance of online platforms dedicated to recording wildlife observations and citizen science in detecting new species records. Data is also presented for seven species from Quebec and two species from New Brunswick reported by Bousquet et al. (2013) without any supporting information for their occurrence in these provinces. Among the species reported here, 32 are adventive.

Keywords

British Columbia, Canada, Coleoptera, Manitoba, New Brunswick, new records, Nova Scotia, Prince Edward Island, Quebec, Yukon Territory

Introduction

The Coleoptera of New Brunswick, Nova Scotia, and Quebec have received considerable attention since the publication of Bousquet et al. (1991) as shown by the significant increase in the number of known species from these three provinces in Table 1 in Bousquet et al. (2013). Another 303 species were added to the New Brunswick provincial list in "The Coleoptera of New Brunswick and Canada: Providing Baseline Biodiversity and Natural History Data" (Bouchard et al. 2016). Webster (2016) included an updated checklist for New Brunswick in this special issue of ZooKeys and reported 3,062 species. Additional species of Staphylinidae were reported from New Brunswick by Klimaszewski et al. (2017, 2018a, 2018b) (Aleocharinae) and Knopf and Gilmore (2018) (Staphylininae). A new coccinellid was added to the faunal list by McAlpine et al. (2018). The checklist by Bousquet et al. (2013) included 2,286 species for Nova Scotia and 4,127 for Quebec. Since then, many additional Coleoptera species have been reported from Quebec in a number of recent publications: Van Vondel and Alarie (2016) (Haliplidae), Brousseau et al. (2014) (Histeridae), Klimaszewski et al. (2018a, 2018b) (Staphylinidae, Aleocharinae), Sikes et al. (2016) (Silphidae), Hardy (2014) (Scarabaeidae), Jendek et al. (2015) (Buprestidae), Pelletier and Hébert (2014) (Cantharidae), Háva and Nei (2016) (Dermestidae), Lebel et al. (2019) (Cleridae), Bousquet and Bouchard (2014) and Steiner (2016) (Tenebrionidae), Bousquet et al. (2017) and Wappes and Santos-Silva (2019) (Cerambycidae), Barney et al. (2013) (Chrysomelidae), and de Tonnancour et al. (2017) and Dumont and de Tonnancour (2019) (Curculionoidea). A recent paper by Pentinsaari et al. (2019) using DNA barcoding added other new records from various families to all three provinces. Pelletier and Hébert (2019) reported many new Cryptophagidae (mostly *Atomaria*) to the above provincial faunal lists.

In this publication we report new records from New Brunswick, Nova Scotia, Prince Edward Island, Quebec, Manitoba, British Columbia, and Yukon Territory, including ten new Canadian records.

Methods and conventions

Collection methods

Various methods such as treading, sifting litter, hand collecting, and sweeping foliage were employed to collect the specimens reported in this publication. Details are outlined in Webster et al. (2009, appendix). Some specimens were collected from Lindgren funnel trap samples during a study to develop improved methods for detection of invasive species of Cerambycidae. These traps are visually similar to tree trunks and are often effective for sampling species of Coleoptera that live in microhabitats associated with standing trees (Lindgren 1983). Traps were baited with various combinations of lures used for detecting Cerambycidae and Scolytinae. See Hughes et al. (2014) and Webster et al. (2016a) for details of the lures used and methods used to deploy Lindgren traps and sample collection. Most specimens from Quebec were either swept or beaten from various plant species, attracted to mercury vapor, ultraviolet or porch lights or handpicked from various substrates or from a flight interception trap (window or tulle fabric). A description of the habitat was recorded for many specimens reported in this survey. Locality and habitat data are presented as written on the labels for each record except for habitat and collection method data recorded in French which were translated to English for Quebec records. Information is separated by a // in the data presented from each specimen where more than one label is present. GPS data are presented in decimal degrees.

Specimen preparation and determination

Males of some species were dissected to confirm their identities. The genital structures were dehydrated in absolute alcohol and either mounted in Canada balsam on celluloid microslides or glued onto cards that were then pinned with the specimen from which they originated. Most specimens reported in this study were determined by the authors by examination and comparison of specimens in the collections at the CNC and CMNC (Curculionidea) and using various keys such as Bousquet (2010) for Carabidae, Ashbee et al. (2017) for Haliplidae, Larsin (2000) for Dytiscidae and many other keys to families or genera in other publications cited in the species accounts in this publication. Species that could not be confidently determined were sent to experts at the CNC: Adam Brunke (Staphylinidae: Aleocharinae and Oxytelinae), Patrice Bouchard (Tenebrionidae), Anthony Davies (Nitidulidae, Staphylinidae, Paederinae), Hume Douglas (Elateridae, Chrysomelidae), Serge Laplante (Histeridae, Elateridae, Erotylidae, Laemophloeidae), and Karine Savard (Chrysomelidae). Other experts consulted were Donald Bright (Scolytinae, *Pityophthorus*) and the late Michael C. Thomas (Laemophloeidae).

Internet records

A number of species records from New Brunswick not previously recorded in Bousquet et al. (2013), Webster (2016), or other recent publications were found on BugGuide.Net and iNaturalist. Many are based on photographs of living adults and specimen vouchers are not available for further study. Only species for which determination could be confirmed by experts are reported in this paper. These records are reported in **bold** for New Brunswick (see below) under the **Distribution in Canada and Alaska** in order to note their presence in New Brunswick but are treated as previously reported records for the province by those who submitted them.

Distribution

All species are cited with current Distribution in Canada and Alaska, using abbreviations for the states, provinces, and territories. New provincial records are indicated in **bold** under the heading Distribution in Canada and Alaska. The following abbreviations are used in the text:

AK	Alaska
MB	Manitoba
YT	Yukon Territory
ON	Ontario
NT	Northwest Territories
QC	Quebec
NU	Nunavut
NB	New Brunswick
BC	British Columbia
PE	Prince Edward Island
AB	Alberta
NS	Nova Scotia
SK	Saskatchewan
NL & LB	Newfoundland and Labrador*

USA state abbreviations follow those of the US Postal Service.
Acronyms of collections referred to in this study are as follows:

AFC	Atlantic Forestry Centre, Fredericton, New Brunswick, Canada
CCC	Claude Chantal Collection (private collection), Varennes, Quebec, Canada
CFIADC	Canadian Food Inspection Agency Diagnostic Collection, Ottawa, Ontario, Canada

* Newfoundland and Labrador are each treated separately under the heading Distribution in Canada and Alaska.

CMNC	Canadian Museum of Nature Collection, Ottawa, Ontario, Canada
CNC	Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada Research Centre, Ottawa, Ontario, Canada
CTC	Claude Tessier Collection (private collection), Quebec, Quebec, Canada
NBM	New Brunswick Museum, Saint John, New Brunswick, Canada
PdTC	Pierre de Tonnancour Collection (private collection), Terrasse-Vaudreuil, Quebec, Canada
RWC	Reginald Webster Collection (private collection), Charters Settlement, New Brunswick, Canada
RVC	Robert Vigneault Collection (private collection), Oka, Quebec, Canada
SDC	Stéphane Dumont Collection (private collection), Montreal, Quebec, Canada

Results

One-hundred-eleven new provincial and territorial Coleoptera records are reported from NB (64), NS (20), PE (5), QC (14), MB (3) BC (3), and YT (2) from 26 families. Among these are ten new Canadian records. Eleven species from NB not included in published checklists or publications were found on BugGuide.Net and iNaturalist and are reported in this publication. Data is presented for seven species from QC and two species from NB reported by Bousquet et al (2013) without any supporting information for their occurrence in these provinces. We also remove *Plesiobaris disjuncta* Casey (Curculionidae) from the Canadian list (Bousquet et al. 2013) based on incorrectly identified specimens of *Plesiobaris albilata* (LeConte) from QC and NB (Webster et al. 2012a). Among the species reported here, 32 are adventive.

Species accounts

Species which are adventive to Canada are indicated with †, Holarctic species with *. The determination that a species record was new is based on absence from print version of Bousquet et al. (2013), Webster (2016), and other publications since Bousquet et al. (2013). The classification used below follows Bousquet et al. (2013), except for the Aleocharinae (Staphylinidae) which follows Klimaszewski et al. (2018b).

Family Carabidae Latreille, 1802
Subfamily Cicindelinae Latreille, 1802

***Cicindela scutellaris* Say, 1823, new to New Brunswick**

Note. The closest known localities for this tiger beetle are in central ME in Clinton, Fairfield, and Skowhegan (Dearborn et al. 2014). The NB population appears to be very

small; in addition to the four individuals that were captured on May 20, 2018, only 10 individuals were observed, including a mating pair. Six individuals were observed on May 25, 2018 at the same site, including another mating pair. This tiger beetle was not observed in adjacent open sandy areas with more coarse sand. The sand blowout with the fine sand where the specimens were observed is quite small (only a few hectares). Additional surveys should be conducted in open sandy areas in NB and adjacent parts of ME to see if this species is more widespread and occurs in intervening areas between the known populations. The subspecies in NB is *C. s. lecontei* Haldeman, 1853.

Specimen data. New Brunswick, York Co., Upper Brockway, 20.V.2018, R.P. Webster // Jack pine forest, large bare sand area (fine sand) (2, NBM, 2, RWC).

Distribution in Canada and Alaska. MB, ON, QC, **NB** (Bousquet et al. 2013).

Cicindela tranquebarica Herbst, 1806, new to Yukon Territory

Note. This species has a wide distribution across Canada from NF to NT (Bousquet et al. 2013) and its presence in YT was not unexpected. Adults were very common on moist clay along a trail through a native grassland area. The subspecies occurring in YT is likely *C. t. kirbyi* LeConte, 1867 which ranges east to MB (Bousquet et al. 2013).

Specimen data. Yukon Territory, 18 km N jct. Rtes. 1 & 2, W of Rt. 2, grassland area with poplar stands, 60.9571N, 135.1752W, 22.V.2016, R.P. Webster & M.-A. Giguère (8, RWC).

Distribution in Canada and Alaska. YT, NT, AB, SK, MB, ON, QC, NB, NS, PE, LB, NF (Bousquet et al. 2013).

Subfamily Harpalinae Bonelli, 1810

Chlaenius tomentosus (Say, 1823), new to New Brunswick

Note. This species was known to range as far northeast as Quebec City in Canada and to southwestern ME in the United States (Dearborn et al. 2014). The record from NB represents a significant range extension to the northeast. This xerophilous species is often found in gravel pits and other xeric habitats (Bousquet 2010, Dearborn et al. 2014). It is likely more widespread in the region and should be searched for in sandy dry habitats.

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8395N, 66.7391W, residential area, on driveway, 2.IX.2017, R.P. Webster (1, RWC).

Distribution in Canada and Alaska. AB, SK, MB, ON, QC, **NB** (Bousquet et al. 2013).

Acupalpus pumilus Lindroth, 1968, new to New Brunswick

Specimen data: New Brunswick, Queens Co., Scotchtown, Grand Lake Meadows P.N.A. (Protected Natural Area), 45.8763N, 66.1822W, 16.VI.2013, R.P. Webster

// Lakeshore / sand dune with red oak, sifting flood debris (1, RWC). **York Co.**, 8.5 km W of Tracy off Rte. 645, 45.6821N, 66.7894W, 6.V.2008, R.P. Webster, coll. // Wet alder swamp in leaf litter & grass on hummocks (1, NBM); Spednic Lake P.N.A. near Diggity Stream (and Pats Brook), 45.6210N, 67.4342W, 15.VI.2018 (4), 16.VI.2018 (2), R.P. Webster // Freshwater marsh, treading *Carex* hummocks (2, NBM; 4, RWC); Spednic Lake Prov. Park, 45.6183N, 67.4276W, 20.VI.2018, R.P. Webster // Marsh near Diggity Stream, treading *Carex* & grass into water (11, NBM; 6, RWC).

Distribution in Canada and Alaska. ON, QC, **NB**, NS, PE (Bousquet et al. 2013).

Anisodactylus merula (Germar, 1824), new to New Brunswick

Note. This carabid is widespread in southern ME with one isolated record from Columbia Falls in Washington Co. in eastern ME (Dearborn et al. 2014).

Specimen data. New Brunswick, York Co., Spednic Lake P.N.A., trail S of East Brook Rd., 45.6716N, 67.4576W, 21.VI.2018, R.P. Webster // Sand pit, under leaves on sand (1, NBM; 1, RWC).

Distribution in Canada and Alaska. MB, ON, QC, **NB** (Bousquet et al. 2013).

Stenolophus humidus Hamilton, 1893, new to New Brunswick

Specimen data. New Brunswick, York Co., Spednic Lake P.N.A., East Brook Rd., 45.6745N, 67.4605W, 21.VI.2018, R.P. Webster // Brook with marshy margin, treading vegetation (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB,** NS (Bousquet et al. 2013).

Cymindis platicollis (Say, 1823), new to New Brunswick

Note. *Cymindis platicollis* has been recorded as far north as southern QC at Mt. St. Gregoire and Iberville, and in southern ME at Appleton (Dearborn et al. 2014). The records from NB are a significant range extension to the northeast. Most specimens were captured in Lindgren funnel traps deployed in tree canopies in mixed forests.

Specimen data. New Brunswick, Queens Co., C.F.B. Gagetown, 45.7516N, 66.1866W, 18.VII–31.VIII.2018, C. Alderson & V. Webster // Old mixed forest with *Quercus rubra*, Lindgren funnel trap 1 m high under trees (1, AFC). **York Co.**, Spednic Lake P.N.A., 45.6751N, 67.4726W, 24.V–6.VI.2018 (3), 21.VI–4.VII.2018 (1), 31.VII–16.VIII.2018 (1), 16–30.VIII.2018 (4), 30.VIII–12.IX.2018 (3), C. Alderson & V. Webster // Mixed forest, Lindgren funnel traps in tree canopies (2, AFC; 3, NBM; 7, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

***Colliuris pensylvanica* (Linnaeus, 1758), new to New Brunswick**

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8395N, 66.7391W, 3.VII.2016, R.P. Webster // Residential lawn, in grass (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

***Pterostichus brevicornis* (Kirby, 1837)*, new to New Brunswick**

Specimen data. New Brunswick, Restigouche Co., Mount Atkinson, 447 m elev., 47.8192N, 68.2618W, 21.VII.2010, M. Turgeon & R.P. Webster // Boreal forest, small shaded spring-fed brook with mossy margin, sifting moss (1, RWC).

Distribution in Canada and Alaska. AK, YT, NT, NU, BC, AB, MB, ON, QC, **NB**, LB, NF (Bousquet et al. 2013).

Family Haliplidae Aubé, 1836

***Haliplus apostolicus* Wallis, 1933, new to New Brunswick**

Specimen data. New Brunswick, Sunbury Co., Sand Brook Rd. at Sand Brook, 45.4984N, 66.6014W, 18.IX.2017, R.P. Webster // Stream margin in dense trailing vegetation in embayment (1, RWC).

Distribution in Canada and Alaska. QC, **NB**, NS (Bousquet et al. 2013).

Family Dytiscidae Leach, 1815
Subfamily Hydroporinae Aubé, 1836

***Heterosternuta oppositus* (Say, 1823), new to Canada and New Brunswick**

Note. Matta and Wolfe (1981) included this species as occurring in eastern Canada but did not provide any supporting data. Larson et al. (2000) did not see Canadian specimens and Bousquet et al. (2013) did not include it as a member of the Canadian fauna. Here, we provide supporting data for its occurrence in Canada.

Specimen data. New Brunswick, Restigouche Co., Jacquet River Gorge P.N.A., 47.8010N, 66.0962W, 15.VIII.2010, R.P. Webster // Margin of Jacquet River, backwater pool with gravel/clay bottom (1, RWC).

Distribution in Canada and Alaska. NB

***Hydroporus morio* Aubé, 1838*, new to New Brunswick**

Specimen data. New Brunswick, Carleton Co., Juniper Barrens at Juniper Station, 46.5534N, 67.1847W, 21.VI.2005, R.P. Webster, coll. // Black spruce bog, shaded

moss-lined pool (1, RWC). **York Co**., 14 km WSW of Tracy, S of Rt. 645, 45.6741N, 66.8861W, 10–26.V.2010, R. Webster & C. MacKay, coll. // Old mixed forest with red & white spruce, red & white pine, balsam fir, eastern white cedar, and *Populus* sp., Lindgren funnel trap (1, RWC).

Distribution in Canada and Alaska. AK, YT, NT, NU, BC, AB, SK, MB, ON, QC, **NB**, NS, LB, NF (Bousquet et al. 2013).

Sanfilippodytes planiusculus (Fall, 1923), new to New Brunswick

Specimen data. New Brunswick, Restigouche Co., 1.5 km S of Quebec (border), 425 m elev., 47.9058N, 68.1505W, 22.VI.2010, R.P. Webster, coll. // Boreal forest, small cold shaded brook, in gravel in brook (1, RWC).

Distribution in Canada and Alaska. QC, **NB**, LB, NF (Bousquet et al. 2013).

Family Histeridae Gyllenhal, 1808
Subfamily Dendrophilinae Reitter, 1909

Paromalus seeversi (Wenzel, 1936), new supporting data for Quebec

Note. The first Canadian record of *Paromalus seeversi* was based on a single collection made in 1967, in Essex Co., ON (Bousquet and Laplante 2006). Included by Bousquet and Laplante (2000) in a list of species that may eventually be found in QC, this species was later recorded from this province by Bousquet et al. (2013) based on four specimens (reported below) from Terrasse-Vaudreuil collected by P. de Tonnancour, in 2013. Subsequently, numerous additional individuals were found in moist organic debris samples extracted from two hollow trees [silver maple (*Acer saccharinum* L.) and American linden (*Tilia americana* L.)] in a suburban residential area. This microhabitat matches closely the description given by Kovarik and Caterino (2001). Under-sampling undoubtedly explains the rarity of this species and other cavity dwelling histerids in collections.

Specimen data. Quebec, MRC de Vaudreuil-Soulanges, Terrasse-Vaudreuil, 45.3924N, 73.9921W, 3.VII.2013 (4), 16.VIII.2018 (1), 19.VIII.2018 (3), 22.VIII.2018 (1), 23.VIII.2018 (14), 27.VIII.2018 (12), 4.IX.2018 (6), 5.IX.2018 (8), 19.VII.2019 (8), P. de Tonnancour, moist organic debris (rotten *Cerioporus squamosus*) extracted from a tree cavity of an old *Acer saccharinum* (2, CCC; 4, CMNC; 4, CNC; 37, PdTC; 8, RVC; 2, SDC); same collector but Terrasse-Vaudreuil, 45.3926N, 73.9929W, 9.VII.2019, moist organic debris extracted from a hollow trunk section of a large *Tilia americana* occupied by red squirrels, 8 m above ground (17, PdTC).

Distribution in Canada and Alaska. ON, QC (Bousquet et al. 2013).

Family Staphylinidae Latreille, 1802
Subfamily Pselaphinae Latreille, 1802

***Euplectus karstenii* (Reichenbach, 1816) †, new to New Brunswick**

Note. Wagner (1975) reported this adventive species from well-rotted haystacks, corncob piles, horse manure, and occasionally from tree holes. The two NB specimens were captured in Lindgren funnel traps in conifer forests.

Specimen data. New Brunswick, Sunbury Co., Acadia Research Forest, 45.9868N, 66.3841W, 13–21.VII.2009, R.P. Webster & M.-A. Giguère, coll. // Red spruce forest with red maple & balsam fir, Lindgren funnel trap (1 ♀♂ (dissected), RWC). **York Co.**, Fredericton, Odell Park, 45.9571N, 66.6650W, 15–28.VI.2012, C. Alderson & V. Webster // Old-growth hemlock forest, Lindgren funnel trap in canopy of *Betula alleghaniensis* (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. BC, SK, MB, ON, QC, **NB**, PE (Bousquet et al. 2013).

Subfamily Aleocharinae Fleming, 1821

***Philhygra pseudopolaris* Klimaszewski and Langor, 2011, new to British Columbia**

Note. The BC specimens were collected by treading emergent grasses and sedges in a small pond. Nothing was previously known about the habitat associations of this species (Klimaszewski et al. 2018b).

Specimen data. British Columbia, Rt. 97 near Smart River, 59.9326N, 131.7556W, 6.VI.2019, R.P. Webster // Small pond with emergent grasses & sedges (2 ♂♂ (dissected), 3 ♀♀ (dissected), RWC).

Distribution in Canada and Alaska. AK, YT, NT, **BC**, MB, QC, NF (Klimaszewski et al. 2018b).

***Gyrophaena blatchleyi* Seevers, 1951, new to Canada and Quebec**

Note. This species has been reported from MI and IN in the United States (Seevers 1978; Enushchenko 2017). The record reported here is the first for Canada and represents a significant range extension to the northeast. The initial determination made by Tim Struyve was confirmed by Adam Brunke.

Specimen data: Canada, Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, Calvaire d'Oka, 25.VI.2016, R. Vigneault (1 ♂ (dissected), RVC).

Distribution in Canada and Alaska. QC.

Calodera parviceps (Casey, 1893) new to British Columbia

Specimen data. British Columbia, Rt. 97 near Smart River, 59.9326N, 131.7556W, 6.VI.2019, R.P. Webster // Small pond with emergent grasses & sedges (1 ♀ (dissected), RWC).

Distribution in Canada and Alaska. YT, **BC**, ON, NB, NS (Klimaszewski et al. 2018b).

Phloeopora canadensis Klimaszewski and Langor, 2011, new to Nova Scotia

Specimen data. Nova Scotia, Annapolis Co., Kejimkujik N.P., 44.40366N, 65.21969W, 13–30.VIII.2018, Elyse Simms, coll. // Mixed forest, Lindgren funnel trap, Trap 3 (1, AFC). **Queens Co.**, Kejimkujik N.P., 44.38505N, 65.20715W, 30.VII–13.VIII.2018, G. Marten-Carpenter, coll. // Mixed forest, Lindgren funnel trap, Trap 10 (1, AFC).

Distribution in Canada and Alaska. BC (CNC, Klimaszewski et al. 2020), NB, **NS**, NF (Klimaszewski et al. 2018b).

Subfamily Oxytelinae Fleming, 1821

Anotylus suspectus (Casey, 1893), new to New Brunswick

Note. All specimens were sifted from material from a large nest of a black *Formica* ant species. R. P. Webster has not found this species elsewhere in NB in ant nests. It is unclear if this species is normally associated with ants.

Specimen data. New Brunswick, Carleton Co., Meduxnekeag Valley Nature Preserve, 46.1979N, 67.6854W, 21.V.2005, M.-A. Giguère & R.P. Webster, coll. // Mixed forest, in large nest of black *Formica* species (8, RWC), same data as above but 4.V.2008, R.P. Webster, coll. (2, RWC).

Distribution in Canada and Alaska. MB, ON, **NB** (Bousquet et al. 2013).

Anotylus tetracarinatus (Block, 1799) †, new to New Brunswick

Note. The adventive *Anotylus tetracarinatus* was newly reported from NB by Webster et al. (2012e). Re-examination of these specimens revealed that they are a different species, tentatively determined by Adam Brunke as *A. nanus* Erichson, 1840. Until a proper review of the native species is completed this determination is considered tentative (Brunke, pers. com.). One specimen of *A. tetracarinatus* (determined by Adam Brunke and reported below) was recently collected from compost, maintaining this species on the faunal list of NB.

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8395N, 66.7391W, 17.V.2018, R.P. Webster // Mixed forest, in decaying corncobs & cornhusks (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. BC, AB, ON, QC, **NB**, NS (Bousquet et al. 2013).

Carpelimus erichsoni (Sharp, 1871) †, new to Quebec

Note. This adventive species is listed by Schülke and Smetana (2015) as widely distributed in southern Europe from Russia (Southern Territory) and Yugoslavia south to Algeria and east to the Netherlands and Belgium. It was recently reported from North America from Charters Settlement, NB by Webster et al. (2016b). The specimen reported below was collected at light. The initial determination made by Tim Struyve was confirmed by Adam Brunke.

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, 19.VI.2016, R. Vigneault, deciduous forest near beach, attracted to mercury vapor lamp (1 ♂ (dissected), RVC).

Distribution in Canada and Alaska. QC, NB (Webster et al. 2016b).

Carpelimus gracilis (Mannerheim, 1830) †, new to Quebec

Note. This adventive species has long been known to occur in North America (Fauvel 1889) but was reported only recently from Canada, in NB (Webster et al. 2016b). The specimen recorded below was collected with a car net along a road running through a deciduous forest. The initial determination made by Tim Struyve was confirmed by Adam Brunke.

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, chemin des Collines, 12.VII.2016, T. Struyve, car net (1 ♂ (dissected), RVC).

Distribution in Canada and Alaska. QC, NB (Webster et al. 2016b).

Oxytelus nimius Casey, 1893, new to New Brunswick

Note. Most NB specimens were collected from horse or deer dung. One was found among debris in the entrance of a woodchuck or groundhog [*Marmota monax* (L.)] burrow.

Specimen data. New Brunswick, York Co., Keswick Ridge, 45.9962N, 66.8781W, 25.V.2015, R.P. Webster // Old field / forest margin, entrance to *Marmota monax* (L.) burrow (1, RWC); Charters Settlement, 45.8349N, 66.7436W, 8.V.2018, R.P. Webster // Old brushy field, in horse dung on gravel road (1, RWC); same locality but, 45.8447N, 66.7292W, 28.V.2018, R.P. Webster // Mixed forest in deer dung (5, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Subfamily Steninae MacLeay, 1825

***Stenus quebecensis* Puthz, 1971, new to Yukon Territory**

Note. This species has a wide distribution from NF to AK (Bousquet et al. 2013) and its presence in YT was not unexpected. The two specimens were collected from emergent sedges in a gravel pit pond.

Specimen data. Yukon Territory, 47 km W of Watson Lake off Rt.1, 60.1313N, 129.5523W, 5.VI.2019, R.P. Webster // Gravel pit pond with emergent sedges (1 ♂, 1 ♀ (dissected), RWC).

Distribution in Canada and Alaska. AK, **YT**, NT, BC, AB, SK, MB, ON, QC, NB, NS, NF (Bousquet et al. 2013).

***Stenus niveus* Fauvel, 1865*, new to British Columbia, new supporting data for New Brunswick**

Note. *Stenus niveus* was reported from NB by Bousquet et al. (2013) on the basis of the record below. This species is reported for the first time from BC. Adults were tread from *Sphagnum* and *Carex* hummocks in NB and emergent grasses and *Carex* on the margin of a pond in BC.

Specimen data. New Brunswick, Charlotte Co., near New River, 7.VII. 2006, 13.VI.2008, 45.2118N, 66.6179W, R.P. Webster, coll. // Small marsh, treading *Sphagnum* & *Carex* hummocks into water (3 ♂, 1 ♀ (dissected), RWC).

British Columbia, Rt. 97 near Smart River, 59.9326N, 131.7556W, 6.VI.2019, R.P. Webster // Small pond with emergent grasses & sedges (1 ♀ (dissected), RWC).

Distribution in Canada and Alaska. AK, YT, NT, **BC**, MB, NB (Bousquet et al. 2013).

Subfamily Paederinae Fleming, 1821

***Pseudolathra ambigua* (LeConte, 1880), new to New Brunswick**

Specimen data. New Brunswick, York Co., Douglas, Currie Mountain, 45.9844N, 66.7592W, 19.VIII–6.IX.2013, C. Hughes & V. Webster // Mixed forest with *Quercus rubra*, Lindgren funnel trap in canopy of *Q. rubra* (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

***Tetartopeus tetricus* Casey, 1905, new to New Brunswick**

Note. Watrous (1980) reported *Tetartopeus tetricus* from NH and VT but it has not yet been reported from ME (Majka et al. 2011). Watrous (1980) notes that *Tetartopeus* species are usually found in wetland habitats and occur among damp leaf litter,

moss, and other debris along streams, marshes, bogs, ponds, including vernal ponds in swamps and forests, but he does not provide any details of the microhabitat associations for *T. tetricus*. Most NB specimens of *T. tetricus* were found among moist leaves on the margin of a vernal pond in a mixed forest. The first author has found this species in very similar habitats in RI.

Specimen data. New Brunswick, York Co., Spednic Lake P.N.A., East Brook Rd., 45.6752N, 67.4739W, 9.V.2018 (3), 21.VI.2018 (1), R.P. Webster // Mixed forest, vernal pond margin in leaf litter (1 ♀, NBM; 1 ♂, 2 ♀♀ (dissected), RWC); Spednic Lake P.N.A., 45.6980N, 67.4982W, 12.VI.2018, R.P. Webster & M.-A. Giguère // Stream margin, in gravel / sand (1 ♂, NBM).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Subfamily Staphylininae Latreille, 1802

Erichsonius civicus Frank, 1975, new to New Brunswick

Note. *Erichsonius civicus* has been recorded from NH and NY south to GA and LA (Frank 1975) and FL (Frank 1981) but has not yet been recorded from ME (Majka et al. 2011). Specimens reported below were collected from bare mud and treading vegetation in a marsh along the margin of a slow flowing stream. One individual was collected from moist leaves on a vernal pond margin, another was captured in a Lindgren funnel trap adjacent to a marsh. This species was collected from May to August.

Specimen data. New Brunswick, York Co., Dumfries, Slagundy Dry Ponds, 45.85960N, 67.18490W, 8.VII.2008, R.P. Webster, coll. // Large vernal pond, in moist leaves near water (1 ♂ (dissected), NBM); Spednic Lake P.N.A., near Diggity Stream, 45.6205N, 67.4319W, 10.VIII.2017, R.P. Webster // Marsh near slow flowing stream, on bare mud (5) and treading vegetation (2) (5 ♂♂ , 2 ♀♀ (dissected), RWC); Spednic Lake P.N.A., near Pats Brook, 45.6210N, 67.4342W, 16.VI.2018, R.P. Webster // Freshwater marsh with slow flowing stream with emergent vegetation, treading vegetation (1, RWC); Spednic Lake P.N.A., Palfrey Stream at East Brook Rd., 45.6988N, 67.4987W, 21.VIII.2017, R.P. Webster & M.-A. Giguère // Rocky to gravel stream margin, under rock near alders (1 ♂ (dissected), NBM); Spednic Lake P.N.A., Small stream at East Brook Rd., 45.6982N, 67.4969W, 20.VI.2018, R.P. Webster // Brook with marshy margin, treading vegetation (1, RWC); Spednic Lake P.N.A., 45.6201N, 67.4297W, 10–24.V.2018, C. Alderson & V. Webster // Marsh margin near mixed forest, Lindgren funnel trap 1 m above ground on red maple (1 ♂ (dissected), NBM).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Hesperus apicialis (Say, 1830), new to Nova Scotia

Specimen data. Nova Scotia, Annapolis Co., Kejimkujik N.P., 44.39812N, 65.23401W, 30.VII–13.VIII.2018, G. Marten-Carpenter, coll. // Mixed forest, Lindgren funnel trap, Trap 7 (1, AFC); Kejimkujik N.P., 44.40317N, 65.24613W, 30.VI-

II–28.X.2018, Donna Crossland, coll. // Mixed forest, Lindgren funnel trap, Trap 8 (1, AFC). **Queens Co.**, Kejimkujik N.P., 44.38505N, 65.20715W, 13–30.VIII.2018, Elyse Simms, coll. // Mixed forest, Lindgren funnel trap, Trap 10 (1, AFC).

Distribution in Canada and Alaska. ON, QC, NB, **NS** (Bousquet et al. 2013).

Family Scarabaeidae Latreille, 1802
Subfamily Aphodiinae Leach, 1815

***Diapterna pinguis* (Haldeman, 1848)**

Diapterna pinguis was reported for the first time from NB by Webster et al. (2012c) on the basis of a specimen from Cranberry Lake P.N.A. in Queens County. This specimen was misidentified and is *D. hyperborea* (LeConte, 1850) (Andrew Smith, pers. comm.). Andrew Smith noted that there is a NB specimen of *D. pinguis* in the CNC from Tabusintac (Northumberland County) collected by W.J. Brown on June 27, 1939, and thus maintaining the species on the NB faunal list.

Subfamily Melolonthinae Leach, 1819

***Serica elusa* Dawson, 1919, new to New Brunswick**

Specimen data. New Brunswick, York Co., Kingsclear, 45.9456N, 66.7948W, 29.VI–5.VII.2016 (1), 6–14.VII.2016 (3), C. Alderson & V. Webster // Mixed forest, Lindgren funnel trap 1 m above ground (4 ♂♂ (dissected), AFC); same locality and habitat data and collectors but 13.VIII.2018, white light trap (1 ♂ (dissected), NBM); Spednic Lake P.N.A., 45.6751N, 67.4726W, 6–21.VI.2018, C. Alderson & V. Webster // Mixed forest, Lindgren funnel trap in tree canopy (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Family Buprestidae Leach, 1815
Subfamily Agrilinae Laporte, 1835

***Agrilus arcuatus* (Say, 1825), new to Nova Scotia**

Note. *Agrilus arcuatus* was common at Magazine Hill with 95 individuals captured in Lindgren funnel traps during 2018. American beech (*Fagus grandifolia* Ehrh.), a known host of this species (Paiero et al. 2012), was common at this site.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 1.VIII.2016, coll., K. Van Rooyen & N. Higgins (1, AFC); same locality data but 8–16.VII.2018, 16–23.VII.2018, K. Van Rooyen & J. Palmer // Hardwood dominated forest, Green Lindgren funnel trap in tree canopy (2 ♂♂ (dissected), AFC).

Distribution in Canada and Alaska. SK, MB, ON, QC, NB, **NS** (Bousquet et al. 2013).

***Agrilus bilineatus* (Weber, 1801), new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 27.VI.2016 (1), 11.VII.2016 (1), 25.VII.2016 (1), 22.VIII.2016, coll., K. Van Rooyen & N. Higgins (4, AFC).

Distribution in Canada and Alaska. MB, ON, QC, NB, **NS** (Bousquet et al 2013).

***Agrilus cyanescens cyanescens* (Ratzeburg, 1837) †**

This adventive buprestid species was reported for the first time from NB on BugGuide.Net by Denis A. Doucet from near the Fundy National Park Headquarters, Albert Co. based on a photo taken on July 12, 2015. See https://bugguide.net/node/view/1107551. Eduard Jendek (Canadian Food Inspection Agency) confirmed the determination.

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

***Agrilus egenus* Gory, 1841, new to New Brunswick**

Note. Black locust (*Robinia pseudoacacia* L.), which was planted at this site on mine tailings, is host of this species (Paiero et al. 2012).

Specimen data. New Brunswick, Queens Co., Rt. 690 near Flowers Cove, 46.0367N, 66.0376W, 16.VI.2013, M.-A. Giguère & R.P. Webster // Roadside stand of *Robinia pseudoacacia* L., beating *Robinia* foliage (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

***Agrilus obsoletoguttatus* Gory, 1841, new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 4–11.VII.2016 (1), 2–8.VII.2018 (1), 16–23.VII.2018 (2), K. Van Rooyen & J. Palmer // Hardwood dominated forest, green Lindgren funnel trap in tree canopy (4 (2 ♂♂ dissected), AFC)

Distribution in Canada and Alaska. ON, QC, NB, **NS** (Bousquet et al. 2013).

***Agrilus planipennis* Fairmaire, 1888 †, new to New Brunswick, Nova Scotia, and Manitoba**

Note. The emerald ash borer, *Agrilus planipennis,* native to Asia, was first detected in North America in Detroit, MI and Windsor, ON in July 2002. As of February 2020,

A. planipennis had been detected in 35 states in the USA (from CO to ME), and in five Canadian provinces (EAB Information Network http://www.emeraldashborer.info/about-eab.php). This invasive species has killed millions of ash trees (*Fraxinus* spp.) trees in North America; its spread has been exacerbated by human movement of infested material such as firewood (Herms and McCullough 2014). Here, we report data on its occurrence in NB, NS, and MB. Some of the new records reported below are based on larval collections from symptomatic *Fraxinus* trees and adults reared from infested *Fraxinus pennsylvanica* Marsh. bolts.

Specimen data. Manitoba, Winnipeg, 582 Cote Street, 49.87705N, 97.09884W, 9.XI.2017 (larval collection date), Jason Watts (2 larvae, CFIADC). **New Brunswick, Madawaska Co**., Edmundston, 633 rue St-Francois, 47.35824N, 68.360050W, 7-V-2018 (larval collection date), Bernard Michaud, coll. (16 larvae, CFIADC); same locality but 47.3580N, 68.3607W, 19.VII.2018 (adult emergence date) (*Fraxinus pennsylvanica* bolts collected May 2018), K. Van Rooyen & J. Palmer, coll. (6 adults, AFC). **Sunbury Co.,** Oromocto Highway exit, Waasis Rd. and Restigouche Road; 45.84420N, 66.510310W, 16-VII-2019, Aaron Perry, green sticky prism trap baited with Z3-hexenol + lactone (1 adult, CFIADC). **Westmoreland Co.**, Moncton, 50 Hastings Street, 46.10323N, 64.820200W, 20-VII-2019, Matt Linton, green prism trap (2 adults, CFIADC). **Nova Scotia, Halifax Co.**, Bedford, 91 Waterfront Drive, 44.71975N, 63.671530W, 7-IX-2018 (larval collection date), Ron Neville (1 larva, CFIADC); Bedford, DeWolfe Park, 44.71705N, 63.67117W, ex. *Fraxinus pennsylvanica* bolts collected Nov. 2018, Sweeney Crew (3 adults, AFC).

Distribution in Canada and Alaska. ON, QC, **MB, NB, NS** (Bousquet et al. 2013).

Family Eucnemidae Eschscholtz, 1829
Subfamily Melasinae Fleming, 1821

Dirrhagofarsus ernae Otto, Muona & McClarin, 2014 †, new to Nova Scotia

Note. *Dirrhagofarsus ernae* was newly reported from Canada and NB by Webster et al. (2016c). Although this species was described from OH, it is thought to be an introduction to North America from Asia (Otto et al. 2014). This species is widespread in the eastern United States and appears to be common in NB (Webster et al. 2016c). Its presence in NS is not unexpected.

Specimen data. Nova Scotia, Queens Co., Kejimkujik N.P., 44.38505N, 65.20715W, 30.VII–13.VIII.2018, G. Marten-Carpenter, coll. // Mixed forest, Lindgren funnel trap, Trap 10 (1, AFC).

Distribution in Canada and Alaska. NB, **NS** (Webster et al. 2016c).

Family Elateridae Leach, 1815
Subfamily Elaterinae Leach, 1815

***Ampedus melsheimeri* (Leng, 1918), new to New Brunswick**

Specimen data. New Brunswick, Gloucester Co., Bathurst, Daly Point Reserve, 47.6392N, 65.6098W, 28.V–15.VI.2015, C. Alderson & V. Webster // Mixed forest, purple Lindgren funnel trap 1 m high (1, RWC). **York Co.**, Douglas, Currie Mountain, 45.9832N, 66.7564W, 24.VI–9.VII.2013, C. Alderson & V. Webster // Old *Pinus strobus* stand, Lindgren funnel trap in canopy of *P. strobus* (1, RWC); Fredericton, Odell Park, 29.VI–14.VII.2015 (1), 14–28.VII.2015 (2), 28.VII–10.VIII.2015 (1), C. Alderson & V. Webster // Hardwood forest, Lindgren funnel traps in canopy of hardwoods (4, RWC).

Distribution in Canada and Alaska. SK, MB, ON, QC, **NB**, NS (Bousquet et al. 2013).

Family Cantharidae Imhoff, 1856
Subfamily Cantharinae Imhoff, 1856

***Rhagonycha hirticula* (Green, 1941), new to New Brunswick**

Note. Adults were swept from vegetation in freshwater marshes, a salt marsh, a calcareous fen, along the margin of a salt spring, and along a trail through a mixed forest. Two individuals were captured in Lindgren funnel traps in the canopy of trees in hardwood forests, and one from traps in a jack pine (*Pinus banksiana* Lamb.) forest. Nothing was previously known about the habitat associations of this species (Pelletier and Hébert 2014).

Specimen data. New Brunswick, Albert Co., Shepody N.W.A., Mary's Point Section, 45.7320N, 64.6765W, 29.VI.2004, R.P. Webster, coll. // Margin of salt marsh, sweeping foliage (1, RWC). **Carleton Co.**, Jackson Falls, Bell Forest, 46.2200N, 67.7231W, 17–31.VII.2012, C. Alderson & V. Webster // Rich Appalachian hardwood forest, Lindgren funnel trap in canopy of *Tilia americana* (1 female, RWC). **Northumberland Co.**, ca. 2.5 km W of Sevogle, 47.0876N, 65.8613W, 26.VI–6.VII.2013, C. Alderson & V. Webster // Old *Pinus banksiana* forest, Lindgren funnel trap (1, RWC). **Sunbury Co.**, off Coy Rd., Grand Lake Meadows P.N.A., 45.9804N, 66.1824W, 20.VI.2013, R.P. Webster / Trail through mixed forest, sweeping vegetation (alders, willows, sweet fern & blueberry) (1, RWC). **Westmorland Co.**, off Fawcett Hill Rd., 45.9719N, 65.2249W, 19.VI.2012, R.P. Webster & D. Sabine // Salt spring, sweeping vegetation (1, RWC). **York Co.**, Charters Settlement, 45.8395N, 66.7391W, 20.VI.2012, 14.VII.2012, R.P. Webster // mixed forest, m.v. light (2 females, RWC); Charters Settlement, 45.8451N, 66.7289W, 17.VI.2018, R.P. Webster // Marsh below beaver dam, sweeping foliage (5, RWC); Charters Settlement, 45.8346N, 66.7328W, 17.VI.2018, R.P. Webster // Marsh / alder swamp, sweeping vegetation (2, RWC); Fredericton, Odell Park, 45.9539N,

66.6666W, 9–24.VII.2013, C. Alderson & V. Webster // Hardwood stand, Lindgren funnel trap in canopy (1, NBM); Canterbury, Eel River P.N.A., 45.8967N, 67.6343W, 23.VI.2014, R.P. Webster // Calcareous fen with shrubby cinquefoil, sweeping vegetation with *Myrica gale* & Labrador tea (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Pelletier & Hébert 2014).

Family Melyridae Leach, 1815
Subfamily Malachiinae Fleming, 1821

***Anthocomus equestris* (Fabricius, 1781) †**

This distinctive looking adventive species was reported for the first time from NB from Nasonworth, York Co. in BugGuide.Net by Eric Knopf. See https://bugguide.net/node/view/1236752. This individual was photographed on June 7, 2016. A voucher specimen was not collected.

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Family Erotylidae Latreille, 1802
Subfamily Loberinae Bruce, 1951

***Loberus impressus* LeConte, 1863, new to Quebec**

Note. Bousquet et al. (2013) report this species only from ON, but a photograph taken by Alain Hogue in Salaberry-de-Valleyfield, QC in 2015, 30 km north of the USA border (https://bugguide.net/node/view/1073833/bgimage), and the numerous specimens reported below confirm its presence in QC.

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, composting site, 45.4764N, 74.0545W, 30.V.2016, 19 h 30–20 h 30, P. de Tonnancour, flight interception trap (white tulle fabric) (2, PdTC). **MRC Le Fjord-du-Saguenay,** parc national des Monts-Valin, 48.5783N, 70.8773W, 10.VIII.2016, 21–24 h, P. de Tonnancour, attracted to mercury vapor lamp (1, PdTC). **MRC de Vaudreuil-Soulanges,** Notre-Dame-de-l'Île-Perrot, 45.3787N, 73.9426W, 19.V.2011, 14 h, P. de Tonnancour, swept from *Trifolium repens* (1, PdTC); Notre-Dame-de-l'Île-Perrot, 45.3766N, 73.9438W, 8.VII.2013, 15 h, P. de Tonnancour, swept from *Scirpus atrovirens* (1, PdTC); Notre-Dame-de-l'Île-Perrot, 45.3702N, 73.9592W, 13.IX.2018, 15 h, P. de Tonnancour, beaten from *Carya ovata* (1, PdTC); Notre-Dame-de-l'Île-Perrot, 45.3781N, 73.9396W, 18.VIII.2019, 13 h, P. de Tonnancour, swept from herbaceous plants (1, PdTC); Pointe-des-Cascades, parc nature de Pointe-des-Cascades, 45.3331N, 73.9557W, 1.VII.2013, 16 h, P. de Tonnancour, swept from herbaceous plants, marsh margin (4, PdTC; 2, RVC); Terrasse-Vaudreuil, 45.3923N, 73.9922W, 7.VI.2011, 22–24 h (1), 17.V.2017, 21–22 h (1), P. de Tonnancour, attracted to porch + UV lamps (2, PdTC); same locality data and collector but 21.VIII.2013, 1 h (1),

1.VIII.2018, 22–24 h (1), attracted to porch + UV + mercury vapor lamps (2, PdTC); same locality data and collector but 26.VI.2014, 23 h (1), 30.VI.2014, 23 h (1), attracted to UV lamp (2, PdTC); same locality data and collector but 6.VII.2017, 23–24 h, attracted to mercury vapor lamp (1, PdTC).

Distribution in Canada and Alaska. ON, **QC** (Bousquet et al. 2013).

Subfamily Languriinae Hope, 1840

Acropteroxys lecontei Crotch, 1873, new to Canada and Manitoba

Note. *Acropteroxys lecontei* has been reported as far north as MT and SD in the United States (Vaurie 1948, Downie & Arnett 1996). The record below is the first for Canada.

Specimen data. Manitoba, ca. 5 km E of jct. Hwy 21 & 345, 49.3849N, 100.4378W, 7.VII.2007, R.P. Webster, coll. // Gravel pit in short grass prairie area, sweeping vegetation, sunflowers, sweet clover, alfalfa, sage brush, etc. (5, RWC).

Distribution in Canada and Alaska. MB.

Subfamily Erotylinae Latreille, 1802

Triplax festiva Lacordaire, 1842, new to New Brunswick

Specimen data. New Brunswick, York Co., Spednic Lake P.N.A., 45.6751N, 67.4726W, 31.VII–16.VIII.2018, C. Alderson & V. Webster // Mixed forest, Lindgren funnel trap in tree canopy (1, RWC).

Distribution in Canada and Alaska. QC, **NB** (Bousquet et al. 2013).

Subfamily Cryptophylinae Reitter, 1874

Cryptophilus obliteratus Reitter, 1874 †, new to New Brunswick and Quebec

Note. *Cryptophilus seriatus* Casey, 1924 was until recently thought to be a native Nearctic species described from MA. However, Esser (2017) synonymized it with the Palaearctic *C. obliteratus* and established that it is adventive in North America. The occurrence of *C. obliteratus* in Canada, specifically in ON, was very recently confirmed by DNA barcoding (Pentinsaari et al. 2019) also representing the first record for Canada. A recent review of the 46 Canadian *Cryptophilus* specimens in the CNC initially determined as *C. integer* (Heer, 1841) revealed that all are actually *C. obliteratus* (Serge Laplante, pers. com. 2019). The vast majority were from ON, but five of them were collected in QC, in Montreal: (1.VI.1978 (1), 26.V.1982 (1), 14.VI.1986 (1), E.J. Kiteley (3, CNC); 23.IX.1987, L. LeSage (2, CNC). These specimens represent the first report of *C. obliteratus* from QC. Additional more recent specimens are reported below. This species is associated with decaying organic matter. Specimens from NB were collected in compost, and most of those from

QC were found in close proximity of a regularly fed compost heap in a suburban residential area.

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8395N, 66.7391W, 10.V.2018 (11), 17.V.2018 (5), 17.IX.2018 (1) R.P. Webster // Mixed forest, in compost (decaying vegetable matter) (6, NBM: 11, RWC). **Quebec, Agglomération de Longueuil**, Saint-Lambert, 17.V.1970, P. de Tonnancour (1, PdTC). **MRC de Deux-Montagnes**, Oka, rue Mont-Saint-Pierre, 45.4993N, 74.0204W, 4.V.2002 (1), 16.V.2002 (3), R. Vigneault, attracted to UV lamp (4, RVC); Oka, parc national d'Oka, composting site, 45.4765N, 74.0542W, 28.IV.2013 (1), 25.V.2014 (1), R. Vigneault, flight interception trap (white tulle fabric) (2, RVC); same locality, but 3.V.2015, 14–18 h, P. de Tonnancour, flight interception trap (white tulle fabric) between log piles (white pine and deciduous) (2, PdTC). **MRC de Marguerite-D'Youville**, Varennes, 20.VI.2005 (1), 29.VI.2012 (1), 31.V.2015 (1), C. Chantal, attracted to UV lamp (3, CCC). **MRC de Vaudreuil-Soulanges**, Terrasse-Vaudreuil, 45.3923N, 73.9922W, 20.V.2014 (1), 21.V.2014, 17 h (1), 8.V.2015, 18 h (1), 21.V.2016, 13 h (2), 14.VI.2016, 18 h (1), P. de Tonnancour, flight interception trap (white tulle fabric) (6, PdTC); same locality data and collector but 28.VI.2014, 23 h, attracted to UV lamp (1, PdTC); same locality data and collector but 9.X.2018, 18–19 h, window flight interception trap baited with ill-smelling decayed plant matter (1, PdTC); Ville de L'Île-Perrot, 20.III.2013, 17 h 30 (22 °C), P. de Tonnancour, in flight (1, PdTC).

Distribution in Canada and Alaska. ON**, QC, NB** (Pentinsaari 2019)

Cryptophilus propinquus Reitter, 1874 †, additional records for Quebec

Note. Esser (2016, 2017) showed that the name *Cryptophilus integer* (Heer, 1841) was not valid and that all North American records previously treated as *C. integer* include two adventive species, *C. propinquus* Reitter and *C. angustus* (Rosenhauer, 1856). Only *C. propinquus* was found among barcoded specimens from Canada (BC and ON) (Pentinsaari et al. 2019). *Cryptophilus integer* was listed by Bousquet et al. (2013) from QC and ON. However, all the CNC specimens were another species, *Cryptophilus obliteratus* (see comments for previous species). *Cryptophilus propinquus* was previously recorded from the province of QC (under the name *C. integer*) from Hemmingford, in 1933 (Klimaszewski et al., 2015). Here, we report additional modern records from the province. Most of the above specimens were collected late in the season in a suburban residential area, at most 15 m away from a regularly fed compost heap.

Specimen data. Quebec, Agglomération de Québec, Sainte-Foy, 30.VI.1975, C. Chantal, attracted to UV lamp (1, CCC). **Agglomération de Montréal**, Montréal, 9.VII.1975, C. Chantal, attracted to UV lamp (1, CCC). **MRC de Deux-Montagnes**, Oka, 4.VIII.2001, C. Chantal (1, CCC); Oka, parc national d'Oka, composting site, 45.4765N, 74.0542W, 26.VI.2015, R. Vigneault, flight interception trap (white tulle fabric) (1, RVC); Oka, rue Mont-Saint-Pierre, 13–27.IX.2017, R. Vigneault, attracted to UV lamp (2, RVC). **MRC de Marguerite-D'Youville**, Varennes,

15.VI.1998 (1), 22.VI.1998 (1), 15.VII.1998 (1), 4.VIII.2001 (1), 19.VII.2005 (1), 19.VIII.2009 (1), 31.VII.2010 (1), 3.VIII.2012 (1), C. Chantal, attracted to UV lamp (8, CCC). **MRC de Vaudreuil-Soulanges**, Terrasse-Vaudreuil, 45.3924N, 73.9922W, 20.V.2012, 14 h, P. de Tonnancour, decayed plant matter, compost heap (1, PdTC); same locality data and collector but 45.3923N, 73.9922W, 5.IX.2012, 23 h (12), 9.VII.2013, 22–24 h (1), 25.VIII.2014, 23 h (1), 31.VIII.2014, 21–24 h (2), 1.IX.2014, 21–24 h (3), 4.IX.2014, 20–24 h (2), 1.IX.2015, 20–24 h (2), 15.IX.2015, 23 h (1), 13.VII.2018, 22–23 h (1), 29.VIII.2018, 22 h (1), attracted to porch + UV lamps (26, PdTC); same locality data and collector but 13.VII.2013, 16 h, rotten banana peel, compost heap (1, PdTC); same locality data and collector but 16.VII.2018, 22 h, attracted to porch + UV + mercury vapor lamps (1, PdTC); same locality data and collector but 26-27.VII.2018, 18–9 h (6), 9.X.2018, 18–19 h (5), window flight interception trap baited with ill-smelling plant compost (11, PdTC); same locality data and collector but 26.VIII.2018, 23 h, attracted to porch + mercury vapor lamps (9, PdTC).

Distribution in Canada and Alaska. BC, ON, QC (Klimaszewski et al. 2015, Pentinsaari et al. 2019).

Family Monotomidae Laporte, 1840
Subfamily Rhizophaginae Redtenbacker, 1845

***Rhizophagus sayi* C. Schaeffer, 1913, new to Quebec**

Note. This species seems to be associated with deciduous trees, such as *Quercus* sp., American beech, American chestnut (*Castanea dentata* (Marsh.)), sugar maple (*Acer saccharum* Marsh.), and black cherry (*Prunus serotina* Ehrh.) (Bousquet, 1990).

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, ~1 km W of lac de la Sauvagine, 17.IV.2015, R. Vigneault (1, RVC); **MRC de Vaudreuil-Soulanges,** Ville de l'Île-Perrot, 45.3958N, 73.9780W, 8.V.2019, 15 h (1), 20.V.2019, 16 h (1), P. de Tonnancour, large *Fagus grandifolia* log (2, PdTC).

Distribution in Canada and Alaska. ON, **QC** (Bousquet et al. 2013).

Family Cryptophagidae Kirby, 1826
Subfamily Cryptophaginae Kirby, 1826

***Caenoscelis ferruginea* (C.R. Sahlberg, 1820), new to New Brunswick**

Specimen data. New Brunswick, Restigouche Co., ca. 3 km SE of Simpsons Field, 47.5377N, 66.5142W, 14–28.V.2015, C. Alderson & V. Webster // Old cedar & spruce forest with *Populus tremuloides*, Lindgren funnel trap (1, RWC). **York Co.**, Canterbury, Eel River P.N.A., 45.8966N, 67.6345W, 6–21.V.2014, C. Alderson & V. Webster // Old-growth eastern white cedar swamp & fen, Lindgren funnel trap (1,

RWC); Fredericton, Odell Park, 45.9508N, 66.6723W, 27.VI–5.VII.2017, C. Alderson & V. Webster // Old mixed forest, Lindgren funnel trap (1, RWC).

Distribution in Canada and Alaska. AK, YT, NT, BC, AB, SK, MB, ON, QC, **NB**, NS (Bousquet et al. 2013, Pelletier and Hébert 2019).

Cryptophagus confertus Casey, 1900

Bousquet et al. (2013) treated *C. confertus* as a synonym of *C. jakowlewi* Reitter, 1888. However, Esser (2018) showed that *C. jakowlewi* and *C. confertus* are distinct species and noted that there were no valid records of *C. jakowlewi* from North America. Webster et al. (2016c) newly reported *C. jakowlewi* from NB. These specimens were checked again using the keys in Woodroffe and Coombs (1961) and Pelletier and Hébert (2019) and they are *C. confertus*. Pelletier and Hébert (2019) did not list *C. confertus* for NB or note the original NB record of *C. jakowlewi* by Webster et al (2016c). This species is easily confused with the very similar and mostly western *C. bidentatus* Mäklin, 1853 that occurs as far east as QC (Pelletier and Hébert 2019).

Henoticus pilifer (Reitter, 1888) †, new to New Brunswick

Note. Pelletier and Hébert (2019) newly reported the adventive Asian *Henoticus pilifer* from North America from QC, ON, and BC in Canada. Webster et al. (2012b) newly reported *H. serratus* (Gyllenhal, 1808) from NB. However, only one of these specimens (from McAdam, Georgia Pacific Plywood Mill, 19.V.1978 in the AFC collection) is *H. serratus*. The other specimens are *H. pilifer*, a new species for the province. Below we report the data from the Webster et al. (2012b) study and include a few more recent records of *H. pilifer*. Pelletier and Hébert (2019) show locality points for *H. serratus* in southeastern and northern NB indicating a broad distribution for this native Holarctic species. Interestingly, the adventive *H. pilifer* appears to be more common than *H. serratus* in southern NB.

Specimen data. New Brunswick, Queens Co., Cranberry Lake P.N.A., 46.1125N, 65.6075W, 24.IV-V.2009, 5–12.V.2009, 12–21.V.2009, 21–27.V.2009, 27.V–5.VI.2009, 5–11.VI.2009, 11–18.VI.2009, 18–25.VI.2009, R. Webster & M.-A. Giguère, coll. // Mature red oak forest, Lindgren funnel traps (6, AFC; 2, NBM; 9, RWC); same locality data but 4–18.VIII.2011, M. Roy & V. Webster, coll. (1, RWC). **York Co**., Charters Settlement, 45.8395N, 66.7391W, 5.IX.2006, R.P. Webster // Mixed forest, among moldy corncobs and cornhusks (1, RWC); Fredericton, Odell Park, 45.9539N, 66.6666W, 10–24.VI.2012, C. Alderson & V. Webster // Hardwood forest, Lindgren funnel trap 1 m high under trees (1, AFC).

Distribution in Canada and Alaska. BC, ON, QC, **NB** (Pelletier and Hébert 2019).

Subfamily Atomariinae LeConte, 1861

***Atomaria morio* Kolenati, 1846 †, new to New Brunswick**

Note. Pelletier and Hébert (2019) reported this uncommon adventive European species for the first time from North America. Most NB specimens were captured in Lindgren funnel traps in various forest types. One individual was collected from the nest box contents of a barred owl (*Strix varia* Barton). This species appears to be widespread in southern NB but was usually captured as singletons at a given locality.

Specimen data. New Brunswick, Carleton Co., Jackson Falls, "Bell Forest", 46.2200N, 67.7231W, 14–20.V.2009, R. Webster & M.-A. Giguère, coll. // Rich Appalachian hardwood forest with some conifers, Lindgren funnel trap (1, RWC). **Queens Co.**, Pleasant Villa, 45.7023N, 66.1732W, 15.VI.2007, S. Makepeace & R. Webster, coll. // Nest box contents of Barred Owl (6 litres), damp organic material with feathers & small bones (1, RWC); Jemseg, 45.8412N, 66.1195W, 28.V–12.VI.2012, C. Alderson, C. Hughes, & V. Webster // Hardwood woodland near seasonally flooded marsh, Lindgren funnel trap 1 m high under *Quercus macrocarpa* (1, RWC). **Sunbury Co.**, Acadia Research Forest, 45.9866N, 66.3841W, 24–30.VI.2009, R. Webster & M.-A. Giguère, coll. // Red spruce forest with red maple & balsam fir, Lindgren funnel trap (1, RWC). **York Co.**, 15 km W of Tracy, off Rt. 645, 45.6848N, 66.8821W, 19–25.V.2009, R. Webster & M.-A. Giguère, coll. // Red pine forest, Lindgren funnel trap (1, RWC); Douglas, Currie Mountain, 45.9832N, 66.7564W, Old *Pinus strobus* stand, Lindgren funnel trap, 1 m high under *P. strobus* (1, RWC); Keswick Ridge, 45.9962N, 66.8781W, 19.V–3.VII.2014 (1), 5–19.V.2015 (1), 3–18.VI.2015 (2), C. Alderson & V. Webster // Mixed forest, Lindgren funnel traps 1 m high under trees (4, RWC); Douglas, N.B. Walking Trail, 45.9819N, 66.7568W, 5–15.V.2015, C. Hughes & V. Webster // Hardwood forest, Lindgren funnel trap 1 m high under trees (1, RWC).

Distribution in Canada and Alaska. AB, SK, ON, QC, **NB**, NS (Pelletier and Hébert 2019).

***Atomaria impressa* Erichson, 1846 †, new to New Brunswick**

Note. Pelletier and Hébert (2019) reported this adventive European species for the first time from North America, from strawberry fields and American beaver (*Castor canadensis* Kuhl) lodges. The only specimen from NB with microhabitat data was collected from debris on an American beaver dam.

Specimen data. New Brunswick, Carleton Co., Jackson Falls, "Bell Forest", 46.2200N, 67.7231W, 9–14.V.2009, R. Webster & M.-A. Giguère, coll. // Rich Appalachian hardwood forest with some conifers, Lindgren funnel trap (1, AFC). **York Co.**, Charters Settlement, 45.8331N, 66.7279W, 20.V.2010, R.P. Webster, coll. // Beaver dam among sticks, debris, and clay on dam (1, RWC).

Distribution in Canada and Alaska. AB, ON, QC, **NB** (Pelletier and Hébert 2019).

Atomaria planulata Mäklin, 1853, new to New Brunswick

Specimen data. New Brunswick, Gloucester Co., Bathurst, Daly Point Reserve, 47.6392N, 65.6098W, 15–25.VI.2015, C. Alderson & V. Webster // Mixed forest, black Lindgren funnel trap 1 m high (1, RWC). **Northumberland Co.**, ca. 1.5 km NW of Sevogle, 47.0939N, 65.8387W, 11–26.VI.2013 (2), 26.VI–8.VII.2013 (4), C. Alderson & V. Webster // *Populus tremuloides* stand with a few conifers, Lindgren funnel traps in canopy of *P. tremuloides* (2, AFC; 1, NBM; 3, RWC). **Restigouche Co.**, Dionne Brook P.N.A., 47.9064N, 68.3441W, 31.V–15.VI.2011 (1), 15–27.VI.2011 (1), 27.VI–14.VII.2011 (1), M. Roy & V. Webster // Old-growth white spruce & balsam fir forest, Lindgren funnel traps (3, RWC); same locality and collectors but 47.9030N, 68.3503W, 27.VI–14.VII.2011 // Old-growth northern hardwood forest, Lindgren funnel traps (1, AFC; 2, NBM; 3, RWC); Jacquet River Gorge P.N.A., 47.8257N, 66.0764W, 10–25.VI.2014, Old *Populus balsamifera* stand near river, Lindgren funnel trap 1 m high under trees (1, AFC; 2, NBM; 1, RWC). **York Co.**, Keswick Ridge, 45.9962N, 66.8781W, 3–18.VI.2015, C. Alderson & V. Webster // Lindgren funnel trap 1 m high under trees (1, NBM).

Distribution in Canada and Alaska. AK, YT, BC, AB, QC, **NB** (Bousquet et al. 2013, Pelletier and Hébert 2019).

Family Passandridae Blanchard, 1845

Catogenus rufus (Fabricius, 1792), new to New Brunswick

Note. The *Catogenus rufus* specimen reported below represents the first record of the family Passandridae from NB.

Specimen data. New Brunswick, York Co., Crabbe Mountain, 46.1208N, 67.1056W, 27.VII – 10.VIII.2018, C. Alderson & V. Webster // Hardwood forest, Lindgren funnel trap in tree canopy (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Family Phalacridae Leach, 1815

Phalacrus politus Melsheimer, 1844, new supporting data for New Brunswick

Note. *Phalacrus politus* was reported for the first time from Canada by Majka et al. (2008) based on specimens from two localities in NF. Bousquet et al. (2013) listed this species as occurring in NB. However, there is no published or supporting data in the CNC database for its occurrence in NB (Serge Laplante, pers. com.). Here, we report supporting data for NB.

All NB specimens of *P. politus* were collected from wetland habitats (marshes and fens, calcareous cedar fen, silver maple forest). Adults and larvae are associated with smuts on grasses (Steiner 1984).

Specimen data. New Brunswick, Sunbury Co., Maugerville, Portobello Creek N.W.A., 45.8992N, 66.4248W, 5.VI.2004, R.P. Webster, coll. // Silver maple forest, sweeping foliage on margin of forest road (1, RWC). **York Co.**, Charters Settlement, 45.8282N, 66.7367W, 9.IV.2005, 16.IV.2015, R.P. Webster, coll. // *Carex* marsh, in leaf litter at base of trees & shrubs (2, RWC); same locality data and collector but 9.VI.2016 // Pond margin / marsh, sweeping vegetation (1, RWC); same locality and collector but 45.8267N, 66.7343W, 23.V.2005 // Sedge marsh & fen, treading saturated sphagnum/sedge hummocks into water (1, RWC); same locality data and collector but 8.VII.2005, 23.VII.2005 // Sedge marsh & fen, on flowers of *Spiraea alba* (2, RWC); Canterbury, Eel River P.N.A., 45.8967N, 67.6343W, 20.VI.2014, R.P. Webster // Calcareous cedar fen with shrubby cinquefoil, sweeping vegetation with *Myrica gale* & *Rhododendron groenlandicum* (2, RWC); Spednic Lake P.N.A., near Pats Brook, 45.6210N, 67.4342W, 15.VI.2018, R.P. Webster // Freshwater marsh with slow flowing stream with emergent vegetation, sweeping vegetation (1, RWC).

Distribution in Canada and Alaska. ON, NB, NF (Bousquet et al. 2013).

Family Laemophloeidae Ganglbauer, 1899

Charaphloeus convexulus (LeConte, 1879), new supporting data for Quebec

Note. This species was added to the entomofauna of QC without any further details by Bousquet et al. (2013). Here, we provide supporting data for its occurrence in the province. Very little is known about its biology, except that it is usually found under bark. Most specimens listed below were captured in hardwood forests.

Specimen data. Quebec, Agglomération de Montréal, Dollard-des-Ormeaux, 30.V.1992. C. Chantal (1, CCC). **Agglomération de Québec,** Saint-Augustin, Portneuf, 26.VI.1982, C. Chantal (1, CCC); Saint-Étienne-de-Lauzon, Lévis, 9.V.1981 (1), 12.VI.1982 (1), C. Chantal (2, CCC). **MRC de Deux-Montagnes,** Oka, 14.VII.1982, C. Chantal (1, CCC); Oka, parc national d'Oka, 14.VI.1995, R. Vigneault (1, RVC); Oka, parc national d'Oka, La Grande Baie, 10.V.2003 (1), 13.V.2017, beating (1) (2, RVC); Oka, parc national d'Oka, Welcoming center, La Grande Baie, 15.VI.2003 (1, RVC); Oka, parc national d'Oka, wooded area ca. 1 km W of lac de la Sauvagine, 5.V.2019 (2), 19.V.2019 (1), 24.VI.2019 (1), R. Vigneault, flight interception trap (white tulle fabric) (4, RVC); Oka, parc national d'Oka, 4.VI.2016, 17 h, P. de Tonnancour, swept from understory vegetation (1, PdTC). **MRC de Joliette,** Joliette, 19.V.1979, C. Chantal, attracted to UV lamp (1, CCC). **MRC de Vaudreuil-Soulanges,** Notre-Dame-de-l'Île-Perrot, 14.V.2016, 15 h, P. de Tonnancour, underside of freshly cut *Acer saccharum* log (1, PdTC); Ville de l'Île-Perrot, 45.3958N, 73.9780W, 15.V.2019, 16 h (1), 16.V.2019, 14 h (5), 20.V.2019, 16 h (2), 25.V.2019 (1), 30.V.2019 (1), P. de Tonnancour, large *Fagus grandifolia* log (10, PdTC).

Distribution in Canada and Alaska. ON, QC, NB, NS (Bousquet et al. 2013).

***Lathropus vernalis* Casey, 1884, new supporting data for Quebec**

Note. The identity of the first specimen recorded below was confirmed by Michael C. Thomas in 2017.

Specimen data. Quebec, Agglomération de Longueuil, Boucherville, 3.VIII.1992, C. Chantal (1, CCC); Longueuil, 25.VII.1992, C. Chantal // Beating (1, CCC). **Agglomération de Montréal,** Montréal, parc Zotique-Racicot, 45.541392N, 73.682889W, 28.VI.2016, 13 h, P. de Tonnancour, beaten from *Ulmus americana* (1, PdTC). **MRC de Marguerite-d'Youville,** 6.VII.2000, C. Chantal // *In copula* (2, CCC). **MRC de Vaudreuil-Soulanges,** Saint-Lazare, (45.3807N, 74.1691W), 28.VII.2016, 14 h, P. de Tonnancour, beaten from dead *Pinus sylvestris* (with needles still attached) (1, PdTC).

Distribution in Canada and Alaska. SK, QC (Bousquet et al, 2013)

***Placonotus falinorum* Thomas, 2011, new to Canada and Quebec**

Note. The identity of one of the two specimens reported below was confirmed by Michael C. Thomas in 2016 (see M.C. Thomas comments and photo of the specimen at https://bugguide.net/node/view/1100475/bgpage).

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, Calvaire d'Oka, 30.IV.2001, R. Vigneault (1, RVC); Oka, parc national d'Oka, La Grande Baie, 5.VII.2015, R. Vigneault, beaten from dead branches, deciduous forest (1, RVC).

Distribution in Canada and Alaska. QC.

Family Nitidulidae Latreille, 1802
Subfamily Epuraeinae Kirejtshuk, 1986

***Epuraea fulvescens* Horn, 1879, new to New Brunswick**

Specimen data. New Brunswick, Carleton Co., Belleville, Meduxnekeag Valley Nature Preserve, 46.1888N, 67.6762W, 13.VIII.2007, R.P. Webster, coll. // River margin, sweeping flowers of *Daucus carota* (3, RWC); Jackson Falls, "Bell Forest", 46.2200N, 67.7231W, 8.VII.2004, R.P. Webster, coll. // Rich Appalachian hardwood forest, m.v. light (5, RWC). **Queens Co.**, Cranberry Lake PNA, 46.1125N, 65.6075W, 5–11. VI.2009, R. Webster & M.-A. Giguère // Red oak forest, Lindgren funnel trap (1, RWC). **York Co.**, Charters Settlement, 45.8395N, 66.7391W, 16.VI.2007, R.P. Webster, coll. // Mixed forest, on flowers of ornamental *Spiraea* species (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Subfamily Carpophilinae Erichson, 1842

Carpophilus melanopterus Erichson, 1843, new supporting data for Quebec

Note. This species is closely associated with *Yucca* spp. both in the larval and adult stages. Parsons (1943) recorded it as ranging in the United States from NY, NJ, and IL south to FL and west to IA and TX. The CNC contains specimens from ON (Windsor, 3.VIII.1954, ex. *Yucca filamentosa* L. [6 specimens]; Ancaster, 7.VII.1978, on *Yucca* flowers; Ottawa, 5.VII.2012, yucca, H. Goulet [4 specimens]), but since no potential host *Yucca* sp. grows native in the province, McNamara in Bousquet et al. (1991) considered the Windsor occurrence doubtful or incidental and opted not to include this species in the checklist. The recent discovery of a few specimens in Ottawa by H. Goulet and of the specimens recorded hereafter, which were the basis of the record from QC reported by Bousquet et al. (2013), confirms its presence in both ON and QC. The popularity of yuccas as garden plants in southern Canada has likely played a key role in the northward range expansion of this species. Label data suggest that the adults are mostly active in late afternoon and early evening during the first half of July, when their host plants are in bloom.

Specimen data. Quebec, Agglomération de Longueuil, Boucherville, 7.VII.2011, 19 h (3), 10.VII.2011, 19 h (3), G. Lafrance & L. de Tonnancour, flower stalk of *Yucca filamentosa* (2, CTC; 4, PdTC). **MRC de Marguerite-D'Youville**, Varennes, 7.VII.2012 (1), 4.VII.2013 (3), 30.VI.2014 (5), C. Chantal, *Yucca* sp. (9, CCC). **MRC de Vaudreuil-Soulanges,** Terrasse-Vaudreuil, 45.3923N, 73.9925W, 1.VII.2011, 18 h (5), 4.VII.2011, 20 h (16), 7.VII.2011, 19 h (3), 10.VII.2011, 19 h (1), 10.VII.2015 (6), 4.VII.2016, 12 h (1), 9.VII.2019, 12 h (2), P. de Tonnancour, flower stalk of *Yucca filamentosa* (6, SDC; 26, PdTC); same locality and biological data but 18.VII.2017, S. Dumont (1, SDC).

Distribution in Canada and Alaska. ON, QC (Bousquet et al. 2013).

Subfamily Amphicrossinae Kirejtshuk, 1986

Amphicrossus ciliatus (Olivier, 1811), new supporting data for Quebec

Note. Label data presented below indicate that *Amphicrossus ciliatus* has been present in QC since at least 1993. Parsons (1943) mentioned that this species is found at sap in the spring but occurs on flowers of *Eupatorium* and allied plants in the autumn. However, the vast majority of the specimens reported below have been collected at light.

Specimen data. Quebec, Agglomération de Montréal, Sainte-Anne-de-Bellevue, 12.VI.1993, C. Chantal (1, CCC); **MRC de Deux-Montagnes,** Oka, parc national d'Oka, 26.VI.2016, 23 h, P. de Tonnancour, wooded area next to beach, attracted to mercury vapor lamp (1, PdTC); **MRC de Laval,** Laval, 30.VI.1997, R. Vigneault (2, RVC); **MRC Des-Jardins-de-Napierville,** Saint-Bernard-de-Lacolle, 16.VII.1994, C. Chantal (1, CCC); **MRC de la Vallée-du-Richelieu,** Mont-Saint-Hilaire, 45.5364N,

73.1590W, 23.VI.2013, Henri Miquet-Sage (1, PdTC); **MRC de Marguerite-D'Youville**, Varennes, 16.VII.1997 (1), 11.VI.1998 (1), 22.VI.1998 (1), 23.VI.1998 (1), 29.VI.1998 (1), 6.VI.1999 (1), 3.VII.1999 (1), 2.VI.1999 (1), C. Chantal, attracted to UV lamp (8, CCC); **MRC de Vaudreuil-Soulanges,** Terrasse-Vaudreuil, 1.VII.2007, 23 h (1), 12.VII.2007, 22 h (1), 31.VII.2010, 23 h (1), P. de Tonnancour, attracted to UV lamp (3, PdTC); same locality data and collector, but 30.V.2011, 22 h (2), 18.VII.2011, 0 h (1), 13.VIII.2011, 23 h (1), 28.VI.2012, 23 h (1), 1.IX.2012, 1 h (1), 30.V.2013, 21 h (1), 15.VII.2013, 23 h (1), 25.VIII.2013, 21 h (1), 28.V.2014, 22 h (2), 25.VI.2014, 23 h (1), 6.IX.2014, 23 h (1), 28/29.V.2016, 23–1 h (2), 1.VI.2016, 22 h–23 h 30 (2), 2.VI.2016, 22–24 h (3), 3.VI.2016, 22–23 h (2), 18.VI.2016, 23 h (2), 15.VII.2016, 23 h (1), 17.VIII.2016, 22 h (1), attracted to porch + UV lamps (26, PdTC); Mont Rigaud, 45.4636N, 74.2711W, 4.VII.2013, 23 h, P. de Tonnancour, attracted to UV lamp (1, PdTC); **MRC du Haut-Saint-Laurent,** Dundee, 23.V.2010, attracted to UV lamp, C. Tessier, *Juglans nigra* stand (1, CTC).

Distribution in Canada and Alaska. ON, QC (Bousquet et al. 2013).

Subfamily Nitidulinae Latreille, 1802

Stelidota geminata (Say, 1825), new supporting data for Quebec

Note. The 2011 specimens reported below were the basis of the record from QC reported by Bousquet et al. (2013).

Specimen data. Quebec, MRC de Marguerite-D'Youville, Varennes, 20.VI.2012 (2), 29.VI.2012 (1), 22.VII.2012 (1), 26.VI.2016 (1), 4.VII.2016 (1), C. Chantal, attracted to UV lamp (6, CCC). **MRC de Brome-Missisquoi**, Saint-Armand, 5.VII.2016, C. Chantal, attracted to UV lamp (1, CCC). **MRC de D'Autray**, Berthierville, 9.VI.2009, C. Chantal, attracted to UV lamp (1, CCC). **MRC de Vaudreuil-Soulanges,** Terrasse-Vaudreuil, 45.3924N, 73.9921W, 26.IX.2011, 14 h, P. de Tonnancour, fermented cantaloupe (9, PdTC); Terrasse-Vaudreuil, 45.3875N, 73.9906W, 5.VI.2011, 16 h, P. de Tonnancour, swept from *Erysimum cheiranthoides* (1, PdTC); Terrasse-Vaudreuil, 45.3923N, 73.9922W, 9.V.2013, 18 h (1), 31.V.2013, 19 h (2), 25.VIII.2013, 18 h (1), 15.IX.2013, 18 h (7), P. de Tonnancour, flight interception trap (white tulle fabric) (11, PdTC); 45.3924N, 73.9921W, 20.VI.2013, 17 h, P. de Tonnancour, fermented pineapple (10, PdTC); Terrasse-Vaudreuil, 26–27.VII.2018, 18–9 h, P. de Tonnancour, window flight interception trap baited with ill-smelling plant decayed matter (1, PdTC).

Distribution in Canada and Alaska. ON, QC (Bousquet et al. 2013).

Family Anamorphidae Strohecker, 1953

Symbiotes duryi Blatchley, 1910, new to Quebec

Note. This native species was known to occur in Canada exclusively in ON (Bousquet et al. 2013) until Webster et al. (2016) recorded its presence in NB.

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, 45.4744N, –74.0362W, 9.VII.2019, 16–19 h 30 (1), 19.VII.2019, 17 h 30–19 h (1), flight interception trap (white tulle fabric), red oak-white pine stand, P. de Tonnancour (2, PdTC).

Distribution in Canada and Alaska. ON, **QC**, NB (Webster et al. 2016).

Family Coccinellidae Latreille, 1807

Majka and McCorquodale (2010) reported 40 coccinellid species from NB. Five additional species were added to the NB faunal list by Webster et al. (2012d, 2016c) and 45 species were recognized as established in NB by Webster (2016c). Most recently, McAlpine et al. (2018) reported *Coleomegilla maculata lengi* Timberlake, 1943 from the province. Members of the genus *Scymnus* can be difficult to determine due to variation in coloration and size, and many species can only be determined with certainty by dissecting males (Gordon 1976). A review of *Scymnus* and *Stethorus* specimens in several NB collections resulted in the discovery of seven additional species of *Scymnus* and one adventive *Stethorus* species, bringing the total number of NB coccinellids to 54 species. These new records are reported below.

Subfamily Coccinellinae Latreille, 1807

Scymnus abbreviatus LeConte, 1852, new to New Brunswick

Note. Gordon (1976) reported *Scymnus abbreviatus* from the Great Lakes area and along the St. Lawrence River in ON, QC, and MI and suggested it should be found throughout the region north of the Great Lakes. Majka et al. (2011) did not report it from ME. Its presence in NB is somewhat surprising.

Specimens of *S. abbreviatus* were collected by sweeping vegetation along a roadside and in a brushy area. One was collected from trembling aspen and three were captured in Lindgren funnel traps (that were either all green or all black) in a mixed forest. Adults were collected during May and June. No habitat data for this species were provided by Gordon (1976).

Specimen data. New Brunswick, Gloucester Co., Bathurst, Daly Point Reserve, 47.6392N, 65.6098W, 13–28.V.2015, C. Alderson & V. Webster // Mixed forest, green Lindgren funnel trap 1 m high (1 ♂ (dissected), RWC); same data as previous but black Lindgren funnel traps (2 ♀♀, RWC). **Queens Co.**, 2 mi W of S. Minto, 4.VI.1962 // 62-0138-01, ex. trembling aspen // 640811 // AFCF0010387 (1 ♂ (dissected), AFC). **Sunbury Co.**, Maugerville, off Rt. 105, 45.8662N, 66.4559W, 4.VI.2013, R.P. Webster // Flood plain forest, sweeping roadside vegetation (1 ♂ (dissected), RWC). **York Co.**, New Maryland, 45.8430N, 66.7275W, 17.VI.2007, R.P. Webster, coll. // Regenerating mixed forest, sweeping foliage in brushy area (1 ♀, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Scymnus caudalis LeConte, 1850, new to New Brunswick

Note. Majka and McCorquodale (2006) recorded this species from Halifax, NS as a "seemingly isolated" population. This species is common and broadly distributed in eastern and central North America (Gordon 1976) and appears to be widespread in NB.

Two individuals were captured in Lindgren funnel traps in a hardwood forest and a mixed forest. The only specimen with specific habitat data was swept from foliage along a lakeshore on an old dune with oaks. No habitat data for this species were provided by Gordon (1976) or Majka and McCorquodale (2006, 2010).

Specimen data. New Brunswick, Carleton Co., Jackson Falls, "Bell Forest", 46.2200N, 67.7231W, 12–19.VI.2008, R.P. Webster, coll. // Rich Appalachian hardwood forest with some conifers, Lindgren funnel trap // AFCF0010382 (1 ♂ (dissected), AFC). **Gloucester Co.**, Bathurst, Daly Point Reserve, 47.6392N, 65.6098W, 28.V–15.VI.2015, C. Alderson & V. Webster // Mixed forest, green Lindgren funnel trap 1 m high (1 ♂ (dissected), RWC). **Queens Co.**, Canning, Grand Lake near Scotchtown, 45.8762N, 66.1816W, 1.VII.2004, D. Sabine & R. Webster, coll. // Lakeshore, old dune with oaks, sweeping foliage (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. SK, MB, ON, QC, **NB**, NS (Bousquet et al. 2013).

Scymnus puncticollis LeConte, 1852, new to New Brunswick

Note. NB specimens were captured in Lindgren funnel traps in a hardwood forest, a mixed forest with red oak, a mixed forest, and an old balsam poplar (*Populus balsamifera* L.) stand near a river. Most of these were captured in traps in the forest canopy. Adults with specific habitat data were collected by beating or sweeping foliage in a regenerating mixed forest and in a sand pit. Adults were collected from April to September. No habitat data were provided by Gordon (1976). This appears to be the most common and widespread *Scymnus* species in NB.

Specimen data. New Brunswick, Carleton Co., Jackson Falls, "Bell Forest", 46.2200N, 67.7231W, 13–25.IV.2012, R. Webster, J. Sweeney, & C. Hughes // Rich Appalachian hardwood forest with some conifers, Lindgren funnel trap in canopy of *Acer saccharum* // AFCF0018637 (1 ♂ (dissected), AFC). **Queens Co.**, C.F.B. Gagetown, 45.7516N, 66.1866W, 9–22.V.2013, C. Alderson & V. Webster // Old mixed forest with *Quercus rubra*, Lindgren funnel trap in canopy of *Q. rubra* // AFCF0018639 (1 ♂ (dissected), AFC); same data but 22.V–4.VI.2013 // AFCF0018640 (1 ♂ (dissected), AFC). **Restigouche Co.**, Jacquet River Gorge P.N.A., 47.8257N, 66.0764W, 10–25.VI.2014, C. Alderson & V. Webster // Old *Populus balsamifera* stand near river, Lindgren funnel trap 1 m high under trees (1 ♂ (dissected), RWC). **York Co.**, New Maryland, 45.8428N, 66.7279W, 5.VI.2003, R.P. Webster, coll. // Regenerating mixed forest, beating foliage (1 ♂ (dissected), RWC); New Maryland, Charters Settlement,

45.8430N, 66.7275W, 17.VI.2004, R.P. Webster, coll. // Regenerating mixed forest, sweeping foliage (1 ♂ (dissected), NBM, 1 ♂ (dissected), RWC); same data as previous but 12.VII.2005 // Regenerating mixed forest, beating foliage (1 ♂ (dissected), NBM): Upper Brockway near abandoned airport, 45.5729N, 67.0959W, 28.V.2018, R.P. Webster // Sand pit, beating *Salix* foliage (1 ♂ (dissected), RWC); Spednic Lake P.N.A., 45.6751N, 67.4726W, 10–24.V.2018 (1), 31.VII–16.VIII. 2018 (2), 16–30. VIII.2018 (3), 30.VIII–12.IX.2018 (1), C. Alderson & V. Webster // Mixed forest, Lindgren funnel traps in tree canopies (1 ♂ (dissected), AFC; 2 ♂♂ (dissected), NBM; 4 ♂♂ (dissected) , RWC); Crabbe Mountain, 46.1208N, 67.1056W, 13–27.VII.2018 (1), 27.VII – 10.VIII.2018 (1), 24.VIII – 6 IX.2018 (1), C. Alderson & V. Webster // Hardwood forest, Lindgren funnel traps in tree canopies (1 ♂ (dissected), AFC; 2 ♂♂ (dissected), RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Scymnus securus J. Chapin, 1973, new to New Brunswick

Note. *Scymnus securus* is a coastal plain species recorded from LA north to MA with an isolated record from Tilbury, ON (Gordon, 1976, 1985). The record from NB represents a significant range extension to the northeast. The three known NB specimens were sifted from moist grass litter in a small sedge marsh and swept from marsh vegetation along the margin of a beaver pond. Adults were collected in April, July, and September. No habitat data were provided by Gordon (1976).

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8428N, 66.7279W, 28.IV.2004, R.P. Webster, coll. // Mixed forest, small sedge marsh, in moist grass litter (1 ♀, RWC); same data as previous but 11.VII.2005 (1 ♀, NBM); Charters Settlement, 45.8296N, 66.7347W, 20.IX.2017, R.P. Webster // Beaver pond margin, sweeping vegetation (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. ON, **NB** (Bousquet et al. 2013).

Scymnus suturalis Thunberg, 1795 †, new to New Brunswick

Note. *Scymnus suturalis* appears to be widespread in NB but is apparently uncommon as only three specimens have been collected. This adventive Palaearctic species was first reported from Canada from Oka, QC in 1983 (McNamara 1992) and from Halifax, NS in 1993 by Hoebeke and Wheeler (1996) and was still present in Halifax in 2003 (Majka and McCorquodale 2010). The introduction into NS was likely an accidental one, possibly associated with conifer nursery stock (Hoebeke and Wheeler 1996, Majka and Klimaszewski 2004). This species was intentionally released in MI from Germany in 1961 and is apparently now established in the state and was also inadvertently introduced to other areas in the Northeast where it has become established (Gordon 1985).

Scymnus suturalis preys on adelgids and aphids found on conifers and has been found on Scots pine (*Pinus sylvestris* L.) and jack pine in NS (Majka and McCorquodale

2010). The three NB specimens reported below were captured in Lindgren funnel traps; one in an old black spruce (*Picea mariana* (Mill.) BSP) forest, one in a red oak (*Quercus rubra* L.) forest near a seasonally flooded marsh, and another in a mixed forest. The specimens were captured from June to September.

Specimen data. New Brunswick, Northumberland Co., Upper Graham Plains, 47.1001N, 66.8154W, 21.VIII–4.IX.2014, C. Alderson & V. Webster // Old black spruce forest, Lindgren funnel trap (1, RWC). **Sunbury Co.**, Sunpoke Lake, 45.7656N, 66.5550W, 9–20.VII.2012, C. Alderson & V. Webster // Red oak forest near seasonally flooded marsh, Lindgren funnel trap 1 m high under *Quercus rubra* (1, RWC). **York Co.**, Keswick Ridge, 45.9962N, 66.8781W, 4–16.VI.2014, C. Alderson & V. Webster // Mixed forest, Lindgren funnel trap in canopy (1, RWC).

Distribution in Canada and Alaska. QC, **NB**, NS (Bousquet et al. 2013).

Scymnus tenebrosus Mulsant, 1850, new to New Brunswick

Specimen data. New Brunswick, Gloucester Co., Bathurst, Daly Point Reserve, 47.6392N, 65.6098W, 13–28.V.2015, C. Alderson & V. Webster // Mixed forest, black Lindgren funnel trap 1 m high (1 ♂ (dissected), RWC).

Distribution in Canada and Alaska. NT, AB, SK, MB, ON, QC, **NB,** NS, PE (Bousquet et al. 2013).

Scymnus americanus Mulsant, 1850, new to New Brunswick

Note. *Scymnus americanus* is widespread in the central and eastern USA and was reported close to the NB border in eastern ME (Gordon 1976). The single specimen from NB was sifted from moist grass litter in a small sedge marsh in April. No habitat data were provided by Gordon (1976).

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8428N, 66.7279W, 15.IV.2005, R.P. Webster, coll. // Mixed forest, small sedge marsh, in moist grass litter (1 ♀, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Stethorus punctillum Weise, 1891 †, new to New Brunswick

Note. The earliest record of this Palaearctic species from North America is from Leamington, ON in 1931 with later records from Lulu Island, BC in 1950 and Saint-Nicolas (Lévis), QC in 1993 (Brown, 1950, Klimaszewski et. 2015). It was first reported from the United States from Framingham, MA sometime before 1950 (Brown 1950). This species was inadvertently introduced and appears to have now become established throughout much of the Northeast west to MB, AB, southward to ID and on the west coast in BC and OR (Gordon, 1985, Klimaszewski et al. 2015). Majka et al. (2011)

reported it from ME and thus its presence in NB is not unexpected. This species is easily confused with the native *S. punctum* (LeConte, 1852) and has been confused in collections (Gordon 1985). Re-examination of specimens previously determined as *S. punctum* may result in the discovery of additional localities for *S. punctillum* in the region.

Stethorus punctillum feed on mites and soft-bodied insects such as aphids, adelgids, and scales (Gordon 1985, Klimaszewski et al. 2015). The NB specimens were captured in Lindgren funnel traps in an old jack pine forest, an old red oak forest, and a hardwood woodland near a seasonally flooded marsh. Adults were collected from late May to late August.

Specimen data. New Brunswick, Northumberland Co., ca. 2.5 km W of Sevogle, 47.0879N, 65.8585W, 27.V–11.VI.2014, C. Alderson & V. Webster // Old *Pinus banksiana* forest, Lindgren funnel trap (1, RWC). **Queens Co.**, Cranberry Lake P.N.A., 46.1125N, 65.6075W, 25.V–7.VI.2011, M. Roy & V. Webster, coll. // Old red oak forest, Lindgren funnel trap (1, RWC); Jemseg, 45.8412N, 66.1195W, 8–21. VIII.2012, C. Alderson & V. Webster // Hardwood woodland near seasonally flooded marsh, Lindgren funnel trap 1 m high under *Quercus macrocarpa* (1, RWC).

Distribution in Canada and Alaska. BC, AB, SK, MB, ON, QC, **NB** (Bousquet et al. 2013, Klimaszewski et al. 2015).

Family Latridiidae Erichson, 1842
Subfamily Latridiinae Erichson, 1842

***Dienerella costulata* (Reitter, 1877) †, new to New Brunswick**

Specimen data. New Brunswick, Westmorland Co., Sackville, Morgan Lane, 45.9001N, 64.3651W, house, basement, J. Klymko (1, RWC; 3 NBM).

Distribution in Canada and Alaska. SK, MB, ON, QC, **NB,** NS, PE (Bousquet et al. 2013).

Family Mordellidae Latreille, 1802
Subfamily Mordellinae Latreille, 1802

***Falsomordellistena hebraica* (LeConte, 1862), new to New Brunswick**

Specimen data. New Brunswick, Gloucester Co., Bathurst, Daly Point Preserve, 47.6392N, 65.6098W, 5–21.VIII.2015, C. Alderson & V. Webster // Mixed forest, green Lindgren funnel trap 1 m high (1, RWC).

Distribution in Canada and Alaska. MB, ON, QC, **NB** (Bousquet et al. 2013).

***Mordellina andreae* LeConte, 1862, new to New Brunswick**

Note. Bousquet et al (2013) placed this species in the genus *Mordellina*. However, Lisberg (2003) recommended keeping this species in the genus *Mordellistena* but noted

that it was not well placed in either genus. A specimen (not available) of this species from Edmundston, Madawaska Co. was photographed by Richard Migneault on June 12, 2017. See https://bugguide.net/node/view/1481467.

Specimen data. New Brunswick, York Co., Charters Settlement, 45.8430N, 66.7275W, 27.VI.2004, R.P. Webster, coll. // Regenerating mixed forest, sweeping foliage (1, RWC); Spednic Lake PNA, nr. Palfrey Stream at East Brook Rd., 45.6984N, 67.4968W, 16.VIII.2017, R.P. Webster // Slow flowing stream with emergent vegetation, sweeping foliage (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Mordellistena divisa LeConte, 1859, new to New Brunswick

Note. It was surprising to find this distinctive species in NB. The NB specimens clearly key out to *Mordellistena divisa* and fit the description in Liljeblad (1945) and appear identical to the type specimen in the MCZ Type Database @ Harvard Entomology. This species has been reported from NJ and NY in the eastern United States but appears to be mainly mid-western in distribution (Downie & Arnett 1996). Adults were swept from vegetation in an old field with open bare sandy areas.

Specimen data. New Brunswick, Sunbury Co., 9.5 km NE Jct. 101 & 645, 45.7586N, 66.6755W, 17.VII.2008, R.P. Webster, coll. // Old field with open sandy areas, sweeping foliage (10, RWC).

Distribution in Canada and Alaska. SK, MB, **NB** (Bousquet et al. 2013).

Mordellistena sericans Fall, 1907, new to New Brunswick

Specimen data. New Brunswick, Sunbury Co., Sunpoke Lake, 45.7656N, 66.5550W, 5–15.VIII.2012, 5–27.VIII.2012, C. Alderson & V. Webster // Red oak forest near seasonally flooded marsh, Lindgren funnel trap 1 m high under *Quercus rubra* (2, RWC).

Distribution in Canada and Alaska. SK, MB, **NB,** NS, PE (Bousquet et al. 2013).

Family Meloidae Gyllenhal, 1810
Subfamily Nemognathinae Laporte, 1840

Tricrania sanguinipennis (Say, 1823)

Note. *Tricrania sanguinipennis* was first reported from NB on BugGuide.Net, https://bugguide.net/node/view/1512612/bgimage by Anthony W. Thomas, based on a photograph of an individual taken on 24 April, 2018 in Fredericton (Douglas). The individual was not collected (A. Thomas, pers. comm., 2019). This is the first record of

this species from the province. The first author visited the same site on 5 May 2019 and collected four individuals representing the first specimen vouchers. Two additional individuals were observed on 6 May at the same site. Adults were observed crawling on the ground in areas of short grass with bare patches of sandy soil in or near colonies of ground nesting bees. Larvae of this genus are parasitoids of ground nesting bees and are phoretic on adult bees. Phoresy appears to be the main means this flightless species uses to reach their host nests (Pinto and Bologna 2002) and may also be the primary way it disperses to new areas.

This meloid has been reported as far north as Clinton, Kennebec Co., in central ME (Majka et al. 2011) and is known from QC and ON in Canada (Bousquet et al. 2013). The population in NB represents a significant range extension to the northeast. This species is currently known from only one locality in NB but may be more widespread. Adults may have been overlooked because they are active very early in the spring when red maples (*Acer rubrum* L.) are in flower.

Specimen data. New Brunswick, York Co., Douglas, 45.9779N, 66.6859W, 5.V.2019, R.P. Webster // Area with short grass and sandy soil, on ground in area with ground nesting bees (2, NBM; 2, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Family Tenebrionidae Latreille, 1802
Subfamily Diaperinae Latreille, 1802

***Adelina pallida* (Say, 1824), new to Canada and Quebec**

Note. *Adelina pallida* was known to occur in the United States as far north as IN, OH, and MD (Bousquet et al. 2018). The record from QC represents a significant northward range extension and the first occurrence of this species and of its genus in Canada. This small species is readily recognized among other members of its family by its markedly flat cucujid-like body.

Specimen data. Quebec, MRC de Deux-Montagnes, Oka, parc national d'Oka, 27.VII.2006, wooded area next to beach, R. Vigneault (1, RVC).

Distribution in Canada and Alaska. QC.

Family Anthicidae Latreille, 1819
Subfamily Anthicinae Latreille, 1819

***Sapintus fulvipes* (Laferté-Sénectère, 1847)**

This species was reported for the first time from NB on BugGuide.Net by Richard Migneault. See https://bugguide.net/node/view/861873 for a photograph of the specimen. The specimen, determined by D.S. Chandler, was collected in Edmundston, NB (Madawaska Co.) on June 6, 2013.

Distribution in Canada and Alaska. BC, SK, MB, ON, QC, **NB**, NS (Bousquet et al. 2013).

Family Cerambycidae Latreille, 1802
Subfamily Lamiinae Latreille, 1825

***Acanthocinus obsoletus* (Olivier, 1795), new to Nova Scotia**

Specimen data. Nova Scotia, Annapolis Co., Kejimkujik N.P., 44.39889N, 65.21999W, 30.VII–13.VIII.2018, G. Marten-Carpenter, coll. // Mixed forest, Lindgren funnel trap, Trap 4 (1, AFC). **Queens Co.**, Kejimkujik National Park, 44.30972N, 65.32986W, 30.VII–17.VIII.2018, G. Marten-Carpenter, coll. // Mixed forest, Lindgren funnel trap, Trap 12 (9, AFC).

Distribution in Canada and Alaska. ON, QC, **NS** (Bousquet et al. 2017).

***Eupogonius pauper* LeConte, 1852, new to New Brunswick**

Note. This longhorn has been reported as far north as the Quebec City area of QC and uses a wide variety of deciduous trees, shrubs and vines as host plants (Bousquet et al. 2017). Its presence in NB is not unexpected.

Specimen data. New Brunswick, York Co. Kingsclear, 45.9458N, 66.7948W, 8–21.VII.2017, C. Alderson & V. Webster // Mixed forest, Green 5-Funnel Lindgren funnel trap in tree canopy (1, AFC).

Distribution in Canada and Alaska. MB, ON, QC, **NB** (Bousquet et al. 2017).

***Mecas cineracea* Casey, 1913, new to Manitoba**

Note. The first specimen of *Mecas cineracea* reported from Canada was swept from vegetation near Willow Bunch Lake, SK in 1991 (Bousquet et al. 2017). The new MB record represents the second known Canadian specimen; it was swept from vegetation in a marshy area in a native tall grass prairie.

Specimen data. Manitoba, near Jct. 36N, 144W, N of Grande Clairière, 49.5289N, 100.7324W, 8.VII.2007, R.P. Webster, coll. // Native tall grass prairie, sweeping vegetation in marshy area (1, RWC).

Distribution in Canada and Alaska. SK, **MB** (Bousquet et al. 2017).

***Tetrops praeusta* (Linnaeus, 1758) †, new to Nova Scotia**

Note. This adventive species is common and widespread in NB (Webster and Sweeney, unpublished data). Its presence in NS is not unexpected.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 17.VI.2018, K. Van Rooyen & J. Palmer // Hardwood dominated forest, green Lindgren funnel trap in tree canopy (1, AFC)

Distribution in Canada and Alaska. ON, QC, NB, **NS** (Bousquet et al. 2013, 2017).

Family Chrysomelidae Latreille, 1802
Subfamily Bruchinae Latreille, 1802

***Acanthoscelides tenuis* Bottimer, 1935, new to New Brunswick and Quebec**

Note. As Kingsolver (2004) noted, "The genus *Acanthoscelides* is a large and diverse, poorly defined aggregate of mostly small species of Bruchidae". Identification often requires an examination of the genitalia. The identification of the specimens from QC and NB is the result of a joint effort by H. Douglas and K. Savard (CNC), Geoffery Morse (U. of San Diego), and G.J. Kergoat (INRAE, France). *Acanthoscelides tenuis* was known to occur in ON, but the records presented here represents a significant range extension to the northeast.

Specimen data. New Brunswick, **Carleton Co.**, Jackson Falls, 46.2251N, 67.7401W, 24.VIII.2017, R.P. Webster // River margin, sweeping *Lythrum salicaria* (1, RWC). **Quebec, MRC de Deux-Montagnes,** Oka, parc national d'Oka, 14.VI.2017, R. Vigneault, beating in a field at the western end of the park (2, RVC). **MRC Vaudreuil-Soulanges,** Notre-Dame-de-l'Île-Perrot, 8.VI.2011, 13 h, P. de Tonnancour, swept from *Barbarea vulgaris* (1, PdT); same locality data and collector but 19.VI.2011, 13 h, beaten from *Cornus obliqua* inflorescence (2, CNC; 5, PdTC); same locality data and collector but 19.VII.2011, 15 h, beaten from *Scirpus* sp. (1, PdTC); same locality and collector but 12.VIII.2011, 15 h, swept from flowering *Ambrosia artemisiifolia* (1, PdTC); Notre-Dame-de-l'Île-Perrot, 45.3757N, 73.9457W, 1.VIII.2018, 14 h, P. de Tonnancour, beaten from *Lythrum salicaria* (1, PdTC); Saint-Lazare, 24.VI.2012, P. de Tonnancour, beaten from flowering *Brassica* sp. (1, PdTC).

Distribution in Canada and Alaska. ON, **QC**, **NB** (Bousquet et al. 2013).

***Bruchus brachialis* Fåhraeus, 1839 †, new to Nova Scotia**

Note. The vetch bruchid, *B. brachialis,* is native to Europe and is a seed predator of *Vicia* spp. It was first collected in North America in NJ, DE, and MD in 1931 (Bottimer 1931) and by 1968 had spread to most of eastern and northwestern United States and southwestern Canada (Bottimer 1968). This is the first record for NS. Adults seek overwintering sites in protected places such as grain storage bins and under lichens and loose bark on trees. NS specimens emerged from trunk sections of red maple trees that had been girdled (the bark and top 2 cm of sapwood removed from circumference of the trunk near the ground) in spring of 2014, cut 23 February 2016, stored at -2 °C until 12 April 2016, and then incubated at 20 °C in emergence cages. The emergence date of 27 June 2016 may not accurately reflect the earliest date that adults became active because emergence cages were checked only twice after being set up: 27 June and 23 August 2016. In OR, Steinhauer (1959) observed the first adults of *B. brachialis* in early April and reported peak abundance of males in late May and females in late June. The girdling/felling/incubation of sections of red maple trees was intended as a way

of detecting species of bark and wood boring beetles, but here we demonstrated that the method may also detect leaf feeders that overwinter under bark scales of trees. We collected several adults of the beech leaf-mining weevil, *Orchestes fagi* (L., 1758) from the same bolts.

Specimen data. Nova Scotia, **Halifax Co.,** Magazine Hill, 44.7143N, 63.6331W, emgd. 27.VI.2016 from red maple bolts coll. 23.II.2016, K. Van Rooyen & N. Higgins (9, AFC).

Distribution in Canada and Alaska. BC, ON, QC, **NS** (Bousquet et al. 2013).

Subfamily Donaciinae Kirby, 1837

***Donacia biimpressa* Melsheimer, 1847, new to New Brunswick**

Specimen data. New Brunswick, **Queens Co.,** Scotchtown, Grande Lake Meadows P.N.A., 45.8763N, 66.1822W, 16.VI.2013 (1), 17.VI.2013 (3), R.P. Webster // Lake shore / sand dune with red oak, sweeping vegetation (4, RWC).

Distribution in Canada and Alaska. MB, ON, QC, **NB** (Bousquet et al. 2013).

***Donacia limonia* C. Schaeffer, 1925, new to New Brunswick**

Specimen data. New Brunswick, Queens Co., Upper Gagetown, bog adjacent to Hwy 2, 45.8316N, 66.2346W, 23.V.2006, R.P. Webster, coll. // Tamarack bog, treading *Carex* into water (1, RWC). **Restigouche Co.,** McDonald Road, 47.8333N, 68.2777W, 20.VI.2011, R. Webster & M. Turgeon // *Carex* marsh, sweeping vegetation (3, RWC); Dionne Brook P.N.A., 47.8981N, 68.3646W, 15.VI.2011 // Beaver flowage // pond, treading sedges into water (1, RWC). **Saint John Co.**, Musquash, 45.1856N, 66.3402W, 30.V.2008, R.P. Webster, coll. // *Carex* & cattail marsh, treading vegetation into water (1, RWC); Chance Harbour off Rt. 790, 45.1355N, 66.3672W, 12.V.2008, R.P. Webster, coll. // Shrubby cinquefoil fen, on *Carex* species (1, RWC). **Sunbury Co.**, Bull Pasture Bog, 46.0354N, 66.3358W, 21.VI.2013, R.P. Webster // Moss lawn bog with black spruce & tamarack on margin, sweeping vegetation on bog margin (2, RWC). **York Co.**, Charters Settlement, 45.8267N, 66.7343W, 14.V.2005, R.P. Webster, coll. // Margin of *Carex* marsh / fen in sphagnum & leaf litter at base of tree (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

***Poecilocera harrisii* (J.L. LeConte, 1851), new to Canada and New Brunswick**

Note. *Poecilocera harrisii* has been reported as far east as MA and NH in the Northeast (Riley et al. 2003) but has yet to be reported from ME (Majka et al, 2011). The NB record is a significant range extension to the northeast and represents the first occurrence of this species in Canada. Both specimens were captured in a calcareous fen with

shrubby cinquefoil (*Dasiphora fruticosa* (L.) Rydb.). Little is known about the biology of the species other than an association with *Carex* (Riley et al. 2002).

Specimen data. New Brunswick, **York Co.,** Canterbury, Browns Mtn. Fen [now Eel River P.N.A.], 45.8967N, 67.6343W, 23.VI.2005, J. Edsall & R. Webster coll. // Calcareous fen, sweeping (1, RWC); same locality data but 23.VI.2014, R.P. Webster // Calcareous cedar fen with shrubby cinquefoil, sweeping vegetation with *Myrica gale* & *Rhododendron groenlandicum* (1, RWC).

Distribution in Canada and Alaska. NB

Subfamily Cassidinae Gyllenhal, 1813

Chalepus walshii walshii (Crotch, 1873), new to New Brunswick

Note. *Chalepus w. walshii* was reported from ME by Majka et al. (2011). Larval hosts are grasses (Riley et al. 2003). The NB specimens were found on the adventive reed canary grass (*Phalaris arundinacea* L.).

In Bousquet et al. (2013), this species is incorrectly listed as *Chalepus walshi walshi* (Olivier, 1792). The correct name is *Chalepus walshii walshii* (Crotch, 1873) (Yves Bousquet, Hume Douglas, and Patrice Bouchard, pers. comm., 2019).

Specimen data. New Brunswick, York Co., Spednic Lake P.N.A., Palfrey Stream at East Brook Road, 45.6980N, 67.4982W, 13.VI.2018, R.P. Webster & M.-A. Giguère // Roadside, on grass (1, NBM); nr. Palfrey Stream at East Brook Road, 45.6987N, 67.4965W, 13.VI.2018, R.P. Webster & M.-A. Giguère // Roadside, on grass (2, RWC)

Distribution in Canada and Alaska. ON, **NB** (Bousquet et al. 2013).

Chelymorpha cassidea (Fabricius, 1775)

Note. Adults of *Chelymorpha cassidea* were photographed in NB by Stuart Tingley at the Dunes de Bouchtouche in Bouchtouche on June 20 and June 30, 2015. These are the first records of this species in NB. Photographs of these specimens and others can be seen on the iNaturalist website at https://inaturalist.ca/observations?place_id=7587&taxon_id=216654

On August 2, 2019, Marie-Andrée Giguère and the first author visited the site and found both adults and pupae on bindweed (*Calystegia sepium* L.) growing in a salt marsh adjacent to sand dunes. Seven pupae were collected, and adults emerged from these pupae on August 5 and 6, 2019.

Specimen data. New Brunswick, Kent Co., Dune de Bouctouche, 46.5212N, 64.6758W, 2.VIII.2019, R.P. Webster & M.-A. Giguère // Salt marsh adjacent to sand dune, on *Calystegia sepium* L. (3, NBM; 2, RWC); same data as above but ex. Pupa, emgd. 5–6.VIII.2019 (2, NBM; 5, RWC).

Distribution in Canada and Alaska. AB, SK, MB, ON, QC, **NB** (Bousquet et al. 2013).

Subfamily Galerucinae Latreille, 1802

***Chaetocnema hortensis* (Geoffroy, 1785) †, new to New Brunswick**

Note. Most specimens in the CNC from Canada determined as *Chaetocnema borealis* R. White, 1996 are *C. hortensis* (Pentinsaari et al 2019). This species is native to the Palaearctic where it is widespread (Döberl 2010). It is adventive in Canada in BC and in eastern Canada in NF, LB, NS, and ON (Pentinsaari et al 2019). Here we report it for the first time from NB. Majka and LeSage (2010) reported *C. borealis* for the first time from NB, but it is possible that these specimens represent this adventive species. The specimen from Coxheath, Cape Breton Island, NS, illustrated as *C. borealis* in Majka and LeSage (2010) was dissected and is *C. hortensis* (Hume Douglas & Karine Savard, pers. comm.). This specimen exhibits the purple tone typical of most specimens from NB.

Specimen data. New Brunswick, **Kent Co.**, Kouchibouguac National Park, 46.8072N, 64.9082W, 21.V.2015, R.P. Webster // Alder swamp in mixed forest, in leaf litter (1, RWC). **Queens Co.**, W of Jemseg at "Trout Creek", 45.8237N, 66.1225W, 6.IX.2007, R.P. Webster, coll. // Silver maple swamp, sweeping vegetation along margin of marsh (1, RWCD); Cranberry Lake P.N.A., 46.1125N, 65.6075W, 13–25.V.2011, R. Roy & V. Webster, coll. // Red oak forest, Lindgren funnel trap (1, RWC). **York Co.**, Charters Settlement, 45.8395N, 66.7391W, 17.VII.2014 (2), 27.VII.2006 (1), 27.VI.2007 (1), R.P. Webster, coll. // Mixed forest, m.v. light (4, RWC); same locality data and collector but 10.V.2007 // Mixed forest, in flight on warm (28 °C) sunny afternoon (1, RWC); Charters Settlement, 45.8263N, 66.7341W, 8.IX.2017, R.P. Webster // Pond margin / marsh, sweeping vegetation (1, RWC); Canterbury, trail to "Browns Mtn Fen", 45.8964N, 67.6273W, 8.IX.2007, R.P. Webster, coll. // Mixed forest, sweeping roadside vegetation (1, RWC).

Distribution in Canada and Alaska. BC, ON, **NB**, NS, LB, NF (Pentinsaari et al. 2019).

***Chaetocnema irregularis* LeConte, 1857, new to New Brunswick**

Specimen data. New Brunswick, York Co., Mazerolle Settlement, 45.8729N, 66.8311W, 28.IV.2006, R.P. Webster, coll. // Stream margin, in grass litter on muddy soil (1, RWC); Mazerolle Settlement, 45.8765N, 66.8260W, 8.VI.2008, R.P. Webster // Beaver meadow, sweeping vegetation along brook margin (1, RWC); Charters Settlement, 45.8348N, 66.7406W, 8.V.2018, R.P. Webster // Old brushy field, beating *Salix* catkins (1, NBM); Charters Settlement, 45.8263N, 66.7341W, 9.VI.2018, R.P. Webster // Pond margin / marsh, sweeping vegetation (7, RWC); Charters Settlement, 45.8451N, 66.7289W, R.P. Webster // Stream margin in marsh / alder swamp, sweeping cruciferous sp. (1, RWC); Spednic Lake P.N.A., near Pats Brook, 45.6209N, 67.4342W, 15.VIII.2017 (1), 15.VI.2018 (2), R.P. Webster // Freshwater marsh,

sweeping vegetation (3, NBM); Spednic Lake P.N.A., Palfrey Stream at East Brook Rd., 45.6980N, 67.4982W, 13.VI.2018, R.P. Webster & M.-A. Giguère // Stream margin, sweeping vegetation (1, NBM); **Queens Co.**, W of Jemseg at "Trout Creek", 45.8237N, 66.1225W, 6.IX.2007, R.P. Webster // Silver maple swamp, sweeping foliage along margin of marsh (1, RWC). **Sunbury Co.**, Burton, near Sunpoke Lake, 45.7662N, 66.5526W, 20.VI.2007, R.P. Webster, coll. // seasonally flooded marsh, sweeping vegetation (1, RWC).

Distribution in Canada and Alaska. NT, BC, AB, SK, MB, ON, QC, **NB** (Bousquet et al. 2013).

Crepidodera decora Parry, 1986, new to New Brunswick

Note. *Crepidodera decora* is externally very similar to *C. luminosa* Parry, 1986 and best distinguished by the shape of the male aedeagus and female spermathecae (Parry 1986). Both species were found on *Salix* catkins and foliage in NB.

Specimen data. New Brunswick, **Carleton Co.**, Red Brook Rd. at Meduxnekeag River, 46.1998N, 67.6989W, 7.VI.2018, R.P. Webster // River margin, sweeping vegetation (1 ♀ (dissected), RWC). **York Co.**, Charters Settlement, 45.8348N, 66.7406W, 6.V.2018 (3), 8.V.2018 (1), 17.V.2018 (3), R.P. Webster // Old brushy field, beating *Salix* catkins (2 ♀♀ (dissected), NBM; 3 ♂♂, 2 ♀♀ (dissected), RWC); near Thomaston Corner, 45.6171N, 67.0993W, 25.V.2018, R.P. Webster // Marsh, beating *Salix* foliage (3 ♀♀ (dissected), NBM; 2 ♂♂, 2 ♀♀ (dissected), RWC).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Longitarsus melanurus (Melsheiner, 1847), new to New Brunswick

Specimen data. New Brunswick, **York Co.**, Spednic Lake P.N.A., near Pats Brook, 45.6210N, 67.4342W, 15.VI.2018, R.P. Webster // Freshwater marsh with slow flowing stream with emergent vegetation, sweeping vegetation (3 (1 ♂ (dissected), RWC); Spednic Lake Prov. Park, 45.6183N, 67.4276W, 20.VI.2018, R.P. Webster // Marsh near Diggity Stream, treading *Carex* & grass (1, RWC).

Distribution in Canada and Alaska. MB, ON, QC, **NB** (Bousquet et al. 2013).

Subfamily Cryptocephalini Gyllenhal, 1813

Diachus pallidicornis (Suffrian, 1867), new to New Brunswick

New Record: New Brunswick, **York Co.**, 16 km W of Tracy, off Rt. 645, 45.6854N, 66.8839W, 16.VIII–5.IX.2014, C. Alderson & V. Webster // Old red pine forest, Lindgren funnel trap (1, RWC).

Distribution in Canada and Alaska. ON, **NB** (Bousquet et al. 2013).

Family Anthribidae Billberg, 1820
Subfamily Anthribinae Billberg, 1820

***Anthribus nebulosus* Forster, 1770 †, new to Prince Edward Island and Quebec**

Note. *Anthribus nebulosus* is a Palaearctic species that was intentionally introduced to VA in 1978–1979 as a biological agent against scale insects. It has since been recorded in southern New England (Hoebeke and Wheeler 1991) and adjacent regions of PA and NJ and, in Canada, from the region of Guelph, ON (Bouchard et al. 2017). Most specimens from QC were recovered from an intercept trap in a suburban residential area. Specimens from PE were captured in green or black Lindgren funnel traps set up either in the canopy of poplar (6) or 1 m high under trees (2).

Specimen data. Prince Edward Island, Queens Co., Auburn, Auburn Demonstration Woodlot, 46.2882N, 63.9267W, 13.VI–3.VII.2018 (1), 2.VIII–13.IX.2018 (1), 4.VI–3.VII.2019 (3), 3.VII–14.VIII.2019 (2), 14.VIII–17.IX.2019 (1), C. Hughes // Mixed forest, green Lindgren funnel trap in canopy of poplar snag (1), green Lindgren funnel trap in canopy of poplar (5), low black Lindgren funnel trap (2) (2, AFC; 6, RWC). **Quebec, Agglomération de Montréal,** Sainte-Anne-de-Bellevue, 45.4091N, 73.9442W, 5.VII.2012, 15 h, P. de Tonnancour, beaten from *Ulmus americana* + *Vitis riparia* (3, PdTC); Montréal, parc Zotique-Racicot, 45.543N, 73.690W, 6.VII.2015, ca. 14 h, beaten from *Fraxinus* sp., S. Dumont (1, SDC). **MRC de Deux-Montagnes:** Oka, Welcoming center, La Grande Baie, flight interception trap (white tulle fabric), 22.V.2018, R. Vigneault (1, RVC); **MRC de Vaudreuil-Soulanges**, Mont Rigaud, 45.4667N, 74.3258W, 12.VII.2014, 16 h, P. de Tonnancour, beaten from *Amelanchier* sp., rocky outcrop (1, PdTC); Notre-Dame-de-l'Île-Perrot, 45.3756N, 73.9448W, 26.VII.2015, 17 h, P. de Tonnancour, beaten from *Viburnum cassinoides* (1, PdTC); Terrasse-Vaudreuil, 45.3924N, 73.9922W, 7.V.2013, 17 h (1), 17.V.2013, 13–14 h (4), 30.V.2013, 14–15 h (1), 1.VI.2013,11 h (1), 12.V.2014, 14–18 h (2), 15.V.2014, 15 h (1), 20.V.2014, 18 h (1), 24.V.2014, 13 h (1), P. de Tonnancour, flight interception trap (white tulle fabric) (1, CCC; 3, CMNC; 2, CNC; 6, PdTC); same locality data and collector but 31.V.2013, 21–23 h 30, attracted to porch + UV lamps (2, CMNC; 2, PdTC); same locality data and collector but 25.VI.2019, 23 h 30, attracted to porch + UV + mercury vapor lamps (1, PdTC); Ville de l'Île-Perrot, 45.3969N, 73.9628W, 31.V.2015, 16 h, P. de Tonnancour, beaten from fruiting branches of *Fraxinus pennsylvanica* (1, PdTC); Terrasse-Vaudreuil, 45.3925N, 73.9923W, 11.X.2019, 15 h, resting between two freshly cut logs of *Fraxinus pennsylvanica* (1, PdTC).

Distribution in Canada and Alaska. ON, **QC**, **PE** (Bouchard et al. 2017).

Family Brentidae Billberg, 1820
Subfamily Apioninae Schönherr, 1823

***Rhopalapion longirostre* (Olivier, 1807) †**

Note. This distinctive looking adventive species was reported for the first time from NB on BugGuide.Net by Eric Knopf. See https://bugguide.net/node/view/1355652 for a

photograph of this species. The first individual from Nasonworth, York, Co. was photographed on April 11, 2017. Another individual was photographed on July 10, 2017 https://bugguide.net/node/view/1401639. Determinations were verified by R.S. Anderson.

Distribution in Canada and Alaska. BC, SK, ON, QC, **NB**, NS (Bousquet et al. 2013).

Fallapion melanarium (Gerstaecker, 1854), new to New Brunswick

Note. *Fallapion melanarium* was reported from MA, NY, and ON south to TX by Downie & Arnett, Jr. (1996). It was not reported from ME by Majka et al. (2011). Host plants are *Bidens* spp. (beggar ticks) which occur in water or very moist situations (Tuttle 1954, Bright 1993). Most specimens from NB were swept from vegetation in marshes where *Bidens* was present.

Specimen record. New Brunswick, Restigouche Co., Summit Lake, 47.7825N, 68.3199W, 7.VI.2011, R.P. Webster // Lake margin, *Carex* marsh, treading *Carex* hummocks and emergent vegetation (1, NBM; 2, RWC). **York Co.**, Charters Settlement, 45.8266N, 66.7365W, 2.VI.2007, R.P. Webster (1, NBM); Charters Settlement, 45.8263N, 66.7341W, 6.IX.2017 (4), 10.IX.2017 (8), R.P. Webster // Pond margin/marsh, sweeping vegetation (4, NBM; 8, RWC); 9.0 km W of Tracy, off Rt. 645, 45.6888N, 66.8004W, 22.V.2008, R.P. Webster, coll. // Sedge marsh, in *Carex* hummock (1, NBM).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Stenopterapion meliloti (Kirby, 1808) †

This adventive species associated with the Eurasian sweet clover (*Melilotus officinalis* (L.) Lam.), as its specific name implies, was reported for the first time from NB on BugGuide.Net by Richard Migneault. See https://bugguide.net/node/view/503497 for a photograph of the specimen that was collected in Edmundston, Madawaska Co. on June 27, 2010. Another photo of an individual collected at the same locality on May 14, 2012 is shown at https://bugguide.net/node/view/736051. Determinations were verified by R.S. Anderson.

Distribution in Canada and Alaska. QC, **NB** (Bousquet et al. 2013).

Family Dryophthoridae Schönherr, 1825
Subfamily Rhynchophorinae Schönherr, 1833

Sphenophorus australis australis Chittenden, 1905, new to New Brunswick

Specimen data. New Brunswick, **Albert Co.**, Waterside, Waterside Beach, 45.6282N, 64.8129W, 29.VI.2014, R.P. Webster // Salt marsh near tidal stream on sand in area with sparse *Spartina*. **York Co.**, Spednic Lake P.N.A., near Pats Brook, 45.6210N,

67.4342W, 15.VI.2018, R.P. Webster // Freshwater marsh, sweeping vegetation (1, RWC); Spednic Lake Prov. Park, 45.6183N, 67.4276W, 20.VI.2018, R.P. Webster // Marsh near Diggity Stream, treading *Carex* & grass (1, NBM).

Distribution in Canada and Alaska. ON, QC, **NB** (Bousquet et al. 2013).

Family Curculionidae Latreille, 1802
Subfamily Curculioninae Latreille, 1802

***Curculio rubidus* (Gyllenhal, 1835) †, new to Nova Scotia**

Note. This adventive weevil was first reported from Canada from QC and a BugGuide. Net record from ON (de Tonnancour et al. 2017). Most specimens from QC were beaten from foliage of gray birch (*Betula populifolia* Marshall) in late summer (de Tonnancour et al. 2017). This species will likely be found in NB.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 13–20.VIII.2018, K. Van Rooyen & J. Palmer // Hardwood forest, green Lindgren funnel trap in tree canopy (1, AFC).

Distribution in Canada and Alaska. ON, QC, **NS** (de Tonnancour et al. 2017).

***Curculio sulcatulus* (Casey, 1897), new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 20–27.VIII.2018, K. Van Rooyen & J. Palmer // Hardwood dominated forest, green Lindgren funnel traps in tree canopy (4, AFC).

Distribution in Canada and Alaska. ON, QC, NB, **NS** (Bousquet et al. 2013).

***Ellescus bipunctatus* (Linnaeus, 1758), new to Nova Scotia**

Note. This species was first reported by Webster et al. (2016c) from NB, where it is common, and thus, its presence in NS is not unexpected.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 16.V.2016, K. Van Rooyen & N. Higgins (1, AFC).

Distribution in Canada and Alaska. MB, ON, QC, NB, **NS** (Bousquet et al. 2013, Webster et al. 2016c).

***Ellescus borealis* Carr, 1920, new to Quebec**

Note. The record of *E. borealis* from northwestern QC represents a significant range extension to the northeast. Like other *Ellescus* species, *E. borealis* is associated with *Salix* spp. It was found in abundance on smallfruit willow (*Salix brachycarpa* Nuttall) growing on the eastern shore of James Bay.

Specimen data. Quebec, Région administrative du Nord-du-Québec, Longue-Pointe, 53.9752N, 79.0685W, 6.VIII.2018, 14 h, P. de Tonnancour, beaten from *Salix brachycarpa* var. *brachycarpa* (11, PdTC); same locality and habitat data and collector but 7.VIII.2018, 12 h (59) (2, CCC; 5, CMNC; 3, CNC; 47, PdTC; 2, RVC).

Distribution in Canada and Alaska. AK, YT, AB, MB, **QC** (Bousquet et al. 2013).

Mecinus pascuorum (Gyllenhal, 1813) †

This adventive weevil was reported for the first time from NB on BugGuide.Net by Richard Migneault. See https://bugguide.net/node/view/862006 for the illustration of the specimen which was collected in Edmundston, Madawaska Co. on June 23, 2013. This monophagous weevil feeds on the developing seeds of English plantain (*Plantago lanceolata* L.), also adventive in North America. Determination was verified by R.S. Anderson.

Distribution in Canada and Alaska. BC, ON, QC, **NB**, NS, PE (Bousquet et al. 2013).

Orchestes steppensis (Korotyaev, 2016) †, additional record from Nova Scotia.

Note. As noted by Korotyaev (2016), this adventive species was misidentified as *Orchestes alni* (L., 1758) since its introduction in North America, and the distribution given in Bousquet et al. (2013) and the NS record of *O. alni* in Webster et al. (2016c) therefore applies to *O. steppensis*. An additional specimen of this species was reported from NS in 2019 and is reported below. This is the second record of this adventive species from the Maritime Provinces.

Specimen data. Nova Scotia, Halifax Co. Burnside Industrial Park, 42.87467N, 63.58778W, 9.VII.2019, K. Van Rooyen & C. Kostanowicz // Green Lindgren funnel trap in canopy of elm (*Ulmus americana*) (1, CNC).

Smicronyx amoenus (Say, 1832), new to Quebec

Note. The record from southern QC represents a significant eastern range extension in Canada, as this species was previously known only from SK and MB (Bousquet et al. 2013). Host records, although sparse, associate this species with Asteraceae (Anderson et al. 2014). Determination was made by R.S. Anderson.

Specimen data. Quebec, MRC de Vaudreuil-Soulanges, Terrasse-Vaudreuil, 45.3924N, 73.9923W, 14.VIII.2018, 1–2 h, P. de Tonnancour, attracted to porch + mercury vapor lamps (1, PdTC).

Distribution in Canada and Alaska. SK, MB, **QC** (Bousquet et al. 2013).

Subfamily Bagoinae C.G. Thomson, 1859

***Bagous magister* LeConte, 1876, new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 4.VII.2016, K. Van Rooyen & N. Higgins // hardwood dominated forest, purple Lindgren funnel in understory (1, AFC).

Distribution in Canada and Alaska. ON, QC, **NS** (Bousquet et al. 2013, de Tonnancour et al. 2017).

Subfamily Baridinae Schönherr, 1836

***Plesiobaris albilata* (LeConte, 1876), new to Canada, New Brunswick, and Quebec**

Specimens recorded as *Plesiobaris disjuncta* Casey, 1892 in Webster et al. (2012a) were reviewed following examination of the holotype of this species by R.S. Anderson in February 2020. These records from NB and QC were found to refer to *Plesiobaris albilata* (LeConte, 1876), a species not previously recorded in Canada, thus *P. disjuncta* should be removed from the Canadian, NB and QC faunal lists.

Distribution in Canada and Alaska. QC, NB.

Subfamily Ceutorhynchinae Gistel, 1848

***Ceutorhynchus oregonensis* Dietz, 1896**

This weevil was reported for the first time from NB on BugGuide.Net by Richard Migneault. See https://bugguide.net/node/view/736516 for the illustration of the specimen that was collected in Edmundston, Madawaska Co. on June 12, 2012. The determination was confirmed by R.S. Anderson.

Distribution in Canada and Alaska. YT, BC, AB, MB, ON, QC, **NB**, NS (Bousquet et al. 2013).

***Prorutidosoma decipiens* (LeConte, 1876)**

This weevil was reported for the first time from NB on BugGuide.Net by Richard Migneault. See https://bugguide.net/node/view/1029494 for the illustration of the specimen that was collected in Edmundston, Madawaska Co. on May 29, 2014. The determination was confirmed by R.S. Anderson.

Distribution in Canada and Alaska. AK, YT, BC, AB, SK, MB, ON, QC, **NB**, PE (Bousquet et al. 2013).

Subfamily Cossoninae Schönherr, 1825

***Phloeophagus canadensis* Van Dyke, 1927, new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 27.VI.2016, coll., K. Van Rooyen & H. Higgins (1, AFC); same locality data but 4–11.VII.2016, K. Van Rooyen & N. Higgins // Hardwood dominated forest, purple Lindgren funnel trap in understory (1, AFC).

Distribution in Canada and Alaska. AK, BC, AB, SK, MB, QC, NB, **NS** (Bousquet et al. 2013).

Subfamily Entiminae Schönherr, 1823

***Polydrusus impressifrons* Gyllenhal, 1834 †, new to Prince Edward Island**

Specimen data. Prince Edward Island, Kings Co., Valleyfield, Valleyfield Demonstration Woodlot, 46.1356N, 62.7198W, 12.VI–3.VII.2018, C. Hughes // Green Lindgren funnel trap in canopy of poplar (1, RWC).

Distribution in Canada and Alaska. MB, ON, QC, NB, NS, **PE** (Bousquet et al. 2013).

Subfamily Lixinae Schönherr, 1823

***Larinus carlinae* (Olivier, 1807) †**

This adventive weevil was reported for the first time from NB on BugGuide.Net by Richard Migneault. See https://bugguide.net/node/view/736349 for the illustration of the specimen that was collected in Edmundston, Madawaska Co. on June 12, 2012. This species was listed as *Larinus planus* (Fabricius, 1792) by Bousquet et al. (2013) and is still reported as such on BugGuide.Net. Gültekin and Alonso-Zarazaga (2015) showed that the correct name is *Larinus carlinae* (Olivier, 1807). Determination was verified by R.S. Anderson.

Distribution in Canada and Alaska. BC, AB, ON, QC, **NB**, NS (Bousquet et al. 2013).

Subfamily Mesoptiliinae Lacordaire, 1863

***Magdalis alutacea* LeConte, 1878, new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 2.VII.2015, K. Van Rooyen & T. Nelson (3, AFC).

Distribution in Canada and Alaska. AK, YT, NT, BC, AB, SK, QC, NB, **NS** (Bousquet et al. 2013).

***Magdalis hispoides* LeConte, 1876, new to Nova Scotia**

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 4.VII.2016 (2), 11.VII.2016 (1), Coll., K. Van Rooyen & N. Higgins (3, AFC).

Distribution in Canada and Alaska. YT, BC, AB, ON, QC, NB, **NS**, NF (Bousquet et al. 2013).

Subfamily Scolytinae Latreille, 1804

***Pityophthorus ramiperda* Swaine, 1917, new to New Brunswick**

Specimen data. New Brunswick, Kent Co., Kouchibouguac N.P., 46.8072N, 64.9100W, 27.V–12.VI.2015, C. Alderson & V. Webster // Jack pine forest, Lindgren funnel trap 1 m high (2, RWC). **York Co.** Odell Park, 45.9508N, 66.6723W, 19.V–3. VI.2015, C. Alderson & V. Webster // Old mixed forest, Lindgren funnel trap in canopy of hardwood (1, RWC).

Distribution in Canada and Alaska. ON, QC, **NB,** NS (Bousquet et al. 2013).

***Pseudopityophthorus asperulus* (LeConte, 1868), new to Canada and Nova Scotia**

Note. This species differs from the much more common *Pseudopityophthorus minutissimus* (C.C.A. Zimmerman, 1868) by being more slender, and having elytral striae with minute punctures in fairly definite rows. In *P. minutissimus* there is little evidence of strial rows (Bright 1976). Bright (1976) predicted this species might be found in NB as it is known from ME. Its presence in NS is not unexpected.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 16.V.2016, K. Van Rooyen & N. Higgins // Hardwood dominated forest, purple Lindgren funnel trap in tree canopy (1, AFC); same locality, habitat and collectors but 17–30.V.2016, green Lindgren funnel trap 1 m above ground (1, AFC); same locality but 3–10.VI.2018, K. Van Rooyen & J. Palmer // green Lindgren funnel traps 1m above ground (2), in tree canopy (1). (3, AFC).

Distribution in Canada and Alaska. NS.

***Hylastes opacus* Erichson, 1836 †, new to Nova Scotia and Prince Edward Island**

Note. Since its initial discovery in North America, in the state of NY in 1989 (Wood, 1992), this adventive Palaearctic species has rapidly extended its distribution and now occurs in several Canadian provinces and states in the United States. Its main hosts are *Pinus* spp.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 16.V.2016, coll., K. Van Rooyen & N. Higgins (1, AFC). **Prince Edward Island, Kings Co.**, Valleyfield, Valleyfield Demonstration Woodlot, 46.1385N, 62.7194W, 7.V–4. VI.2019, C. Hughes // Green Lindgren funnel trap in canopy of poplar (1, AFC). **Queens**

Co., Brookvale, Brookvale Demonstration Woodlot, 46.2920N, 63.4052W, 13.VI–3.VII.2018, 4.VI–3.VII.2019, C. Hughes // Lindgren funnel traps 1 m high (2, AFC).

Distribution in Canada and Alaska. BC, ON, QC, NB, **NS, PE** (Bousquet et al. 2013).

Hylurgops palliatus (Gyllenhal, 1813) †, new to Canada and New Brunswick

Note. This Eurasian species was one of the most commonly intercepted species in inspections of wood packaging material at United States ports between 1985 and 2005 (Haack 2006). Its first North American records were from PA (Haack 2001) and later NY and OH (Hoebeke and Acciavatti 2006). There have been no reports of damage or hosts in the United States (Haack 2006). The specimen reported below was determined by Donald Bright in 2020 and represents a new record for Canada.

Specimen data. New Brunswick, York Co., Fredericton, U.N.B. Woodlot, 45.9206N, 66.6520W, 31.V–14.VI.2013, C. Alderson & V. Webster // Mature mixed forest, Lindgren funnel trap 2 m high (1, RWC).

Distribution in Canada and Alaska. NB.

Hylastinus obscurus (Marsham, 1802) †, new to New Brunswick

Note. This adventive species is known as the clover root borer and is sometimes a serious pest of clover and alfalfa in the eastern United States (Bright 1976). A specimen (determination confirmed by RPW) of this species from Edmundston, Madawaska Co. was photographed by Richard Migneault on June 18, 2019. See https://bugguide.net/node/view/1785474.

Specimen data. New Brunswick, York Co., Crabbe Mountain, 46.12115N, 67.10524W, 6–27.VI.2018, C. Alderson & V. Webster // Hardwood forest, black Lindgren funnel trap in open tree canopy (1), green Lindgren funnel trap on edge of tree canopy (1) (2, AFC); Keswick Ridge, 45.99618N, 66.87813W, 11–29.VI.2018, C. Alderson & V. Webster // Hardwood forest, black Lindgren funnel trap in understory (1, AFC).

Distribution in Canada and Alaska. BC, ON, QC, **NB**, NS (Bousquet et al. 2013).

Heteroborips seriatus (Blandford, 1894) †, new to Canada and Nova Scotia

Note. This specimen was determined by R.J. Rabaglia in 2019 and represents a new record for Canada. This Asian species was first detected in North America in MA in 2005 (Hoebeke and Rabaglia 2008) and subsequently in ME in 2009 and PA in 2011, using semiochemical-baited black funnel traps as part of the US Forest Services Early Detection Rapid Response (EDRR) trapping surveillance program (Rabaglia et al. 2019). Mandelshtam et al. (2019) recently removed the genus *Heteroborips* from synonymy with *Xyleborus* and placed *Xyleborus seriatus* Blandford in the genus *Heteroborips*.

Specimen data. Nova Scotia, Halifax Co., Magazine Hill, 44.7143N, 63.6331W, 16–23.VII.2018, K. Van Rooyan & J. Palmer // Hardwood dominated forest, black Lindgren funnel trap in understory (1, AFC).

Distribution in Canada and Alaska. NS

Xyleborinus saxesenii (Ratzeburg, 1837) †, new to Prince Edward Island

Note. Since its initial discovery in the USA (NY) in 1890 and in Canada (BC) in 1928, this highly polyphagous species has extended its range to more than 30 states and to ON, QC, and the Maritimes in Canada (Klimaszewski et al. 2010).

Specimen data. Prince Edward Island, Kings Co., Valleyfield, Valleyfield Demonstration Woodlot, 46.1385N, 62.7194W, 4.VI–3.VII.2019, 3.VII–13.VIII.2019, C. Hughes // Lindgren funnel traps 1 m high (2, AFC); New Harmony, New Harmony Demonstration Woodlot, 46.3914N, 62.2021W, 3.VII–13.VIII.2019, C. Hughes // Lindgren funnel trap 1 m high (1, AFC).

Distribution in Canada and Alaska. BC, ON, QC, NB, NS, **PE** (Bousquet et al. 2013).

Xylosandrus germanus (Blandford, 1894) †, new to Prince Edward Island and New Brunswick

Note. This ambrosia beetle is native to Japan, Korea, the Kuril Islands, Vietnam, China, and Taiwan, and is adventive in Central Europe and North America. In Europe, it was first detected in Germany in 1951 and has spread to Austria, Belgium, France, Italy, and Switzerland (Ranger et al. 2010). It was first detected in North America in NY in 1932 and has since become established over much of the United States (Rabaglia et al. 2006). It was first reported in Canada from ON in 1987 (Bright 1989). It is highly polyphagous, infesting several families of coniferous and broadleaf trees but prefers the latter. Common hosts include black walnut (*Juglans nigra* L.), American beech, and maples (*Acer* spp.) (Weber and McPherson 1983; Ranger et al. 2010). It typically colonizes stressed trees but can be a significant pest of tree nurseries (Olivier and Mannion 2001) and apple orchards (Agnello et al. 2017) in the United States. Adults are attracted to ethanol (Miller and Rabaglia 2009; Ranger et al. 2010).

Specimen data. New Brunswick, Queens Co., Gagetown, 45.75162N, 66.18655W, 27VII–14.VIII.2017, C. Alderson & V. Webster // Old mixed forest with *Quercus rubra*, Lindgren funnel trap in tree canopy (1, AFC). **York Co.** Kingsclear, 45.9458N, 66.7948W, 8–21.VII.2017, C. Alderson & V. Webster // Mixed forest, Purple Lindgren funnel trap 1 m above ground. (1, AFC). **Prince Edward Island, Queens Co.**, Brookvale, Brookvale Demonstration Woodlot, 46.2920N, 63.4052W, 4.VI–3.VII.2019, C. Hughes // White panel trap (1, AFC).

Distribution in Canada and Alaska. BC, ON, QC, **NB,** NS, **PE** (Bousquet et al. 2013).

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References

Agnello AM, Breth DI, Tee EM, Cox KD, Villani SM, Ayer KM, Wallis AE, Donahue DJ, Combs DB, Davis AE, Neal JA, English-Loeb FM (2017) *Xylosandrus germanus* (Coleoptera: Curculionidae: Scolytinae) occurrence, fungal associations, and management trials in New York apple orchards. Journal of Economic Entomology 110: 2149–2164. https://doi.org/10.1093/jee/tox189

Anderson RS, Bouchard P, Douglas H (2014) Weevils (Coleoptera: Dryophthoridae, Brachyceridae, Curculionidae) of the Prairies Ecozone in Canada. In: Giberson DJ, Cárcamo HA (Eds) Arthropods of Canadian Grasslands (Volume 4): Biodiversity and Systematics Part 2. Biological Survey of Canada, 143–167.

Ashbee HV, Marshall SA, Alarie Y (2017) Haliplidae of eastern Canada. Canadian Journal of Arthropod Identification 32: 1–80.

Barney RJ, LeSage L, Savard K (2013) *Pachybrachis* (Coleoptera, Chrysomelidae, Cryptocephalinae) of eastern Canada. ZooKeys 332: 95–175. https://doi.org/10.3897/zookeys.332.4753

Bottimer LJ (1931) A vetch bruchid established in the Middle Atlantic States. Insect Pest Survey Bulletin 11: 347, 955–435.

Bottimer LJ (1968) Notes on Bruchidae of America north of Mexico with a list of world genera. The Canadian Entomologist 100: 1009–1049. https://doi.org/10.4039/Ent1001009-10

Bouchard P, Webster RP, Klimaszewski J (2016) The Coleoptera of New Brunswick and Canada: Providing baseline biodiversity and natural history data [Special issue]. ZooKeys 573: 1–512.

Bouchard P, Smith ABT, Douglas H, Gimmel ML, Brunke AJ, Kanda K (2017) Chapter 11, Biodiversity of Coleoptera. In: Foottit RG, Adler PH (Eds) Insect Biodiversity: Science and Society. Vol. 1, Second Edition. John Wiley & Sons, Ltd., West Sussex, UK, 337–417. https://doi.org/10.1002/9781118945568.ch11

Bousquet Y (1990) A review of the North American species of *Rhizophagus* Herbst and a revision of the Nearctic members of the subgenus *Anomophagus* Reitter (Coleoptera: Rhizophagidae). The Canadian Entomologist 122: 131–171. https://doi.org/10.4039/Ent122131-1

Bousquet Y (1991) Checklist of beetles of Canada and Alaska. Research Branch, Agriculture Canada, Ottawa. Cat. no. A43-1861/1991E, vi + 430 pp.

Bousquet Y (2010) Illustrated identification guide to adults and larvae of northeastern North American ground beetles (Coleoptera: Carabidae). Pensoft, Sofia-Moscow, 562 pp.

Bousquet Y, Bouchard P (2014) Review of the species of *Paratenetus* Spinola inhabiting America, north of Mexico (Coleoptera, Tenebrionidae). ZooKeys 415: 23–51. https://doi.org/10.3897/zookeys.415.6524

Bousquet Y, Bouchard P, Davies AE, Sikes D (2013) Checklist of beetles (Coleoptera) of Canada and Alaska. Pensoft Series Faunistica No. 109, Sofia-Moscow, 402 pp. https://doi.org/10.3897/zookeys.360.4742

Bousquet Y, Laplante S (2000) Présence de *Caerosternus americanus* (J.E. LeConte) et de *Xestipyge geminatum* (J.E. LeConte) (Coleoptera: Histeridae) au Québec. Fabreries 24[1999]: 73–77.

Bousquet Y, Laplante S (2006) The Insects and Arachnids of Canada, Part 24. Coleoptera Histeridae. NRC Research Press, Ottawa, Ontario, Canada, 485 pp.

Bousquet Y, Laplante S, Hammond HEJ, Wagner DW (2017) Cerambycidae (Coleoptera) of Canada and Alaska: Identification guide with nomenclatural, taxonomic, distributional, host-plant, and ecological data. Nakladatelství Jan Farkač, Prague, 300 pp.

Bousquet Y, Thomas DB, Bouchard P, Smith AD, Aalbu RL, Johnston MA, Steiner WE Jr (2018) Catalogue of Tenebrionidae (Coleoptera) of North America. ZooKeys 728: 1–455. https://doi.org/10.3897/zookeys.728.20602

Bright DE Jr (1976) The Bark Beetles of Canada and Alaska. Coleoptera: Scolytidae. The Insects and Arachnids of Canada. Part 2. Agriculture Canada, Ottawa. 241 pp.

Bright DE (1989) *Xylosandrus germanus* (Blandford), an ambrosia beetle new to Canada. The Canadian Agricultural Insect Pest Review 66[1988]: 93–94.

Bright DE (1993) The weevils of Canada and Alaska: Volume 1. Coleoptera: Curculionoidea, excluding Scolytidae and Curculionidae. The insects and arachnids of Canada. Part 21. Agriculture Canada, Ottawa, 217 pp.

Bright DE, Skidmore RE (2002) A Catalog of Scolytidae and Platypodidae (Coleoptera): Supplement 2 (1995–1999). National Research Council Research Press, Ottawa, 523 pp.

Brousseau P-M, Gravel D, Handa IT (2014) The first record in Canada of *Onthophilus pluricostatus* LeConte (Coleoptera: Histeridae) and a new mention for the rare species *Lordithon niger* (Gravenhorst) (Coleoptera: Staphylinidae). The Coleopterists Bulletin 68(2): 343–344. https://doi.org/10.1649/0010-065X-68.2.343

Brown WJ (1950) The extralimital distribution of some species of Coleoptera. The Canadian Entomologist 82: 197–205. https://doi.org/10.4039/Ent82197-10

Dearborn RG, Nelson RE, Donahue C, Bell RT, Webster RP (2014) The ground beetle (Coleoptera: Carabidae) fauna of Maine, USA. The Coleopterists Bulletin 68: 441–599. https://doi.org/10.1649/072.068.0317

de Tonnancour P, Anderson RS, Bouchard P, Chantal C, Dumont S, Vigneault R (2017) New Curculionoidea (Coleoptera) records for Quebec, Canada. ZooKeys 681: 95–117. https://doi.org/10.3897/zookeys.681.12469

Döberl M (2010) Alticinae. In: Löbl I, Smetana A (Eds) Catalogue of Palaearctic Coleoptera (Vol 6). Apollo Books, Stenstrup, 491–563.

Douglas H, Bouchard P, Anderson RS, de Tonnancour P, Vigneault R, Webster RP (2013) New Curculionoidea (Coleoptera) records for Canada. ZooKeys 309: 13–48. https://doi.org/10.3897/zookeys.309.4667

Downie NM, Arnett RH Jr (1996) The beetles of northeastern North America, Vol. 1 & 2, Sandhill Crane Press, Gainesville Florida, 1721 pp.

Dumont S, de Tonnancour P (2019) First records of *Larinus turbinatus* Gyllenhal (Coleoptera: Curculionidae: Lixinae) in Canada. The Coleopterists Bulletin 73: 828–830. https://doi.org/10.1649/0010-065X-73.4.828

Enushchenko IV (2017) Five new species of the tribe Gyrophaenina Kraatz 1830 (Coleoptera: Staphylinidae: Aleocharinae) from the southern part of the United States. Zootaxa 4504: 209–224. https://doi.org/10.11646/zootaxa.4504.2.3

Esser J (2016) Über die Identität von *Cryptophilus integer* (Heer, 1841) (Coleoptera: Erotylidae). Entomologische Nachrichten und Berichte 60: 213–218.

Esser J (2017) On the Nearctic *Cryptophilus* Reitter, 1874 (Coleoptera: Erotylidae). Linzer Biologische Beiträge 49: 1133–1137.

Esser J (2018) Notes on taxonomy and distribution of *Cryptophagus jakowlewi* Reitter, 1888 (Coleoptera: Cryptophagidae) with remarks on further species. Linzer Biologische Beiträge 50: 245–253.

Fauvel A (1889) Liste des coléoptères communs à l'Europe et à l'Amérique du Nord. D'après le catalogue de M. J. Hamilton. Avec remarques et additions. Revue d'Entomologie 8: 92–174.

Frank JH (1975) A revision of the New World species of the genus *Erichsonius* Fauvel (Coleoptera: Staphylinidae). The Coleopterists Bulletin 29: 177–203.

Frank JH (1981) A new *Erichsonius* species from Arizona with discussion on phylogeny within the genus (Coleoptera: Staphylinidae). The Coleopterists Bulletin 35: 97–106.

Gordon RD (1976) The Scymnini (Coleoptera: Coccinellidae) of the United States and Canada: key to genera and revision of *Scymnus*, *Nephus*, and *Diomus*. Bulletin of the Buffalo Society of Natural Science. No. 28: 362 pp.

Gordon RD (1985) The Coccinellidae (Coleoptera) of America north of Mexico. Journal of the New York Entomological Society 93: 1–912.

Gültekin L, Alonso-Zarazaga MA (2015) A review of the Palaearctic species of *Larinus* Dejean (Coleoptera: Curculionidae) in C. J. Schoenherr collection: Nomenclature and lectotype designations. Journal of Insect Biodiversity 3(9): 1–26. https://doi.org/10.12976/jib/2015.3.9

Haack RA (2001) Intercepted Scolytidae (Coleoptera) at U.S. ports of entry: 1985–2000. Integrated Pest Management Review 6: 253–282. https://doi.org/10.1023/A:1025715200538

Haack RA (2006) Exotic bark- and wood-boring Coleoptera in the United States: recent establishments and interceptions. Canadian Journal of Forest Research 36: 269–288. https://doi.org/10.1139/x05-249

Hardy M (2014) Guide d'identification des scarabées du Québec (Coleoptera: Scarabaeoidea). Entomofaune du Québec Inc., Saguenay, 166 pp.

Háva J, Nei I (2016) New records of *Megatoma* (*Pseudohadrotoma*) *graeseri* (Reitter, 1887) (Coleoptera: Dermestidae: Megatominae) from Canada. Onychium 12: 135–136.

Herms DA, McCullough DG (2014) Emerald ash borer invasion of North America: History, biology, ecology, impacts, and management. Annual Review of Entomology 59: 12–30. https://doi.org/10.1146/annurev-ento-011613-162051

Hoebeke ER, Acciavatti RE (2006) *Hylurgops palliatus* (Gyllenhal) (Coleoptera: Curculionidae: Scolytinae), an Eurasian bark beetle new to North America (Coleoptera: Curculionidae: Scolytinae). Proceedings of the Entomological Society of Washington 108: 267–273.

Hoebeke ER, Rabaglia RJ (2008) *Xyleborus seriatus* Blandford (Coleoptera: Curculionidae: Scolytinae), an Asian ambrosia beetle new to North America. Proceedings of the Entomological Society of Washington 110: 470–476. https://doi.org/10.4289/07-048.1

Hoebeke ER, Wheeler AG Jr (1991) *Anthribus nebulosus*, a Eurasian scale predator in the eastern United States (Coleoptera: Anthribidae): Notes on biology, recognition, and establishment. Proceedings of the Entomological Society of Washington 93: 45–50.

Hoebeke ER, Wheeler AG Jr (1996) Adventive lady beetles (Coleoptera: Coccinellidae) in the Canadian Maritime Provinces, with new eastern U.S. records of *Harmonia quadripunctata*. Entomological News 107: 281–290.

Hughes CC, Johns RC, Sweeney JD (2014) A technical guide to installing beetle traps in the upper crown of trees. Journal of the Acadian Entomological Society 10: 12–18.

Jendek E, Grebennikov VG, Bocak L (2015) Undetected for a century: Palaearctic *Agrilus ribesi* Schaefer (Coleoptera: Buprestidae) on currant in North America, with adult morphology, larval biology and DNA barcode. Zootaxa 4034: 112–126. https://doi.org/10.11646/zootaxa.4034.1.5

Kingsolver JM (2004) Handbook of the Bruchidae of the United States and Canada (Insecta, Coleoptera). US Department of Agriculture. Technical Bulletin No. 1912, 2 vol., 636 pp.

Klimaszewski J, Hoebeke R, Godin B, Davies A, Perry KI, Bourdon C, Winchester N (in press) Aleocharine rove beeetles of British Columbia: a hotspot of Canadian biodiversity (Coleoptera, Staphylinidae). Springer Nature, Cham, Switzerland, xvi + 621 pp.

Klimaszewski J, Langor DW, Hammond HEJ, Pelletier G, Bousquet Y, Bourdon C, Webster RP, Borowiec L, Scudder GGE, Majka CG (2015) Synopsis of adventive species of Coleoptera (Insecta) recorded from Canada. Part 3: Cucujoidea. Pensoft, Sofia-Moscow, Pensoft Series Faunistica No. 113, 171 pp.

Klimaszewski J, Langor D, Majka CG, Bouchard P, Bousquet Y, LeSage L, Smetana A, Sylvestre P, Pelletier G, Davies A, DesRochers P, Goulet H, Webster R, Sweeney J (2010) Review of adventive species of Coleoptera (Insecta) recorded from eastern Canada. Pensoft, Sofia-Moscow, Pensoft Series Faunistica No. 94, 272 pp.

Klimaszewski J, Webster RP, Davies A (2017) Genus *Hydrosmecta* C.G. Thomson: a review of species occurring in eastern Canada (Coleoptera, Staphylinidae, Aleocharinae). Insecta Mundi 0593: 1–17.

Klimaszewski J, Webster RP, Davies A, Bourdon C (2018a) Description of *Hydrosmectomorpha* Klimaszewski and Webster, a new subgenus of *Atheta* C.G. Thomson, with three new Canadian species (Coleoptera: Staphylinidae: Aleocharinae) Insecta Mundi 0648: 1–12.

Klimaszewski J, Webster RP, Langor DW, Brunke A, Davies A, Newton AF, Bourdon C, Labrecque M, Dorval JA, Frank JH (2018b) Aleocharinae rove beetles of eastern Canada (Coleoptera, Staphylinidae, Aleocharinae): a glimpse of megadiversity. Springer Nature Switzerland AG., xvi + 902 pp. https://doi.org/10.1007/978-3-319-77344-5

Knopf E, Gilmore W (2018) The first recorded occurrences of *Platydracus immaculatus* (Mannerheim) and *Ocypus nitens* (Schrank), (Coleoptera; Staphylinidae), in New Brunswick, Canada. Journal of the Acadian Entomological Society 14: 25–27.

Korotyaev BA (2016) New data on the changes in the abundance and distribution of several species of beetles (Coleoptera) in European Russia and the Caucasus. Entomological Review 96: 620–630. https://doi.org/10.1134/S0013873816050080

Kovarik PW, Caterino MS (2001) Family 15, Histeridae Gyllenhal, 1808. [p. 212–227]. In: Arnett RH, Thomas MC Jr. (Eds) American Beetles, Volume 1. Archostemata, Myxophaga, Adephaga, Polyphaga: Staphyliniformia. CRC Press, Boca Raton, Florida, xv + 443 p.

Larson DJ, Alarie Y, Roughley RE (2000) Predaceous diving beetles (Coleoptera: Dytiscidae) of the Nearctic region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa, xiv + 982 pp.

Lebel M, Dumont S, Racine M (2019) Nouvelles mentions de trois espèces de Cleridae (Coleoptera) pour le Québec. Le Naturaliste Canadian 143(2): 12–17. https://doi.org/10.7202/1060051ar

Liljeblad E (1945) Monograph of the family Mordellidae (Coleoptera) of North America, north of Mexico. Miscellaneous Publications, University of Michigan, Museum of Zoology, No. 62, 229 pp.

Lindgren BS (1983) A multiple funnel trap for scolytid beetles (Coleoptera). The Canadian Entomologist 115: 299–302. https://doi.org/10.4039/Ent115299-3

Lisberg AE (2003) Taxonomic changes for fifteen species of North American Mordellidae (Coleoptera). Insecta Mundi 17: 191–194.

Majka CG, Chandler DS, Donahue CP (2011) Checklist of the beetles of Maine, USA. Empty Mirrors Press, Halifax, Nova Scotia, 328 pp.

Majka CG, Gimmel ML, Langor D (2008) The Phalacrididae (Coleoptera: Cucujoidea) of Canada: new records, distribution, and bionomics with a particular focus on the Atlantic Canadian fauna. ZooKeys 2: 209–220. https://doi.org/10.3897/zookeys.2.16

Majka CG, Klimaszewski J (2004) *Phloeocharis subtilissima* Mannerheim (Staphylinidae: Phloeocharinae) and *Cephennium gallicum* Ganglbauer (Scydmaenidae) new to North America: a case study in the introduction of exotic Coleoptera to the port of Halifax, with new records of other species. Zootaxa 781: 1–15. https://doi.org/10.11646/zootaxa.781.1.1

Majka CG, LeSage L (2010) *Chaetocnema* flea beetles (Coleoptera: Chrysomelidae, Alticini) of the Maritime Provinces of Canada. Journal of the Acadian Entomological Society 6: 34–38.

Majka CG, McCorquodale DB (2006) The Coccinellidae (Coleoptera) of the Maritime Provinces of Canada: new records, biogeographic notes, and conservation concerns. Zootaxa 1154: 49–68. https://doi.org/10.11646/zootaxa.1154.1.5

Majka CG, McCorquodale DB (2010) Lady beetles (Coleoptera: Coccinellidae) of the Atlantic Maritime Ecozone. In: McAlpine DF, Smith LM (Eds) Assessment of Species diversity in the Atlantic Maritime Ecozone. National Research Council Press, Ottawa, Ontario, 439–452.

Mandelshtam MY, Petrov AV, Smith AM, Cognato AI (2019) Resurrection of *Heteroborips* Reitter, 1913 (Coleoptera: Curculionidae: Scolytinae) from synonymy with *Xyleborus* Eichhoff, 1864. The Coleopterists Bulletin 73: 387–394. https://doi.org/10.1649/0010-065X-73.2.387

Matta JF, Wolfe GW (1981) A revision of the subgenus *Heterosternuta* Strand of *Hydroporus* Clairville (Coleoptera: Dytiscidae). The Pan-Pacific Entomologist 57: 176–219.

McAlpine DF, Migneault R, Webster RP (2018) *Coleomegilla maculata lengi* Timberlake, 1943 (Coleoptera: Coccinellidae), a native North American lady beetle new to Maritime Canada. Journal of the Acadian Entomological Society 14: 8–10.

McNamara J (1992) The first Canadian records of *Scymnus* (*Pullus*) *suturalis* Thunberg (Coleoptera: Coccinellidae). The Coleopterists Bulletin 46: 359–360.

Miller DR, Rabaglia RJ (2009) Ethanol and (-)-α-pinene: Attractant kairomones for bark and ambrosia beetles in the Southeastern US. Journal of Chemical Ecology 35: 435–448. https://doi.org/10.1007/s10886-009-9613-9

Oliver J, Mannion CM (2001) Ambrosia beetle (Coleoptera Scolytidae) species attacking chestnut and captured in ethanol-baited traps in middle Tennessee. Journal of Economic Entomology 30: 909–918. https://doi.org/10.1603/0046-225X-30.5.909

Otto RL, Muona J, McClarin J (2014) Description of *Dirrhagofarsus ernae* n. sp. With a key to known *Dirrhagofarsus* species (Coleoptera: Eucnemidae). Zootaxa 3878: 179–185. https://doi.org/10.11646/zootaxa.3878.2.4

Paiero SM, Jackson MD, Jewiss-Gaines A., Kimoto T, Gill BD, Marshall SA (2012) Field guide to the jewel beetles (Coleoptera: Buprestidae) of northeastern North America. Canadian Food Inspection Agency Publication A104-94/2012E, 411 pp.

Parry RH (1986) The systematics and biology of the flea beetle genus *Crepidodera* Chevrolat (Coleoptera: Chrysomelidae) in America, north of Mexico. Insecta Mundi 1: 156–196.

Parsons CT (1943) A Revision of Nearctic Nitidulidae. Bulletin of the Museum of Comparative Zoology 92: 121–278.

Pelletier G, Hébert C (2014) The Cantharidae of eastern Canada and northeastern United States. Canadian Journal of Arthropod Identification 25: 1–246. https://doi.org/10.3752/cjai.2014.25

Pelletier G, Hébert C (2019) The Cryptophagidae of Canada and the northern United States of America. Canadian Journal of Arthropod Identification 40:1–305.

Pentinsaari M, Anderson R, Borowiec L, Bouchard P, Brunke A, Douglas H, Smith ABT, Hebert PDN (2019) DNA Barcodes reveal 63 overlooked species of Canadian beetles (Insecta, Coleoptera). ZooKeys 894: 53–150. https://doi.org/10.3897/zookeys.894.37862

Pinto JD, Bologna MA (2002) Family 111. Meloidae Gyllenhal 1810. In: Arnett RH, Jr Thomas MC, Skelley PE, Frank JH (Eds) American Beetles. Volume 2. Polyphaga: Scarabaeoidea through Curculionidea, CRC Press, Boca Raton, Florida, 522–529.

Rabaglia RJ, Cognato AI, Hoebeke ER, Johnson CW, Labonte JR, Carter ME, Vlach JJ (2019) Early detection and rapid response: A 10-year summary of the USDA Forest Service program of surveillance for non-native bark and ambrosia beetles. American Entomologist 65: 29–42. https://doi.org/10.1093/ae/tmz015

Rabaglia RJ, Dole SA, Cognato AI (2006) Review of American Xyleborina (Coleoptera: Curculionidae: Scolytinae) occurring North of Mexico, with an illustrated key. Annals of the Entomological Society of America 99: 1034–1055. https://doi.org/10.1603/0013-8746(2006)99[1034:ROAXCC]2.0.CO;2

Ranger CM, Reding ME, Persad AB, Herms DA (2010) Ability of stress-related volatiles to attract and induce attacks by *Xylosandrus germanus* and other ambrosia beetles. Agricultural and Forest Entomology 12: 177–185. https://doi.org/10.1111/j.1461-9563.2009.00469.x

Riley EG, Clark SM, Flowers RW, Gilbert AJ (2002) Family 124. Chrysomelidae Latreille 1802. In: Arnett RH Jr, Thomas MC, Skelley PE, Frank JH (Eds) American Beetles. Volume 2. Polyphaga: Scarabaeoidea through Curculionidea, CRC Press, Boca Raton, Florida, 617–691.

Riley EG, Clark SM, Seeno TN (2003) Catalog of the leaf beetles of America north of Mexico. Coleopterists Society Special Publication 1, 290 pp.

Schülke M, Smetana A (2015) Staphylinidae. In: Löbl I, Löbl D (Eds) Catalogue of Palaearctic Coleoptera. Volume 2/1 revised and updated. Hydrophiloidea – Staphylinoidea. Brill, Leiden and Boston, 304–900.

Seevers LH (1978) A generic and tribal revision of the North American Aleocharinae (Coleoptera: Staphylinidae) [with additions and annotations by Lee H. Herman]. Fieldania: Zoology 71, Publication 1282, vi + 289 pp. https://doi.org/10.5962/bhl.title.3136

Sikes DS, Trumbo ST, Peck SB (2016) Cryptic diversity in the New World burying beetle fauna: *Nicrophorus hebes* Kirby; new status as a resurrected name (Coleoptera: Silphidae; Nicrophorinae). Arthropod Systematics & Phylogeny 74: 299–309.

Steiner WE Jr. (1984) A review of the biology of phalacrid beetles (Coleoptera). In: Wheeler Q, Blackwell M (Eds) Fungus-Insect Relationships: Perspectives in Ecology and Evolution. Columbia University Press, New York, 424–455.

Steiner WE Jr (2016) New assignments among the genera *Haplandrus* LeConte, *Metaclisa* Jacquelin Du Val and *Tharsus* LeConte with descriptions of larvae and pupae and a new genus for North America (Coleoptera: Tenebrionidae). Annales Zoologici 66: 529–550. https://doi.org/10.3161/00034541ANZ2016.66.4.005

Steinhauer AL (1959) The biology and seasonal development of the vetch bruchid, *Bruchus brachialis* Fåhraeus, in Oregon. Journal of Economic Entomology 52: 955–957. https://doi.org/10.1093/jee/52.5.955

Tuttle DM (1954) Notes on the bionomics of six species of *Apion* (Curculionidae, Coleoptera). Annals of the Entomological Society of America 47: 301–307. https://doi.org/10.1093/aesa/47.2.301

Vaurie P (1948) A review of the North American Languriidae. Bulletin of the American Museum of Natural History 92: 119–156.

Van Vondel BJ, Alarie Y (2016) A new species of *Haliplus* Latreille, 1802 (Coleoptera: Adephaga: Haliplidae) from Canada. The Coleopterists Bulletin 70: 801–804. https://doi.org/10.1649/0010-065X-70.4.801

Wagner JA (1975) Review of the genera *Euplectus*, *Pycnoplectus*, *Leptoplectus*, and *Acolonia* (Coleoptera: Pselaphidae) including Nearctic species north of Mexico. Entomologica Americana 49: 125–207.

Wappes JM, Santos-Silva A (2019) A new species and synonymy in North American *Phymatodes* (*Phymatodes*) Mulsant, 1839 (Coleoptera: Cerambycidae: Cerambycinae: Callidiini). Insecta Mundi 0687: 1–9.

Watrous L (1980) *Lathrobium* (*Tetartopeus*): natural history, phylogeny and revision of the Nearctic species (Coleoptera, Staphylinidae). Systematic Entomology 5: 303–338. https://doi.org/10.1111/j.1365-3113.1980.tb00418.x

Weber BC, McPherson JE (1983) World list of host plants of *Xylosandrus germanus* (Blandford) (Coleoptera: Scolytidae). The Coleopterists Bulletin 37: 114–134.

Webster RP (2016) Checklist of the Coleoptera of New Brunswick, Canada. In: Webster RP, Bouchard P, Klimaszewski J (Eds) The Coleoptera of New Brunswick and Canada: providing baseline biodiversity and natural history data. ZooKeys 573: 387–512. https://doi.org/10.3897/zookeys.573.8022

Webster RP, Alderson CA, Webster VL, Hughes CC, Sweeney JD (2016a) Further contributions to the longhorn beetle (Coleoptera, Cerambycidae) fauna of New Brunswick and Nova Scotia, Canada. ZooKeys 552: 109–122. https://doi.org/10.3897/zookeys.552.6039

Webster RP, Anderson RS, Sweeney JD, DeMerchant I (2012a) New Coleoptera records from New Brunswick, Canada: Anthribidae, Brentidae, Dryophthoridae, Brachyceridae, and Curculionidae, with additions to the fauna of Quebec, Nova Scotia and Prince Edward Island. In: Anderson R, Klimaszewski J (Eds) Biodiversity and Ecology of the Coleoptera of New Brunswick, Canada. ZooKeys 179: 349–406.

Webster RP, Davies AE, Klimaszewski J, Bourdon C (2016b) Further contributions to the staphylinid fauna of New Brunswick, Canada, and the USA, with descriptions of two new *Proteinus* species (Coleoptera, Staphylinidae). In: Webster RP, Bouchard P, Klimaszewski J (Eds) The Coleoptera of New Brunswick and Canada: providing baseline biodiversity and natural history data. ZooKeys 573: 31–83.

Webster RP, Klimaszewski J, Pelletier G, Savard K (2009) New Staphylinidae (Coleoptera) records with new collection data from New Brunswick, Canada. I. Aleocharinae. In: Majka CG, Klimaszewski J (Eds) Biodiversity, ecology of Canadian Coleoptera II. ZooKeys 22: 171–248. https://doi.org/10.3897/zookeys.22.152

Webster RP, Sweeney, JD, DeMerchant I (2012b) New Coleoptera records from New Brunswick, Canada: Sphindidae, Erotylidae, Monotomidae, and Cryptophagidae. In: Anderson R, Klimaszewski J (Eds) Biodiversity and ecology of the Coleoptera of New Brunswick, Canada. ZooKeys 179: 169–192. https://doi.org/10.3897/zookeys.179.2466

Webster RP, Sweeney JD, DeMerchant I (2012c) New Coleoptera records from New Brunswick, Canada: Geotrupidae and Scarabaeidae. In: Anderson R, Klimaszewski J (Eds) Biodiversity and ecology of the Coleoptera of New Brunswick, Canada. ZooKeys 179: 27–40. https://doi.org/10.3897/zookeys.179.2607

Webster RP, Sweeney JD, DeMerchant I (2012d) New Coleoptera records for New Brunswick, Canada: Kateretidae, Nitidulidae, Cerylonidae, Endomychidae, Coccinellidae, and Latridiidae. In: Anderson R, Klimaszewski J (Eds) Biodiversity and ecology of the Coleoptera of New Brunswick, Canada. ZooKeys 179: 193–214.

Webster RP, Sweeney JD, DeMerchant I (2012e) New Staphylinidae (Coleoptera) records with new collection data from New Brunswick, Canada: Scaphidiinae, Piestinae, Osorinae, and Oxytelinae. In: Klimaszewski J, Anderson R (Eds) Biosystematics and Ecology of Canadian Staphylinidae (Coleoptera) II. ZooKeys 186: 239–262.

Webster RP, Webster VL, Alderson CA, Hughes CC, Sweeney JD (2016c) Further contributions to the Coleoptera fauna of New Brunswick with an addition to the fauna of Nova Scotia, Canada. In: Webster RP, Bouchard P, Klimaszewski J (Eds) The Coleoptera of New Brunswick and Canada: providing baseline biodiversity and natural history data. ZooKeys 573: 265–338.

Wood SL (1992) Nomenclatural changes and new species in Platypodidae and Scolytidae (Coleoptera), Part II. Great Basin Naturalist 52: 78–88.

Woodroffe GE, Coombs CW (1961) A revision of the North American *Cryptophagus* Herbst (Coleoptera: Cryptophagidae). Miscellaneous Publications of the Entomological Society of America 2: 179–211.

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A revision of the genus *Teleopsis* Rondani (Diptera, Diopsidae) in Sri Lanka with descriptions of two new species and a review of the other stalk-eyed flies from the island

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Abstract

The literature on Sri Lankan Diopsidae is reviewed. Eight Diopsidae are now known to occur in Sri Lanka, five species in the genus *Teleopsis* and one species each in the genera *Sphyracephala*, *Diopsis*, and *Cyrtodiopsis*. The presence of *Cyrtodiopsis* requires confirmation to exclude the possibility of mislabelling. All five *Teleopsis* species are endemic, as are the *Diopsis* species and probably the *Cyrtodiopsis* species. Only *Sphyracephala bipunctipennis* Senior-White has a larger distribution as it also occurs in India. A key is presented for the Diopsidae of Sri Lanka. Three *Teleopsis* species were already known to occur in Sri Lanka: *T. ferruginea* Röder, *T. krombeini* Feijen and *T. maculata* Feijen. These species form the *T. ferruginea* species group. Two new species are now described for this group: *Teleopsis neglecta* **sp. nov.** and *Teleopsis sorora* **sp. nov.** *Teleopsis ferruginea* is redescribed, as an earlier redescription turned out to be based on a series of specimens of its sister species *T. sorora* **sp. nov.** The other three Diopsidae of Sri Lanka are listed and illustrated. Allometric aspects of the five *Teleopsis* species are discussed. Three *Teleopsis* species are sexually dimorphic with regard to eye span, while two species are monomorphic. It is assumed that sexual dimorphism developed independently in the *T. ferruginea* species group. This brings the number of known cases of independent development of sexual dimorphism in the Diopsidae to ten.

Keywords

Cyrtodiopsis, *Diopsis*, *Sphyracephala*, sexual dimorphism, stalk-eyed flies, *Teleopsis*

Introduction

Five species and three genera of Diopsidae were known to occur in Sri Lanka (Feijen 1998). The genera *Diopsis* Linnaeus and *Sphyracephala* Say were both represented by one species, while *Teleopsis* Rondani counted three species. An overview will now be given of the rather limited literature on Diopsidae from Sri Lanka. The *Teleopsis* species in Sri Lanka belong to the *Teleopsis ferruginea* species group and this group will now be revised, expanding the group to five species. In the collections of NHMUK, two *Teleopsis* specimens were found which represent an undescribed species. These specimens will here be described as *Teleopsis neglecta* sp. nov. In the collections of NHMB, two male *Teleopsis* specimens were found which proved to be conspecific with *Teleopsis ferruginea* Röder of which the female holotype was fixed by monotypy. Feijen (1998) examined the teneral holotype and gave a redescription of *T. ferruginea* based on a series of 50 specimens. Comparison of the holotype and the two NHMB males with the series of 50 specimens showed that in fact two closely related species were involved. This issue will now be resolved by redescribing *T. ferruginea* based on its holotype and the two NHMB males, while as new species *Teleopsis sorora* sp. nov. will be described based on the series of 50 specimens and some additional specimens. Additional information will also be given for the two other *Teleopsis* species in Sri Lanka: *T. krombeini* Feijen and *T. maculata* Feijen. These species will be illustrated with photographs of the holotype and/or paratype.

In the collection of ZMUO, three specimens of *Cyrtodiopsis* Frey with Ceylon (Sri Lanka) labels were found. These belong to the *Cyrtodiopsis dalmanni* species group and would form a remarkable extension of the range of genus and species group. A key will be presented to the eight species now known to occur in Sri Lanka. The three species of the genera *Sphyracephala*, *Cyrtodiopsis* and *Diopsis* will be listed and illustrated. Allometric aspects with regard to the sexual dimorphism of the eye stalks in the *Teleopsis ferruginea* species group will be discussed. Allometric data will also be presented for the monomorphic *Diopsis* species.

Material and methods

The description of *T. sorora* sp. nov. is based on a large series of pinned specimens. For the description of *T. neglecta* sp. nov. only two pinned specimens in rather poor condition were available, one specimen lacking the abdomen, while a male specimen lacked the head. Fortunately, five photographs of live specimens became available via www.iNaturalist.org. From the same source also photographs for *T. krombeini* and *T. sorora* sp. nov. were obtained. The redescription of *T. ferruginea* (Röder, 1893) is based on the rather teneral female holotype and two pinned male specimens. For the rate of dimorphism D, the difference between males and females in allometric slope for eye span on body length is used in the Diopsidae (Baker and Wilkinson 2001). Details on procedures for preparing genitalia slides, and procedures for taking measurements are given in Feijen et al. (2018a). For information on morphological terminology and on

photographic equipment used, the reader is referred to the same source. The following institutional codens and abbreviations are used:

NHMUK	The Natural History Museum, London, United Kingdom,
CNMS	National Museum, Colombo, Sri Lanka,
MLUH	Wissenschaftsbereich Zoologie, Martin-Luther-Universität, Halle (Saale), Germany,
NHMB	Naturhistorisches Museum, Basel, Switzerland,
RMNH	Naturalis Biodiversity Center (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands,
USNM	National Museum of Natural History (formerly United States National Museum), Washington D.C., United States of America,
ZSM	Zoologische Staatssammlung des Bayerischen Staates, München, Germany.
D	Rate of Dimorphism,
SE	Standard Error.

Overview of literature on Sri Lankan Diopsidae

The literature on Diopsidae from Sri Lanka is rather limited. The first paper is by Röder (1893) and describes *Diopsis ferruginea* from southern Sri Lanka (Ceylon meridionalis). Wulp (1896) listed *Diopsis ferruginea* in his catalogue of Diptera from South Asia. Likewise, Brunetti (1907) listed *Diopsis ferruginea* in his catalogue of Oriental Diopsidae. In 1922, Senior-White described *Teleopsis bipunctipennis* from "five males and seven females, all in good condition, and all taken at one sweep of the net on leaf of a plant growing in the water at edge of the Suduganga river". Frey (1928) assumed that *Diopsis ferruginea* should eventually be placed in *Megalabops* Frey. Curran (1936) reported *Diopsis ferruginea* from Mergui, India, which is now in southern Myanmar. However, Shillito (1940) stated that this was a misidentification and that it concerned *Cyrtodiopsis currani* Shillito. Shillito furthermore considered that *Diopsis ferruginea* should be placed in *Megalabops* and *Teleopsis bipunctipennis* in *Pseudodiopsis* Hendel. Shillito (1971) maintained these allocations for the two Sri Lanka species. Descamps (1957) mentioned *Diopsis ferruginea* and *Teleopsis bipunctipennis* in his catalogue. Steyskal (1972) still listed *Teleopsis bipunctipennis* as such, while he placed *Diopsis ferruginea* in *Teleopsis*. In 1977, Steyskal in his catalogue of Oriental Diopsidae listed *Pseudodiopsis bipunctipennis* and *Teleopsis ferruginea* from Ceylon. Feijen (1989) transferred *Pseudodiopsis bipunctipennis* to *Sphyracephala*. Feijen (1998) listed five Diopsidae species for Sri Lanka. *Sphyracephala bipunctipennis* and a *Diopsis* of the *indica* species group were dealt with in a key to the diopsids of Sri Lanka and briefly discussed. *Teleopsis ferruginea* was redescribed, while as new species *Teleopsis krombeini* and *Teleopsis maculata* were described. Feijen (2011) placed these three *Teleopsis* in the *Teleopsis ferruginea* species group of Sri Lanka and described it as a distinct and aberrant species group in its genus. Feijen & Feijen (2019) indicated *T. ferruginea* as an

endemic species of Sri Lanka, while the *T. ferruginea* species group was thought to form an isolated group in its genus. *Sphyracephala bipunctipennis* was reported from Tamil Nadu, India, so it no longer qualified as an endemic species of Sri Lanka.

Taxonomy

Family Diopsidae Billberg, 1820

Diopsidae: Billberg 1820: 115 (as Natio Diopsides). Type genus: *Diopsis* Linnaeus, 1775: 5.

Genus *Teleopsis* Rondani, 1875

Figures 1–63

Teleopsis Rondani, 1875: 442; Feijen 1998: 49 (diagnosis, catalogue, discussion); Baker et al. 2001: 92 (cladogram, phylogenetic position within Diopsidae); Feijen 2011: 80 (discussion of taxonomic position); Feijen and Feijen 2011: 143 (biogeographic range). Type species: *Diopsis sykesii* Westwood, 1837 [= *T. fulviventris* Bigot, 1880 and *T. onopyxus* Séguy, 1949], by original designation.

Not *Cyrtodiopsis* Frey, 1928: 70; Shillito 1940: 156 (revision of *Cyrtodiopsis*); Feijen 1981: 480 (note on *Cyrtodiopsis*, disagreeing with the various synonymies of *C. dalmanni* proposed by Shillito 1940); Baker and Wilkinson 2001: 92 (*Teleopsis* paraphyletic and embedded within *Cyrtodiopsis*); Meier and Baker 2002: 332 (designation of synonymy); Liu et al 2009: 57 (maintaining *Cyrtodiopsis*); Feijen 2011: 80 (rejection of synonymy). Type species *Diopsis dalmanni* Wiedemann, 1830, by original designation.

Not *Megalabops* Frey, 1928: 70; Steyskal 1972: 11 (designation of synonymy); Feijen 1989: 62 (supporting synonymy); Baker et al., 2001, (supporting synonymy based on molecular analyses); Feijen 2011: 80 (re-instating *Megalabops*); Feijen and Feijen 2019: 48 (discussion of taxonomic position). Type species, *Diopsis quadriguttata* Walker, 1857, by original designation.

Teleopsis ferruginea (Röder, 1893)

Figures 1–7, 12–17, 51, 62, 63

Diopsis ferruginea Röder, 1893: 235; Wulp 1896: 171; Brunetti 1907: 165; Descamps 1957: 18.

? *Megalabops ferruginea* (Röder): Frey 1928: 70.

Megalabops ferruginea (Röder): Shillito 1940: 157.

Teleopsis ferruginea (Röder): Steyskal 1972: 11, 1977: 34; Feijen 1998: 55 (record of holotype only, redescription based on "Further material" now referred to *Teleopsis sorora* sp. nov.).

Not *Teleopsis ferruginea*: Curran, 1936: 2 (= *Cyrtodiopsis currani* Shillito, 1940).
Not *Teleopsis ferruginea*: Kotrba et al. 2013: 190 (= *Teleopsis sorora* sp. nov.).

Type material. ***Holotype***, ♀, [Sri Lanka], Ceylon meridionalis [South Sri Lanka], v.1889, H. Fruhstorfer (MLUH).

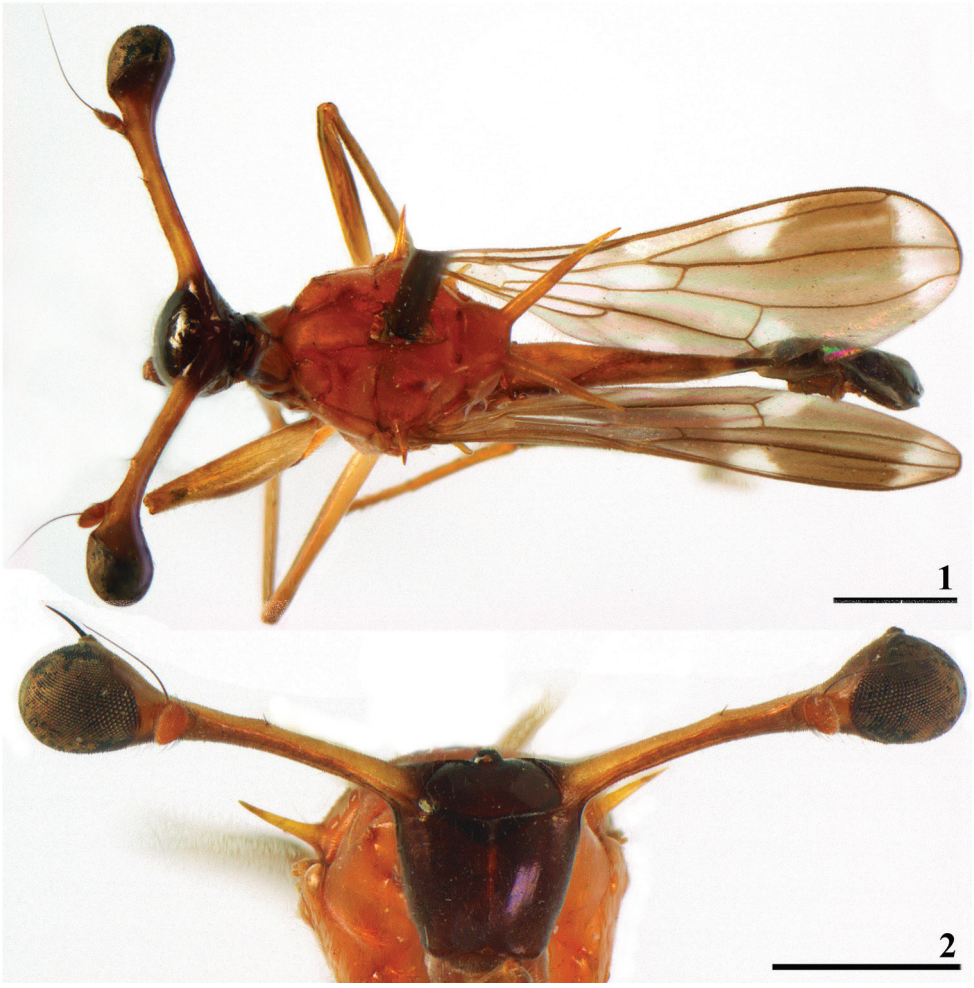
Material studied. Holotype ♀; 2 ♂, Uva, Lunugala, [7°2'26"N, 81°12'06"E, ~760 m], 25.ix.[19]53, F. Keiser (NHMB).

Diagnosis. *Teleopsis ferruginea* can be recognised by its size, slender habitus, bareness, wing pattern (apical infuscation, three crossbands, broad preapical crossband, irregular central crossband with darker patches along veins, irregular narrow basal crossband, two small pale spots between basal and central crossbands, two distinct clear spots between central and preapical crossbands), wing mostly covered by microtrichia except for bare spots on basal third, small, setula-like inner vertical seta 0.5× the stalk diameter, outer vertical seta 1.4× stalk diameter, tiny base of inner vertical seta, no facial teeth, pollinose collar, reddish brown, thinly pollinose scutum and scutellum, ratio scutellar spine/scutellum ~ 2.8, moderately incrassate front femora with around 44–60 (♂) tubercles, large glossy spot laterally on terga 1 and 2, abdomen brown with dark parts of terga 3–5 forming a black circle, pair of pollinose spots on tergum 3, left male spiracle 7 in lateral slit of synsternum, right spiracle 7 in synsternum, articulate surstyli very small, apically rounded (as long as wide in lateral view), surstyli without microtrichia, large male cerci apically pointed (ratio length/width 1.6), anterior arm of phallapodeme quite straight, only slightly curving downward anteriorly, ratio eye span/body length 0.81 in ♀, 0.85 and 1.01 in ♂, and assumed sexual dimorphism with regard to eye span of ~ 0.8. *Teleopsis ferruginea* can be considered the sister species of *T. sorora* sp. nov. and gives its name to the *T. ferruginea* species group.

Description. ***Measurements.*** Body length holotype ♀ 6.3 mm (estimate, specimen is teneral, see Fig. 1), 2 ♂ respectively 4.8 and 6.8 mm; eye span holotype 5.1 mm, 2 ♂ 5.6 and 6.8 mm; wing length holotype 4.8 mm, 2 ♂ 4.0 and 4.8 mm; length of scutellar spine holotype 1.24 mm, 2 ♂ 0.96 and 1.25 mm.

Head. Central part glossy dark brown, almost black (Figs 2, 3), face laterally with some very fine pollinosity; frons (Figs 2, 3) very smooth, surrounded by simple, semicircular ridge; arcuate groove thin and concolourous; face very smooth, no facial teeth, lateroventral corners rounded, almost bare, a few tiny pale setulae; eye span in holotype ♀ small (19% shorter than body length) and small to medium-sized in the two males (15% shorter than body length in the small male and 1% longer than body length in the large male); probably moderate rate of dimorphism in eye span, comparison of the three data points with the graph for *T. sorora* sp. nov. (see Fig. 51) indicates a D of around 0.8; stalks brown, broad apical parts blackish, dorsal part of stalks pollinose; inner vertical seta small and setula-like in the ♀, just more than 0.5× the diameter of the stalk, in the two ♂ the inner vertical seta is likely to be broken off, base of inner vertical seta small, just more than 0.1× the stalk diameter; outer vertical seta 1.4× stalk diameter.

Thorax. Collar brown pollinose, but anteriorly and laterally more blackish brown; scutum, scutellum and scutellar spines reddish brown (ferruginous), thinly pollin-



Figures 1, 2. *Teleopsis ferruginea*, ♀, holotype **1** habitus, dorsal view **2** head, anterior view. Scale bars: 1 mm.

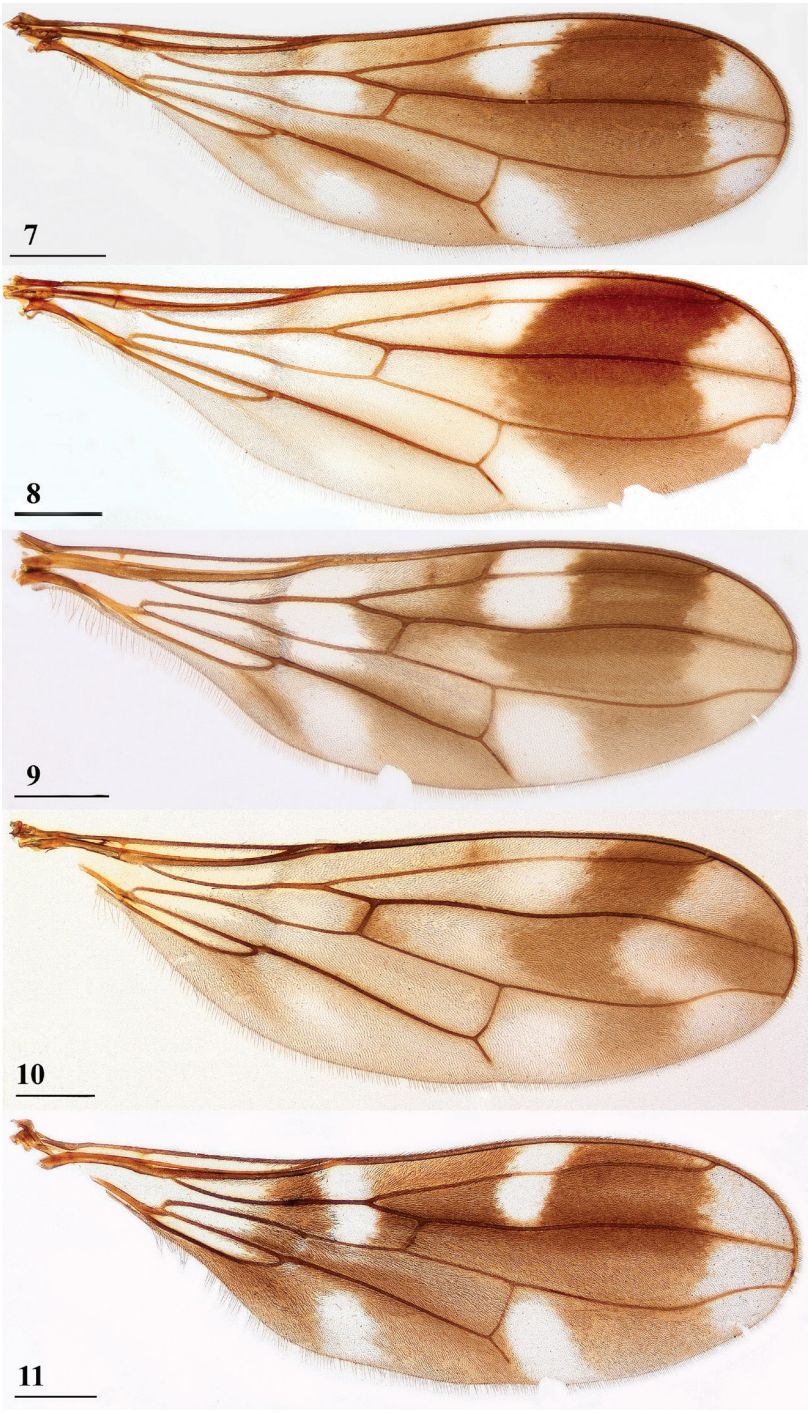
ose (Figs 1, 4); pleura glossy brown, only some pollinosity on anterior and posterior margins; supra-alar spines (Figs 1, 4) glossy brown, almost 3× as long as pleurotergal spines, dorsolaterally directed; scutellar spines almost straight, diverging under an angle of about 75° (Figs 1, 4), ratio scutellar spine/scutellum in holotype ♀ 2.76, in the small ♂ 2.67 and in the large ♂ 2.89, ratio scutellar spine/body length in holotype 0.20, in small ♂ 0.17 and in large ♂ 0.19; pleurotergal spines pollinose, medium-sized and blunt, posterolaterally directed; apical seta small (13% of length of scutellar spine in holotype, partly broken off in ♂); tiny white setulae on thorax, scutellar spines without warts, only with tiny setulae.

Wing. Irrorated with three crossbands (Figs 1, 7); apex (apical 6% of wing) distinctly infuscated, infuscated area linked to preapical band along veins and wing edge; preapical band broad, almost uniformly dark, posteriorly slightly paler, broadly linked to

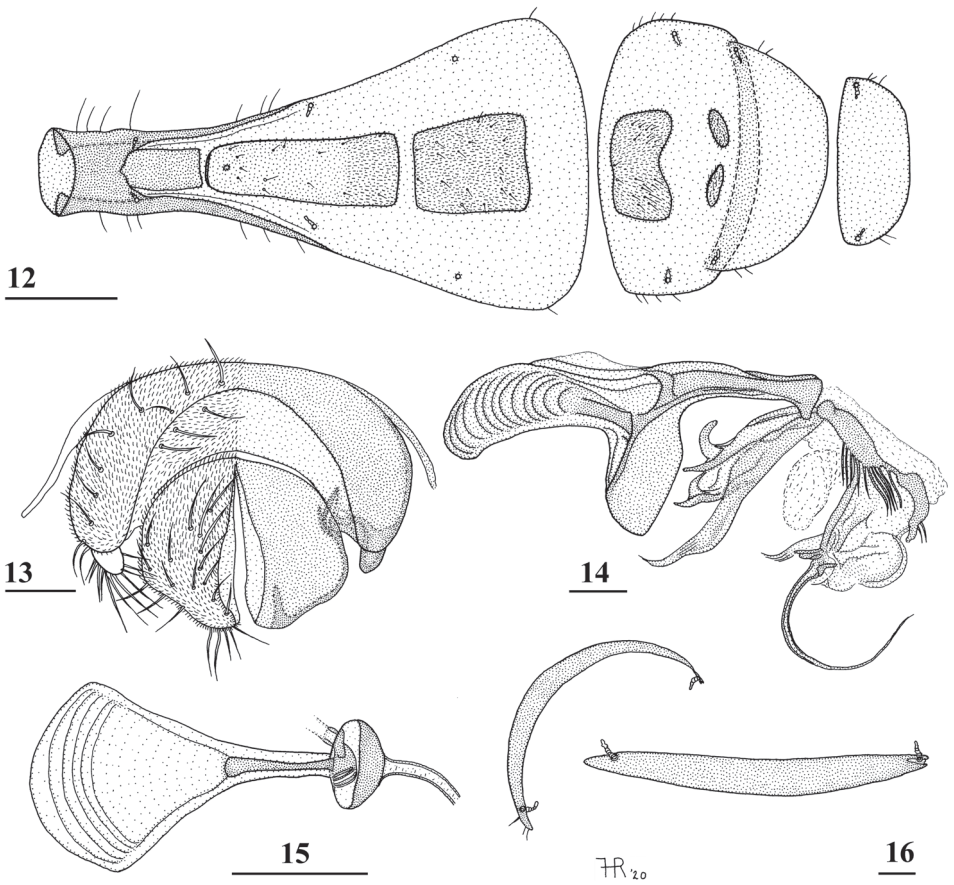
Figures 3–6. *Teleopsis ferruginea*, ♂, Lunugala **3** head, anterior view **4** thorax, dorsal view **5** abdomen, dorsal view **6** habitus, lateral view (**3, 5** larger ♂, **4, 6** smaller ♂). Scale bars: 1 mm.

central crossband in cell r4+5, slightly extending into cells r2+3 and m; two clear spots in between the central and preapical bands, one in cells r1 and r2+3, and one basally in cell m1; broad, but irregular central crossband including crossveins r-m and dm-m, darker in cell r1 and around veins R4+5 and M4; irregular basal band narrow, darker in cell r1 and around vein M4, several connections to central band, giving two pale spots in cell br and cell m4, a vague dark stripe running from cell cua to the pale spot in cell m4; cell r4+5 narrower basally and apically; vein M4 from crossvein dm-m onward turning downward and reaching till more than three-quarters of the distance to the wing edge; glabrous basal areas including basal half of cell c, tiny basal spot in cell r1, basal half of cell br, basal quarter of cell bm+dm except for posterior edge, and posterior half of cell cua.

Legs. Front leg with brown coxa, trochanter and femur, coxa glossy on outer side and pollinose on inner side, femur pollinose with vague darker spot on outer side, tibia and basal half of metatarsus blackish brown, remainder of tarsus very pale brown; mid leg and hind leg brown, hind femur and hind tibia dark brown; femur 1 (Figs 1, 6) moderately incrassate (ratio of length/width in ♀ 4.7 and in both ♂ 4.5), tubercles on distal three-quarters of ventral side, inner row in ♀ with 23 tubercles and in ♂ with 28.5 ± SE 2.6



Figures 7–11. Dorsal view of *Teleopsis* wings **7** *T. ferruginea*, ♂, Lunugala **8** *T. sorora* sp. nov., ♂, paratype, Roseneath **9** *T. krombeini*, ♂, paratype, Thawalamtenne **10** *T. maculata,* ♂, paratype, Hakgala **11** *T. neglecta* sp. nov., unknown sex, paratype, Pundaluoya. Scale bars: 0.5 mm.



Figures 12–16. *Teleopsis ferruginea* ♂, Lunugala **12** six basal abdominal segments, ventral view (note absence of sternum 6) **13** epandrium with surstyli and cerci, posterior view **14** phallapodeme and aedeagus, lateral view **15** ejaculatory apodeme and sac **16** synsternum 7+8, natural, curved state in dorso-anterior view and stretched state in ventral view. Scale bars: 0.5 mm (**12**); 0.1 mm (**13–16**).

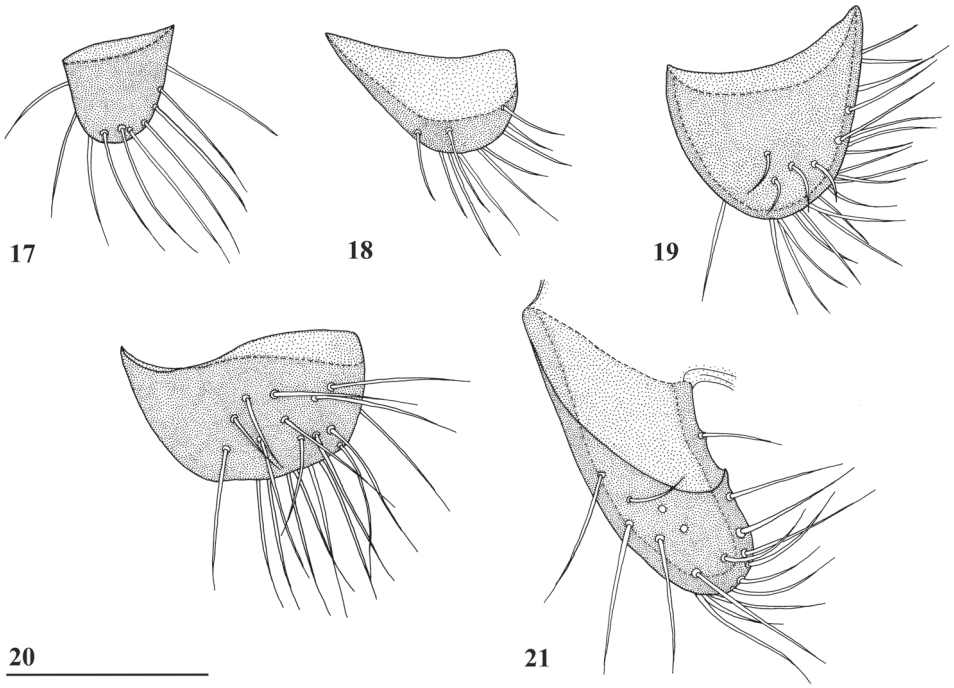
tubercles (range 24–34, $N = 4$), outer row in ♀ with 20 tubercles (range 19–21) and in ♂ with 23.0 ± 1.7 tubercles (range 20–26, $N = 4$), in both rows a few double tubercles.

Preabdomen. Terga 1 and 2 and base of tergum 3 brown, remainder of tergum 3, terga 4, 5 and 6 blackish, the dark parts of terga 3–5 forming a black circle (Figs 5, 6); terga thinly pollinose, a glossy lateral spot on tergum 1 and basal half of tergum 2, anterolaterally on tergum 3 a pair of densely pollinose spots; seam between terga 2 and 3 not very distinct; sternum 1 and intersclerite brown, sternum 1 more glossy basally, other sterna pale yellowish brown, pollinose; basal half of sternum 1 seamlessly fused to tergum 1; spiracle 1 in tergum; intersclerite posteriorly connected to sternum 2 (Fig. 12), sternum 2 narrow and long, slightly broadening posteriorly; rectangular sternum 3 slightly broader than sternum 2, sternum 4 again slightly broader and more or less rectangular (Fig. 12).

Female postabdomen. Given the teneral and damaged state (Fig. 1) of the abdomen of the holotype ♀, it was decided not to dissect the abdomen.

Male postabdomen. Strongly deflexed, sternum 5 represented by two very small, strongly sclerotised sclerites (Fig. 12), sternum 6 hardly discernible: synsternum 7+8 (Fig. 16, on the left the natural, curved position and at right the flattened shape); left spiracle 7 in vague lateral slit of synsternum, right spiracle 7 in synsternum at anterior edge; epandrium (Fig. 13) rounded, covered with microtrichia and about 11 pairs of setulae, anterior section largely separated; surstyli articulate, very small, apically rounded, in lateral view symmetrical and rounded, ratio length/width 1.0 (Fig. 17), no microtrichia, at apical edge 10 setulae, setulae about 1.5 times as long as surstylus; surstyli just connected to lateral side of cerci, not interconnected via processus longi; cerci large, apically pointed towards the meson (Fig. 13), ratio length/width 1.6, widest subapically, covered with microtrichia and about 20 setulae; phallapodeme (Fig. 14) quite straight, anterior arm slightly curving downward anteriorly, anteriorly rounded, anterior arm marginally longer than posterior arm, posterior arm bifurcated, vane not very broad; aedeagus a complicated open structure of sclerites and membranes (Fig. 14), rather long "male genital process" sticking out from apex (for terminology see Kotrba et al. 2013); ejaculatory apodeme wedge-shaped (Fig. 15).

Distribution. *Teleopsis ferruginea* occurs in the Uva Province in south-eastern Sri Lanka. The holotype originates from southern Sri Lanka.



Figures 17–21. Lateral view of *Teleopsis* surstyli **17** *T. ferruginea*, Lunugala **18** *T. sorora* sp. nov., paratype, Udawattakele **19** *T. krombeini*, paratype, Thawalamtenne **20** *T. maculata*, paratype, Hakgala **21** *T. neglecta* sp. nov., holotype, Pundaluoya. Scale bar: 0.1 mm (all drawn to the same scale).

***Teleopsis krombeini* Feijen, 1998**
Figures 9, 19, 22–24, 28–30, 62, 63

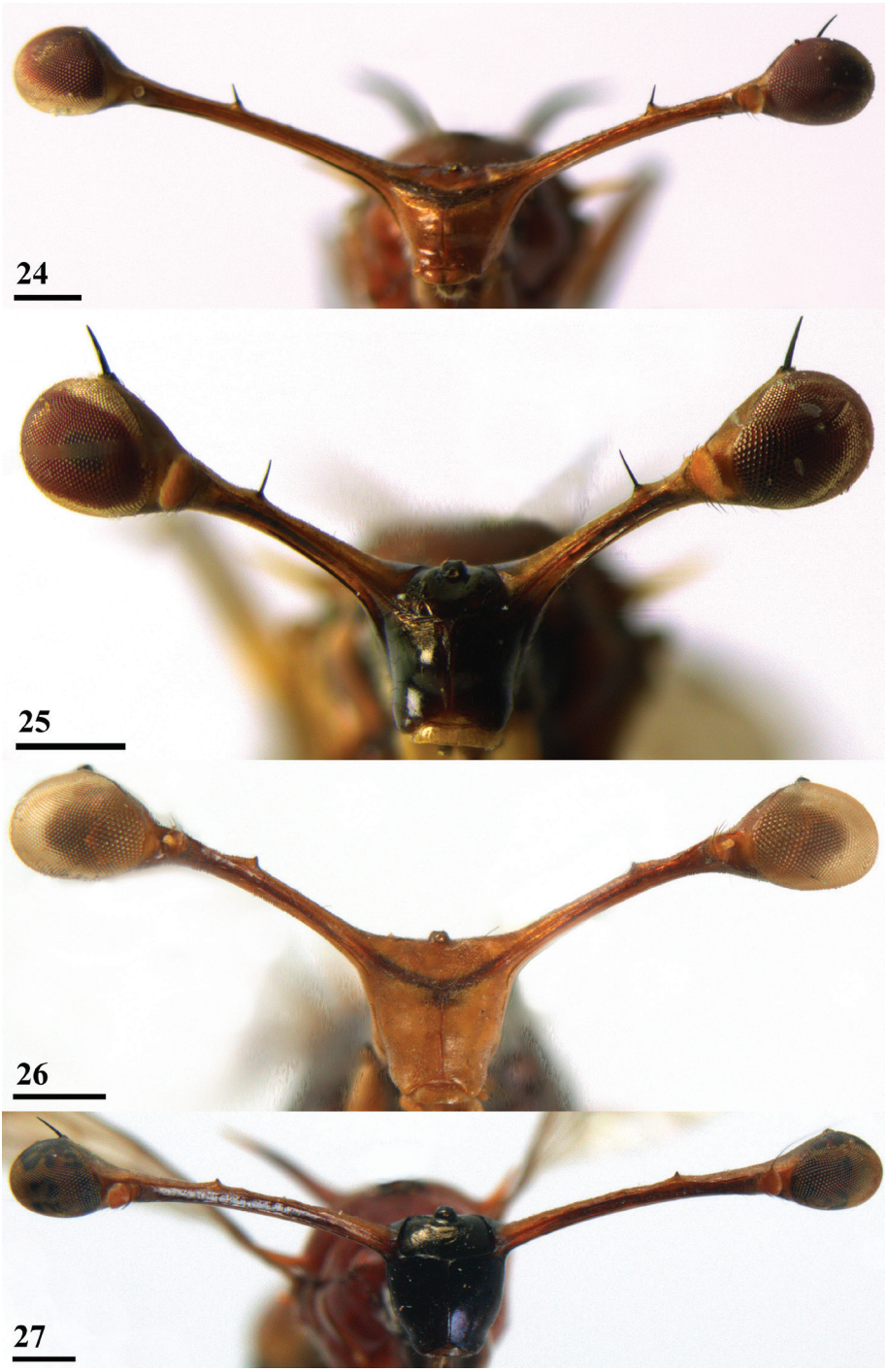
Teleopsis krombeini Feijen, 1998: 57.

Type material. ***Holotype***, ♂, Sri Lanka, Kan[dy] Dist[rict], Thawalamtenne, 2200 ft, 4.ix.1980, K.V. Krombein et al. (USNM). ***Paratypes*:** 4 ♀, 6 ♂ and 2 ?sex, same data as holotype (USNM, RMNH); 1 ♀, Kitulgala, Bandarakele Jungle, Keg[alle] Dist., 17–18.iii.1979, K. V. Krombein et al. (USNM); 3 ♀ Kandy, 28.v.1892, Lt Col. Yerbury (NHMUK); 2 ♂, [Kandy District], Haragam[a], 24.v.1892, Lt Col. Yerbury (NHMUK); 1 ♂ (NHMUK genitalia slide), Kandy, 24.v.1892, Lt Col. Yerbury; 1 ♀ (NHMUK genitalia slide), Haragam[a], 1.vi.1892, Lt Col. Yerbury.

Additional material. Photographs (www.inaturalist.org/observations/29425824) by Amila Prasanna Sumanapala taken at Central Province, Matale District, Rattota, 7°31'05"N, 80°43'52"E, 1155 m, 27.ii.2019. Although these pictures were sufficient for identification, they were not sharp enough to be reproduced here.

Notes. Holotype and paratypes from USNM and RMNH were re-examined. Holotype ♂ and a paratype ♀ were photographed (Figs 9, 22–24). The re-examined

Figures 22, 23. Dorsal view of *Teleopsis krombeini* **22** ♂, holotype, Thawalamtenne **23** ♀, paratype, Kitugala. Scale bars: 1 mm.



Figures 24–27. Anterior view of *Teleopsis* heads **24** *T. krombeini*, ♂, holotype, Thawalamtenne **25** *T. maculata*, ♂, paratype, Hakgala **26** *T. neglecta* sp. nov., unknown sex, paratype, Pundaluoya **27** *T. sorora* sp. nov., ♂, paratype, Roseneath. Scale bars: 0.5 mm.

flies were measured. Below, only data additional to the description given in Feijen (1998) are presented.

Measurements. Body length ♀ 5.9 mm ± SE 0.2 (range 5.4–6.5, *N* = 5), ♂ 5.9 mm ± 0.2 (range 5.0–6.4, *N* = 7); eye span ♀ 4.6 mm ± 0.1 (range 4.2–5.0, *N* = 5), ♂ 5.7 mm ± 0.4 (range 4.2–6.8, *N* = 7); wing length ♀ 4.3 mm ± 0.1 (range 4.0–4.7, *N* = 5), ♂ 4.4 mm ± 0.1 (range 3.8–4.7, *N* = 7); length of scutellar spine ♀ 1.14 ± 0.05 (range 1.04–1.30, *N* = 5), ♂ 1.11 mm ± 0.05 (range 0.89–1.25, *N* = 7).

Head. Eye span (Figs 22–24) small in female (78.4 ± 0.7% of body length) and medium-sized in male (96.8 ± 3.3% of body length); a dimorphic species with a moderate rate of dimorphism D = 1.03 (Fig. 28); inner vertical seta small, equal in size to stalk diameter, usually not broken off; base of inner vertical seta small, almost 0.5× the stalk diameter; outer vertical seta medium-sized, about 1.7× the stalk diameter, spinous.

Thorax. Ratio scutellar spine/scutellum in ♀ 3.16 ± 0.06 (*N* = 5) and in ♂ 3.13 ± 0.05 (*N* = 7), ratio scutellar spine/body length in ♀ and ♂ 0.19 ± 0.00 (*N* = 5, resp. 7); apical seta small, one-fifth of length of scutellar spine (lacking in most specimens).

Wing. See Fig. 9.

Male postabdomen. Sternum 6 indiscernible; synsternum 7+8 a short transverse sclerite with parallel anterior and posterior edges (Fig. 29), right spiracle 7 in sclerite, left spiracle 7 in slit in lateral tip of synsternum (Fig. 30) [for the remark by Feijen (1998) "left spira-

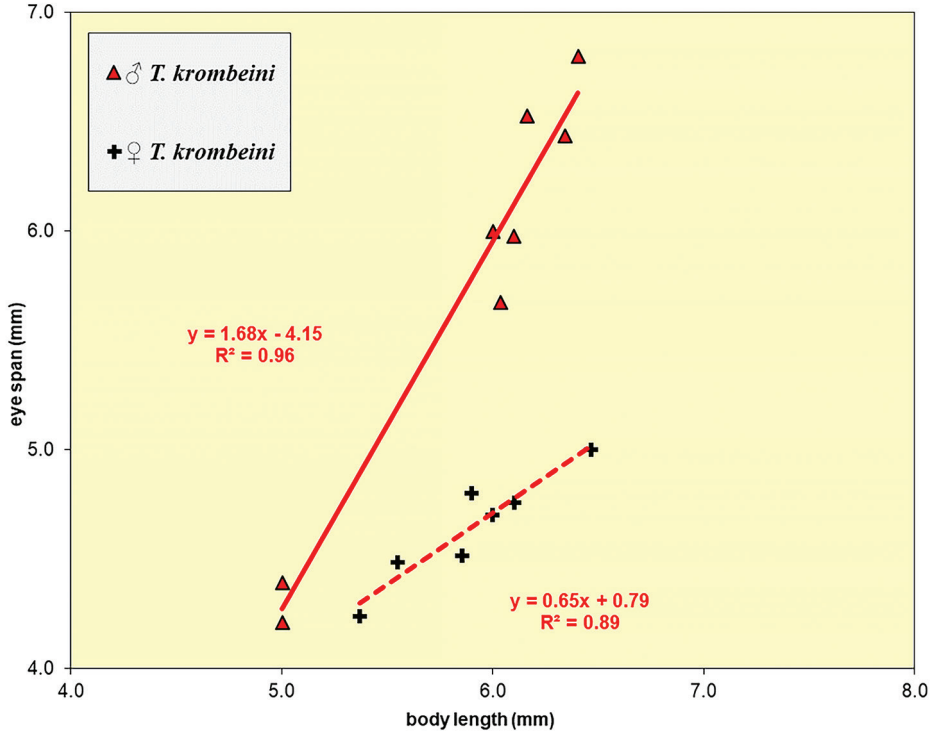


Figure 28. *Teleopsis krombeini*, eye span plotted against body length.

cle 7 in sternum 7+8, right spiracle 8 in lateral slit of sternum 7+8 (fig. 20)" left and right have to be reversed as is also clear from the figure]; surstyli articulate, small (but relatively large, as compared to *T. ferruginea* and *T. sorora* sp. nov.), apically rounded, in lateral view symmetrical and rounded, ratio length/width 0.9 (Fig. 19), no microtrichia, at apical and posterior edges with about 25 setulae, setulae distinctly shorter than length of surstylus.

Distribution. *Teleopsis krombeini* is now known from Kandy District and Matale District, Central Province and Kegalle District, Sabaragamuwa Province.

Teleopsis maculata Feijen, 1998

Figures 10, 20, 25, 31–33, 62, 63

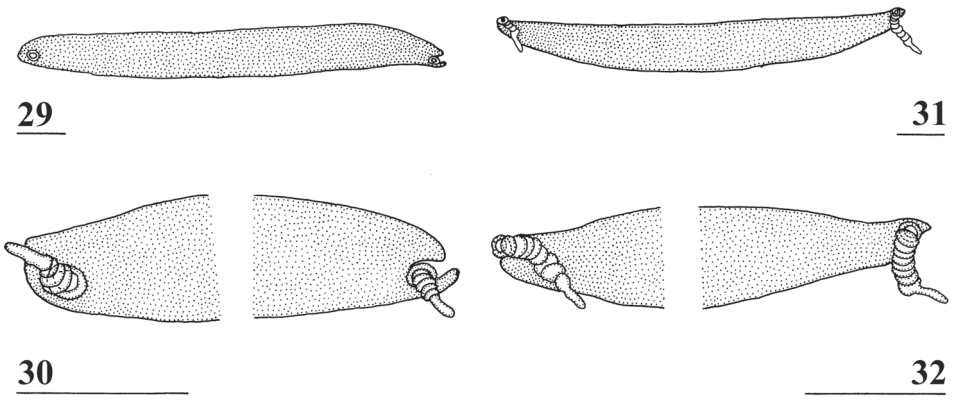
Teleopsis maculata Feijen, 1998: 61.

Type material. ***Holotype***, ♂, Sri Lanka, Nuwara Eliya, 14.vii.1892, Lt Col. Yerbury (NHMUK). ***Paratypes:*** 1 ♂, Hakgala Natural Reserve, N.E. Dist., Sri Lanka, 6–7. ii.1979, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, S. Siriwardane, T. Gunawardane (USNM); 1 ?sex (no head and abdomen), Punda luoya [Pundaloya], Sri Lanka, E. E. Green (NHMUK).

Notes. The USNM paratype was re-examined and photographed (Figs 10, 25, 33). Below, only data additional to the description given in Feijen (1998) are presented.

Diagnosis. *Teleopsis maculata* forms part of the *T. ferruginea* species group. For the position of this monomorphic species within this group can be referred to the remarks made under *T. neglecta* sp. nov.

Description. ***Head***. Eye span (Figs 25, 33) very small in male (62.4 ± 1.7% of body length); although no females are available, the very small eye spans in the two available males form a clear indication that this is a monomorphic species; when the



Figures 29–32. Ventral view of *Teleopsis* male synsternum 7+8 **29** *T. krombeini*, paratype, Thawalamtenne **30** same, details of lateral sections **31** *T. maculata*, paratype, Hakgala **32** same, details of lateral sections. Scale bars: 0.1 mm.

two data points for ratio eye span/body length in *T. maculata* (Figs 62, 63) are compared with the data points for the dimorphic *T. ferruginea*, *T. krombeini* and *T. sorora* sp. nov., these two points are in slope similar to the females of the three dimorphic species; inner vertical seta medium-sized, about 1.5× the stalk diameter; base of inner vertical seta small, less than 0.5× the stalk diameter; outer vertical seta medium-sized, about 2.0× the stalk diameter, spinous (Figs 25, 33).

Thorax. Ratio scutellar spine/scutellum in paratype ♂ 3.00, ratio scutellar spine/body length in holotype 0.20 and in paratype ♂ 0.19; ratio apical seta/scutellar spine in holotype 0.27 and in paratype ♂ 0.29.

Wing. See Fig. 10.

Male postabdomen. Sternum 6 indiscernible; synsternum 7+8 (Fig. 31) a symmetrical, short, transverse sclerite, slightly curved and tapering laterally; spiracles 7 in synsternum near the lateral tips (Fig. 32); surstyli articulate, small, apically somewhat rounded, in lateral view distinctly wider than long, ratio length/width 0.6 (Fig. 20), no microtrichia, on large, distoposterior section about 19 setulae, most setulae slightly longer than length of surstylus.

Distribution. *Teleopsis maculata* is known from the Central Province (Nuwara Eliya district). As the Hakgala Reserve is partly located in Uva Province, it probably also occurs there.

***Teleopsis neglecta* sp. nov.**

http://zoobank.org/9772DF96-ACAD-4DC9-BC70-F7CF807939D4
Figures 11, 21, 26, 34–47, 62, 63

Type material. ***Holotype***, ♂, Ceylon [Sri Lanka, Central Province], Pundaluoya, [7°0'47"N, 80°39'48"E, ~1060 m], 90–115 [undated, but 90–115 probably indicates

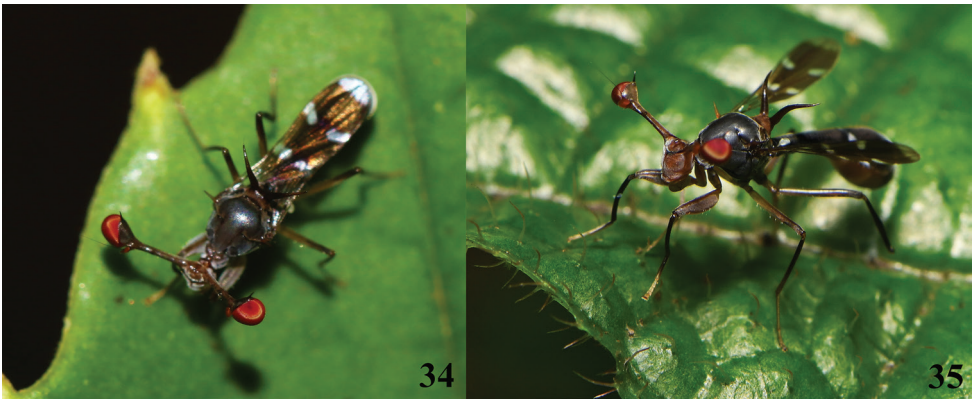
Figure 33. *Teleopsis maculata*, ♂ paratype, Hakgala, dorsal view. Scale bar: 1 mm.

1890], E. E. Green (NHMUK), [head lacking]. ***Paratype:*** 1 ? sex, same data as holotype [abdomen lacking].

Additional material. Photographs: 1 ♂?, Sabaragamuwa province, Ratnapura, Kalawana, 6°25'12"N, 80°25'05"E, 510 m, 6.xi.2018 by Amila Prasanna Sumanapala (Fig. 34) (www.inaturalist.org/observations/29425825); 1 ♂, Southern Province, Matara, Kotapola, Sinharaja Forest Reserve, 6°21'47"N, 80°29'19"E, 420 m, 28.xi.2019 by "Baeru" (www.inaturalist.org/observations/45756128); 1?sex, Southern Province, Matara District, Kotapola, Sinharaja Forest Reserve, 6°21'45"N, 80°29'13"E, 350 m, 28.xi.2019 by "Baeru" (www.inaturalist.org/observations/45756204); 1 ♀, Sabaragamuwa Province, Ratnapura, Kalawana, Sinharaja Rainforest, 6°24'01"N, 80°29'58"E, 860 m, by "Baeru" (Fig. 35) (www.inaturalist.org/observations/45907083).

Diagnosis. *Teleopsis neglecta* sp. nov. can be recognised by its slender habitus, bareness, wing pattern (apical 10% vaguely infuscated, three distinct crossbands strongly interconnected giving four distinct pale spots, basal anterior spot not extending into cell bm+dm), wing mostly covered by microtrichia except for most of basal quarter and anterior spots, inner vertical seta and outer vertical seta spinous, tiny base of inner vertical seta, no facial teeth, dorsally glossy collar, reddish brown, thinly pollinose scutum and scutellum, ratio scutellar spine/scutellum ~ 3.1, incrassate front femora with around 54 (♂) tubercles, abdomen dark, large glossy spot laterally on terga 1 and 2, pair of pollinose spots on tergum 3, tergum 4 glossy, tergum 5 densely pollinose, male spiracles 7 symmetrically in synsternum, surstyli articulate, slender, apically rounded, ratio length/width in lateral view 2.5, surstyli without microtrichia, broad male cerci, ratio eye span/body length ~0.60–0.70 in ♂, and assumed sexual monomorphism with regard to eye span.

Teleopsis neglecta sp. nov. forms part of the *T. ferruginea* species group. Like *T. maculata*, it is more distant from the dimorphic species in this group (*T. ferruginea*, *T. krombeini* and *T. sorora* sp. nov.), also given the differences in the male synster-



Figures 34, 35. *Teleopsis neglecta* sp. nov., live photographs **34** by Amila Prasanna Sumanapala, Kalawana (www.inaturalist.org/observations/29425825) **35** by "Baeru", Sinharaja Rainforest (www.inaturalist.org/observations/45907083).

num. However, for an understanding of the phylogenetic relationship between *T. neglecta* sp. nov. and *T. maculata* more information has to become available (morphology of female genitalia, molecular analyses and wing geometric morphometrics analyses).

Description. ***Measurements***. Body length holotype ♂ 6.9 mm (estimate: collar - abdominal apex 6.3 mm, head length assumed 0.6 mm); eye span paratype 4.8 mm; wing length holotype 4.1 mm and paratype 4.8 mm; length of scutellar spine holotype 1.08 mm and paratype 1.18 mm.

Head. Central part yellowish brown (Figs 34–37), thinly pollinose; frons (Fig. 37), smooth, with a shallow dimple in front of ocellar tubercle; arcuate groove dark brown; face smooth, slightly bulging centrally, no facial teeth, lateroventral corners rounded, bare, no setulae; eye span probably very small, in holotype estimated as ~60% of the body length (based on comparison of measurements of holotype and paratype), from the photograph of a live specimen an estimate of ~70% of body length is made; the rate of dimorphism in eye span cannot be estimated from the few data available, but it seems quite certain that *T. neglecta* sp. nov. is a monomorphic species; although no females are available, the very small eye span in the holotype forms a clear indication that this is a monomorphic species; when the data point for ratio eye span/body length in *T. maculata* (Figs 62, 63) is compared with the data points for the dimorphic *T. ferruginea*, *T. krombeini*, and *T. sorora* sp. nov., this point is similar to those for the females of the three dimorphic species [measurements are, like for *T. maculata* falling in the range for the monomorphic genus *Megalabops*]; stalks brown, broad apical parts blackish, thinly pollinose; inner vertical seta tiny, 0.1× the diameter of the eye stalk (Fig. 36), base of inner vertical seta small, 0.2× the stalk diameter; outer vertical seta broken off, but spinous (distinct in live photograph, Figs 34, 35).

Thorax. Collar dorsally glossy brown, but posteriorly and laterally pollinose; scutum reddish brown pollinose (darker in live photographs, Figs 34, 35), scutellum and scutellar spines yellowish brown (darker in live flies), thinly pollinose (Figs 36, 38); pleura reddish brown pollinose, anepisternum, anepimeron, katepisternum, and meron glossy reddish brown; supra-alar spines (Figs 36, 38) glossy brown, almost 2½x as long as pleurotergal spines, dorsolaterally directed; scutellar spines curving upward and outward, diverging under an angle of 100° (Figs 34–36), ratio scutellar spine/scutellum in holotype 3.21 and in paratype 3.06, ratio scutellar spine/body length in holotype ~ 0.16; pleurotergal spines pollinose, medium-sized and blunt, posterolaterally directed; apical seta broken off in holotype and paratype, but on photograph small, ~ 20% of length of scutellar spine; no setulae on thorax, a few tiny setulae on scutellar spines, no warts.

Wing. Irrorated with three distinct crossbands (Figs 11, 34, 35); apical 10% of wing uniformly vaguely infuscated; preapical band broad and dark, posterior half slightly paler, broadly linked to central crossband in cell r4+5, slightly extending into cells r2+3 and m; two clear spots in between the central and preapical bands, one in cells r1 and r2+3, and one basally in cell m1; central crossband dark and almost as wide

Figures 36–40. *Teleopsis neglecta* sp. nov. **36–39** unknown sex, paratype, Pundaluoya **40** ♂, holotype, Pundaluoya **36** head and thorax, dorsal view **37** central head, anterior view **38** thorax, lateral view **39** front femur, lateral view **40** abdomen, ventral (left) and dorsolateral (right) view. Scale bars: 0.5 mm.

as preapical band, including crossveins r-m and dm-m, darker veins R4+5 and M4, slightly less dark on posterior half, preapical and central crossband together forming a solid H-configuration; basal band dark and half the width of the other bands, darker around vein M4 and posteriorly of cell cua, a strong connection to central band in

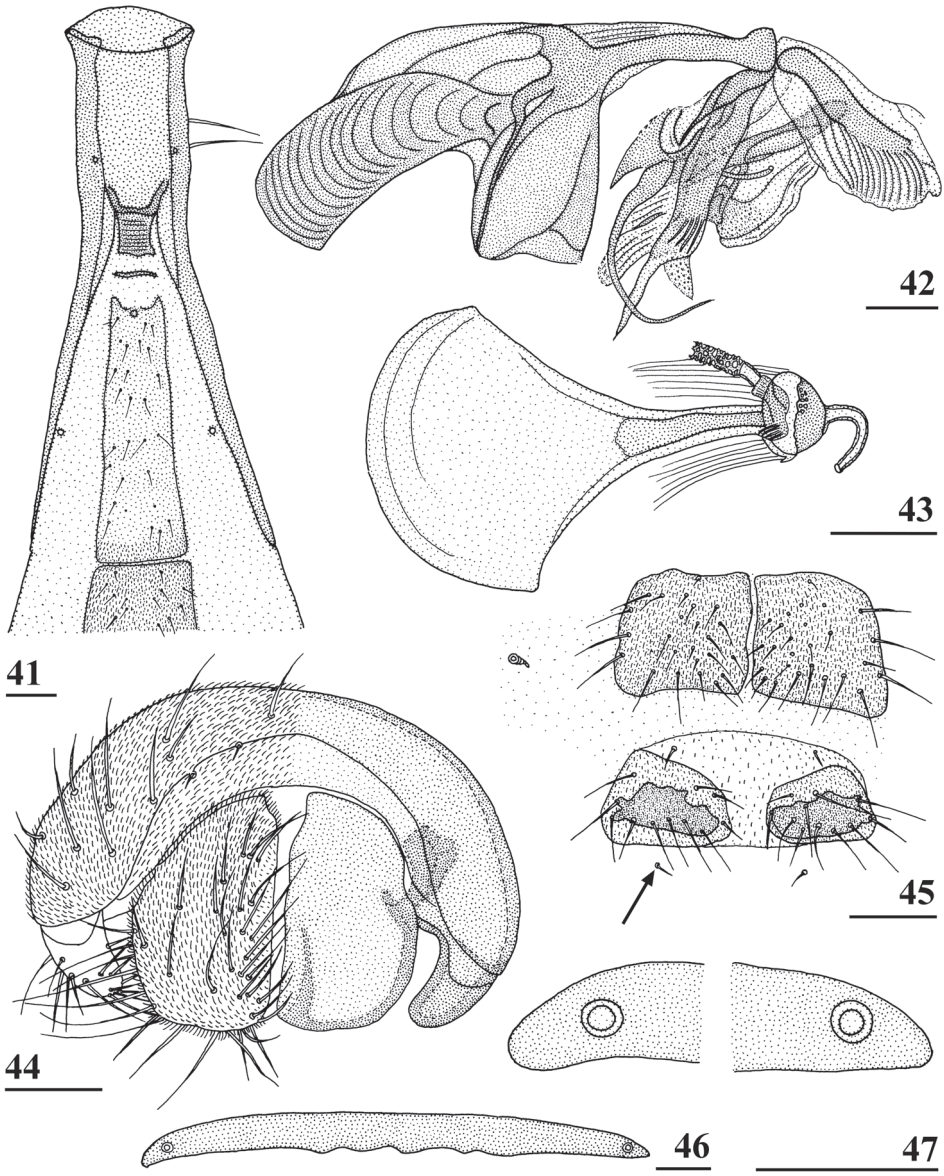
cell bm+ dm and around vein M4, giving two pale spots, one in cells r1 and br and the other centrally in cell m4; cell r4+5 narrower basally and apically; vein M4 from crossvein dm-m onward turning slightly downward and reaching till just more than half the distance to the wing edge; glabrous basal areas including most of cell c except for apex, posterior basal sixth of cell r1, basal half of cell br, basal fifth of cell bm+dm except for posterior edge, and most of cell cua except for apex and anterior margin; anterior spots also almost bare.

Legs. Front leg yellowish brown pollinose (darker in live flies), femur with very vague brown stripe on inner side, tibia darker brown; mid leg brown, femur with dark brown stripes on distal half; hind leg brown, femur with dark brown stripe on whole length, hind tibia darker brown; femur 1 (Fig. 39) incrassate in paratype, ratio of length/width 3.9, tubercles on distal three-quarters of ventral side, inner row in paratype with 28 tubercles ($N = 1$), outer row with 26 tubercles.

Preabdomen. Terga 1, 2 and 3 reddish brown to black, other terga slightly darker; basal terga thinly pollinose, a glossy lateral spot on tergum 1 and basal half of tergum 2, laterally on tergum 3 a pair of more densely pollinose spots, tergum 4 glossy dorsally, tergum 5 densely pollinose, appearing pale grey on live photograph; seam between terga 2 and 3 not very distinct; sternum 1 and intersclerite blackish brown, other sterna brown, sternum 1 and most of sternum 2 glossy (Figs 40, 41), posterior edge of sternum 2 and other sterna thinly pollinose; basal three-quarters of sternum 1 fused to tergum 1 (Figs 40, 41), sternum 1 with typical U-shaped ridge posteriorly; spiracle 1 in tergum; intersclerite not clearly connected to sternum 2, sternum 2 hardly widening posteriorly, ratio length/width 3.8; sternum 3 a rectangular plate broadening posteriorly; sternum 4 consisting of two square sclerites, narrowly separated on the meson (Fig. 45).

Male postabdomen. Sternum 5 represented by two sclerites with only the central sections strongly sclerotised; sternum 6 indiscernible, only the two characteristic anterior tiny setulae could be found (Fig. 45); synsternum 7+8 (Figs 46, 47) a symmetrical, very short, broad sclerite, hardly tapering laterally; spiracles 7 quite symmetrically in synsternum; epandrium (Fig. 44) broad, rounded, covered with microtrichia and about 12 pairs of setulae; surstyli articulate, slender, small and apically rounded in posterior view, in lateral view slightly curved, ratio length/width 2.5 (Figs 21, 44), glabrous, no microtrichia, on outer and apical side with about 18 setulae; surstyli connected to lateral side of cerci, not interconnected via processus longi; cerci large, broad, apical edges sclerotised (Fig. 44), ratio length/width 1.7, covered with microtrichia and especially along edges with setulae; phallapodeme (Fig. 42) strongly curving downward anteriorly, anterior arm broadening above the vane and 1.3× the posterior arm, posterior arm weakly bifurcated, vane broad; aedeagus a complicated open structure of sclerites and membranes (Fig. 42), rather long male genital process sticking out from apex; ejaculatory apodeme fan-shaped (Fig. 43).

Distribution. *Teleopsis neglecta* sp. nov. is known from Sabaragamuwa Province, Southern Province and Central Province.



Figures 41–47. *Teleopsis neglecta* sp. nov., ♂, holotype, Pundaluoya **41** basal section of abdomen, ventral view **42** phallapodeme and aedeagus, lateral view **43** ejaculatory apodeme and sac **44** epandrium with surstyli and cerci, posterior view **45** sterna 4 and 5, ventral view (arrow indicating the anterior setulae of the otherwise absent sternum 6) **46** synsternum 7+8, ventral view **47** same, details of lateral sections. Scale bars: 0.2 mm (**41**); 0.1 mm (**42–47**).

Etymology. The specific epithet *neglecta* reflects the fact that, after collecting, it took 130 years for this species to be finally described (*neglecta*, ignored).

***Teleopsis sorora* sp. nov.**
http://zoobank.org/6C00A046-4E57-4B53-B3BB-1D486FCA0AF5
Figures 8, 18, 27, 48–63

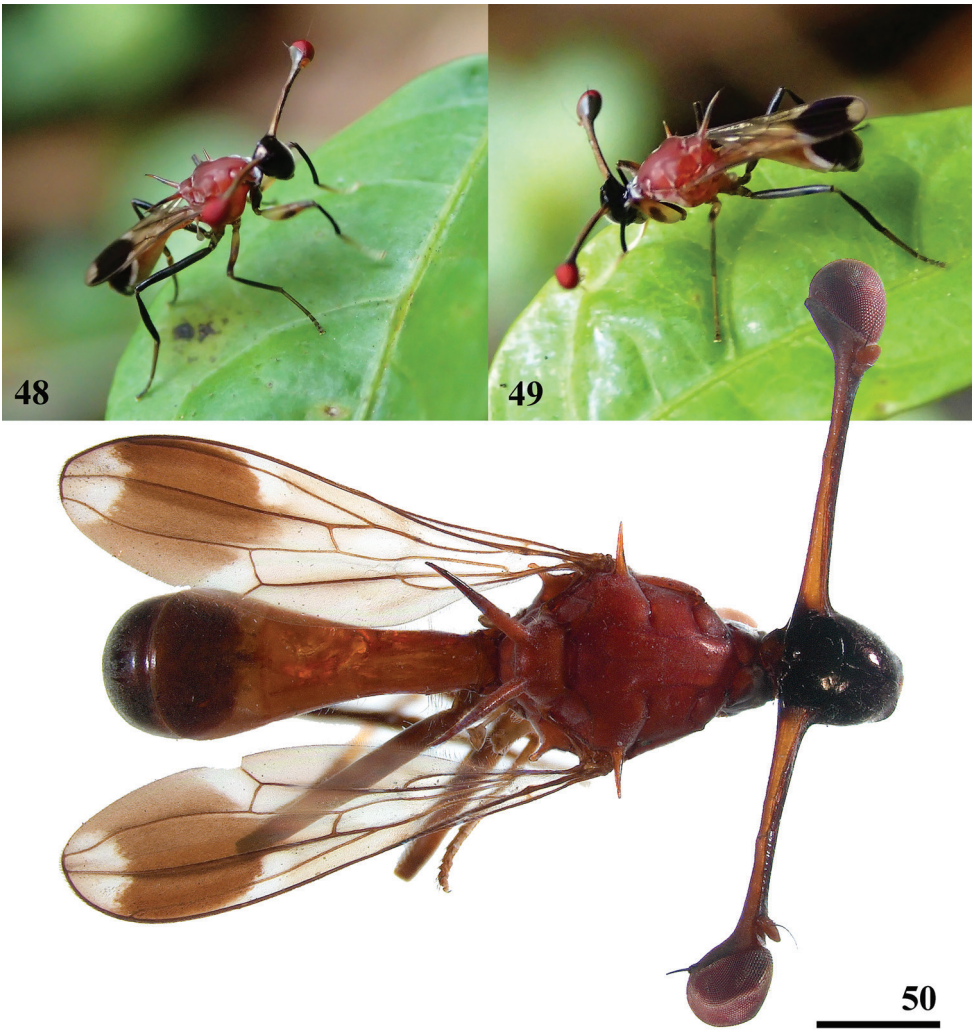
Teleopsis ferruginea: Feijen 1998: 55 (all specimens except for holotype of *Diopsis ferruginea*); Kotrba et al. 2013: 190, fig. 3f.

Type material. ***Holotype***, ♂ Sri Lanka**,** Kan. Dist. [Central Province, Kandy District], Udawattakele Sanct., [7°17'55"N, 80°38'32"E, ~ 600 m], 1–3.ix.1980, K.V. Krombein, P.B. Karunaratne, T. Wijesinhe, L. Jayawickrema, V. Gunawardane (USNM). ***Paratypes*:** 3 ♀, 5 ♂, 1 ?sex, same data as holotype; 4 ♀, 6 ♂, Kandy, Udawattakele Sanct., Kan. Dist., 6–8.vi.1978, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, V. Kulasekare, L. Jayawickrema; 2 ♀, 3♂, Udawattakele Sanct., Kan. Dist., 8–11.ii.1979, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, S. Siriwardane, T. Gunawardane; 1 ♀, 3 ♂, Kandy Reservoir Jungle, Kan. Dist., [probably Darwin reservoir, 7°17'01"N, 80°38'18"E, 600 m], 10.ii.1979, K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, S. Siriwardane, T. Gunawardane (all Krombein material in USNM with some specimens in RMNH); 1 ♂, C.P. [Central Province], Kandy, Roseneath [tea plantation?], [7°16'44"N, 80°38'19"E, ~ 655 m], 12.vii.1953, F. Keiser (NHMB); 1 ♂, C.P., Kandy, Roseneath, 11.viii.1953, F. Keiser (NHMB).

Notes. Feijen (1998) included in the material studied as "*T. ferruginea*" the following specimens: 1 ♀, 1 ♂, Sri Lanka (NHMUK); 5 ♂, Sri Lanka, Dr. Thwaites, 67-25 (NHMUK); 2 ♀, 2 ♂, 3?, Sri Lanka, Weston Coll., NHMUK 1924-199; 1 ♀, 2 ♂, Peradeniya, Sri Lanka, 30.iv.1891, Lt Col. Yerbury (NHMUK); 2 ♂, Henaratgoda, Sri Lanka, i.1901 (NHMUK); 1 ♂, Suduganga, 10.ix.1919, R. Senior White (NHMUK). These specimens are also likely to represent *T. sorora* sp. nov., but this remains to be ascertained.

Additional material. First set of photographs by Pieter D. H. Prins taken at Kandy, K. F. G. & G. Korale, Udawattakele Sanctuary, 7°18'11"N, 80°38'32"E, 22.xi.2010, 580 m, 23.xi.2010 and 12.xii.2010 (www.inaturalist.org/observations/35209123). Second set of photographs (www.inaturalist.org/observations/36624976) from same location and by the same photographer, 5.xii.2014 (Figs 48, 49).

Diagnosis. *Teleopsis sorora* sp. nov. is the most colourful of all diopsids with its glossy black head, reddish legs, reddish thorax, reddish basal abdomen and black apical abdomen. Furthermore it can be recognized by its slender habitus, bareness, wing pattern (broad and curved dark preapical crossband and two very indistinct crossbands), small glabrous area of wing, setula-like inner vertical seta 0.6× the stalk diameter (usually broken off), medium-sized outer vertical seta 1.8× stalk diameter, small base of inner vertical seta, no facial teeth, blackish collar covered with dense white pollinosity, reddish brown, thinly pollinose scutum and scutellum, moderately curved scutellar spines, ratio scutellar spine/scutellum close to 3.0, moderately incrassate front femora (ratio length/width ~ 4.5) with around 48 (♀) to 50 (♂) tubercles, blackish terga 3–5 forming a circle, pair of pollinose spots on tergum 3, rectangular



Figures 48–50. *Teleopsis sorora* sp. nov. **48–49** live photographs by Pieter D.H. Prins, Udawattakele (www.inaturalist.org/observations/36624976) **50** ♂, holotype, Udawattakele, photograph Cobi Feijen. Scale bar: 1 mm.

♀ sternum 6, almost completely divided ♀ sternum 7, ♀ spiracle 7 in membrane, rounded pentagonal subanal plate, rather elongate ♀ cerci, round spermathecae with 8–10 rounded protuberances, right ♂ spiracle 7 in synsternum 7+8, left spiracle 7 in lateral slit of synsternum, articulate and very small surstyli wider than long (ratio length/width 0.5) without microtrichia and with 10 setulae, large and rectangular ♂ cerci (ratio length/width 1.9), phallapodeme with broad anterior arm, strongly curving downward anteriorly, small eye span in female (79% of body length), medium-sized eye span in male (99% of body length), and low rate of sexual dimorphism with regard to eye span D = 0.82. *Teleopsis sorora* sp. nov. can be considered the sister species of *T. ferruginea* and forms part of the *T. ferruginea* species group.

Description. The following description is partly based on the redescription of *Teleopsis ferruginea* by Feijen (1998: 55) for which specimens were used that are now placed in *Teleopsis sorora* sp. nov.

Measurements. Body length ♀ 5.8 mm ± SE 0.2 (range 4.8–6.5, *N* = 9), ♂ 5.9 mm ± 0.1 (range 4.7–6.5, *N* = 20); eye span ♀ 4.6 mm ± 0.2 (range 3.8–5.3, *N* = 10), ♂ 5.9 mm ± 0.2 (range 4.1–7.3, *N* = 20); wing length ♀ 4.4 mm ± 0.2 (range 3.7–4.8, *N* = 8), ♂ 4.5 mm ± 0.1 (range 3.8–4.8, *N* = 17); length of scutellar spine ♀ 1.18 ± 0.03 (range 1.01–1.33, *N* = 9), ♂ 1.17 mm ± 0.02 (range 0.99–1.30, *N* = 19).

Head. Central part glossy black (Figs 27, 48–50), face laterally and ventrally covered with a typical, 'woolly' type of pollinosity, face and frons otherwise bare with only a few tiny pale setulae; frons (Fig. 27) very smooth with laterally at base of stalk a deep groove; arcuate groove narrow and concolourous; face flat and very smooth, facial sulcus indistinct, no facial teeth, lateroventral corners rounded; mouthparts greyish brown; eye span small in female (78.6 ± 0.9% of body length) and medium-sized in male (99.4 ± 1.5% of body length); a dimorphic species with a low rate of dimorphism D = 0.82 (Fig. 51); stalks yellowish brown, anteriorly and posteriorly with a blackish band, apices blackish pollinose; inner vertical seta usually appears minute, 0.1× the diameter of the eye stalk, in a single teneral specimen there is a small, setula-like inner vertical seta of 0.6× the stalk diameter (these slender inner vertical seta probably drop off early in the life of the fly); base of inner vertical seta small, just more than 0.2× the stalk diameter; outer vertical seta medium-sized, about 1.8× the stalk diameter, spinous.

Thorax. Collar blackish brown, covered with dense white pollinosity, dorsoposterior edge brown and laterally a brown band; scutum, scutellum and scutellar spines brown, almost reddish brown, thinly pollinose (Figs 48–50), scutellar spines with darker central band; pleura brown, very thinly pollinose, katepisternum ventrally glossy, prosternum with black spot between front coxae; supra-alar spines (Fig. 50) glossy brown, almost 2½ x as long as pleurotergal spines, laterally directed, somewhat turned upward; scutellar spines moderately curving upward and outward, diverging under an angle of 75° (Fig. 50), ratio scutellar spine/scutellum in ♀ 2.79 ± 0.05 (*N* = 9) and in ♂ 2.98 ± 0.05 (*N* = 19), ratio scutellar spine/body length in ♀ and ♂ 0.20 ± 0.00 (*N* = 9, resp. 19); pleurotergal spines pollinose, medium-sized and blunt, posterolaterally directed; apical seta small, 0.15 ± 0.00% of length of scutellar spine (*N* = 21); very few tiny setulae on scutum, a few more on ventral thorax, scutellar spines with a few tiny setulae, no basal warts.

Wing. Irrorated with a dominant, dark, curved preapical band (Figs 8, 50) and, in addition, two very indistinct crossbands; apex (apical 12% of wing) infuscated, slightly less infuscated area centrally near preapical band; preapical band broad, curved, apically convex, proximally concave, uniformly very dark, broadly linked to central crossband in and around cell r4+5; two pale spots in between the central and preapical bands, one in cells r1 and r2+3, and one basally in cell m1; broad, but vague and irregular central crossband including crossveins r-m and dm-m, slightly darker around vein M4; narrow, indistinct and irregular basal band, connections to central band, giving two pale spots, one distally in cell br and one centrally in cell m4; cell r4+5 narrowing subapically; vein M4 from crossvein dm-m onward turning downward and reaching till three-fifth of the distance to the wing edge; glabrous basal areas including basal half of cell c, tiny spot

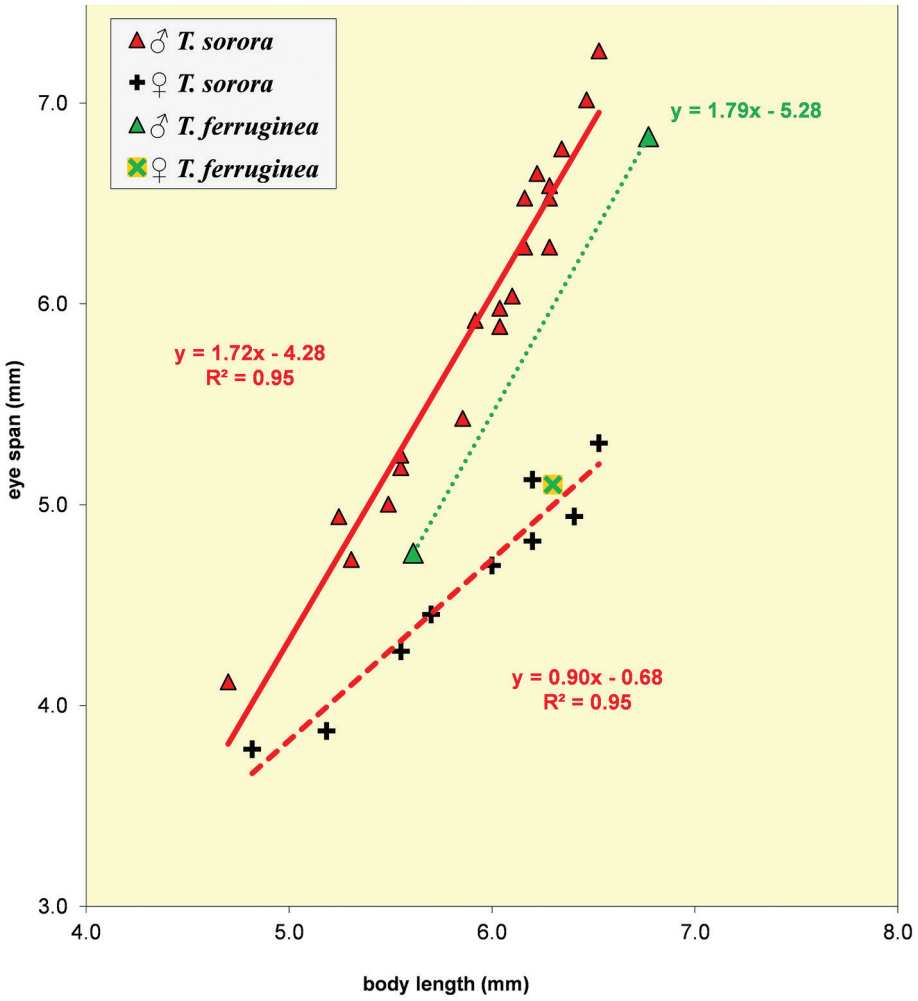


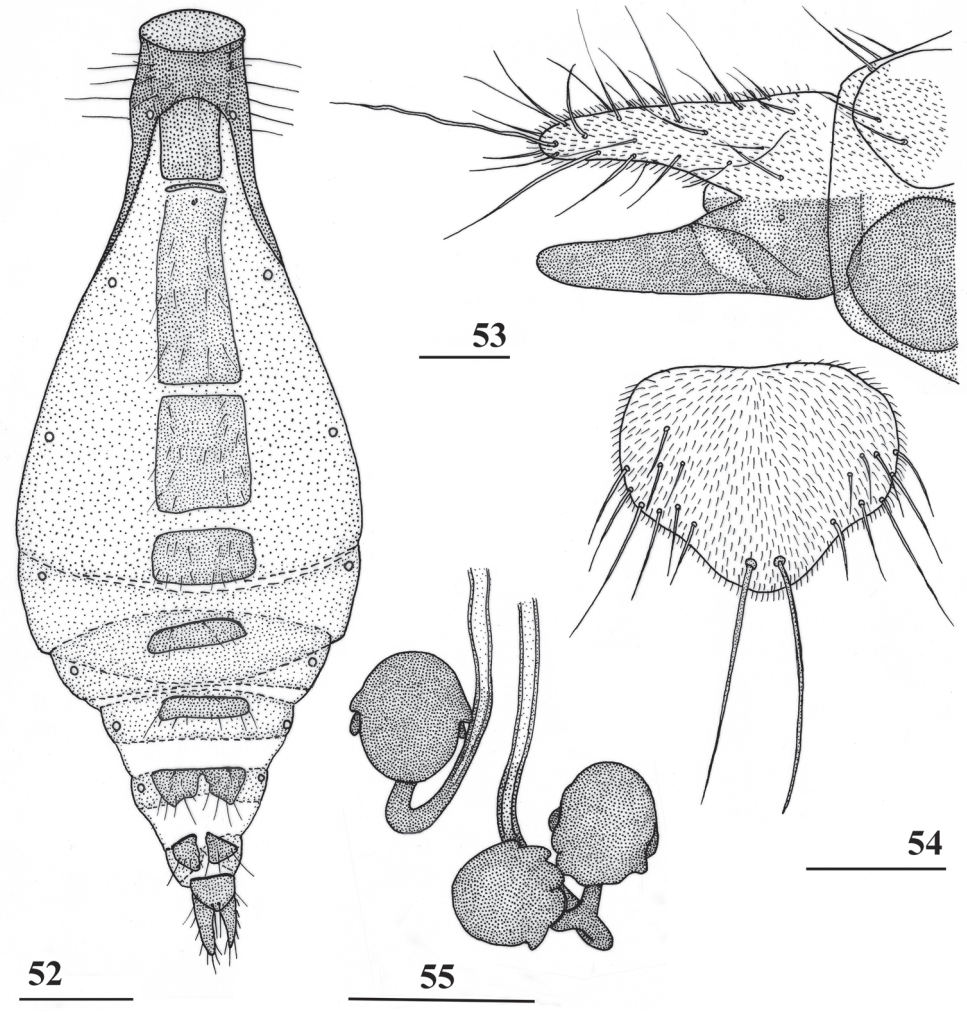
Figure 51. *Teleopsis sorora* sp. nov., eye span plotted against body length. For comparison, the three data points for *Teleopsis ferruginea* are also indicated.

basally in cell r1, central quarter of cell br, basal third of cell bm+dm except for edges, and posterior half of cell cua. The two pale wing spots proximally of the dark preapical band clearly coincide with the pair of whitish, densely pollinose spots adjoining the black apical section of the abdomen (Figs 48–50, especially Fig. 49). The same phenomenon was observed in the sister species *T. ferruginea* (Feijen 1998). Coinciding wing spots and abdominal spots are a common phenomenon in several Diopsidae genera.

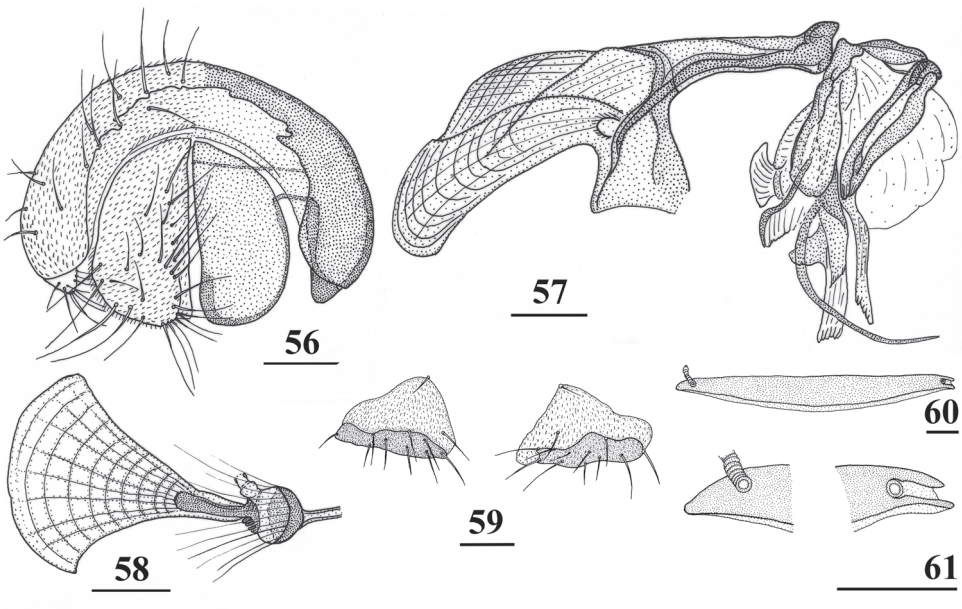
Legs. Front leg with coxa glossy brown on outer side and dark brown pollinose on inner side, pale brown on anterior side, trochanter and femur pale brown, pollinose, femur with small dark spot basally on inner side and large black spot on distal two-thirds of outer side (Figs 48, 49), tibia glossy blackish brown, tarsus whitish except for brown base of metatarsus; mid leg brown with dark spots on femur and darker tibia; hind leg dark brown (almost black in the live specimens); femur 1 (Fig. 48) moderately incrassate with ratio

length/width in ♀ 4.5 ± 0.0 (*N* = 10) and in ♂ 4.6 ± 0.0 (*N* = 19), two rows of tubercles on distal three-quarters, inner row in ♀ with 25.7 ± 0.6 tubercles (range 22–30, *N* = 19) and in ♂ with 27.6 ± 0.4 tubercles (range 24–31, *N* = 26), outer row in ♀ with 21.9 ± 0.4 tubercles (range 19–25, *N* = 18) and in ♂ with 22.6 ± 0.4 tubercles (range 19–26, *N* = 28); legs with some setulae, ventral side of femur 1 densely covered with small setulae.

Preabdomen. Terga 1 and 2 and base of tergum 3 brown, remainder of tergum 3 and terga 4, 5 and 6 blackish brown, forming a black circle (Figs 48–50) which coincides with the dark preapical wing bands; two basal terga thinly pollinose except for glossy lateral parts, laterally on tergum 3 a pair of whitish, densely pollinose spots adjoining the blackish section, apical terga with dense, whitish pollinosity; seam between terga 2 and 3 very indistinct; sterna yellowish brown, sternum 1 and interscleritе brown, sternum 1 glossy,



Figures 52–55. *Teleopsis sorora* sp. nov., ♀, paratype, Udawattakele **52** abdomen, ventral view **53** terga 8, 10 and cerci, dorsal view **54** subanal plate, ventral view **55** spermathecae. Scale bars: 0.5 mm (**52**); 0.1 mm (**53–55**).



Figures 56–61. *Teleopsis sorora* sp. nov., ♂, paratype, Udawattakele **56** epandrium with surstyli and cerci, posterior view **57** phallapodeme and aedeagus, lateral view **58** ejaculatory apodeme and sac **59** sternum 5, ventral view **60** synsternum 7+8, ventral view **61** same, details of lateral sections. Scale bars: 0.1 mm.

other sterna yellowish brown, pollinose; basal half of sternum 1 seamlessly fused to syntergum; spiracle 1 in sclerite; intersclerite not connected to sternum 2 (Fig. 52), sterna slightly broadening towards abdominal apex.

Female postabdomen. Deflexed; terga 6 and 7 single rectangular sclerites (Fig. 52); tergum 8 represented by two rounded sclerites (Fig. 53), sclerites anteriorly glabrous; tergum 10 ill-defined, with one pair of setulae; cerci rather elongate, ratio of length/width 3.6, covered with microtrichia and a number of setulae; sterna 5 and 6 single rectangular sclerites; sternum 7 posteriorly constricted medially, giving two sclerites joined anteriorly; spiracle 7 in membrane; sternum 8 represented by two triangular sclerites; subanal plate (Fig. 54) pentagonal with rounded corners, at apex a pair of large setulae; laterally about 8 pairs of small setulae, covered with microtrichia; spermathecae (Fig. 55) rounded with few rounded protuberances, ten in the single theca and eight each in the pair, heavily sclerotised; sclerotised ring of ventral vagina tapering towards one side.

Male postabdomen. Sternum 4 a single rectangular sclerite; sternum 5 consisting of two small strongly sclerotised sclerites with anteriorly vaguely sclerotised sections (Fig. 59); sternum 6 indiscernible; synsternum 7+8 without sclerotised connection to anterior sclerites of epandrium; right spiracle 7 in anterior edge of synsternum, left spiracle 7 in slit in lateral tip of synsternum (Figs 60, 61); epandrium (Fig. 56) rounded, covered with microtrichia and about 14 pairs of setulae; surstyli articulate, very small, apically rounded, in lateral view asymmetrical (one corner acute and the other one rectangular), wider than long, ratio length/width 0.5 (Fig. 18), no microtrichia, apically 10 setulae, setulae about as long as surstylus; surstyli just connected to lateral side of cerci, not intercon-

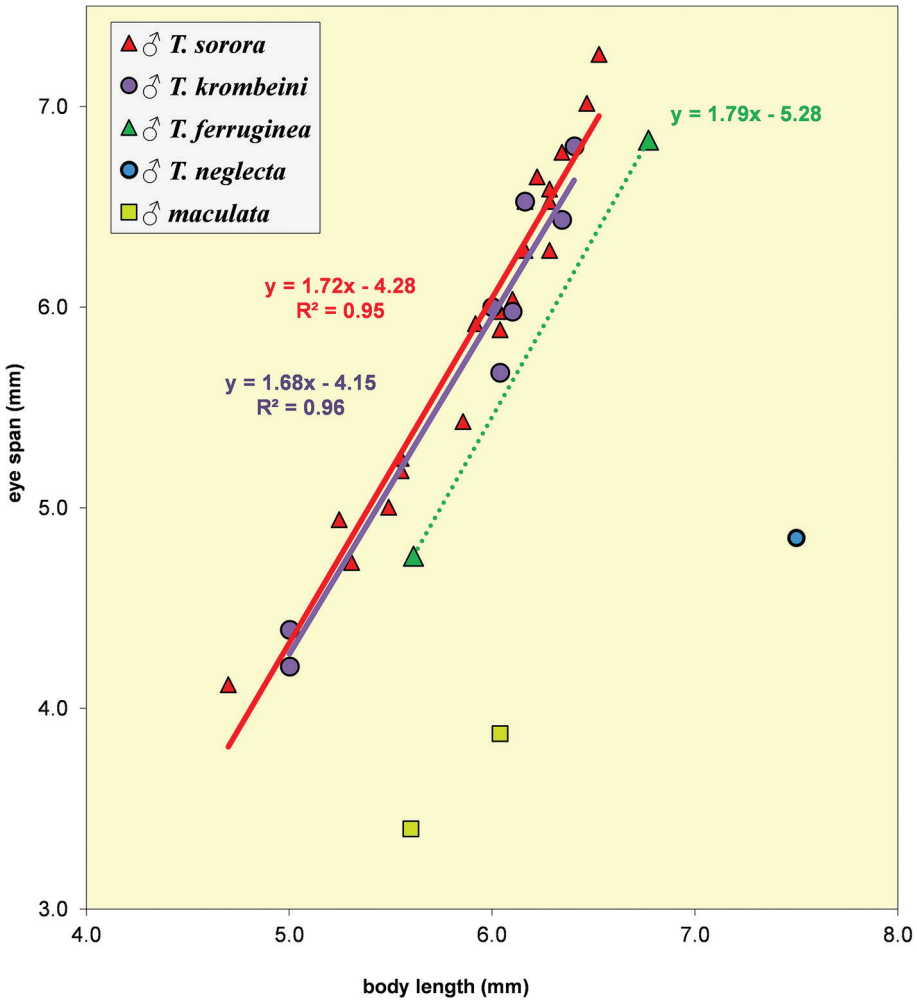


Figure 62. Eye span plotted against body length for the males of the five Sri Lankan *Teleopsis* showing the difference in allometric slopes between the dimorphic *T. sorora* sp. nov., *T. krombeini* and *T. ferruginea* and the few data points for the monomorphic *T. maculata* and *T. neglecta* sp. nov.

nected via processus longi; cerci large, broad, flat, quite rectangular with rounded corners, equal width along most of its length, ratio length/width 1.9, covered with microtrichia and especially along edges with setulae; phallapodeme (Fig. 57) with broad anterior arm, abruptly narrowing anteriorly and strongly curving downward, anterior arm slightly longer than posterior arm; aedeagus (Fig. 57) with rather long male genital process sticking out from apex; ejaculatory apodeme fan-shaped (Fig. 58), ejaculatory sac relatively small.

Distribution. The specimens of the type series are from three neighbouring locations in Kandy: Udawattakele Sanctuary, Darwin Reservoir and Roseneath. If the NHMUK specimens also represent *T. sorora* sp. nov., this would extend the known distribution to the surroundings of Colombo and the wider surroundings of Kandy.

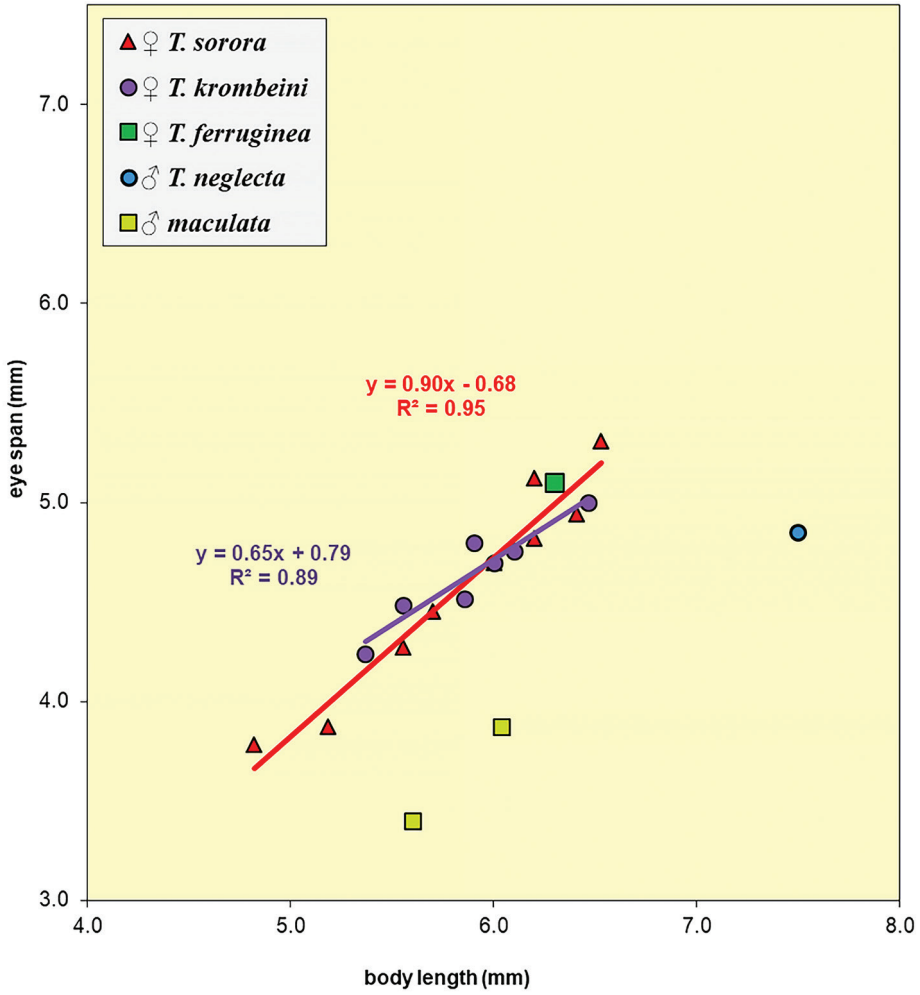


Figure 63. Eye span plotted against body length for the females of three dimorphic species *T. sorora* sp. nov., *T. krombeini* and *T. ferruginea* and the few data points for males of the monomorphic species *T. maculata* and *T. neglecta* sp. nov. Note the similarity in allometric slopes.

Etymology. This new species is considered the sister species of *Teleopsis ferruginea*, hence the name *sorora* (sister).

Discussion

The biogeographic range of *Teleopsis*

Feijen and Feijen (2011) discussed the biogeographic range of the genus *Teleopsis*. They indicated *Teleopsis* s. s. as a purely Oriental genus with species occurring in India, ? Myanmar, Sri Lanka, Indonesia (Sumatra, Java, Bali and Borneo only), Malaysia, Brunei,

Thailand, China (only Hainan), and the Philippines. For the second Diopsidae genus with supra-alar spines, *Megalabops* Frey, they gave a more northern distribution with species in occurring in Nepal, Northern India, Myanmar, West Malaysia, Thailand, Cambodia, Vietnam, and China (mainland and Taiwan). To the range for *Teleopsis* can now be added Vietnam and Southern Mainland China (Yunnan), while to the range of *Megalabops* can be added Bhutan (see Feijen and Feijen 2019) and Laos.

Feijen and Feijen (2019) discussed the *Teleopsis* species groups in India and Sri Lanka. The Indian and Sri Lankan *Teleopsis* form isolated groups in their genus from morphological as well as geographical point of view. In India, only the *Teleopsis sykesii* species group occurs with its two species distributed in Western India. From Eastern India, *Teleopsis* are not known, so the *T. sykesii* group forms an isolated group. The *Teleopsis* species geographically closest to the *T. sykesii* group are found in Sri Lanka. They belong to the equally isolated *T. ferruginea* species group. Otherwise the nearest *Teleopsis* members are found in Thailand and Peninsular Malaysia. The two *T. sykesii* records for Myanmar are very doubtful (Feijen and Feijen 2011). Molecular data for India and Sri Lankan *Teleopsis* are still lacking, but a close relationship between the two species groups appears unlikely.

The *Teleopsis ferruginea* species group

For the phylogenetic position of *Teleopsis* within the Diopsidae can be referred to Feijen et al. (2018a). *Teleopsis* forms part of the *Teleopsis* genus group, characterised by irrorated wings. Within *Teleopsis*, the species of the *T. ferruginea* group can be characterised by their bareness, small to medium-sized inner vertical seta (0.5–1.5× stalk diameter), tiny to small base of inner vertical seta (0.1–0.5× stalk diameter), absence of facial teeth, moderately incrassate to incrassate front femora (mean ratio length/width varying from 3.8–4.9), male sternum 5 consisting of two sclerites, indiscernible male sternum 6, small and articulating surstyli with 10–25 setulae and without microtrichia, and ribbon-like male synsternum with 7th spiracles in sclerite or in lateral slit of sclerite. Female genitalia have only been described for *T. krombeini* and *T. sorora* sp. nov. Based on only these two species, additional character states of the *T. ferruginea* group might be: ♀ tergum 7 and sternum 7 unconnected, ♀ spiracles 7 in membrane, and spermathecae with very short tubercles.

Within the species group, *T. ferruginea*, *T. sorora* sp. nov., and *T. krombeini* form a subgroup based on similarities in shape and setulae of the surstylus, the lateral slit in the male synsternum accommodating left spiracle 7, the sexual dimorphism with regard to eye span and the similar allometric slope for male eye span on body length. *Teleopsis ferruginea* and *T. sorora* sp. nov. are obvious sister species based on shape and colouration of central head, colour pattern of scutum and dorsal abdomen and male genitalia. The sexually monomorphic *T. neglecta* sp. nov. and *T. maculata* stand separate from the three dimorphic species, given also that in both species the left male spiracle 7 is located in sclerite. However, as indicated above, more information is required to determine the relationships between *T. neglecta* sp. nov. and *T. maculata* and with the group of dimorphic species.

Dimorphism and monomorphism in the Sri Lankan *Teleopsis*

Baker and Wilkinson (2001), comparing allometric data with a phylogenetic tree based on molecular analyses, concluded that for the Diopsidae "Sexual dimorphism in eye span has evolved independently at least four times in the family ...". Later, Feijen and Feijen (2014) and F.A.A. Feijen (pers. obs.) found that there were, at least, eight cases of independent development of sexual dimorphism with regard to eye span within the Diopsidae. This concerned three cases in the Sphyracephalinae, one in the *Diasemopsis* genus group, at least three in the *Teleopsis* genus group (the irrorated wings group) and one in the genus *Diopsis*. The dimorphic Malagasy *Diopsis nigrosicus*, distantly related to the monomorphic *Diopsis ichneumonea* species group of African Mainland, provided the ninth case (Feijen et al. 2018b). The five Sri Lankan *Teleopsis* species can, based on morphological criteria, be assumed to belong to the monophyletic *Teleopsis ferruginea* species group. Within this species group there are three distinctly dimorphic species: *T. ferruginea*, *T. krombeini*, and *T. sorora* sp. nov. For the other two species, *T. maculata* and *T. neglecta* sp. nov., only a few specimens are available, but they can, in all likelihood, be assumed to represent monomorphic species. As such the number of cases of independent development of sexual dimorphism with regard to eye span now comes to ten.

Key to the Diopsidae species of Sri Lanka

1 Arista tripartite, alula present, vein CuA+CuP extending past cell cua (Fig. 66), syntergum including terga 1–2, apical scutellar seta several times longer than scutellar spine ..... ***Sphyracephala bipunctipennis*** **(Senior-White, 1922)**

– Arista bipartite, alula absent, vein CuA+CuP not extending past cell cua (Figs 69, 72), syntergum including terga 1–3, apical scutellar seta smaller than the length of the scutellar spine or absent..... **Diopsinae 2**

2 Scutellar spine almost straight, apical bristle absent, wing with dark and round apical wing spot and vague central infuscation especially around crossvein r-m (Fig. 72), scutum uniformly black..... ***Diopsis*** **near** ***indica***

– Scutellar spine strongly curved, apical bristle present (often broken off), irrorated wings with dark crossbands and pale spots (Figs 7–11, 69), scutum reddish or brown..... **3**

3 No supra-alar spines, covered with long setulae, especially head and legs (Fig. 67), inner vertical seta long (≥3× stalk diameter), female tergum 7 and sternum 7 forming a complete ring ..... ***Cyrtodiopsis*** **near** ***dalmanni***

– Supra-alar spines present, almost bare (only some tiny setulae) (Figs 1, 22, 23), inner vertical seta tiny to medium-sized (≤1.5× stalk diameter), female tergum 7 and sternum 7 not forming a complete ring..... **4**

4 Ratio eye span/body length in males < 0.7 (Fig. 33), sexual monomorphism with regard to eye span, left male spiracle 7 in synsternum **5**

– Ratio eye span/body length in males > 0.85, on average ~1.0 (Fig. 22), sexual dimorphism with regard to eye span, left male spiracle 7 in lateral slit of synsternum **6**

5 Central head and collar glossy black (Fig. 33), wing with dark, V-shaped preapical crossband and distinct apical spot (Fig. 10), dorsal abdomen with posterolateral pale spots on first five terga, pale spots on tergum 3 covered with dense pollinosity, terga 4 and 5 pollinose, femur 1 with two distinct brown spots on inner side, surstylus broad and short (ratio length/width 0.6, Fig. 20) ..... ***Teleopsis maculata* Feijen, 1998**

– Central head yellowish brown and thinly pollinose (Figs 26, 37), collar reddish brown, wing with three dark crossbands strongly interconnected giving four distinct pale spots (Fig. 11), no lateral pale spots on first five terga, tergum 3 with a pair of densely pollinose spots, tergum 4 glossy dorsally, tergum 5 densely pollinose, femur 1 with very vague brown stripe on inner side, surstylus narrow and long (ratio length/width 2.5, Fig. 21)..... ..... ***Teleopsis neglecta* sp. nov.**

6 Central head brown, concolorous with stalks (Fig. 24), upper half of face more pronounced, face tapering ventrally, inner vertical seta spinous, scutum brown with posterior half glossy, wing with central and preapical crossbands equal in width (Fig. 9), dorsal abdomen yellowish brown basally and dark brown more apically, surstyli relatively large with 25 setulae (Fig. 19) .... ***Teleopsis krombeini* Feijen, 1998**

– Central head black, stalks brown, face smooth and rounded (Fig. 2), inner vertical seta a thin setula (usually broken off), scutum reddish brown and thinly pollinose, wing with broad dominant preapical crossband (Figs 7, 8), dorsal abdomen reddish brown with terga 3 and 4 forming a black circle, surstyli very small with 10 setulae (Figs 17, 18) 7

7 Wing with three distinct crossbands, preapical crossband straight (Fig. 7), front femur pollinose with vague darker spot on outer side, very small surstyli with ratio length/width 1.0 (Fig. 17), male cerci widest subapically (ratio length/width 1.6), phallapodeme quite straight, anterior arm slightly curving downward anteriorly..... ***Teleopsis ferruginea* (Röder, 1893)**

– Wing with one dominant, dark, curved preapical crossband and two indistinct crossbands (Fig. 8), front femur with small dark spot basally on inner side and large black spot on distal two-thirds of outer side, very small surstyli with ratio length/width 0.5 (Fig. 18), rectangular male cerci (ratio length/width 1.9), phallapodeme with broad anterior arm strongly curving downward anteriorly ..... ***Teleopsis sorora* sp. nov.**

Other Diopsidae in Sri Lanka

Notes. The three other Diopsidae known from Sri Lanka are *Sphyracephala bipunctipennis*, *Cyrtodiopsis* sp. and *Diopsis* sp. For descriptions of the latter two species, large scale revisions will be required for, respectively, the *Cyrtodiopsis dalmanni* species group and the *Diopsis indica* species group. Here, the collecting data are given for the three species concerned. For all three species illustrations are provided for the habitus (Figs 64, 67, 70), the anterior view of the head (Figs 65, 68, 71) and the wing (Figs 66, 69, 72). As

a very large sample of flies was available for the *Diopsis* sp., its monomorphism with regard to eye span, will briefly be discussed.

Sphyracephala Say, 1828

Sphyracephala bipunctipennis (Senior-White, 1922)

Figures 64–66

Teleopsis bipunctipennis Senior-White, 1922: 165, pl. 13, fig. 1; Descamps 1957: 19; Steyskal 1972: 11.
Pseudodiopsis bipunctipennis (Senior-White): Shillito 1940: 150; Steyskal 1977: 35.
Sphyracephala bipunctipennis (Senior-White): Feijen 1989: 67; Feijen 1998: 50; Feijen and Feijen 2019: 39.

Type material. ***Holotype***, ♂ Sri Lanka, [Central Province] Suduganga [Sudu Ganga] river, Indiganga, on leaves of Liliacrans (sic!) plant, 10.viii.1919 (NHMUK). ***Paratypes*:** 7 ♀, 4 ♂, same data as holotype (NHMUK).

Distribution. India (Tamil Nadu), Sri Lanka (Central Province). Except for the 1919 type series, no other specimens are known from Sri Lanka.

Cyrtodiopsis Frey, 1928

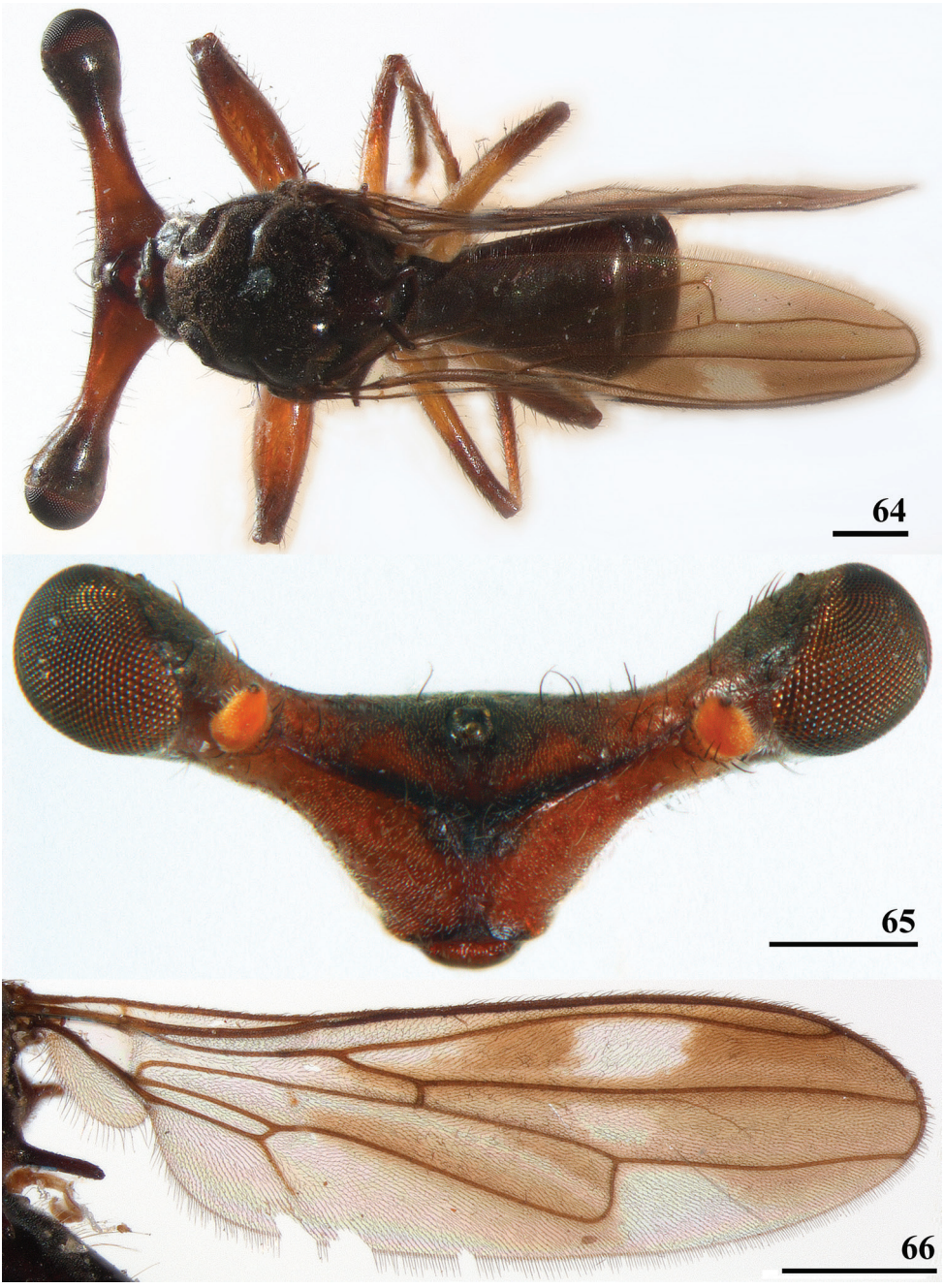
Cyrtodiopsis sp.

Figs 67–69

Material examined. 2 ♀, 1 ♂, Ceylon [Sri Lanka], Morin, 1914 (ZMUO). The label information is very limited. It is not clear whether "Morin" is a locality name or the name of the collector. The only reference to Morin for Sri Lanka is a "Morin Inn" in Negombo.

Notes. This species forms part of the *Cyrtodiopsis dalmanni* species group. The presence of *Cyrtodiopsis* in Sri Lanka would be rather surprising, given that the nearest relatives in the *C. dalmanni* group occur in Malaya and Indonesia. The geographically closest *Cyrtodiopsis* is *C. whitei* Curran from north-eastern India. However, that species belongs to a different species group. The Sri Lankan record certainly requires confirmation to exclude the possibility of mislabelling.

Although many non-taxonomic papers have been written about "*Cyrtodiopsis dalmanni*", the taxonomy of this species and the *C. dalmanni* species group still requires a full-scale taxonomic revision. This species group can be characterized by the many, long setulae covering the body, the wing pattern with three pale spots in between the central and preapical crossbands and the peculiar peg and hollow modification on the male front leg, the peg located basally on the tibia and the hollow distally on the femur. This leg modification is also referred to as "nutcracker" and can be found in all males, except for small ones. For illustrations of this modification can be referred to Földvári et al. (2019: fig. 4).



Figures 64–66. *Sphyracephala bipunctipennis,* paratypes, Sudu Ganga **64** ♂, habitus, dorsal view **65** ♀, head, anterior view (inner vertical seta absent, but outer vertical seta broken off) **66** ♂, wing. Scale bars: 0.5 mm.

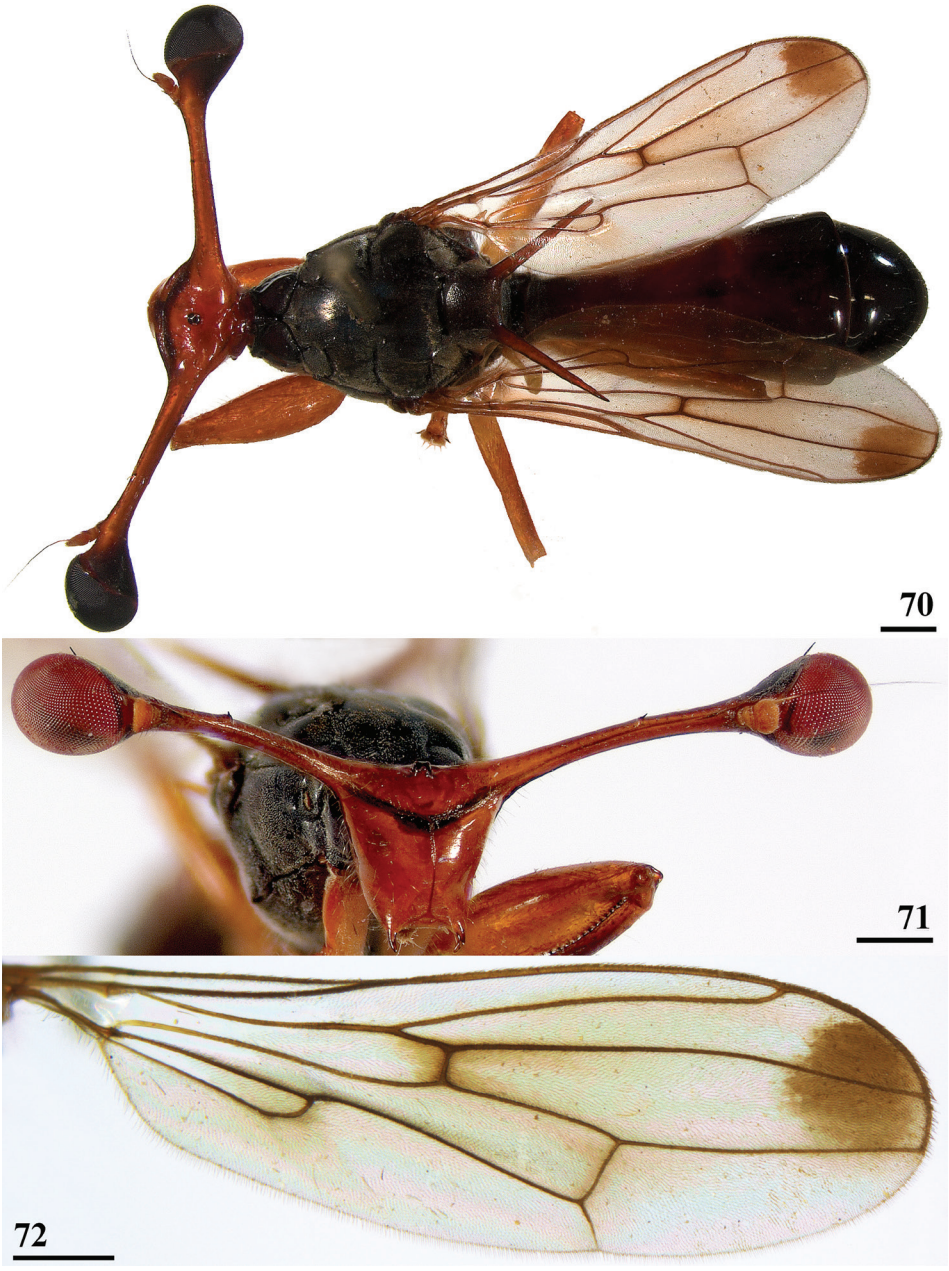
Figures 67–69. *Cyrtodiopsis* sp., Morin? **67** ♀, habitus, lateral view **68** ♂, head, anterior view (inner vertical seta broken off) **69** ♀, wing. Scale bars: 0.5 mm.

Diopsis Linnaeus, 1775

Diopsis sp.

Figs 70–73

Material examined. Sri Lanka, 168 ♀, 108 ♂, [Uva Province], Bad[ulla]. Distr., Girandurakotte Circ., Bungalow 10 mi NNE Mahiyangan[ay]a, UV trap, 4–7.ix.1980, K.V. Krombein (USNM, RMNH); 1 ♀, [Uva Province, Ratnapura District], Ug-



Figures 70–72. *Diopsis* sp., Mahiyangana **70** ♂, habitus, dorsal view **71** ♂, head, anterior view **72** ♀, wing. Scale bars: 0.5 mm.

galkaltota, 500', 10–14.x.1970, O.S. Flint jr (RMNH); 1 ♀, 1 ♂, [Uva Province], Bad[ulla] Distr., Mahiyanganaya, 2750', 23.xi.1970, O.S. Flint jr (RMNH); 2 ♂, Uva [Province], Inginiyagala, 1.ix.1953, F. Keiser, on grass (NHMB).

Notes. The large Girandurakotte sample of 276 flies, collected by a UV trap, is quite remarkable. We are not aware of any other substantial collection of Diopsidae by this type of trap. Although this *Diopsis* of the *D. indica* species group definitely represents a new species, its description has to await designation of a neotype for *D. indica* and a full revision of the species group it belongs to. The group counts more than 20 undescribed Oriental species. For more information on this group can be referred to Feijen and Feijen (2009, 2019).

Sexual monomorphism. As has already been indicated in Feijen and Feijen (2019), all species in the *D. indica* group are sexually monomorphic with regard to eye span. As a large sample of the Sri Lankan species was available, the opportunity was taken to measure 40 ♀ and 40 ♂ to demonstrate the monomorphism in this species group (Fig. 73). The slopes of the allometric lines are almost similar for males and females: respectively 0.88 ± SE 0.06 and 0.93 ± 0.04. The difference gives a rate of dimorphism D of - 0.05 and indicates, as such, a sexually monomorphic species. The intercepts show a small difference. There are monomorphic Diopsidae taxa, like *Megalabops*, where the allometric lines fully coincide, but in others a difference in intercept occurs. This depends on differences in the shape of the abdomen, like rate of deflexion in males.

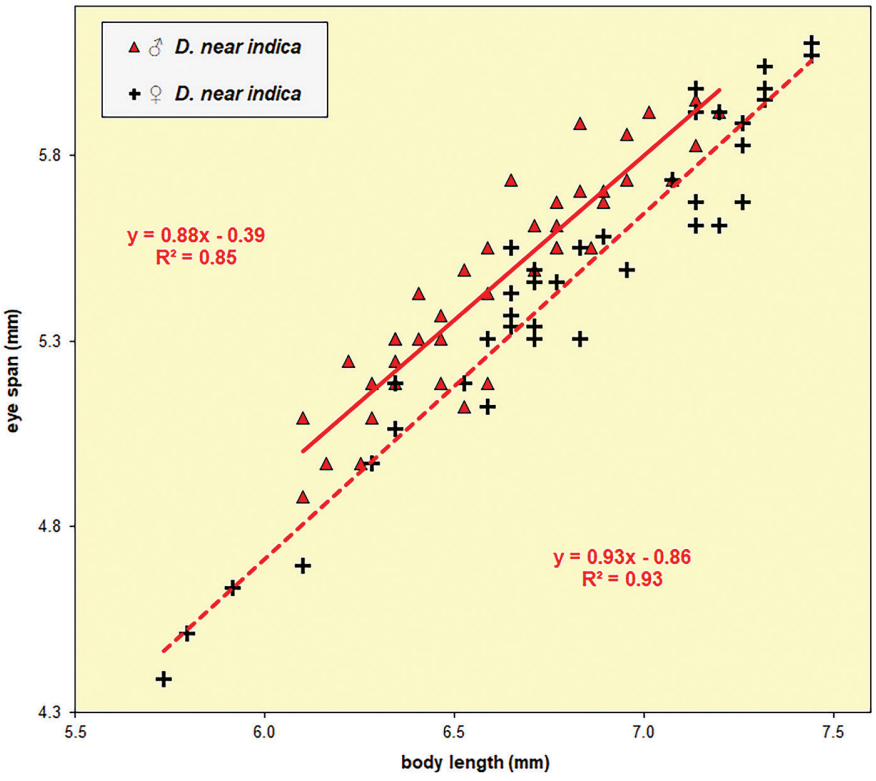


Figure 73. *Diopsis* nr *indica* from Sri Lanka, eye span plotted against body length. The graph is based on measurements for 40 ♀ and 40 ♂ and demonstrates an unequivocally homomorphic species.

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References

Baker RH, Wilkinson GS (2001) Phylogenetic analysis of sexual dimorphism and eye-span allometry in stalk-eyed flies (Diopsidae). Evolution 55: 1373–1385. https://doi.org/10.1111/j.0014-3820.2001.tb00659.x

Baker RH, Wilkinson GS, DeSalle R (2001) Phylogenetic utility of different types of molecular data used to infer evolutionary relationships among stalk-eyed flies (Diopsidae). Systematic Biology 50: 87–105. https://doi.org/10.1080/106351501750107512

Billberg GJ (1820) Enumeratio insectorum in Museo Gust. Joh. Billberg. Gadelianis, Stockholm, 138 pp. https://doi.org/10.5962/bhl.title.49763

Brunetti E (1907) Notes on Oriental Diptera. I. Note on *Sphyracephala hearseyana* Westwood, with a list of the Oriental species of Diopsinae. Records of the Indian Museum 1: 163–166. http://faunaofindia.nic.in/php/records/toc.php?vol=001&part=02

Curran CH (1936) A new *Diopsis* from India, with notes on others (Diptera). American Museum Novitates 833: 1–2. http://hdl.handle.net/2246/2148

Descamps M (1957) Recherches morphologiques et biologiques sur les Diopsidae du Nord-Cameroun. Ministère de la France d'Outre-Mer, Direction de l'Agriculture, de l'Élevage et des Forêts, Section Technique d'Agriculture Tropicale, Bulletin Scientifique 7: 1–154. https://gallica.bnf.fr/ark:/12148/bpt6k9743074v/f8.image.texteImage

Feijen HR (1981) A review of *Diopsina* Curran, 1928 (Diptera: Diopsidae), with a note on *Cyrtodiopsis*. Annals of the Natal Museum 24: 465–482. https://journals.co.za/content/annals/24/2/AJA03040798_549

Feijen HR (1989) Diopsidae. Volume IX, Cyclorrhapha III (Schizophora other than Calyptratae), Part12. In: Griffiths GCD (Ed.) Flies of the Nearctic Region. Schweizerbart, Stuttgart, 1–122. https://doi.org/10.1002/mmnd.19910380108

Feijen HR (1998) *Teleopsis* Rondani (Diptera, Diopsidae): generic review and the *ferruginea* group from Sri Lanka. Tijdschrift voor Entomologie 141: 49–63. http://www.nev.nl/tve/pdf/te0141049.pdf https://doi.org/10.1163/22119434-99900005

Feijen HR (2011) The genus *Teleopsis* Rondani (Diptera, Diopsidae): discussion of its taxonomic position and revision of the species occurring in the Philippines. Zoologische Mededelingen Leiden 85: 79–140. http://www.repository.naturalis.nl/record/376602

Feijen HR, Feijen C (2009) *Diopsis* (Diopsidae, Diptera) with unusual wing spots: two new species from Malawi with a longer eye span in females than in males. Zoologische Mededelingen Leiden 83: 701–722. http://www.repository.naturalis.nl/document/141977

Feijen HR, Feijen C (2011) On the biogeographic range of the genus *Teleopsis* Rondani (Diptera: Diopsidae), with redescription of *Teleopsis sykesii* from India and description of a new species from Borneo. Zoologische Mededelingen Leiden 85: 141–159. http://www.repository.naturalis.nl/document/221355

Feijen HR, Feijen C (2014) Some morphometric aspects of the eye stalks of the Diopsidae (Diptera). In: Dorchin N, Kotrba M, Mengual X, Menzel F (Eds) 8th International Congress of Dipterology, Potsdam, Abstract Volume. AMPYX Verlag, Halle, 99. http://www.nadsdiptera.org/ICD/ICD8/ICD8_Abstract_volume.pdf

Feijen HR, Feijen C (2019) An annotated catalogue of the stalk-eyed flies (Diopsidae: Diptera) of India with description of new species in *Megalabops* Frey and *Teleopsis* Rondani. Israel Journal of Entomology 49(2): 35–72. https://zenodo.org/record/3349984

Feijen HR, Feijen FAA, Feijen C (2018a) Biogeographical and allometric aspects of the Diopsidae of Madagascar. In: Kirk-Spriggs AH, Muller BS (Eds) Abstracts volume. 9th International Congress of Dipterology, 25-30 November 2018, Windhoek, Namibia. John Meinert Printers, Windhoek, 77. http://www.nadsdiptera.org/ICD/ICD9/ICD9_Abstract_volume.pdf

Feijen HR, Feijen FAA, Feijen C (2018b) *Madagopsina* gen. n. and *Gracilopsina* gen. n. (Diptera: Diopsidae) from Madagascar with description of four new species. Tijdschrift voor Entomologie 160(3): 141–215. https://doi.org/10.1163/22119434-00002069

Földvári M, Mikó I, Ulmer JM, dos Santos Rolo T, Csősz S, Pomiankowski A, Baumbach T, van de Kamp T (2019) Jumping and Grasping: Universal Locking Mechanisms in Insect Legs. Insect Systematics and Diversity 3(6): 3; 1–16. https://doi.org/10.1093/isd/ixz018

Frey R (1928) Philippinische Dipteren. V. Fam. Diopsidae. Notulae Entomologicae, Helsingfors 8: 69–77. https://archive.org/details/notulae-entomologicae-300014_08_1928_a

Kotrba M, Huber J, Feijen HR (2013) Driven by choice not conflict – coevolution of male and female genitalia in stalk-eyed flies (Diptera, Diopsidae). Organisms, Diversity and Evolution 14: 187-201. https://doi.org/10.1007/s13127-013-0162-2

Linnaeus C [and Dahl A] (1775) Dissertatio Entomologica, Bigas Insectorum Sistens, Quam Divinis Auspiciis, etc. Thesis, Upsala University. Typis Edmannianis, Upsaliæ, iv + 7 pp. https://www.biodiversitylibrary.org/item/87709 https://doi.org/10.5962/bhl.title.12431

Liu L-Q, Wu H, Yang D (2009) A review of *Cyrtodiopsis* Frey (Diptera, Diopsidae) from China. Zootaxa 2010: 57–68. https://doi.org/10.11646/zootaxa.2010.1.5

Meier R, Baker RH (2002) A cladistic analysis of Diopsidae (Diptera) based on morphological and DNA sequence data. Insect Systematics and Evolution 33: 325–336. https://doi.org/10.1163/187631202X00181

Röder V von (1893) Enumeratio Dipterorum, quae H. Fruhstorfer in parte meridionali insulae Ceylon legit. Entomologische Nachrichten, Berlin 19(15): 234–236. https://www.biodiversitylibrary.org/item/81937

Rondani C (1875) Muscaria exotica Musei Civici Januensis observata et distincta. Fragmentum III. Species in Insula Bonae fortunae (Borneo), Provincia Sarawak, annis 1865–68, lectae a March. J. Doria et Doct. O. Beccari. Annali del Museo Civico di Storia Naturale Giacoma Doria, Genova 7: 421–464. https://www.biodiversitylibrary.org/part/46051

Senior-White RA (1922) Notes on Indian Diptera. 1. Diptera from the Khasia Hills. 2. Tabanidae in the collection of the forest zoologist. 3. New species of Diptera from the Indian Region. Memoirs of the Department of Agriculture in India, Entomological Series 7(9): 83–169. [pls 11–15] https://archive.org/details/n09memoirsentomo07impeuoft

Shillito JF (1940) Studies on Diopsidae (Diptera). Novitates Zoologicae 42: 147–163. https://www.biodiversitylibrary.org/page/3331880

Shillito JF (1971) The genera of Diopsidae (Insecta: Diptera). Zoological Journal of the Linnean Society 50: 287–295. https://doi.org/10.1111/j.1096-3642.1971.tb00763.x

Steyskal G (1972) A catalogue of species and key to the genera of the family Diopsidae (Diptera: Acalyptratae). Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie) 234: 1–20. https://www.biodiversitylibrary.org/part/94956

Steyskal G (1977) Family Diopsidae. In: Delfinado M, Hardy DE (Eds) A catalog of the Diptera of the Oriental Region. 3. University of Hawaii Press, Honolulu, 32–36. https://doi.org/10.1002/mmnd.19780250411

Wulp FM van der (1896) Catalogue of the described Diptera of South Asia. Dutch Entomological Society, The Hague, 1–220. https://doi.org/10.5962/bhl.title.8539