RESEARCH ARTICLE



Orientocardiochiles, a new genus of Cardiochilinae (Hymenoptera, Braconidae), with descriptions of two new species from Malaysia and Vietnam

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Abstract

For the first time in 21 years, a new genus of cardiochiline braconid wasp, *Orientocardiochiles* Kang & Long, **gen. nov.** (type species *Orientocardiochiles joeburrowi* Kang, **sp. nov.**), is discovered and described. This genus represents the ninth genus in the Oriental region. Two new species (*O. joeburrowi* Kang, **sp. nov.** and *O. nigrofasciatus* Long, **sp. nov.**) are described and illustrated, and a key to species of the genus, with detailed images, is added. Diagnostic characters of the new genus are analyzed and compared with several other cardiochiline genera to allow the genus to key out properly using an existing generic treatment. The scientific names validated by this paper and morphological data obtained from this project will be utilized and tested in the upcoming genus-level revision of the subfamily based on combined morphological and molecular data.

Keywords

Malaysia, morphology, parasitoid wasp, taxonomy, type species, Vietnam

Introduction

Cardiochilinae Ashmead, 1900 is a relatively small subfamily of Braconidae Nees, 1811, comprising 221 described species in 16 genera (Yu et al. 2016) and with five of these species recently described (Edmardash et al. 2018; Long et. al. 2019; Dabek et al. 2020). The distribution of the members of the subfamily is cosmopolitan, with the highest diversity in tropical and arid regions (Dangerfield et al. 1999). Members of eight genera are known from the Oriental region, including the introduced genus, *Toxoneuron* (Say, 1836) (Dangerfield et al. 1999). Four cardiochiline braconid genera are known from Malaysia: *Bohayella* Belokobylskij, 1987; *Cardiochiles* Nees, 1819; *Hartemita* Cameron, 1910; and *Psilommiscus* Enderlein, 1912 (Dangerfield et al. 1999). In Vietnam, four genera, *Bohayella, Cardiochiles, Hartemita*, and *Austrocardiochiles* Dangerfield, Austin & Whitfield, 1999, are reported (Dangerfield et al. 1999; Long and Belokobylskij 2003; Long and van Achterberg 2011a, b, 2014; Long et al. 2019). *Orientocardiochiles* Kang & Long, gen. nov. represents the 17th genus in the world, the ninth genus in the Oriental region, and the fifth genus in both Malaysia and Vietnam.

Females of the subfamily are known as solitary koinobiont endoparasitoids of lepidopteran larvae, laying only one egg in each host and allowing the host to continue its development while parasitized. Larvae of Pyralidae and Noctuidae, among other families, are typically hosts and include important crop pests such as the tobacco budworm, *Heliothis virescens* (Fabricius, 1777), and cotton bollworm, *Heliocoverpa armigera* (Hübner, 1808) (Huddleston and Walker 1988). Of the 13 cardiochiline species of Vietnam's fauna, one species, *Cardiochiles philippensis* Ashmead, 1905, is reported as an endoparasitoid reared from larvae of the rice leaf-folder, *Cnaphalocrocis medinalis* (Guenée, 1854) (Lepidoptera: Pyralidae) (Long and Belokobylskij 2003).

Materials and methods

The type specimens for the present work were provided by the Braconidae Collection of the Institute of Ecology and Biological Resources (IEBR: Ha Noi, Vietnam), the Hymenoptera Institute (HIC: 116 Franklin Ave., Redlands, California, USA), and Museums Victoria (MVMA: Melbourne, Victoria, Australia). Other materials were borrowed from HIC and Illinois Natural History Survey (INHS: Champaign, Illinois, USA). All HIC material will be deposited in the Canadian National Collection of Insects (CNC: Ottawa, Ontario, Canada), including the holotype of *Orientocardiochiles joeburrowi* Kang sp. nov. and the holotype of *Orientocardiochiles nigrofasciatus* Long, sp. nov. is housed in IEBR.

The morphological terminology mostly follows Dangerfield et al. (1999) and van Achterberg (1993). Morphological terminology can also be checked at the Hymenoptera Ontology website (http://portal.hymao.org/projects/32/public/ontology/). Terms for sculpture are based on Harris (1979), and wing vein terminology mostly follows the modified Comstock-Needham system (van Achterberg 1993). Definitions of the morphological measurements used in this study are mostly based on van Achterberg (1988). For the specimen of *O. joeburrowi* sp. nov., morphological analysis was conducted using a Leica MZ75 stereomicroscope. Color habitus images were captured using a Visionary Digital BK Plus imaging system (Dun, Inc.), equipped with a Canon EOS 5DS R DSLR camera. Images were stacked in Zerene Stacker v. 1.04 (Zerene Systems LLC.). All images were made by IK and edited in Adobe Photoshop CS 6 (Adobe Systems, Inc). Body parts of the specimen were also measured using Adobe Photoshop CS 6 (Adobe Systems, Inc).

For the specimen of *O. nigrofasciatus* sp. nov., morphological analysis was conducted using an Olympus SZ61 binocular microscope; measurement were carried out using an Olympus SZ40 binocular microscope; the photographs were produced by KDL with a Sony 5000 digital camera attached to a Nikon SMZ 800N binocular microscope at IEBR and processed with Adobe Photoshop CS5 to adjust the size and background.

Abbreviations used in this paper are as follows: POL: distance between posterior ocelli; OOL: distance between posterior ocelli and eye; OD: diameter of posterior ocellus; T1: first metasomal tergum; T2: second metasomal tergum; T3: third metasomal tergum; MT: Malaise trap; "Card. + number": code number indexing for specimens of the Cardiochilinae in the collection at IEBR; NP: National Park, S: South.

The key to species of *Orientocardiochiles* gen. nov. and descriptions of the two species are based on females. Distribution maps were produced using QGIS 3.10.0 (QGIS Development Team 2019). Google satellite maps were downloaded via the QuickMapServices plugin.

Results

Taxonomy

Orientocardiochiles Kang & Long, gen. nov.

http://zoobank.org/B3CD416F-0231-46D0-92F9-9EDD6A6B7204

Type species. Orientocardiochiles joeburrowi Kang, sp. nov.

Diagnosis (based on all the members of the genus). Body large and stout, finely sculptured, whitish to yellow pale in color with black spots and stripes. Head in dorsal view transverse. Antenna 41- or 43-segmented. Eyes sparsely pilose. Clypeus with distinct suture and two clypeal tubercles present apically. Malar suture present. Mandible bidentate and angularly bent ventrally. Mouthparts (the length of galea and glossa) short. Maxillary palpus 5- or 6-segmented. Labial palpi 4-segmented. Notauli deep, crenulate, meeting posteriorly in deep smooth area. Scutellar sulcus curved, with 5+ crenulae. Scutellum more or less elevated medially, without carina laterally and apically. Propodeal areola completely developed and kite-shaped or elongated pentagonal. Epicnemial carina absent. Mesopleuron mostly smooth; precoxal sulcus well-defined and crenulate, not reaching posterior margin. Metapleuron rugulose. Mesosternal sulcus finely crenulate. Hind tibia without apical projection; inner tibial spur distinctly longer than outside spur, subequal to half of hind basitarsus. Tarsal claws pectinate. Forewing with elongated pterostigma; vein r reaching at apical fourth of pterostigma; SR1 sharply angled at basal fourth; basal fourth of vein SR1 almost perpendicular to apical vein 3-SR. Vein 1a present as a spectral short trace; 1st discal cell in forewing rather short compared to first submarginal cell. Second submarginal cell elongated. First subdiscal (brachial) cell broad. M+CU in hind wing distinctly shorter than 1-M. Hind wing with 6 hamuli. T1 widened apically, with lateral suture clearly defined throughout. T2 mostly rugose except for plateau-like projection (Figs 2D, 5G); plateau-like projection of T2 present at anteromedial base. T3 entirely smooth. Hypopygium sharply pointed at apex, median longitudinal area evenly sclerotized or largely desclerotized medially throughout; median enfold of hypopygium present or absent. Ovipositor sheath longer than metasoma, pointed at apex, and with short setae throughout.

Distribution. Oriental (Malaysia, Vietnam).

Biology. Unknown.

Etymology. The name for the genus refers to *Cardiochiles* from the Oriental region. From "orientum" (Latin for the eastern region) and the generic name "*Cardiochiles* Nees, 1819." Gender: masculine.

Notes. Orientocardiochiles gen. nov. will run to couplet 9 in the key to world genera by Dangerfield et al. (1999), but it can be distinguished from *Austerocardiochiles* in the couplet 9b of the key as follows:

Key to species of the genus Orientocardiochiles Kang & Long, gen. nov.



Figure 1. *Austerocardiochiles pollinator*, paratype. **A** Lateral habitus **B** dorsal habitus **C** ventral metasoma; arrow: median enfold on hypopygium **D** dorsal propodeum and metasomal terga 1 to 3; arrow: lens-shaped area **E** dorsal mesonotum **F** anterior head **G** claws.

Species descriptions

Orientocardiochiles joeburrowi Kang, sp. nov. http://zoobank.org/C653D411-AED6-45FA-8BE7-254DBDA02BD9 Fig. 2A–G

Material examined. *Holotype* MALAYSIA • \bigcirc ; female, Perlis, Wang Kelian; 6°40'40.94"N, 100°11'23.94"E; xi.2008; Sharkey & Norliyana.

Description. Body large and stout, 9.1mm. Antenna 6.4 mm. Length of forewing 9.6 mm. Ovipositor sheath 4.4 mm. *Head.* Antenna 41-segmented; length of scape 1.3 × longer than its width (30:23); third segment (basal flagellomere) 2.2 × longer than second segment (pedicel) (29:13); apical segment 1.9 × longer than subapical segment (15:8). Clypeal suture distinct (Fig. 2F); with two well-developed tubercles; width of clypeus 1.9 × its height (72:44); face width 0.9 × length of face and clypeus combined (11:12); distance between tentorial pits 1.9 × distance between a pit and eye margin (60:32). Mandible bidentate; basal width of mandible 0.7 × longer than the distance from mandible to eye margin (22:31). Maxillary palpus 5-segmented. Labial palpus 4-segmented. Galea short with dense setae (Fig. 2F). Glossa short (Fig. 2F). Head transverse, median length 0.35 × longer than the maximum width of head in dorsal view (75:217). Eye length 2.0 × length of temple as viewed dorsally (72:36). Ocellar triangle marginated with shallow suture; POL:OD:OOL= 10:18:42.



Figure 2. *Orientocardiochiles joeburrowi* sp. nov., holotype. **A** Lateral habitus **B** dorsal habitus **C** ventral metasoma; arrow: hypopygium **D** dorsal propodeum and metasomal terga 1–3; arrow: plateau-like projection **E** dorsal mesonotum **F** anterior head **G** claws.

Mesosoma. Length of mesosoma $1.4 \times$ its height (37:26). Notauli present (Figs 2B, E). Mesoscutum with shallow submarginal furrows (Fig. 2E). Scutellar sulcus curved with 5 crenulae, 0.33 × longer than median length of scutellum (19:57) (Fig. 2E). Postscutellar depression absent. Propodeum rugulose; propodeal areola kite-shaped, length of median areola 1.8 × longer than its maximum width (60:34); median transverse carina on the propodeum reaching lateral margin (Fig. 2D). Pronotum mostly smooth and carinate posteriorly. Mesopleuron mostly smooth; precoxal sulcus well-defined and crenulate, not reaching posterior margin. Metapleuron rugulose. Mesosternal sulcus with few barely perceptible crenulae. *Legs.* Fore tibial spur $0.57 \times$ basitarsus (44:77). Length of hind femur, tibia and basitarsus 3.8× (210:55), 7.1× (320:45) and 6.0 × (18:3) longer than maximum width of each. Basal spur of mid tibia 0.58× longer than length of mid-basitarsus (67:115). Basal spur of hind tibia 1.8 × longer than length of apical spur (88:49), and $0.49 \times \text{longer than length of hind basitarsus (88:178)}$. Hind basitarsus $0.56 \times \text{longer}$ than length of hind tibia (18:32), and $0.96 \times \text{longer}$ than length of remaining hind tarsi 2-5 (178:185). Hind tarsal claws pectinate with 10 teeth (Fig. 2G). Wings. Length of forewing 3.2 × longer than its maximum width (96:32). Length of pterostigma 4.4 × longer than its width (191:44). Forewing r:3-SR:2-SR= 33:165:99; 1-M 2.4 × longer than m-cu (88:36); 2-SR+M 1.63 × longer than m-cu (59:36); 1-CU1 0.23 × longer than 2-CU1 (22:96) and 0.37 × longer than cu-a (22:59). Length of hind wing 5.2 × longer than its maximum width (78:15); second submarginal cell trapezoid, maximum length of the cell 3.15× longer than its maximum height (262:83) (Fig. 2A). Hind wing M+CU distinctly shorter than 1-M, and 0.63 × longer than 1-M (75:119); 1-M 3.6 × longer than length of 1r-m (119:33);

2-SC+R horizontal to the longitudinal axis of hind wing; 2-1A absent. *Metasoma*. T1 punctate medially, about $1.1 \times$ longer than its apical width (133:125). (Fig. 2D). T2 dorsally rectangular; median length of T2 $0.34 \times$ longer than its apical width (50:146), and $0.74 \times$ as long as median length of T3 (50:67) (Figs 2B, D). T3 entirely smooth (Fig. 2D). Hypopygium acute apically, fully sclerotized without median suture (Fig. 2A, C). Ovipositor length about $1.23 \times$ longer than length of metasoma (57:46). Ovipositor sheaths densely setose throughout; setose part of ovipositor sheath 0.95 \times longer than length of metasoma (44:46), $1.38 \times$ longer than length of hind tibia (44:32), and $0.46 \times$ longer than length of forewing (44:96).

Color. Body mostly whitish pale and appearing striped; the following areas melanic: antenna, vertex, median mesonotal lobe (mostly melanic except for posterior area), lateral mesonotal lobe (pale basally), scutellum, anterior propodeum, fore trochantellus, basal fore femur, mid trochanter (mostly) and trochanterllus, hind coxa with a large melanic spot posterolaterally, entire hind trochanter and trochantellus, hind femur (except for anteromedial area), mid and hind tarsi, median tergum 1, entire tergum 2, anterior terga 3–6, posterior tergum 7, ovipositor and external ovipositor sheaths. Wings entirely lightly infuscate, stigma dark brown but centrally pale.

Male. Unknown.

Etymology. Named in honor of Joseph Lee Burrow, the world-class college football quarterback for the LSU Tigers and the 2019 Heisman Trophy winner.

Host(s). Unknown.



Figure 3. Distribution map of the members of Orientocardiochiles gen. nov. in Malaysia and Vietnam.



Figure 4. A Distribution map of *Orientocardiochiles joeburrowi* sp. nov. in Wang Kelian **B** distribution map of *O. joeburrowi* sp. nov. in Malaysia.

Distribution. Orientocardiochiles joeburrowi sp. nov., is known from only one female specimen collected from Wang Kelian, Malaysia, which is near the Thailand–Malaysia border (Fig. 4A, B).

Notes. Orientocardiochiles joeburrowi sp. nov., can be distinguished from O. nigrofasciatus sp. nov. due to the following diagnostic characters of the genus: i) forewing entirely lightly infuscate; ii) propodeum without short longitudinal carina anteriorly; iii) propodeal areola quadrate (kite-shaped); iv) hind tarsal claw pectinate with 10 teeth; v) hypopygium entirely sclerotized and without median enfold; vi) scapus entirely brown.

Orientocardiochiles nigrofasciatus Long, sp. nov.

http://zoobank.org/7F9CC61E-28E0-45A2-B6C4-40FA9F4231A9 Fig. 5A–O

Material examined. *Holotype*, VIETNAM ● ♀; female, "**Card.101**" (IEBR), S. Vietnam: Lam Dong, Cat Tien NP, forest; 11°18'N, 107°26'E, 100 m; 8.iv.2007; MP Quy.

Description. Body length 9.7 mm. Length of forewing 9.0 mm. Antenna 7.0 mm, ovipositor sheath 4.7 mm. *Head.* Antenna with 43 segments; length of scape $1.4 \times \text{longer}$ than its width (18:13); third segment $1.5 \times \text{longer}$ than second segment (15:10); apical segment $2.25 \times \text{longer}$ than subapical segment (4:10). Clypeal suture distinct; ventral margin of clypeus evenly convex with indistinct tubercles (Fig. 5C);



Figure 5. Orientocardiochiles nigrofasciatus sp. nov. A Lateral habitus (holotype, female) B head (dorsal view) C head (anterior view) D head (lateral view) E dorsal mesonotum F lateral mesonotum G metasoma (dorsal view) H forewing I hind wing J propodeum K hamuli on hind wing L hind tarsal claw M ventro-lateral mesonotum N ventral metasoma O apex of ovipositor sheath (lateral view).

width of clypeus $1.8 \times$ longer than its height (35:19); face width $0.9 \times$ length of face and clypeus combined (28:32); distance between tentorial pits 1.9 × distance between pit and eve margin (15:8) (Fig. 5C). Mandible angularly bent ventrally (Fig. 5C); basal width of mandible $0.8 \times$ distance from mandible to eye margin (8:10). Frons depressed laterally, with tubercle anteriorly, almost smooth; in dorsal view. Head transverse; median length of head $0.45 \times$ its width (25:56) in dorsal view. Eye length $1.9 \times$ length of temple (17:9). Ocelli rather large; POL:OD:OOL=3:4:13 (Fig. 5B). Vertex sparsely punctate anteriorly, rugose-punctate posteriorly; in lateral view. Length of eve $1.3 \times$ temple (18:14); temple sparsely punctate (Fig. 5D). Mesosoma. Mesosoma robust; length of mesosoma 1.6 × height (55:35) (Fig. 5F). Pronotal side large, almost smooth. Notauli evenly deep, crenulate, meeting deep smooth area posteriorly (Fig. 5E). Lobes of mesoscutum shiny, sparsely punctate. Scutellum slightly convex medially, densely and finely punctate. Scutellar sulcus rather narrow, curved, with 5+ crenulae, median length of scutellar sulcus $0.3 \times \text{longer than median length of scutellum } (7:24)$ (Fig. 5E). Propodeal areola length 1.8 × longer than its width (27:15). Epicnemial carina absent (Fig. 5M). Precoxal sulcus wide, shallow, crenulate (Fig. 5F). Mesopleuron sparsely and finely punctate. Subalar space crenulate. Metapleuron smooth anteriorly, foveate anteriorly. Propodeum with short basal carina; propodeal areola complete, almost occupying whole length of propodeum, areola with two median transverse carinae (Fig. 5]); propodeum coarsely rugose laterobasally. Legs. Fore tibial spur 0.6 × longer than basitarsus (21:35). Length of hind femur, tibia and basitarsus 3.0, 7.0 and 8.0 \times longer than their maximum width, respectively. Hind coxa shiny, smooth. Hind femur sparsely punctate. Hind tibia without apical projection; inner hind tibial spur $1.6 \times$ longer than outer spur (16:10) and $0.5 \times$ longer than hind basitarsus (16:32). Hind basitarsus $0.5 \times \text{longer than hind tibia}$ (32:63), $0.9 \times \text{longer than hind tarsus } 2-5$ (32:37). Hind tarsal claw pectinate, with 4 teeth (Fig. 5L). Wings. Length of forewing 3.1 × longer than its maximum width (90:29). Pterostigma elongate; length of pterostigma 5.0 × longer than its width (45:9) (Fig. 5H). r:3-SR:2-SR=6:33:18. 1-M 2.4 × as long as m-cu (17:7). 2-SR+M 1.7 × as long as m-cu (22:13). 1-CU1 0.14 × 2-CU1 (4:29) and $0.22 \times \text{cu-a}$ (4:18). 1a present as a spectral short trace. Second submarginal cell long, maximum length 3.1 × longer than its maximum width (90:29) (Fig. 5H). Subdiscal cell broad. Length of hind wing $5.3 \times \text{longer than its maximum width (101:19)}$. M+CU of hind wing distinctly shorter 1-M, and 0.65 × longer than 1-M (15:23). 1-M $4.6 \times 1r$ -m (23:5). 2-SC+R horizontal to the longitudinal axis of hind wing (Fig. 5I). Hind wing with six hamuli (Fig. 5K). *Metasoma*. T1 widened apically, 0.96 × longer than it is wide (28:29) (Fig. 5G); coriaceous smooth basally, almost punctate-reticulate medially, rugose apically. T2 transverse, without emarginate basal area, largely rugose (Fig. 5G); median length of T2 $0.3 \times$ longer than its apical width (10:32), and $0.6 \times$ longer than median length of T3 (10:16). T3 sparsely and finely punctate. Remaining tergites almost smooth (Fig. 5G). Hypopygium sharply pointed at apex, median longitudinal area largely desclerotized and folded inwards throughout (Fig. 5N). Ovipositor sheath slender, pointed at apex and shortly setose (Fig. 5O); setose part of ovipositor sheath 1.4 × longer than length of metasoma (64:47), 2.0 × longer than length of hind tibia (64:32), and $0.7 \times \text{longer than length of forewing (64:90)}$.

Color. Pale yellow; antenna black, except scape yellow; stemmaticum and vertex posteriorly black (Fig. 5B); lobes of mesoscutum largely black medially; scutellum black, pale yellow laterally and apically (Fig. 5E); propodeum black medio-basally (Fig. 5J); propleuron posteriorly, mesopleuron medio-dorsally and mesosternum black (Fig. 5F); fore and middle legs pale yellow, except middle trochanters, trochantellus, and tarsus yellowish-brown; hind coxa dorso-basally and ventrally, trochanters, trochantellus, femur basally and apically, hind tibia at base and apically, hind tarsus brown; wing veins brown; wing membrane hyaline, apex of forewing blackish-brown (Fig. 5H); first metasomal tergite with large median black patch; second tergite black, except basal small round yellow area; third tergite pale yellow; fourth–sixth tergites with basal black stripes (Fig. 5G); seventh tergite black apically.

Male. Unknown.

Etymology. From "nigro" (Latin for "black"), and "fascia" (Latin for "band", "zone", "stripe"), because of black stripes basally on metasomal tergites 4–6.

Host(s). Unknown.

Distribution. Orientocardiochiles nigrofasciatus sp. nov., is known from only one female specimen collected from Cat Tien NP, S. Vietnam. (Fig. 6A, B).

Notes. Orientocardiochiles nigrofasciatus sp. nov., from Vietnam can be separated from Orientocardiochiles joeburrowi sp. nov., from Malaysia by the following characters: i) forewing apically strongly infuscate; ii) propodeum with short longitudinal carina anteriorly; iii) propodeal areola pentagonal; iv) hind tarsal claw pectinate with four teeth; v) hypopygium with median longitudinal fold; vi) scape mostly yellow, except for the dorso-apical region.



Figure 6. A Distribution map of *Orientocardiochiles nigrofasciatus* sp. nov. in Cat Tien NP **B** distribution map of *O. nigrofasciatus* sp. nov. in Vietnam.

Discussion

Character discussion

Members of *Orientocardiochiles* Kang & Long, gen. nov., *Austerocardiochiles* Dangerfield, Austin, & Whitfield, 1999, *Hansonia* Dangerfield, 1996, *Heteropteron* Brullé, 1846, and *Wesmaelella* Spinola, 1851 share the presence of lateral sutures on the first metasomal tergum that are clearly defined throughout the length of the tergum (Figs 1D, 2D, 5G). According to the most recent complete genus-level phylogeny of the subfamily based on morphological characters (Dangerfield et al. 1999), three monophyletic clades are separated based on the presence or absence and length of eye setae.

The basal clade of Dangerfield et al. (1999) is composed of members of *Heteropteron* and *Wesmaelella* that have glabrous eyes (Fig. 7B). The members of these genera do not possess clypeal tubercles, nor a median areola on propodeum (Fig. 7A, B). Also absent is the lens-shaped area, or plateau-like projection on the second metasomal tergum. Based on the characters mentioned, *Orientocardiochiles* gen. nov. cannot be placed in the basal clade.

Clade A of Dangerfield et al. (1999) contains *Hansonia* and other genera that have short and sparse eye setae as in *Orientocardiochiles* gen. nov. (Figs 2F, 5C, D). Members of *Austerocardiochiles* and other genera in clade B mostly have long and dense eye setae (Fig. 1F), unlike *Orientocardiochiles* gen. nov. Based on the eye setae character, *Orientocardiochiles* gen. nov. can be placed in clade A. However, *Orientocardiochiles* gen. nov. could be included in the clade B if the short eye setae character is an independently developed character, as has occurred in one of the basal genera of the clade B, *Asiacardiochiles* Telenga, 1955. Based on the hypopygial median fold of *O. nigrofasciatus* sp. nov. (Fig. 5N), placing *Orientocardiochiles* gen. nov. in clade B is more probable than clade A because members of two genera in clade B, *Austerocardiochiles* and *Cardiochiles*, possess the hypopygial median fold (Fig. 1C).

Distribution and diversity

As mentioned in the Introduction, members of Cardiochilinae are distributed worldwide. Regarding the genus-level diversity, the Australasian region has the highest diversity. Ten cardiochiline genera have been recorded from the Australasian region (Dangerfield et al. 1999; Yu et al. 2016). As a result of this work, we confirmed that Cardiochilinae exhibits the second highest genus-level diversity in the Oriental region. Nine genera, including the introduced genus *Toxoneuron* (Say, 1836), are recorded from the region. Five genera have been recorded from Malaysia and Vietnam in each country. More genera will be likely to be found in Malaysia and Vietnam after further collecting.

Future directions

In the past two decades, molecular data combined with morphological data has been widely utilized to improve resolution of the species-, genus-, tribe-, and subfamily-level



Figure 7. *Heteropteron* sp. A Dorsal propodeum B anterior head.

relationships of Braconidae. However, a genus-level phylogeny of Cardiochilinae based on molecular data is lacking. This shows the necessity of a novel phylogeny. Therefore, IK is in process of conducting a new genus-level revision of Cardiochilinae to elucidate the genus-level relationships of the subfamily using a novel phylogeny based on combined molecular and morphological data.

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RESEARCH ARTICLE



Two new species of Cerapanorpa (Mecoptera, Panorpidae) from the Qinling and Minshan mountains

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Abstract

Two new species of *Cerapanorpa* Gao, Ma & Hua, 2016 are described from the Qinling and Minshan mountains, respectively. *Cerapanorpa qinlingensis* **sp. nov.** can be readily distinguished from its congeners by the elongate hypovalves and the extremely developed basal process of gonostylus in male genitalia. *Cerapanorpa minshana* **sp. nov.** is characterized by its bifurcated parameres and a cluster of long black bristles on the inner apex of the gonocoxite. The number of species of *Cerapanorpa* is raised to 21. An updated key to species of *Cerapanorpa* is presented.

Keywords

biodiversity, China, Panorpidae, scorpionfly, taxonomy

Introduction

The single-horned scorpionfly *Cerapanorpa* Gao, Ma & Hua, 2016, an endemic genus of Panorpidae (Insecta, Mecoptera) in central China (Gao and Hua 2019), is mainly characterized by a finger-like anal horn on the posterior margin of tergum VI in males, and a medigynium bearing two pairs of basal plates on both sides of the main plate and an elongate rod-like axis with a pair of weakly divergent arms in females (Ma et al. 2012;

Gao et al. 2016; Gao and Hua 2019). Species of *Cerapanorpa* are widely distributed in the Qinling-Bashan Mountains and adjacent regions, with an altitude ranging from 1400 m to 2800 m (Gao and Hua 2019). The habitats are cool or humid during their flight period, generally including groundcover in broad-leaf forests, mixed forests, and alpine shrub meadows (Gao and Hua 2019).

The eggs are oval and bear polygonal net-like ridges on the chorion surface (Li et al. 2007; Ma et al. 2009). The saprophagous larvae are eruciform and epedaphic, bearing eight pairs of abdominal prolegs, and usually overwinter as grown larvae in soil cavities (Jiang and Hua 2015; Jiang et al. 2019). The larvae possess a pair of compound eyes consisting of ~30 ommatidia (Chen et al. 2012), which almost have the same cellular components as those of their adults although the tiering scheme is different (Chen and Hua 2016). During mating, the male usually secretes a salivary mass as a nuptial gift to attract the female prior to copulation, and uses its single anal horn to clamp the female's abdominal segment to maintain copulation (Tong et al. 2018).

Cerapanorpa currently consists of 19 species (Gao and Hua 2019), which not only display similar internal anatomy (Hou and Hua 2008; Ma et al. 2011), but also have a strongly supported monophyly by phylogenetic analyses (Ma et al. 2012; Hu et al. 2015; Miao et al. 2017, 2019). The alimentary canals are similar in gross morpholgy (Liu and Hua 2009). The male salivary glands uniformly possess six secretory tubes with similar configuration and size (Ma et al. 2011).

Recently, two undescribed species of *Cerapanorpa* were collected from the Qinling and Minshan mountains, a well-known biodiversity hotspot in the world (Myers et al. 2000; Tang et al. 2006; Hu et al. 2019), and are described as new species herein. The number of species of *Cerapanorpa* is raised to 21.

Material and methods

Specimens were collected from the Qinling and Minshan mountains in central China (Fig. 1), and deposited in the Entomological Museum, Northwest A&F University, China (**NWAU**). Specimens were dissected under a Nikon SMZ 1500 Stereoscopic Zoom microscope. Genitalia were macerated in cold 5% NaOH solution for 3 min and rinsed with distilled water. Wings were measured with a vernier calliper. Adult photographs were taken with a Nikon D7100 digital camera, other images were taken using a scientific digital micrography system, ZEISS SteREO Discovery.V20 equipped with an auto-montage imaging system AxioCam IC. The distribution map was constructed using ArcGIS v10.2 and Adobe Illustrator CC. All photographs were assembled with Adobe Photoshop CS6.

Terminology follows Gao et al. (2016), Hua et al. (2018) and Wang et al. (2019). The following abbreviations and acronyms are applied: A1, first abdominal segment (and so forth for other segments); T1, first tergum (and so forth for other segments).



Figure 1. Distribution map of Cerapanorpa qinlingensis sp. nov. and Cerapanorpa minshana sp. nov.

Taxonomy

Cerapanorpa qinlingensis sp. nov.

http://zoobank.org/F0A312C3-EB10-4588-B3AF-326B876FA9E0 Figs 2–4

Type material. *Holotype*: 3, CHINA: Shaanxi Province, Taibaishan Nature Reserve (33°53'N, 107°48'E), 2100 m, 15 August 2016, leg. Ji-Shen Wang. *Paratypes*: 235, same data as for holotype; 6310, Zhouzhi County, Qinlingliang (33°49'N, 107°45'E), 2050 m, 24 July 2019, leg. Kai Gao; 12318, Foping Nature Reserve (33°41'N, 107°52'E), 2200 m, 26 July 2019, leg. Kai Gao; 534, Ningshan County, Pingheliang (33°28'N, 108°29'E), 2200 m, 5 July 2019, leg. Xin Tong and Peng-Yang Wang; 33, Yangxian County, Changqing Nature Reserve (33°42'N, 107°32'E), 2400 m, 18 July 2019, leg. Yu-Chen Zheng.

Etymology. The specific epithet refers to the type locality, Qinling Mountains.

Diagnosis. The new species resembles *C. emarginata* (Cheng, 1949) in appearance, but can be readily distinguished from the latter by the following characters: 1) wing markings greatly reduced with a faint pterostigmal band (cf. with conspicuous pterostigmal band and apical band); 2) hypovalve longer, reaching the apex of the gonocoxite (cf. shorter, not reaching apex of gonocoxite); 3) paramere shorter, reaching



Figure 2. Adults of *Cerapanorpa qinlingensis* sp. nov. **A** male habitus, dorsal view **B** female habitus, dorsal view **C** male head, frontal view **D** male dorsum of head and thorax **E** Male abdomen, lateral view. Abbreviations: **ah** anal horn; **ms** mesonotum; **mt** metanotum; **no** notal organ; **pno** postnotal organ; **pr** pronotum. Scale bars: 5 mm (**A**, **B**); 0.5 mm (**C–E**).

the middle of the gonostylus (cf. longer, reaching apex of gonostylus); 4) gonostylus with an extremely developed basal process (cf. poorly developed).

Description of male (Fig. 2A). *Head* (Fig. 2C, D). Frons, vertex and occiput brownish black. Rostrum brownish frontally, sparsely covered with short black setae. Maxillary and labial palpi brownish and darkening towards apex. Antennae black and filiform with 38–42 flagellomeres.

Thorax (Fig. 2A, D). Pronotum blackish brown, with 8–12 short setae along its anterior margin. Meso- and metanotum black (Fig. 2D). Pleura light grayish yellow. Legs grayish yellow, with distal tarsomere blackish. Forewing length 13.6–14.4 mm, width 3.4–3.7 mm. Wing membrane hyaline and almost without marking, only with significantly degenerated brown pterostigmal band (Fig. 2A). Hindwing length 12.5–13.6 mm, width 3.2–3.5 mm. Hindwing similar to forewing in markings and patterns.

Abdomen (Figs 2E, 4A). T2–T5 blackish, pleura ivory. Notal organ of T3 very short, not prominent. Postnotal organ of T4 small, hook-shaped and projecting forward. A6 uniformly brownish black, with a brown finger-like anal horn on posterior margin of tergite. A7–A8 elongate and yellowish brown, slightly constricted at base, gradually wider toward apices. A7 with a narrow groove at base.



Figure 3. Genitalia of *Cerapanorpa qinlingensis* sp. nov. **A**, **B** genital bulb, ventral and dorsal views **C** gonostylus, dorsal view **D**, **F** aedeagus, ventral and lateral views **E** terminalia, ventral view **G** right paramere, ventral view **H**, **I** medigynium, ventral and dorsal views. Abbreviations: **ax** axis; **bp** basal process; **ce** cercus; **dbp** dorsal basal plate; **dp** dorsal process; **dv** dorsal valve; **ep** epandrium; **gcx** gonocoxite; **gs** gonostylus; **hv** hypovalve; **Ip** lateral process; **mp** main plate; **mt** median tooth; **pa** posterior arm; **pm** paramere; **sgp** subgenital plate; **vbp** ventral basal plate; **vv** ventral valve. Scale bars: 0.5 mm (**A**, **B**, **E**); 0.2 mm (**C**, **D**, **F–I**).

Male genitalia (Fig. 3A, B). Genital bulb yellowish and long oval. Epandrium long and broad, with a nearly trapezoidal emargination distally. Paired hypovalves slender, reaching apex of gonocoxite, bearing a column of long bristles along inner margin. Gonocoxite with a small concave area on apical inner margin, bearing two small protuberances on ventral submedian margin. Gonostylus medially curved, with an indistinct median tooth and an extremely developed basal process on inner margin, and bearing a bundle of short setae dorsally on basal process (Fig. 3C). Parameres extending well beyond base of gonostylus (Fig. 3A), curved distally and pointed apically, bearing a row of dense spines along inner margin (Fig. 3G). Aedeagus sclerotized; dorsal valves of aedeagus long, curved ventrally, with distal part pediform; ventral valves short, membranous; lateral process not prominent (Fig. 3D, F).

Description of female. Similar to the male in wing markings (Figs 2B, 4B). Forewing length 14.3–15.4 mm, width 3.5–3.9 mm; hindwing length 13.8–15.0 mm, width 3.3–3.7 mm, similar to forewings (Fig. 2B).

Female genitalia (Fig. 3E, H, I). Subgenital plate ligulate, not emarginate terminally, bearing long setae on distal portion (Fig. 3E). Medigynium sclerotized, main plate twice as long as wide, intensely constricted medially. Paired posterior arms nar-



Figure 4. Adult habitus and habitat of *Cerapanorpa qinlingensis* sp. nov. **A** male, lateral view **B** female, lateral view **C** habitat in the southern slope of Mount Taibai.

rowing apically, forming a broad U-shaped emargination (Fig. 3H, I). Ventral basal plates translucent, covering two-thirds of the main plate (Fig. 3H). Paired dorsal basal plates reniform and membranous (Fig. 3I). Anterior end of axis bifurcated, extending beyond main plate for half its length (Fig. 3H, I).

Distribution. China (Qingling, Shaanxi Province).

Habitat. In the type locality, Taibaishan Nature Reserve, all specimens were captured on the southern slope of the Taibai Mountain, with an elevation of 2100 m. The species mainly inhabits dense herbaceous and shrubby vegetation under evergreen broad-leaved forests (Fig. 4C).

Cerapanorpa minshana sp. nov.

http://zoobank.org/1E873364-6414-4F8E-8575-053C709D1DD7 Figs 5–7

Type material. *Holotype:* 3° , CHINA: Sichuan Province, Jiuzhaigou County, Anle Town (33°22'N, 104°14'E), 2400 m, 16 June 2019, leg. Kai Gao and Zhi-Chao Jia. *Paratypes:* 27334° , same data as for holotype; 131° , Jiuzhaigou County, Majia Town (33°08'N, 104°05'E), 2100 m, 28 May 2019, leg. Kai Gao and Zhi-Chao Jia;



Figure 5. Adults of *Cerapanorpa minshana* sp. nov. **A** male habitus, dorsal view **B** female habitus, dorsal view **C** male head, frontal view **D** male dorsum of head and thorax **E** male abdomen, lateral view. Abbreviations: **ah** anal horn; **ms** mesonotum; **mt** metanotum; **no** notal organ; **pno** postnotal organ; **pr** pronotum. Scale bars: 5 mm (**A**, **B**); 0.5 mm (**C–E**).

1♀, Jiuzhaigou County, Zhangzha Town (33°16'N, 103°54'E), 2160 m, 19 July 2019, leg. Ning Li and Lu Liu; 18♂22♀, Gansu Province, Wenxian County, Gaoloushan (33°04'N, 104°42'E), 2200 m, 17 June 2019, leg. Kai Gao and Zhi-Chao Jia.

Etymology. The specific epithet refers to the type locality, Minshan Mountains.

Diagnosis. The new species can be readily distinguished from its congeners by the following combination of features: 1) paramere short and bifurcated, bearing a column of long golden spines along the dorsal side; 2) gonocoxite bearing a cluster of black long bristles on the inner apex; 3) dorsal valves of the aedeagus curved ventrally, with the distal part heel-shaped; 4) main plate of medigynium flat, intensely narrowed at the base and broadened distally.

Description of male (Fig. 5A). *Head.* Frons, vertex and occiput entirely black (Fig. 5C, D). Compound eyes dark gray. Rostrum brownish black anteriorly, mandibles, labial and maxillary palps dark-brown (Fig. 5C). Antennae filiform and black, with 38–43 flagellomeres.

Thorax (Fig. 5D). Pronotum black, with 10–14 black setae along anterior margin. Meso- and metanotum entirely black. Pleura and legs pale yellow with a pair of apical spurs; tarsi darkened toward apices. Forewing length 12.0–12.5 mm, width 3.1– 3.3 mm. Wing membrane hyaline, pterostigma and apical band poorly developed, only



Figure 6. Genitalia of *Cerapanorpa minshana* sp. nov. **A**, **B** genital bulb, ventral and dorsal views **C** aedeagal complex, ventral view **D** terminalia, ventral view **E** left paramere, lateral view **F** Aedeagus, lateral view **G**, **H** medigynium, ventral and dorsal views. Abbreviations: **ae** aedeagus; **ax** axis; **ce** cercus; **dbp** dorsal basal plate; **dp** dorsal process; **dv** dorsal valve; **ep** epandrium; **gcx** gonocoxite; **gs** gonostylus; **hv** hypovalve; **lp** lateral process; **mp** main plate; **pa** posterior arm; **pm** paramere; **sgp** subgenital plate; **vbp** ventral basal plate; **vv** ventral valve. Scale bars: 0.5 mm (**A**, **B**); 0.2 mm (**C–H**).

with dark gray trace at apical region (Figs 5A, 7A). Hindwing length 11.8–12.2 mm, width 2.8–3.2 mm, similar to forewings (Fig. 5A).

Abdomen (Fig. 5A, E). T1–T5 brownish black, pleura pale. Notal organ of T3 semicircular, not prominent. Postnotal organ of T4 small, barb-shaped and projecting forward. T6 brownish black, bearing a yellow finger-like anal horn posteriorly (Fig. 5E). A7 and A8 elongate and uniformly yellowish brown, with basal half slightly constricted and slightly thickened apically.

Male genitalia (Fig. 6A, B). Genital bulb globular and yellowish brown. Epandrium broad basally, narrowing gradually toward apex, with a deep U-shaped emargination between two stout setose lobes (Fig. 6B). Paired hypovalves parallel, only reaching three-quarters of gonocoxite, bearing long bristles along inner margins. Gonocoxite bearing a cluster of black bristles on inner apex (Fig. 6A). Gonostylus shorter than gonocoxite, medially curved, bearing an indistinct middle tooth and a large basal process. Parameres bifurcated and short, not extending beyond the apex of gonocoxite, bearing a column of long golden spines along dorsal side (Fig. 6C, E). Dorsal valves of



Figure 7. Adult habitus and habitat of *Cerapanorpa minshana* sp. nov. **A** male, dorsal view **B** female, dorso-lateral view **C** habitat of the type locality, Anle Town, Jiuzhaigou County, Sichuan Province, China.

aedeagus curved ventrally, with distal part heel-shaped (Fig. 6F); ventral valves membranous, weakly developed; lateral process long and curved ventrally.

Description of female. Similar to males in coloration and patterns (Figs 5B, 7B). Forewing length 12.7–13.4 mm, width 3.3–3.7 mm; Hindwing length 12.1–12.5 mm, width 3.1–3.5 mm, similar to forewing (Fig. 5B).

Female genitalia. Subgenital plate long elliptical, ending with a V-shaped incision, bearing long setae on distal portion (Fig. 6D). Medigynium small and weakly sclerotized; main plate flat, intensely narrowed basally, broadened distally (Fig. 6H). Paired posterior arms tapering apically, forming a nearly quadrate emargination. Ventral basal plates membranous and translucent, covering approximately three-quarters of main plate (Fig. 6G). Paired dorsal basal plates oblong, weakly sclerotized (Fig. 6H). Axis elongated and bifurcated anteriorly, extending beyond main plate by nearly half its length (Fig. 6G, H).

Distribution. China (Minshan, Sichuan and Gansu provinces).

Habitat. In the type locality, all specimens were captured on herbaceous groundcover in the Panjiagou Valley (Fig. 7C), with an elevation of 2400 m. Suitable microhabitats in the valley are moist and cool during the imaginal flight period, with the temperature ranging approximately from 14 to 20°C during the day.

Key to species of Cerapanorpa $(male)^*$

1	T5 with an anal horn on posterior margin
_	T5 without anal horns on posterior margin
2	Finger-like anal horn on T6 shorter and stout, at most 0.2 times as long as T6 <i>C. brevicornis</i> (Hua & Li, 2007)
_	Finger-like anal horn on T6 longer, at least 0.3 times as long as T6
3	Paramere with thin stalk, then abruptly swollen into broad plate from middle
	portion4
-	Paramere slightly broader than stalk, with apical portion lanceolate or slightly curved
4	Paramere bifurcated, with subapical branch
_	Paramere unbifurcated, without subapical branch
5	Paramere shorter, only reaching the base of dorsal valves, quadrate plate above the stalk, with an L-shaped subapical branch
_	Paramere longer, reaching apex of dorsal valves, and bearing a column of long
	golden spines along dorsal side C. minshana sp. nov.
6	Paramere exceeding apex of gonocoxite, curved medially at apex; dorsal valve not
	tapering toward apex C. baimaensis Gao & Hua, 2019
_	Paramere not exceeding apex of gonocoxite, lanceolate at apex; dorsal valve taper-
	ing toward apex C. centralis (Tjeder, 1936)
7	Paramere linear, slightly thicker than stalk, bearing a column of extremely short
	spines
_	Paramere flat and broad above stalk, prominently broader than its stalk10
8	Wings with remarkable complete dark-brown markings; middle and hind legs
	with coxae and trochanters brownish black; paramere curved almost at a right
	angle basally C. reni (Chou & Wang, 1981)
-	Wing membrane hyaline, only with faint apical band or without markings; legs
0	with coxae and trochanters yellowish; paramere slightly curved apically
9	Paramere yellowish brown, blunt apically, reaching middle of gonostylus and
	bearing spines along inner margin C. aubia (Chou & Wang, 1981)
_	Paramere dark-brown, reaching apex of gonocoxite and bearing a thorn at apex
10	and spines on dorsal side C. <i>impansnana</i> Gao, Ma & Hua, 2016
10	Paramere sinuate or geniculate
- 11	Paramere strongly curved and sinuate in distal half bearing long comb like aning
11	along inner margin
_	Paramere slightly sinuate or geniculate at distal half 13
	I aramere sugnity sinuate of generate at distal fian

^{*} Modified from Gao and Hua 2019; male of *C. bonis* is unknown.

12	Paramere nearly bow-shaped; dorsal valves of aedeagus with truncate apex and
	membranous apical process C. sinuata Gao, Ma & Hua, 2016
-	Paramere hook-shaped; dorsal valves of aedeagus tapering toward apex and with
	large L-shaped apical process C. taizishana Gao & Hua, 2019
13	Paramere columnar and somewhat sinuate dorsally at apical portion; hypovalves
	of hypandrium slender and dramatically elongate, exceeding apex of gonocoxite
	<i>C. yanggashana</i> Gao & Hua, 2019
_	Paramere geniculate at apical portion; hypovalves of hypandrium exceeding mid-
	dle of gonocoxite14
14	Rostrum blackish brown to black; paramere with short ventral spines at apex
-	Rostrum yellowish to reddish brown; paramere with comb-like spines along me-
	dial margin15
15	Hypovalves slender, with sparse stout bristles along inner margins; dorsal valves
	of aedeagus brawny, slightly expanded apically
	<i>C. xuebaodinga</i> Gao & Hua, 2019
_	Hypovalves broad, with dense long bristles along inner margins; dorsal valves of
	aedeagus elongated and slender apically C. obtusa (Cheng, 1949)
16	Paramere extending to middle of gonostylus17
_	Paramere extending nearly to apex of gonostylus or beyond18
17	Wings only with faint pterostigma and apical bands; paramere with spines from
	its middle length C. funiushana (Hua & Chou, 1997)
_	Wings with prominent pterostigmal and apical bands; paramere with a row of
	short spines on inner margin above basal stalk
18	Wings without markings; paramere extremely elongated, exceeding apex of gono-
	stylus
_	Wings with markings; paramere not exceeding apex of gonostylus
19	Wings only with a faint pterostigmal band; hypovalve elongate, reaching apex of
	gonocoxite; gonostylus with extremely developed basal process
	C. ginlingensis sp. nov.
_	Wings with prominent pterostigmal band and apical band; hypovalve shorter, not
	reaching apex of gonocoxite; gonostylus with weakly-developed basal process
	<i>C. emarginata</i> (Cheng, 1949)
	o (8) -> ->)

Discussion

Cerapanorpa qinlingensis sp. nov. is endemic to the western Qinling Mountains, and closely related to *C. emarginata* (Cheng, 1949), which is patchily distributed in the eastern Qinling Mountains. The parapatric distribution pattern of these two species probably provides an ideal model to examine the mechanisms of species differentia-

tion or speciation (an east-west genetic break) in the Qinling Mountains, as previously uncovered by phylogeographic studies (Wang et al. 2012, 2013; Liu et al. 2014; Huang et al. 2017).

The discovery of *C. minshana* sp. nov. increases the diversity of the genus *Cerapanorpa* to five species in the Minshan Mountains, including *C. bonis* (Cheng, 1949), *C. baimaensis* Gao & Hua, 2019, *C. xuebaodinga* Gao & Hua, 2019, *C. yanggashana* Gao & Hua, 2019, and *C. minshana* sp. nov. *Cerapanorpa minshana* sp. nov. differs greatly from the aforementioned four species by its bifurcated paramere, the shape of dorsal aedeagal valves and a cluster of black bristles on inner apex of gonocoxite. Only two species, *C. minshana* sp. nov. and *C. centralis* (Tjeder, 1936), possess a cluster of long black bristles on inner apex of gonocoxite in *Cerapanorpa*. However, *C. minshana* sp. nov. can be readily distinguished from *C. centralis* by its specific bifurcated paramere and the shape of dorsal aedeagal valves in males.

Cerapanorpa qinlingensis sp. nov. and *C. minshana* sp. nov. are only found in the high-altitude microhabitats of the Qinling and Minshan mountains, respectively (Figs 4C, 7C). These fragmented habitat islands are cool and humid, generally with an altitude above 2000 m (Fig. 1). Most species of *Cerapanorpa* prefer these cool habitats, and usually inhabit the 'sky islands' of mountain tops in these mountainous regions (Gao and Hua 2019). Compared with other genera (such as *Panorpa* Linnaeus, 1758 and *Neopanorpa* van der Weele, 1909), which have a broad spectrum of distribution in elevation (Wang and Hua 2017, 2019; Wang et al. 2019), *Cerapanorpa* is likely a cold-adapted genus in Panorpidae.

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RESEARCH ARTICLE



Two new species of *Limonia* Meigen, 1803 from Northwest China (Diptera, Limoniidae)

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Abstract

Two new species of *Limonia* Meigen, 1803, *Limonia medexocha* **sp. nov.** and *Limonia subcosta* **sp. nov.** are described and illustrated from Northwest China. The following five species are re-described and reported from China for the first time: *L. macrostigma* (Schummel, 1829), *L. phragmitidis* (Schrank, 1781), *L. stigma* (Meigen, 1818), *L. sylvicola* (Schummel, 1829) and *L. taurica* (Strobl, 1895). A key to adult males of *Limonia* from Northwest China is presented.

Keywords

key, Limoniinae, Ningxia, Shaanxi, taxonomy

Introduction

The genus *Limonia* Meigen, 1803 includes 181 known species worldwide, which are distributed in the Oriental (64 species), Holarctic (73 species), Afrotropical (13 species) and Australasian/Oceanian realms (36 species) (Oosterbroek 2019). Prior to this study 24 species were known from China. Adults of *Limonia* are moderately hydrophilic and mesophilous, often found in forest and open meadow biotopes (Savchenko 1985).

Northwest China includes the following six provinces: Xinjiang, Shaanxi, Ningxia, Gansu, Qinghai, and Inner Mongolia (western area). In this region the Altai Mountain

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(northern Xinjiang) and Qinling Mountain (southern Gansu and Shaanxi) are considered biodiversity hotspots in China (Liu and Chen 2014). However, no species of *Limonia* were known to occur in these mountains, and in this paper seven species, including two new species, are recorded. A key to adult males of *Limonia* from Northwest China is provided.

Material and methods

The specimens were collected in northwestern China from July to August 2016–2017 using sweep netting, light trapping, and Malaise trapping. The specimens were studied and illustrated with a ZEISS Stemi 2000-c stereomicroscope; the photo illustrations were taken under a Canon Mark IV with Canon MP-E 65 mm lens. The descriptions were based on specimens preserved in 95% alcohol. Genitalic preparations of males were made by macerating the apical abdomen in cold 10% NaOH for 12–15 hours. After examination, preparations were transferred to fresh glycerin for preservation and stored in a microvial pinned below the specimen. The morphological terminology mainly follows McAlpine (1981). Type specimens are deposited in the Entomological Museum of China Agricultural University (CAU), Beijing, China.

Taxonomy

Limonia Meigen, 1803

Limonia Meigen 1803: 262; Lackschewitz and Pagast 1940: 4–5; Geiger 1986: 106; Savchenko 1989: 328–330.

Type species. *Tipula tripunctata* Fabricius, 1781 (subsequent designation by Westwood 1840) [= *phragmitidis* (Schrank, 1781)].

Remarks. *Limonia* is characterized in the family by the following features: body color from yellow to gray, brown or black; medium-sized (body length 5.3–12.1 mm, wing length 5.4–13.2 mm); first thoracic segment elongate; episternum setose; tarsal claw with three to five teeth; wing wide with well-developed anal angle, pattern ranging from completely transparent or patternless to smoky or with dotted markings; Sc₁ apically reaching from base of Rs to branching point of Rs; Sc₂ close to apex of Sc₁; terminal section of R₁ continuing direction of R₁ and longer than R₂ (often at least two times longer than R₂); discal cell closed; basal deflection of CuA₁ at or slightly before branching point of M; male genitalia with wide ninth tergite slightly emarginate at posterior margin; gonocoxite with wide but often low ventromesal lobe; gonostylus single, situated apically, wider at base, narrowed and slightly arched at apex; aedeagus simple, elongate with bifid apex that is turned into the ventral margin; paramere wide at base; cercus of female terminalia slightly turned upwards (Savchenko 1985; Reusch and Oosterbroek 1997; Stary and Salmela 2004; Kolcsár et al. 2017; Podenas and Podeniene 2017; Starý 2018).

A key to adult males of Limonia from Northwest China

1	Wing with only one spot located at R ₂ (Figs 3, 12) 2
_	Wing with at least two spots located variously at basal Rs, apical Sc or R ₂
	(Figs 19, 28, 37, 47, 57)
2	Body brown; wing with a distinct brown stigma (Figs 1, 3); occiput black
	brown without markings (Fig. 2); prescutum with three longitudinal stripes
	(Fig. 2); gonostylus with slender apex; paramere with slender and pointed
	apex (Figs 4–7)
_	Body light yellow; wing with one indistinct pale brown stigma (Figs 10, 12);
	occiput yellow with Y-shaped marking (Fig. 11); prescutum with one longi-
	tudinal stripe (Fig. 11); gonostylus with obtuse apex (Figs 9, 10); paramere
	with short and obtuse apex (Figs 13–16)L. medexocha sp. nov.
3	Wing with smoky pattern (Figs 37, 47)
_	Wing without smoky pattern (Figs 19, 28, 57)5
4	Femora with two subapical rings (Fig. 37); prescutum with three longitudinal
	stripes (Fig. 36); wing dull brown without grayish spots at basal Rs, apical Sc,
	and R ₂ (Fig. 37); posterior margin of tergite 9 bearing a pair of finger-like
	protrusions (Fig. 39)
_	Femora with one subapical ring (Fig. 45); prescutum with one longitudinal
	stripe (Fig. 46); wings yellow with three grayish spots at basal Rs, apical Sc, and
	R ₂ (Fig. 47); posterior margin of tergite 9 without protrusions (Fig. 48)
	<i>L. sylvicola</i> (Schummel, 1829)
5	Body reddish brown (Fig. 55); wing brown with large spot at R, (Fig. 57);
	prescutum with five longitudinal stripes (Fig. 56); gonostylus not swollen at
	base (Figs 58, 59)
_	Body yellow (Figs 17, 26); wing pale brown with small spot at R ₂ (Figs 19,
	28); prescutum with one longitudinal stripe (Figs 18, 27); gonostylus swollen
	at base (Figs 20, 29)
6	Wing with one obvious spot at R ₂ (Fig. 28); occiput yellow (Fig. 27); para-
	mere with short apex (Fig. 32)
_	Wing with three obvious dark spots (at basal Rs, apical Sc, and R_2) (Fig. 19);
	occiput dark brown (Fig. 18); paramere with slender apex (Fig. 23)

1. Limonia macrostigma (Schummel, 1829)

Figures 1–9

Limnobia macrostigma Schummel 1829: 108.

Limonia alpicola Lackschewitz 1928: 231 (synonymy after Starý 2007).

Limonia (Limonia) venerabilis Alexander 1938: 134 (synonymy after Podenas and Podeniene 2017).

Limonia macrostigma Schummel: Savchenko 1985: 167; 1989: 333.



Figures 1–3. *Limonia macrostigma*, male **I** habitus, lateral view **2** head and thorax, dorsal view **3** right wing. Scale bars: 1.0 mm.

Limnobia macrostigma Schummel: Podenas and Podeniene 2017: 16 (redescription).

Diagnosis. Flagellar verticils 2 times length of corresponding segment. Prescutum with three dark-brown longitudinal stripes. Wing pale brown with distinct, large, brown stigma; apical Sc_1 slightly beyond base of Rs. Posterior margin of tergite 9 broadly emarginated. Paramere ending at 5/6 of aedeagus. Female, hypogynial valve 3.7 times longer than wide at base.

Redescription. Male (n = 10): body length 7–9 mm, wing length 8–9.5 mm.



Figures 4–7. *Limonia macrostigma*, male **4** hypopygium, dorsal view **5** hypopygium, ventral view **6** hypopygium, lateral view **7** Aedeagus and paramere. Scale bars: 0.1 mm.



Figures 8–9. *Limonia macrostigma*, female 8 cercus and hypogynial valves, lateral view 9 cercus and hypogynial valves, ventral view. Scale bars: 1.0 mm.

Head mostly dark brown (Figs 6, 7). Vertex dark brown. Occiput dull yellow. Head with black setulae. Antenna dark brown and 14-segmented; pedicel oval; flagel-lomeres pale brown, nearly cylindrical; flagellar verticils black, 2 times longer than corresponding segment. Rostrum and nasus brown to dark brown. Nasus 3/5 as long as rostrum. Labella pale yellow except inner margin brown, with black setulae. Palpi black brown with black setulae, terminal two segments pale brown.

Thorax mostly brown (Figs 1, 2). Cervical sclerite brown with black outer margin. Pronotum dull brown with black setulae. Prescutum with three dark-brown longitudinal stripes, median one with black setulae at outer margin. Scutum dark brown with black setulae at postero-lateral margin. Scutellum brown with tapered yellow median stripe. Mediotergite dark brown (Fig. 2). Mesopleura yellow to dark brown; subspiracular sclerite dull brown with pale-yellow spot at postero-lateral corner; episternum pale yellow to dark brown; katepisternum with black setulae and tapering, dark-brown marking at antero-lateral corner. Legs with coxae, trochanters yellow to pale brown except fore coxa yellow to dark brown; femora brown with one dark-brown, subapical ring; tibia brown; tarsi reddish brown to dark brown. Setulae on legs black. Wing hyaline, pale brown with large brown stigma at branching of $R_{1,2}$; apical Sc_1 slightly beyond base of Rs, Sc_2 apically reaching 1/5 of Rs; basal deflection of CuA₁ before branching point of M (Fig. 3). Halter: stem dull brown; knob bicolor, upper part pale brown to dark brown, lower part white (Fig. 1).

Abdomen (Fig. 1). Mainly dull brown. Each abdominal segment with one pale yellow ring at posterior margin. Abdomen covered with golden setulae.

Hypopygium dull brown (Figs 4–7). Posterior margin of tergite 9 broadly emarginated (Fig. 4). Gonocoxite weakly constricted at apex. Gonostylus with apex sharp, base swollen (Figs 4, 5). Paramere with fan-shaped base, very slender apex ending at 5/6 of aedeagus (Figs 4–7). Aedeagus forked; ventral mid-protrusion along middle line (Figs 4–7).

Female (n = 4): body length 7–8 mm, wing length 8–9 mm.

Female resembling male in head, thorax and wing. Female terminalia dull brown. Cercus yellowish brown, slightly arched dorsally at apex, slender, 3 times longer than wide at base. Hypogynial valve 3.7 times longer than wide at base; lateral margin with triangular, black marking (Figs 8–9).

Material examined. 1 male, China: Xinjiang, Habahe, Celebaixiang, 48.08N, 86.331E, elev. 530 m, 2016.VII.9, Jinlong Ren (CAU). 7 males, 2 females, China: Xinjiang, Habahe, Baihabacun, 48.69N, 86.80E, elev. 1170 m, 2016.VII. 12, Jinlong Ren (light trap) (CAU). 12 males, 2 females, China: Xinjiang, Habahe, Baihabacun, 48.67N, 86.80E, elev. 1020 m, 2016.VII.12, Jinlong Ren (CAU). 8 males, 4 females, China: Xinjiang, Habahe, Baihabacun, 48.67N, 86.79E, elev. 1630 m, 2016.VII.12, Jinlong Ren (CAU). 2 males, 3 females, China: Xinjiang, Habahe, Baihabacun, 48.69N, 86.79E, elev. 1170 m, 2016.VII.12, Jinlong Ren (light trap) (CAU). 2 females (CAU), China: Xinjiang, Habahe, Baihabacun, 48.66N, 86.79E, elev. 1730 m, 2016.VII.13, Jinlong Ren (CAU). 1 male, China: Xinjiang, Burqin, Kanas, 48.68N, 86.99E, elev. 1470 m, 2016. VII.16, Jinlong Ren (CAU). 1 male, China: Xinjiang, Burqin, Kanas Lake, 48.74N, 87.01E, elev. 1390 m, 2016.VII.17, Jinlong Ren (CAU). 1 male, China: Xinjiang, Burqin, Kanas, 48.69N, 87.00E, elev. 1330 m, 2016.VII.18, Jinlong Ren (CAU). 2 males, China: Xinjiang, Burqin, Hemu, 48.58N, 87.45E, elev. 1160 m, 2016.VII.21, Jinlong Ren (CAU). 1 female, China: Xinjiang, Burqin, Hemu, 48.57N, 87.43E, elev. 1090 m, 2016.VII.22, Jinlong Ren (light trap) (CAU). 1 male, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1200 m, 2016.VII.23, Jinlong Ren (CAU).
Distribution. Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, China (Xinjiang: Burqin, Hababe), Croatia, Cyprus, Czech Rep., Denmark, Finland, France, Georgia, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Kazakhstan, Kyrgyzstan. Latvia, Lithuania, Macedonia, Mongolia, Morocco, Netherlands, North Caucasus, North Korea, Norway, Pakistan, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, Turkey, Turkey, Ukraine, Uzbekistan.

Remark. This is the first report of this species from China. The position of Sc relative to Rs and female body color shows the geographic variation. First, specimens from Xinjiang (Burqin, Altay Mountain) have Sc_1 slightly beyond basal Rs, Sc_2 reaching 1/5 of Rs (Fig. 3), similar wing venation with Savchenko's drawing (Savchenko 1985: 145, fig. 95.2), whereas specimens from Korea have Sc_1 reaching 1/3 of Rs, Sc_2 reaching 1/4 of Rs (Podenas and Podeniene 2017: 17, fig. 25). Moreover, female specimens from Xinjiang have the dark brown sternites, whereas Korean specimens have the yellow sternites (Podenas and Podeniene 2017:19).

2. Limonia medexocha sp. nov.

http://zoobank.org/5587C6AF-1509-4727-A3E1-452312C3254A Figures 10–16

Diagnosis. Occipital marking Y-shaped. Flagellar verticils 3 times longer than corresponding segment. Postgena with short narrow stripe near inner margin of eyes. Prescutum with one broad, dark-brown mid-longitudinal stripe. Wing stigma pale brown with yellowish brown margin; Sc_1 apically reaching 3/5 of Rs. Abdominal dorsum with one dark-brown mid-longitudinal stripe. Posterior margin of tergite 9 with two finger-like sclerotized protrusions. Gonostylus with blunt apex and swollen base. Paramere reniform, apex ended at 2/5 of aedeagus. Aedeagus with strong ventral mid-protrusion.

Description. Male (n = 2): body length 9–10.5 mm, wing length 10–11 mm.

Head mostly yellow (Figs 10, 11). Vertex dull yellow. Occiput dull yellow, covered with black setulae. Occipital marking dark brown, but pale brown at posterior part, Y-shaped, with anterior marking linked with inner margin of eyes. Head with black setulae. Antenna 14-segmented; scape dark brown, pedicel yellowish brown, flagellomeres yellowish brown; flagellar verticils black, three times longer than corresponding segment. Nasus 1/2 as long as rostrum. Rostrum and nasus brown to dark brown. Labella pale yellow, with black setulae and inner margin with brown. Postgena light yellow with short narrow stripe near inner margin of eyes. Palpi dark brown with black setulae.

Thorax mostly yellow (Figs 10, 11). Cervical sclerite pale brown with black outer margin. Pronotum dull yellow with dull brown median stripe. Prescutum with one broad, dark-brown mid-longitudinal stripe and black setulae at lateral margin. Scutum dark brown with black setulae around outer margin. Scutellum dark brown with tapered yellow median stripe. Mediotergite dark brown (Fig. 11). Mesopleura entirely light yellow except katepisternum with dark brown margin at antero-lateral corner and subspiracular sclerite dull yellow; center of episternum with eight black setulae. Legs



Figures 10–12. *Limonia medexocha* sp. nov., male 10 male habitus, lateral view 11 head and thorax, dorsal view 12 right wing. Scale bars: 1.0 mm.

with coxae and trochanters yellow; femora yellowish brown with dark-brown terminal ring; tibiae yellowish brown, with dull brown subapical ring; tarsi reddish brown to dark brown. Setulae on legs black. Wing hyaline, pale brown; stigma pale brown with yellowish brown margin; Sc₁ apically reaching 3/5 of Rs; while Sc₂ apically reaching 3/4 of Rs; basal deflection of CuA₁ far before branching point of M. (Fig. 12). Halter with dull-brown stem and pale-brown to dark-brown knob (Fig. 10).

Abdomen mainly light yellow (Fig. 10). Dorsum with one dark-brown mid-longitudinal stripe. Abdominal segments 7–9 entirely dark brown; hypopygium mostly dark brown.



Figures 13–16. *Limonia medexocha* sp. nov., male 13 hypopygium, dorsal view 14 hypopygium, ventral view 15 hypopygium, lateral view 16 aedeagus and paramere. Scale bars: 0.1 mm.

Hypopygium (Figs 9–12). Posterior margin of tergite 9 with two finger-like, sclerotized protrusions that constrict at base and project outward at apex (Fig. 9). Gonocoxite wide at base and narrow at apex, longer than wide. Gonostylus with blunt apex and swollen basal protrusion that is strongly outward and hairy (Figs 9–11). Paramere reniform with small apical protrusion and rod-shaped; apex ended at 2/5 of aedeagus (Figs 13–16). Aedeagus complex; mid-ventral margin with strong protrusion which is long and rectangular in lateral view (Fig. 15); outer margin serrated; apex with small notch; spherical protrusion located mid-ventrally at base (Figs 13–16).

Female (unknown)

Type material. *Holotype* male, China: Ningxia, Guyuan, Liupan Mountain, 35.38N, 106.31E, elev. 2210 m, 2017.VII.20, Jiale Zhou (CAU). *Paratypes:* 1 male, China: Sichuan, Pingwu, Wanglang, elev. 2910 m, 2017.VII.29, Yuqiang Xi (CAU).

Distribution. China (Ningxia: Guyuan; Sichuan: Pingwu).

Etymology. The specific name, from Latin, *medius* (adj., meaning "middle"), and Greek *exocha* (adj., meaning "protruded"), refers to the median protrusion at the dorsal margin of the aedeagus.

Remarks. This new species is very unique and differs from other known species of *Limonia*. This new species is somewhat similar to *L. macrostigma* (Schummel, 1829) in wing stigma. It can be separated from the latter by the following features: body yellow; occiput yellow with Y-shaped marking; gonostylus with obtuse apex; paramere with obtuse apex; aedeagus with strong mid-ventral protrusion. In *L. macrostigma*, the body is brown; the occiput is black brown; the prescutum has two lateral stripes; the gonostylus has a slender apex; the paramere has a slender and pointed apex; and the aedeagus has no mid-dorsal protrusion (Podenas and Podeniene 2017).

3. Limonia phragmitidis (Schrank, 1781)

Figures 17-25

Tipula phragmitidis Schrank 1781: 605.

Tipula tripunctata Fabricius 1781: 405 (subsequent designation by Westwood 1840). *Tipula phragmitidis* Schrank: Kolcsár et al. 2017: 50 (redescription).

Diagnosis. Flagellar verticils shorter than corresponding segment. Pronotum dark brown. Prescutum with one narrow, deep-brown longitudinal stripe. Wing pale brown with three small, brown markings at base of Rs, apical Sc, and R_2 ; Sc₁ apically reaching 1/2 of Rs. Gonostylus with sharp apex and swollen base. Paramere ended at 3/5 of aedeagus. Aedeagus with unique H-shaped pattern at the mid-ventral margin. Female, hypogynial valve 2.1 times longer than wide at base.

Redescription. Male (n = 7): body length 7–8.5 mm, wing length 8–9 mm.

Head dull brown (Figs 17, 18). Vertex dull brown. Occiput dull yellow, covered with black setulae. Antenna yellow and 14-segmented; scape yellow; pedicel oval; flag-ellomeres nearly cylindrical; flagellar verticils black, shorter than corresponding segment. Rostrum brown or dark brown. Labella pale yellow, except inner margin brown covered with black setulae. Palpi brown with black setulae.

Thorax mostly yellow (Figs 17, 18). Cervical sclerite pale brown, with black outer margin. Pronotum dark brown with black setulae. Prescutum with rather narrow, brown longitudinal stripe (anterior part wider than posterior part). Scutum pale yellow, with black setulae around outer margin. Scutellum pale yellow. Mediotergite pale yellow to yellow (Fig. 18). Mesopleura pale yellow to yellow; subspiracular sclerite pale yellow; anepimeron and katepisternum with black setulae. Legs with coxae and trochanters pale yellow; femora yellow with one dark-brown subapical ring; tibiae brown; tarsi brown to dark brown. Setulae on legs black. Wing hyaline, pale brown, with three small brown markings at base of R_s, apical Sc, and R₂; Sc₁ apically reaching 1/2 of Rs; basal deflection of CuA₁ before branching point of M (Fig. 19). Halter: stem white; knob bicolor with upper part pale yellow to yellow while lower part white (Fig. 17).



Figures 17–19. *Limonia phragmitidis*, male 17 male habitus, lateral view 18 head and thorax, dorsal view 19 right wing. Scale bars: 1.0 mm.

Abdomen mainly yellow (Fig. 17). Sternite 8 reddish brown. Each abdominal segment with one pale-brown ring at posterior margin. Abdomen covered with golden setulae.

Hypopygium pale yellow (Figs 20–23). Posterior margin of tergite 9 narrowly emarginated (Fig. 20). Gonocoxite long cylindrical. Gonostylus with sharp apex and swollen base that covered with black setulae (Figs 20, 21). Paramere with fan-shaped base and sharp apex that ends at 3/5 of aedeagus (Figs 20–23). Aedeagus forked; ventral margin with mid-protrusion that triangular in lateral view and unique H-shaped pattern in middle (Figs 20–23).

Female (n = 6): body length 8–10 mm, wing length 8–10 mm.



Figures 20–23. *Limonia phragmitidis*, male **20** hypopygium, dorsal view **21** hypopygium, ventral view **22** hypopygium, lateral view **23** aedeagus and paramere. Scale bars: 0.1 mm.



Figures 24–25. *Limonia phragmitidis*, female 24 cercus and hypogynial valves, lateral view 25 cercus and hypogynial valves, ventral view. Scale bars: 1.0 mm.

Female resembling male in head, thorax, and wing. Female terminalia pale yellow. Cercus yellowish brown, slightly arched dorsally at apex, slender, and 2.3 times longer than wide at base. Hypogynial valve 2.1 times longer than wide at base; lateral margin with black marking (Figs 24, 25).

Material examined. 1 male, China: Xinjiang, Habahe, Baihabacun, 48.69N, 86.79E, elev. 1170 m, 2016.VII.12, Jinlong Ren (light trap) (CAU). 24 males, 20 females, China: Xinjiang, Burqin, Hemu, 48.43N, 87.57E, elev. 1040 m, 2016.VII.21, Jinlong Ren

(CAU). 60 males, 40 females, China: Xinjiang, Burqin, Hemu, 48.58N, 87.45E, elev. 1160 m, 2016.VII.21, Jinlong Ren (CAU). 47 males, 37 females, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1150 m, 2016.VII.22, Jinlong Ren (CAU). 35 males, 30 females, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1210 m, 2016.VII.23, Jinlong Ren (CAU). 1 female, China, Xinjiang, Gongliu, Kuerdening, 43.28N, 82.95E, elev. 1270 m, 2017.VII.26, Bing Zhang (CAU). 1 female, China, Xinjiang, Gongliu, Kuerdening, 43.25N, 82.83E, elev. 1140 m, 2017.VII.26, Bing Zhang (light trap) (CAU).

Distribution. Albania, Andorra, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, China (Xinjiang: Burqin, Habahe, Gongliu), Croatia, Czech Rep., Denmark, Finland, France, Georgia, Germany, Great Britain, Greece, Hungary, Ireland, Israel, Italy, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Macedonia, Montenegro, Morocco, Netherlands, North Caucasus, Norway, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Turkey, Ukraine.

Remark. This is the first report of this species from China.

4. Limonia stigma (Meigen, 1818)

Figures 26–34

Limnobia stigma Meigen 1818: 138. Limnobia terrestris Linnaeus 1758: 586 (synonymy). Limnobia sexnotata Schumme 1829: 111 (synonymy). Limnobia punctigera Walker 1856: 298 (synonymy).

Diagnosis. Flagellar verticils black, 1.6 times longer than corresponding segment. Prescutum with one triangular, brown longitudinal stripe. Wing pale brown, with one small grayish black marking at R_2 ; Sc_1 apically reaching 1/2 of Rs. Gonocoxite long cylindrical. Gonostylus with sharp apex and swollen, hairy base. Paramere with fan-shaped base and blunt apex that ends at 1/2 of aedeagus. Aedeagus with Y-shaped pattern at mid-ventral margin. Female, hypogynial valve 2.3 times longer than wide at base.

Redescription. Male (n = 19): body length 7–9 mm, wing length 8–9 mm.

Head yellow (Figs 26–28). Vertex yellow. Occiput dull yellow, covered with black setulae. Antenna yellow and 14-segmented; scape yellow; pedicel oval; flagellomeres cylindrical and bicolor, brown at base and pale yellow at apex; flagellar verticils black, 1.6 times longer than corresponding segment. Rostrum and nasus pale yellow, nasus 1/4 as long as rostrum. Labella pale yellow, with black setulae, except inner margin brown. Palpi yellow except terminal segment brown.

Thorax mostly yellow (Figs 17, 18). Cervical sclerite yellow with black margin at antero-lateral margin. Pronotum dark brown, with black setulae. Prescutum with one brown, triangular longitudinal stripe (anterior part wider than posterior part); two setulae and longitudinal rows at middle. Scutum pale yellow, with black, oblique setulae at middle. Scutellum white. Mediotergite pale yellow, variegated with white (Fig. 27). Mesopleura pale yellow to yellow; subspiracular sclerite yellow; katepisternum with black setulae. Legs with coxae and trochanters yellow; femora dull yellow with one dark-brown subapical ring;



Figures 26–28. *Limonia stigma*, male 26 male habitus, lateral view 27 head and thorax, dorsal view 28 right wing. Scale bars: 1.0 mm.

tibiae brown with dark-brown subapical ring; tarsi brown to dark brown. Setulae on legs black. Wing hyaline, pale brown with one small grayish black marking at R_2 ; Sc_1 apically reaching 1/2 of Rs; basal deflection of CuA_1 before branching point of M (Fig. 28). Halter dull yellow; knob bicolor, with upper part dull yellow and lower part white (Fig. 26).

Abdomen mainly yellow (Fig. 26). Sternite 7 reddish brown. Each abdominal segment with one pale-brown ring at posterior margin. Abdomen covered with golden setulae.

Hypopygium yellow (Fig. 26). Posterior margin of tergite 9 emarginated (Fig. 29). Gonocoxite long cylindrical. Gonostylus with sharp apex and swollen and hairy base (Figs 29, 30). Paramere with fan-shaped base and blunt apex that ended at 1/2 of ae-deagus (Figs 29–32). Aedeagus forked; ventral margin with mid-protrusion triangular



Figures 29–32. *Limonia stigma*, male **29** hypopygium, dorsal view **30** hypopygium, ventral view **31** hypopygium, lateral view **32** aedeagus and paramere. Scale bars: 0.1 mm.



Figures 33–34. *Limonia stigma*, female 33 cercus and hypogynial valves, lateral view 34 cercus and hypogynial valves, ventral view. Scale bars: 1.0 mm.

in lateral view; unique Y-shaped pattern at middle that anterior margin with short mid-protrusion (Figs 20–23).

Female (n = 11): body length 7.5–9 mm, wing length 7.5–10 mm.

Female resembling male in head, thorax, and wing. Female terminalia pale yellow. Cercus yellowish brown, slightly arched dorsally at apex, slender, and 3 times longer

than wide at base. Hypogynial valve 2.3 times longer than wide at base; lateral margin with triangular black marking (Figs 33, 34).

Material examined. 6 males, China: Xinjiang, Burqin, Hemu, 48.43N, 87.57E, elev. 1040 m, 2016.VII.21, Jinlong Ren (CAU). 13 males, 2 females, China: Xinjiang, Burqin, Hemu, 48.58N, 87.45E, elev. 1160 m, 2016.VII.21, Jinlong Ren (CAU). 32 males, 16 females, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1150 m, 2016.VII.22, Jinlong Ren (CAU). 10 males, 3 females, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1200 m, 2016.VII.23, Jinlong Ren (CAU).

Distribution. Armenia, Austria, Belarus, Belgium, Bulgaria, China (Xinjiang: Burqin), Czech Rep., Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Italy, Lithuania, Netherlands, Poland, Romania, Russia, Slovakia, Slovenia, Sweden, Switzerland, Ukraine.

Remark. This is the first report of this species from China.

5. Limonia subcosta sp. nov.

http://zoobank.org/142913C6-D932-4AE5-8169-D44C8D3EE2AF Figures 35–37, 39–44

Diagnosis. Flagellar verticils 1.5 times longer than corresponding segment. Prescutum with three reddish-brown longitudinal stripes. Scutum dark brown, with triangular yellow marking at postero-lateral margin. Wing dull brown, variegated with zigzag whitish bands at origin of Rs before cord; Sc_2 apically reaching 1/2 of Rs. Posterior margin of tergite 9 emarginated with two finger-like, sclerotized protrusions. Paramere with blunt apex that ends at 7/10 of aedeagus. Female, hypogynial valve 1.8 times longer than wide at base.

Description. Male (n = 4): body length 6.5–7 mm, wing length 7–7.5 mm.

Head mostly black-brown (Fig. 35). Vertex dark brown. Occiput dark brown, covered with sparse setulae. Antenna 14-segmented; scape, pedicel, and flagellomeres black-brown, except for basally dull-yellow first flagellomere; flagellar verticils black, 1.5 times longer than corresponding segment. Nasus 2/5 as long as rostrum. Rostrum and nasus brown to dark brown, with black setulae. Labella pale brown, with black setulae. Palpi brownish gray, with black setulae.

Thorax (Figs 35, 36). Mostly reddish brown to black brown. Cervical sclerite dark brown, with black outer margin. Pronotum dark brown, with sparse black setulae. Prescutum with three reddish brown longitudinal stripes. Scutum dark brown, with triangular yellow marking at postero-lateral margin. Scutellum brown with black setulae at posterior margin. Mediotergite reddish brown, with U-shaped, black-brown marking at posterior margin (Fig. 28). Mesopleura entirely black-brown; episternum with sparse, yellow setulae. Legs: coxae and trochanters brown, with black setulae; femora, tibiae, and tarsi dull brown; femora with two subapical rings (outer one black-brown, inner one dull brown). Wing dull brown, variegated with zigzag whitish bands at origin of Rs before cord (basal section of R_{4+5} , r-m, and m-cu); Sc₂ apically reaching 1/2 of Rs; basal deflection of CuA₁ slightly beyond branching point of M; R₂ absent (Fig. 37). Halter with stem brown; knob dull brown (Fig. 35).



Figures 35–38. *Limonia subcosta* sp. nov., male 35 male habitus, lateral view 36 head and thorax, dorsal view 37 right wing 38 wing of *Limonia pernigrina* Alexander, 1938, holotype. Scale bars: 1.0 mm.



Figures 39–42. *Limonia subcosta* sp. nov., male **39** hypopygium, dorsal view **40** hypopygium, ventral view **41** hypopygium, lateral view **42** aedeagus and paramere. Scale bars: 0.1 mm.



Figures 43–44. *Limonia subcosta* sp.nov., female 43 cercus and hypogynial valves, lateral view 44 cercus and hypogynial valves, ventral view. Scale bars: 1.0 mm.

Abdomen (Fig. 35). Mainly reddish brown. Posterior margin of abdominal segments 1–4 with dark-brown ring. Venter dull yellow. Posterior margin of abdominal segments 5–8 with pale yellow ring. Hypopygium reddish brown. Abdominal setulae black.

Hypopygium (Figs 39–42). Posterior margin of tergite 9 emarginated with two finger-like, sclerotized protrusions (Fig. 39). Gonocoxite wider than long (Figs 39–41). Gonostylus black-brown, apically slender, and basally with slightly swollen covered with longer setulae (Figs 31, 32). Proctiger globular and membranous. Paramere with short obtuse apex (Fig. 34). Paramere with fan-shaped base and blunt apex that ended at 7/10 of aedeagus (Figs 41, 42). Aedeagus forked; ventral margin with mid-protrusion that anterior margin with cube-shaped (Figs 40, 42).

Female (n = 5): body length 7–8 mm, wing length 7–8.5 mm.

Female resembling male in head, thorax, and wing. Female terminalia (Fig. 46) reddish brown. Cercus brown, with slightly arched dorsally at apex, slender, and 2 times longer than wide at base. Hypogynial valve 1.8 times longer than wide at base; lateral margin with oval, black marking (Figs 43, 44).

Type material. *Holotype* male, China: Shaanxi, Foping, Panda valley, 33.66N, 107.98E, elev. 1470 m, 2016.VII.10–2016.VII.21, Ruie Nie (Malaise trap) (CAU). *Paratypes:* 2 males, 2 females, China: Shaanxi, Foping, Panda valley, 33.67N, 107.98E, elev. 1460 m, 2016.VII.17–2016.VII.19, Ruie Nie (Malaise trap) (CAU). 1 male, China: Shaanxi, Foping, Panda valley, 33.67N, 107.979E, elev. 1470 m, 2016.VII.17, Ruie Nie (Malaise trap) (CAU). 1 male, 1 female, China: Shaanxi, Foping, Panda valley, 33.67N, 107.979E, elev. 1470 m, 2016.VII.17, Ruie Nie (Malaise trap) (CAU). 1 male, 1 female, China: Shaanxi, Foping, Panda valley, 33.67N, 107.98E, elev. 1470 m, 2016.VII.17–2016. VII.21, Ruie Nie (Malaise trap) (CAU). 2 females, China: Shaanxi, Yangxian, Maopingzhen, elev. 910 m, 2017. VIII.8, Xulong Chen (Malaise trap) (CAU).

Distribution. China (Shaanxi: Foping, Yangxian).

Etymology. The specific name, from Latin, *sub* and *costa* (meaning "below the costa", refers to relative position of Sc to Rs.

Remarks. This new species is similar to *L. pernigrina* Alexander, 1938 in the wing marking and shape of the gonostylus. It can be separated from the latter by the following features: Sc_2 ended at 1/2 of Rs; branch pointing of Rs with small, whitish spot; posterior margin of tergite 9 with a narrow, median recession and long, finger-like protrusions (Figs 29, 31). In *L. pernigrina*, the Sc_2 ends almost at branch of Rs; the branch pointing of Rs has a large whitish band that is linked anteriorly with the costal margin of the wing (Fig. 30); and the posterior margin of tergite 9 has a broad, median recession and short, finger-like protrusions (Alexander 1938b).

6. Limonia sylvicola (Schummel, 1829)

Figures 45–53

Limnobia sylvicola Schummel 1829: 605. Limnobia affinis Zetterstedt 1838: 605 (synonymy). Limnobia tripunctata Zetterstedt 1838: 605 (synonymy).

Diagnosis. Flagellar verticils 2 times longer than corresponding segment, but shorter in some specimens. Prescutum with one very broad brown mid-longitudinal stripe. Wings yellow variegated with grayish smoky markings, and three grayish



Figures 45–47. *Limonia sylvicola*, male 45 male habitus, lateral view 46 head and thorax, dorsal view 47 right wing. Scale bars: 1.0 mm.

spots at basal Rs, apical Sc and R_2 ; Sc₁ apically reaching 1/2-3/4 of Rs. Gonostylus long and slender. Posterior margin of tergite 9 emarginated. Gonostylus with sharp apex and swollen base. Apex of paramere ended at 3/4 of aedeagus. Ventral margin of aedeagus with H-shaped. Female, hypogynial valve 2.3 times longer than wide at base.

Redescription. Male (n = 13): body length 6–8 mm, wing length 7–8 mm.



Figures 48–52. *Limonia sylvicola*, male **48** hypopygium, dorsal view **49** hypopygium, ventral view **50** hypopygium, lateral view **51** aedeagus and paramere **52** habitat, Hemu, Burqin, Xinjiang, China on 22 June 2017. Scale bars: = 0.1 mm (48–51).

Head dull brown (Figs 45, 46). Vertex dull brown, with two yellow markings at outer margin near eyes (Fig. 46). Occiput dull yellow, covered with black setulae. Antenna yellow and 14-segmented; scape and pedicel dull brown; flagellomeres nearly



Figures 53–54. *Limonia sylvicola*, female 53 cercus and hypogynial valves, lateral view 54 cercus and hypogynial valves, ventral view. Scale bars: 1.0 mm.

cylindrical; flagellar verticils grayish yellow, 2 times longer than corresponding segment but short in some specimens. Nasus 1/2 as long as rostrum. Rostrum brown or dull brown. Labella pale yellow, except inner margin brown. Palpi brown, with black setulae.

Thorax mostly brownish yellow (Figs 45, 46). Cervical sclerite pale brown, with black outer margin. Pronotum dark brown, with black setulae. Prescutum with broad, brown longitudinal stripe, and with black setulae at lateral margin. Scutum brown, with black setulae at outer margin. Scutellum pale yellow, but mid-anterior margin with round, yellow marking. Mediotergite dull brown (Fig. 46). Mesopleura dull yellow; sub-spiracular sclerite brownish yellow; anepimeron and katepisternum with black setulae. Legs with coxae and trochanters yellow, except frontal coxae brown; femora yellow, with one dark-brown subapical ring; tibiae yellow, with reddish-brown subapical ring; tarsi yellow to dark brown onwards. Setulae on legs black. Wings yellow, variegated with grayish smoky markings, and three grayish spots at basal Rs, apical Sc, and R₂; Sc₁ apically reaching 1/2–3/4 of Rs; basal deflection of CuA₁ beyond branching point of M; some specimens R₂ absent in some specimens (Fig. 47). Halter: stem white; knob dull gray.

Abdomen mainly brown (Fig. 45). Sternite 8 reddish brown. Each abdominal segment with one pale-brown ring at posterior margin. Abdomen covered with golden setulae. Abdominal segments 7–8 reddish brown.

Hypopygium reddish brown (Figs 49–51). Posterior margin of tergite 9 emarginated (Fig. 48). Gonocoxite long cylindrical. Gonostylus with sharp apex and swollen base covered with black setulae (Figs 48, 49). Paramere with fan-shaped base and sharp apex, ending at 3/4 of aedeagus (Figs 49–51). Aedeagus forked; ventral margin with mid-protrusion triangular in lateral view; ventral margin with uniquely H-shaped pattern in middle and anterior margin fish-tail-like in shape (Figs 49, 51).

Female (n = 4): body length 9 mm, wing length 8–10 mm.

Female resembling male in head, thorax, and wing. Female terminalia pale yellow. Cercus yellow with slightly arched dorsally at apex, slender and 2.4 times longer than wide at base. Hypogynial valve 2.3 times longer than wide at base; lateral margin with broad, black marking (Figs 53, 54).

Biology. This species is often collected with *L. phragmitidis* (Schrank, 1781) and *L. stigma* (Meigen, 1818), and it is a dominant species in Hemu (China: Xinjiang, Bur-

qin). These species often aggregate in shaded understory plants in white birch forests during the day (Fig. 46).

Material examined. 1 male, China: Xinjiang, Habahe, Baihabacun, 48.68N, 86.79E, elev. 1350 m, 2016.VII.11, Jinlong Ren (CAU). 1 male, China: Xinjiang, Habahe, Baihabacun, 48.67N, 86.80E, elev. 1020 m, 2016.VII.12, Jinlong Ren (CAU). 1 male, China: Xinjiang, Habahe, Baihabacun, 48.67N, 86.79E, elev. 1630 m, 2016. VII.12, Jinlong Ren (CAU). 1 male China: Xinjiang, Habahe, Baihabacun, 48.66N, 86.79E, elev. 1730 m, 2016.VII.13, Jinlong Ren (CAU). 2 males, China: Xinjiang, Burqin, Kanas, 48.68N, 86.99E, elev. 1470 m, 2016.VII.16, Jinlong Ren (CAU). 7 males, 2 females, China: Xinjiang, Burqin, Kanas Lake, 48.74N, 87.01E, elev. 1390 m, 2016. VII.17, Jinlong Ren (CAU). 2 males, China: Xinjiang, Burgin, Kanas, 48.66N, 87.00E, elev. 1310 m, 2016.VII.19, Jinlong Ren (CAU). 1 female, China: Xinjiang, Burgin, Hemu, 48.43N, 87.57E, elev. 1040 m, 2016.VII.21, Jinlong Ren (CAU). 12 males, 9 females, China: Xinjiang, Burgin, Hemu, 48.58N, 87.45E, elev. 1160 m, 2016.VII.21, Jinlong Ren (CAU). 103 males, 58 females (CAU), China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1150 m, 2016.VII.22, Jinlong Ren. 1 male, 1 female, China: Xinjiang, Burgin, Hemu, 48.572530N, 87.433929E, elev. 1090 m, 2016.VII.22, Jinlong Ren (light trap) (CAU). 276 males, 152 females, China: Xinjiang, Burgin, Hemu, 48.56N, 87.44E, elev. 1200 m, 2016.VII.23, Jinlong Ren (CAU).

Distribution. China (Xinjiang: Burqin, Habahe), Japan (Hokkaido), Kazakhstan, Russia.

Remark. This is the first report of this species from China.

7. Limonia taurica (Strobl, 1895)

Figures 55-63

Limnobia taurica Strobl 1895: 223. *Limonia sudetica* Czizek 1931: 48 (synonymy).

Diagnosis. Flagellar verticils 2.5 times longer than corresponding segment. Prescutum with five narrow, brown longitudinal stripes, except middle and lateral stripes dark brown. Wings with three dull-brown spots at basal Rs, apical Sc, and R_2 ; Sc₁ apically reaching 7/10 of Rs. Gonostylus with sharp apex and wider base. Apical paramere ended at 5/7 of aedeagus. Ventral margin of aedeagus with Y-shaped pattern.

Redescription. Male (n = 3): body length 9–10 mm, wing length 7–8 mm.

Head dark brown (Figs 55, 56). Vertex dark brown (Fig. 56). Occiput dull yellow, covered with black setulae. Antenna yellow and 14-segmented; scape and pedicel dull brown; flagellomeres brown, nearly cylindrical; flagellar verticils grayish yellow, 2.5 times longer than corresponding segment. Nasus 1/2 as long as rostrum. Labella pale yellow, covered with black setulae, except inner margin brown. Palpi brown, with black setulae.

Thorax mostly brown (Figs 55, 56). Cervical sclerite dull brown, with black outer margin. Pronotum dark brown, with black setulae. Prescutum with five nar-



Figures 55–57. *Limonia taurica*, male 55 male habitus, lateral view 56 head and thorax, dorsal view 57 right wing. Scale bars: 1.0 mm.

row, brown longitudinal stripes, except middle and lateral stripes dark brown, lateral margin of prescutum with oval, dark marking (Fig. 56). Scutum reddish brown, with triangular yellow marking at postero-lateral margin, covered with sparse setulae at anterior margin. Scutellum dull yellow, with pale yellow markings at posterior margin. Mediotergite reddish brown, with two dull yellow markings at posterior margin (Fig. 56). Mesopleura reddish brown; subspiracular sclerite reddish brown; katepisternum with black setulae. Legs with coxae and trochanters dull yellow, except frontal coxae brown; femora yellow with dark-brown subapical ring; tibiae yellow with reddish-brown subapical ring; tarsi yellow to dark brown onwards. Setulae



Figures 58–61. *Limonia taurica*, male 58 hypopygium, dorsal view 59 hypopygium, ventral view 60 hypopygium, lateral view 61 aedeagus and paramere. Scale bars: 0.1 mm.



Figures 62–63. *Limonia taurica*, female. 62 cercus and hypogynial valves, lateral view 63 cercus and hypogynial valves, ventral view. Scale bars: 1.0 mm.

on legs black. Wings brown with three dull-brown spots at basal Rs, apical Sc, and R_2 ; Sc₁ apically reaching 7/10 of Rs (Fig. 57). Halter: stem white to brown; knob brown but white at posterior part.

Abdomen mainly pale brown (Fig. 55). Each abdominal segment with broad, reddish-brown ring at posterior margin. Abdominal segments 7 and 8 entirely reddish brown. Abdominal setulae golden.

Hypopygium reddish brown (Figs 58–61). Posterior margin of tergite 9 slightly emarginated (Fig. 58). Gonocoxite long cylindrical. Gonostylus with sharp apex and the wider base (Figs 58, 59). Paramere with fan-shaped base and blunt apex, ending at 5/7 of aedeagus (Figs 58–61). Aedeagus forked; ventral margin with mid-protrusion triangular in lateral view; ventral margin with Y-shaped middle and anterior margin rounded (Figs 49, 51).

Female (n = 5): body length 8.5–9 mm, wing length 9–10 mm.

Female resembling male in head, thorax, and wing. Female terminalia pale yellow. Cercus yellow with slightly arched dorsally at apex, slender, and 3 times longer than wide at base. Hypogynial valve 5.3 times longer than wide at base; lateral margin with triangular, black marking (Figs 62, 63).

Material examined. 2 males, 2 females, China: Xinjiang, Habahe, Baihabacun, 48.69N, 86.79E, elev. 1170 m, 2016.VII.12, Bing Zhang (light trap) (CAU). 1 male, China: Xinjiang, Burqin, Kanas, 48.68N, 86.99E, elev. 1470 m, 2016.VII.16, Jinlong Ren (CAU). 2 females, China: Xinjiang, Habahe, Baihabacun, 48.69N, 86.78E, elev. 1170 m, 2016.VII.13, Bing Zhang (light trap) (CAU). 1 male, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1150 m, 2016.VII.22, Jinlong Ren (CAU). 1 female, China: Xinjiang, Burqin, Hemu, 48.56N, 87.44E, elev. 1200 m, 2016.VII.23, Jinlong Ren (CAU). 2 males, 1 female, China: Inner Mongolia, Hohehot, Xiaojinggou, 39.79N, 111.40E, elev. 1400 m, 2016.VII.27, Ding Yang (CAU).

Distribution. Albania, Austria, Belgium, Bosnia-Herzegovina, Bulgaria, China (Xinjiang: Burqin, Habahe; Inner Mongolia: Hohehot), Czech Rep., France, Germany, Italy, Macedonia, Montenegro, Poland, Romania, Slovakia, Slovenia, Spain, Switzerland, Turkey, Ukraine.

Remark. This is the first report of this species from China.

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RESEARCH ARTICLE



New data on the hoverflies of Morocco (Diptera, Syrphidae) with faunistic and bibliographical inventories

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Abstract

All published records of 148 species of hoverflies from Morocco are reviewed and appropriate literature references, new locality records, and relevant comments are provided for each species. The list is supplemented with records from new field surveys. Two species, *Eumerus obliquus* (Fabricius, 1805) and *Orthonevra brevicornis* Loew, 1843 are recorded for the first time in Morocco. The new checklist comprises 150 nominal species from three subfamilies, 14 tribes, and 49 genera.

Keywords

Checklist, Diptera, hoverflies, Morocco, new records, North Africa, Palaearctic region, Syrphidae

Introduction

Syrphidae (Diptera: Brachycera), commonly named hoverflies, constitute, among the order Diptera, a taxonomically well-characterised family. Most adults feed on pollen and nectar and thus are potentially important pollinators and their conservation is essential to sustain the productivity of natural and agricultural landscapes (Moquet et al. 2018). The larvae of Syrphidae have various food habits; certain species are predators while others are phytophagous, mycophagous or saprophytophagous (Rotheray and Gilbert 1999, Rotheray 1993, Büchs 2003).

Hoverflies occur in all geographical regions except for Antarctica and some isolated islands. They are found from sea level to the highest altitudes in flower-rich habitats. The family contains more than 6,100 species Worldwide (Pape et al. 2011). Of the North African countries bordering the Mediterranean Sea, Morocco is the one best known faunistically. Since Becker and Stein (1913) published an initial list of 42 species, several authors have contributed to the knowledge of Moroccan Syrphidae (Gil Collado 1929, Séguy 1930, 1934, 1941, 1949, 1953, Kanervo 1939, Claussen 1989, Claussen and Hauser 1990, Hurkmans 1993, Kassebeer 1995, 1998, 1999, 2000, Părvu et al. 2006, Popović et al. 2015, Acanski et al. 2016, van Steenis et al. 2017, Vujić et al. 2018, Ebejer et al. 2019).

Morocco has the highest number of total Syrphidae species recorded in the North Africa Mediterranean area so far (N = 150). Ninety-one species are reported from Algeria (Peck 1988, Dirickx 1994, Haffaressas et al. 2017), while 69, 51 and 34 species are recorded from Tunisia (Peck 1988, Claussen and Hauser 1990, Dirickx 1994), Egypt (Peck 1988, Dirickx 1994, El-Hawagry and Gilbert 2019) and Libya (Peck 1988, Dirickx 1994), respectively. Below, we provide an annotated checklist of all syrphid species recorded from Morocco.

Altogether 150 species are recorded in this work, two species are newly recorded for Morocco, and 24 others are new records for at least one of the Moroccan regions: Rif (10), Eastern region (4), High Atlas (5), Middle Atlas (5), and Anti Atlas (6). Morocco has 12 endemic species.

Materials and methods

Syrphidae were collected from 79 localities across the main regions in Morocco, mostly in the Rif Mountains, including the Eastern region, the High Atlas, Middle Atlas and Anti Atlas. Additional material and databases indicated in the text are provided by other researchers.

Collecting was mainly carried out by sweep netting and Malaise trapping adults and/or rearing larvae and puparia in the laboratory from collected substrates in aquatic ecosystems following the technique used by Afzan and Belqat (2016). The majority of the Moroccan hoverflies were identified from external characteristics, except for some species for which male genital morphology was used to confirm their identity. Identifications were done with specific keys (Verlinden 1991, Kassebeer 1995a, Hauser and Kassebeer 1998, Kassebeer 1998b, Kassebeer 1999b, van Veen 2004, Marcos-García et al. 2007, Speight and Sarthou 2013). Fourty-six of the species were identified with the help of Bastiaan Wakkie (Brussels, Belgium).

A total of 690 Syrphidae specimens was collected from 79 Moroccan sites (Table 1, Fig. 1). Maps with collecting localities were created with ArcGIS (Geographic Information System). Literature references on the occurrence in Morocco are given for each species, together with the region of the country from which the species is known. Additional information is given in the section 'Comments'. The Distribution as it is given

Station	Locality	Province	Altitude (m)	Geographical coordinates
Rif				
1. Aïn Afersiw	Mezine	Chefchaouen	750	35°05.945'N, 05°20.439'W
2. Aïn Boughaba	Ibel Bou Bessoui, Cedar Forest	Chefchaouen	1530	34°58.779'N, 04°46.366'W
3. Aïn El Ma Bared	Bouzthate	Chefchaouen	1270	35°00.333'N, 05°12.105'W
4. Aïn El Maounzil	National Park of Talassemtane	Chefchaouen	1110	35°04.577'N, 05°10.406'W
5. Aïn Ouanquben	Ibel Bou Bessoui	Chefchaouen	1600	34°57.750'N, 04°40.783'W
6. Aïn Takhninioute	Bab Rouida, National Park of	Chefchaouen	1510	35°06 881'N. 05°08 270'W
or run runningoute	Talassemtane	Sherenaouen	1910	<i>3,</i> , 00,0011,, 0,, 00,2, 0, 1,
7. Aïn Sidi Brahim Ben Arrif	Road Moulay Abdessalam	Larache	900	35°20.398'N, 05°32.712'W
8. Belyounech	Jbel Moussa	M'diq Fnideq	60	35°54.389'N, 05°23.630'W
9. Bni Maaden	Bni Maaden	Tétouan	20	35°34.420'N, 05°15.901'W
10. Dam Entrasol	Ouedlaou Bni Ferten	Chefchaouen	40	35°22.015'N, 05°10.626'W
11. Dava El Birdivel	Ânasar	Chefchaouen	1300	35°01.089'N, 04°59.477'W
12. Dam Moulay	Larbaa Beni Hassan	Tétouan	360	35°15.864'N, 05°21.221'W
Bouchta				
13. Dam Nakhla	Zinat	Tétouan	240	35°26.954'N, 05°24.326'W
14. Dam Smir	Bouzaghlale (M'diq)	Tétouan	20	35°41.491'N, 05°22.673'W
15. Daya Amsemlil	Jbel Bouhachem	Tétouan	1060	35°15.596'N, 05°25.917'W
16. Daya El Ânassar	Bab Berred	Chefchaouen	1180	35°00.788"N/04°57.419'W
17. Dava Jbel Zemzem	Ibel Zemzem	Tétouan	220	35°45.457'N, 05°22.189'W
18. Dava Mtahen	Ibel Bouhachem	Larache	970	35°16.195'N, 05°26.158'W
19. Dava Rahrah	Tanger	Tanger-Assilah	60	35°46.063'N, 05°51.517'W
20. Dava Tazia	Road Moulay Abdessalam	Larache	720	35°20.814'N, 05°33.139'W
21. Douar Dachervène	Dacheryène	Tétouan	130	35°33.863'N, 05°27.162'W
22. Douar Kitane	Kitane	Tétouan	50	35°32.412'N, 05°20.393'W
23. Forest Bab El	Tamakoute	Chefchaouen	1250	34°58.510'N, 05°11.838'W
Karne				
24. Forest El Mahfoura	Zaouia Sidi Kacem, Amsa	Tétouan	800	35°27.724'N, 05°25.807'W
25. Forest house	National Park of Talassemtane	Chefchaouen	1670	35°08.076'N, 05°08.262'W
26. Garden Ksar Al	Kabila	M'diq-Fnideq	10	35°43.806'N, 05°20.509'W
Rimal		1 1		
27. Jumb Kitane	Kitane	Tétouan	40	35°32.759'N, 05°20.420'W
28. Halouma Kitane	Kitane	Tétouan	140	35°31.912'N, 05°19.861'W
29. 1 km after Derdara	Tanakoub	Chefchaouen	510	35°06.419'N, 05°17.938'W
30. Ksar El Kébir	Ksar El Kébir	Larache	25	35°00.441'N, 05°53.352'W
31. Meadow Mizoghar	El Khizana	Chefchaouen	1000	35°02.725'N, 05°12.969'W
32. Meadow Fahs	Al Alyiene	M'diq Fnideq	590	35°40.148'N, 05°26.537'W
Lmhar				
33. Oued Aârkoub	Aârkoub	Chefchaouen	140	35°15.943'N, 04°50.631'W
34. Oued Achekrade	Douar Aouzighen	Tétouan	640	35°22.931'N, 05°20.364'W
35. Oued Ametrasse	Chrafate	Chefchaouen,	830	35°05.014'N, 05°05.130'W
36. Oued Azila	Azila, Jbel Tidghine	Al Hoceïma	1600	34°52.028'N, 04°32.609'W
37. Oued 15 km from Fifi	Bouzthate	Chefchaouen	1260	35°00.805'N, 05°12.365'W
38. Oued Boumarouil	Larbaa Beni Hassen	Tétouan	550	35°18.733'N, 05°21.271'W
39. Oued Bin El	Ksar Sghir	Tanger-	90	35°46.356'N, 05°31.343'W
Ouidane	-	Tétouan		
40. Oued Derdara	Derdara	Chefchaouen	400	35°06.484'N, 05°17.147'W
41. Oued Mharhar	Tanger	Tanger-Assilah	5	35°35.040'N, 05°59.220'W
42. Oued El Koub	Souk El Had	Chefchaouen	120	35°01.298'N, 05°25.333'W

Table 1. Sampling sites (in alphabetical order) with locality names, altitudes (meters), and geographical coordinates (latitude/longitude).

Station	Locality	Province	Altitude (m)	Geographical coordinates
43 Qued Farda	Akchour	Chefchaouen	400	35°14 350'N 05°10 460'W
44 Qued Inane Niche	Inane Niche	Chefchaouen	40	35°17 019'N 04°51 233'W
45. Qued Maijou	Maijou village	Chefchaouen	800	35°06 175'N 05°10 836'W
(Hafa meglouba)	ivia)jou village	Cherenaouen	000	55 00.17 5 10, 05 10.050 W
46. Qued Martil	Mhannech 2	Tétouan	9	35°33 693'N, 05°22 510'W
47. Qued Mezine	Mezine	Chefchaouen	780	35°06.104'N. 05°21.177'W
48. Qued Sahel	Ben Karrich	Tétouan	40	35°29 238'N. 05°26 352'W
49. Qued Sidi Ben	Derdara	Chefchaouen	220	35°03.921'N. 05°19.895'W
Sâada				
50. Oued Sidi Yahva	Sidi Yahya Aârab	Chefchaouen	60	35°17.545'N, 04°53.503'W
Aârab	, ,			
51. Oued Taïda	Taïda	Larache	500	35°22.250'N, 05°32.355'W
52. Stream at 1 km	Sidi Yahya Aârab	Chefchaouen	2120	35°18.203'N, 04°53.965'W
from Sidi Yahya Aârab				
53. Village Sebt Zinate	Village Sebt Zinate	Tanger-Assilah	60	35°39.272'N, 05°44.071'W
54. Tributary Oued	Mezine	Chefchaouen	730	35°05.670'N, 05°21.991'W
Tazarine				
55. Tributary Tarmast	National Park of Al Hoceïma	Al Hoceïma	170	35°10.666'N, 04°03.088'W
Eastern region				
56. Farm Saf-Saf	Douar Oueld Ben Amrou	Berkane	60	34°54.122'N, 02°37.212'W
	Aklim			
57. Oued El Khemis	Road vers Aklim	Berkane	80	34°54.330'N, 02°30.097'W
58. Oued Tafoughalt	Tafoughalt, Beni Snassen	Berkane	750	34°48.941'N, 02°24.471'W
Middle Atlas Mts				
59. Aïn Ouilili	Sidi Moulay Zarhoun	Meknès	490	34°03.216'N, 05°31.050'W
60. Bridge Oued Oum	El Had Labradia	Fkih Bensalah	420	32°25.865'N, 06°31.883'W
Er-rabie (Douar Ahl				
Souss)	Den Smith	T.C	1(00	22020 200'NL 05000 700'W
61 Douar Den Smim	Zerwiet Cheileb	Vh (nifus	700	22°20 24C'NL 05°54 154'W
O2. Doual Zaoulai Cheilth	Zaoulat Cherkh	Kileiiiita	/00	52 59.240 IN, 05 54.154 W
63 Qued d'Ifrane	Corge of Zad	Ifrane	21/0	33°01 7/0'N 05°0/ 260'W
64 Vicinity of Ifrane	Ifrane	Ifrane	1660	33°32 580'N 05°09 2/0'W
High Atlas Mts	mane	mane	1000	JJ J2. J00 IN, 0 J 0 J. 240 W
65 Aïn Zarka of Meski	Madkhal Meski	Frrachidia	970	31°51 388'N 04°16 917'W
66 Agadir airport	Ikhourbane	Agadir	50	30°20 400'N 09°26 820'W
67 Douar Akhlii Tnine	Ourika	Marrakech	870	31°22 385'N 07°46 608'W
Ourika	Outrika	marrancen	070	51 22.565 14, 67 10.000 W
68. Douar Aourir	Aouirir	Agadir	200	30°28.980'N, 09°38.340'W
69. Lac Oukaïmeden	Oukaïmeden	Marrakech	2590	31°12.420'N, 07°51.120'W
70. Palm grove Igrane	Merzouga village Hassilalbied	Errachidia	710	31°08.520'N, 04°01.260'W
71. Vicinity of Asni	Asni	Marrakech	1400	31°14.880'N, 08°00.480'W
72. Vicinity of Ijoukak	Ijoukak	Marrakech	1790	30°56.100'N, 08°03.840'W
73. Tizi N'Test	Tizi N'Test	Taroudante	1850	30°51.180'N, 08°22.080'W
Anti Atlas Mts				
74. Beach of Tamellalt	Tamellalt	Tiznit	70	29°43.080'N, 09°55.020'W
75. Douar Issafen	Issafen	Tata	1110	29°50.460'N, 08°32.100'W
76. Douar Zaouia	Kelâa M'gouna	Ouarzazate	1240	31°14.275'N, 06°08.169'W
77. 1 km before Douar	Jbel Ras Tarf	Guelmim	190	29°01.320'N, 10°23.100'W
Aïn Lahmar	-			
78. Msidira	El Filaha	Guelmim	260	28°56.865'N, 10°02.979'W
79. Oued Assa	Assa	Assa zag	310	28°36.507'N, 09°25.800'W



Figure 1. Map of Morocco indicating the collecting sites for hoverflies in this study.

for individual species is based on Speight (2018) and Mengual et al. (2020), as the most up-to-date reference, although other published works were consulted for specific taxa in order to obtain a more accurate distribution.

Nomenclature followed Speight (2018) and subfamily classification followed Mengual et al. (2015). Synonyms are given as far as they have been used in the literature dealing with the Moroccan fauna. All the specimens collected in this study are deposited in the collection of Diptera of the Department of Biology, Faculty of Sciences, University Abdelmalek Essaâdi, Tétouan.

Results

Subfamily SYRPHINAE Latreille, 1802 Tribe MELANOSTOMINI Williston, 1885 Genus *MELANOSTOMA* Schiner, 1860

Melanostoma mellinum (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 88, Gil Collado 1929: 405, Kanervo 1939: 2–3). Central Plateau (Séguy 1934: 162). Middle Atlas (Kanervo 1939, Timon-David 1951: 145, Leclercq 1961: 241, Claussen and Hauser 1990: 435). High Atlas (Kanervo 1939, Timon-David 1951, Claussen 1989b: 359, 373, Claussen and Hauser 1990). Distribution map Dirickx (1994: 76, 218).

New sites. Rif: Daya Rahrah, 8/IV/2013, 43/3; Aïn El Ma Bared, 06/V/2013, 499, 06/V/2014, 23/3; Oued Derdara, 24/V/2013, 19; Daya El Ânassar, 24/V/2013, 13/3; Daya Mtahen, 30/V/2013, 13/3; Garden Ksar Al Rimal, 26/V/2013, 73/3/3, 1799, 5/VI/2013, 13/3; Tributary Oued Tazarine, 11/VI/2013, 13/3; Oued Farda, 23/VI/2013, 13/3; Daya El Birdiyel, 27/VI/2013, 19/3; Forest house, 18/V/2014, 13/3, 19/3; Stream at 1 km from Sidi Yahya Aârab, 25/IV/2015, 13/3; Daya Amsemlil, 7/V/2015, 399,, sweep net, leg. Sahib and Belqat. Eastern region: Farm Saf-Saf, 14/VI/2013, 33/3/3, 2199, sweep net, leg. Sahib and Belqat. Middle Atlas: Oued d'Ifrane, 10/VI/2014, 43/3, sweep net, leg. Bot. High Atlas: Lac Oukaïmeden, 18/VI/2014, 13/3, 19, sweep net, leg. Bot.

Distribution. Holarctic.

Comment. New record for the Eastern Region.

Melanostoma scalare (Fabricius, 1794)

Literature records. Rif (Gil Collado 1929: 405). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 76, 219).

New sites. Rif: Aïn El Ma Bared, 06/V/2013, 11 \bigcirc \bigcirc ; Oued Mezine, 11/VI/2013, 1 \bigcirc ; Aïn Quanquben, 27/VI/2013, 6 \bigcirc \bigcirc ; Aïn Takhninjoute, 17/V/2014, 1 \bigcirc ; Oued El Koub, 30/V/2014, 1 \bigcirc ; sweep net, leg. Sahib and Belqat.

Distribution. Palaearctic, Afrotropical, and Indomalayan regions.

Genus PLATYCHEIRUS Le Peletier and Serville, 1828

Platycheirus ambiguus (Fallén, 1817)

Literature record. High Atlas (Kassebeer 1998b: 27). Distribution. Palaearctic.

Platycheirus atlasi Kassebeer, 1998

Literature records. Middle Atlas (Kassebeer 1998b: 28). High Atlas (Kassebeer 1998b: 28).

Comment. Endemic to Morocco. **Distribution.** Morocco.

Platycheirus fulviventris (Macquart, 1829)

Literature record. High Atlas (Ebejer et al. 2019: 150). **Distribution.** Palaearctic.

Platycheirus manicatus (Meigen, 1822)

Literature records. High Atlas (Séguy 1961: 74). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 111, 268).

Distribution. Palaearctic, Greenland, and Alaska.

Platycheirus marokkanus Kassebeer, 1998

Literature record. High Atlas, Middle Atlas (Kassebeer 1998b: 31). Cited (Speight 2018: 209).

New site. Rif: Aïn Takhninjoute, 17/V/2014, 1Å. High Atlas: Douar Akhlij Tnine Ourika 18/IV/2015, 1Å, sweep net, leg. Sahib and Belqat.

Comment. New record for the Rif.

Distribution. Morocco and Portugal.

Genus XANTHANDRUS Verrall, 1901

Xanthandrus comtus (Harris, 1780)

Literature records. Rif (Gil Collado 1929: 405). Listed (Claussen 1989b: 374). Distribution map (Dirickx1994: 128, 290).

Distribution. Palaearctic.

Tribe PARAGINI Glumac, 1961 Genus *PARAGUS* Latreille, 1804

Paragus albifrons (Fallén, 1817)

Literature records. Middle Atlas (Kanervo1939: 2). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 98, 249).

Distribution. Palaearctic.

Paragus atlasi Claussen, 1989

Literature records. High Atlas (Claussen 1989b: 359–361). Cited (Dirickx 1994: 99, Speight 2018: 175).

Comment. Endemic to Morocco. **Distribution.** Morocco.

Paragus bicolor (Fabricius, 1794)

Literature records. Rif (Becker and Stein 1913: 88). Central Plateau (Kanervo 1939: 2). Middle Atlas (Séguy 1930: 128, Kanervo 1939, Timon-David 1951: 144, Claussen 1989, Claussen and Hauser 1990). High Atlas (Kanervo 1939, Claussen 1989b: 361, 373, Claussen and Hauser 1990: 435). Anti Atlas (Séguy 1949: 156). Distribution map (Dirickx 1994: 98, 250).

New sites. Rif: Douar Dacheryène, 4/IV/2014, 19, sweep net, leg. Sahib and Belqat. High Atlas: Vicinity of Asni, 05/VI/2014, 19, sweep net, leg. Bot.

Distribution. Holarctic.

Paragus cinctus Schiner and Egger, 1853

Literature records. High Atlas (Claussen 1989b: 361, 373). Cited (Speight 2018: 176). Distribution map (Dirickx 1994: 99, 250).

New site. High Atlas: Vicinity of Asni, 05/VI/2014, 13, sweep net, leg. Bot. **Distribution.** Western and Central Palaearctic.

Paragus coadunatus Rondani, 1847

Literature records. Middle Atlas (Claussen and Hauser 1990: 436). Cited (Speight 2018: 176). Distribution map (Dirickx 1994: 99, 251).

New site. Rif: Oued Mharhar, 16/VI/2009, 1∂, sweep net, leg. Bot.

Comment. New record from the Rif.

Distribution. Balearic Is, Canary Is, Sicily, Malta, Madeira, Turkey, and Morocco.

Paragus flammeus Goeldlin, 1971

Literature records. Middle Atlas (Claussen and Hauser 1990: 435). Cited (Speight 2018: 178). Distribution map (Dirickx 1994: 100, 252). Distribution. Western and Central Palaearctic.

Paragus haemorrhous Meigen, 1822

Literature records. Recorded and listed from the Middle Atlas (Claussen 1989b: 359, 372). Distribution map (Dirickx 1994: 100, 252).

Distribution. Holarctic and Afrotropical regions.

Paragus hermonensis Kaplan, 1981

Literature record. Middle Atlas (Claussen 1989b: 361, 373). Distribution map (Dirickx 1994: 100, 101, 252).

Distribution. Mediterranean Basin.

Paragus pecchiolii Rondani, 1857

Literature records. Middle Atlas (Claussen and Hauser 1990: 435). Distribution map (Dirickx 1994: 101, 253).

Distribution. Western Palaearctic.

Paragus quadrifasciatus Meigen, 1822

Literature records. Central Plateau (Claussen 1989b: 361, 373). Middle Atlas (Claussen and Hauser 1990: 435, Timon-David 1951: 144, as *Paragus pulcherrimus*). Distribution map (Dirickx 1994: 101, 253).

New sites. Rif: Douar Kitane, 19/VI/2014, 1 \bigcirc , sweep net, leg. Sahib and Belqat. High Atlas: Agadir airport, 7/IV/2015, 1 \bigcirc , leg. Schmid-Egger.

Comment. New record from the Rif and the High Atlas. **Distribution.** Palaearctic.

Paragus strigatus Meigen, 1822

Literature records. Central Plateau (Wiedemann 1824: 33, as *Paragus bimaculatus*). Middle Atlas (Claussen 1989b: 361, 373, Claussen and Hauser 1990: 435). High Atlas (Claussen 1989b: 361, 373). Cited (Speight 2018: 181). Distribution map (Dirickx 1994: 102, 254).

Distribution. Palaearctic.

Paragus tibialis (Fallén, 1817)

Literature records. Rif (Becker and Stein 1913: 88, Leclercq 1961: 241, as *Paragus tibialis meridionalis*). Middle Atlas (Kanervo 1939: 2, Leclercq 1961: 241). High Atlas (Gil Collado 1929: 403, 404 (as *Paragus tibialis* var. *meridionalis*), Kanervo 1939: 2). Anti Atlas (Séguy 1949: 156). Listed (Claussen 1989b: 359, 373). Distribution map (Dirickx 1994: 102, 254).

New sites. High Atlas: Vicinity of Asni, 05/VI/2014, 13, 07/VI/2014, 233; Vicinity of Ijoukak, 17/VI/2014, 13, sweep net, leg. Bot.

Distribution. Western Palaearctic.

Paragus vandergooti Marcos-Garcia, 1986

Literature records. Middle Atlas (Claussen and Hauser 1990: 435). High Atlas (Claussen 1989b: 362, 373). Cited (Speight 2018: 181). Distribution map (Dirickx 1994: 102, 255).

Distibution. France, Portugal, Spain, and Morocco.

Tribe CHRYSOTOXINI Newman, 1834 Genus CHRYSOTOXUM Meigen, 1803

Chrysotoxum intermedium (Meigen, 1822)

Literature records. Rif (Becker and Stein 1913: 86, Gil Collado 1929: 414). Central Plateau (Părvu et al. 2006: 275). Middle Atlas (Séguy 1930: 131, 1961: 120). High Atlas (Séguy 1930: 131, Kanervo 1939: 4, Gil Collado 1929: 414). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 47, 178).

New sites. Rif: 1 km after Derdara, 11/VI/2013, 1 \bigcirc ; Oued Azila, 27/VI/2013, 1 \bigcirc ; Daya Jbel Zemzem, 23/IV/2014, 1 \bigcirc ; Aïn El Maounzil, 17/V/2014, 1 \bigcirc , sweep net, leg. Sahib and Belqat. Eastern region: Oued Tafoughalt, 25/XI/2014, 1 \bigcirc , sweep net, leg. Sahib and Belqat. Middle Atlas: Douar Zaouiat Cheikh, 19/III/2008, 2 \bigcirc \bigcirc , 1 \bigcirc , sweep net, leg. A. van Eck. High Atlas: Vicinity of Asni, 6/VI/2014, 2 \bigcirc \bigcirc , sweep net, leg. Bot. Anti Atlas: Douar Issafen, 14/VI/2015, 3 \bigcirc \bigcirc , 1 \bigcirc , sweep net, leg. Schmid-Egger.

Comment. New record from the Eastern region and the Anti Atlas.

Distribution. Europe and Morocco.

Chrysotoxum volaticum Séguy, 1961

Literature records. Middle Atlas (Timon-David 1951: 146, Leclercq 1961: 242, Séguy 1961: 123). High Atlas (Timon-David 1951, Claussen 1989b: 357, 372). List-ed (Claussen 1989b: 372). Distribution map (Dirickx1994: 46, 49, 175, 181).

Distribution. Algeria and Morocco.

Tribe SYRPHINI Latreille, 1802 Genus *DASYSYRPHUS* Enderlein, 1838

Dasysyrphus albostriatus (Fallén, 1817)

Literature record. High Atlas (Kassebeer 1998a: 22). Distribution. Palaearctic.

Genus EPISTROPHE Walker, 1852

Epistrophe eligans (Harris, 1780)

Literature records. Rif (Becker and Stein 1913: 88, as *Syrphus ochrostoma*). Middle Atlas (Kassebeer 1998a: 22). High Atlas (Kassebeer 1998a: 22). Listed (Claussen 1989b: 372, as *Epistrophe ochrostoma*).

New site. Rif: Daya Tazia, 25/VI/2014, 13, sweep net, leg. Sahib and Belqat. **Distribution.** Western Palearctic.

Genus EPISYRPHUS Matsumura and Adachi, 1917

Episyrphus balteatus (De Geer, 1776)

Literature records. Rif (Becker and Stein 1913: 88, as *Syrphus balteatus*, Gil Collado 1929: 406, Kanervo 1939: 3, as *Epistrophe balteata*). Central Plateau (Séguy 1930: 129, as *Syrphus balteatus*, Timon-David 1951: 144, as *Epistrophe balteatus*). High Atlas (Séguy 1930, Timon-David 1951). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 53, 189).

New sites. Rif: Village Sebt Zinate, 15/III/2008, 1 \bigcirc , sweep net, leg. AvEck; Aïn Sidi Brahim Ben Arrif, 17/IV/2013, 1 \bigcirc ; Dam Nakhla, 24/V/2013, 1 \bigcirc , 1 \bigcirc ; Aïn Boughaba, 24/V/2013, 1 \bigcirc ; Garden Ksar Al Rimal, 5/VI/2013, 1 \bigcirc ; Oued Aârkoub, 19/IV/2013, 4 \bigcirc \bigcirc ; Daya Rahrah, 2/XII/2013, 1 \bigcirc , 1 \bigcirc ; Oued Sahel, 5/III/2014, 1 \bigcirc ; Dam Moulay Bouchta, 5/III/2014, 26 \bigcirc \bigcirc ; Forest house, 17/VI/2014, 1 \bigcirc ; Ksar El Kébir, 19/IV/2014, 1 \bigcirc ; Daya Jbel Zemzem, 23/IV/2014, 13 \bigcirc \bigcirc , 27/IV/2014, 1 \bigcirc ; Oued Taïda, 12/III/2015, 1 \bigcirc ; Stream at 1 km from Sidi Yahya Aârab, 25/IV/2015, 1 \bigcirc ; Aïn Quanquben, 25/IV/2015, 1 \bigcirc ; Oued Majjou (Hafa meqlouba), 25/XII/2015, 1 \bigcirc ; Forest Bab El Karne, 25/XII/2015, 1 \bigcirc ; Douar Kitane, 23/I/2016, 2 \bigcirc \bigcirc , 1 \bigcirc , sweep net, leg. Sahib and Belqat; Douar Kitane, 7/IV/2018, 18 \bigcirc \bigcirc , 4 \bigcirc \bigcirc , sweep net, leg. Sahib and Belqat. High Atlas: Aïn Zarka of Meski, 20/III/2008, 1 \bigcirc , sweep net, leg. A. van Eck. Anti Atlas: Douar Zaouia, 11/VI/2015, 1 \bigcirc ; sweep net, leg. Sahib and Belqat.

Distribution. Palaearctic and Indomalayan regions.

Genus EUPEODES Osten Sacken, 1877

Eupeodes corollae (Fabricius, 1794)

Literature records. Rif (Becker and Stein 1913: 88, as *Syrphus corollae*, Kanervo 1939: 3, as *Syrphus corollae*, Gil Collado 1929: 406, as *Syrphus corollae*). Central Plateau (Timon David 1951: 144, as *Syrphus corollae*, Gil Collado 1929: 406). Middle Atlas (Leclercq 1961: 241, as *Syrphus corollae*). High Atlas (Séguy 1930, Timon-David 1951). Anti Atlas (Timon David 1951). Listed (Bigot 1884: 88, as *Syrphus berber*, Séguy 1930: 129, 1961: 103, Claussen 1989b: 372). Distribution map (Dirickx 1994: 89, 235 (as *Metasyrphus corollae*)).

New site. Rif: Village Sebt Zinate, 15/III/2008, 1 \bigcirc , sweep net leg. AvEck; Aïn El Ma Bared, 27/IV/2013, 1 \bigcirc ; Garden Ksar Al Rimal, 20/V/2013, 1 \bigcirc ; Oued Bin EL Ouidane, 14/XI/2013, 1 \bigcirc ; Oued Sahel, 5/III/2014, 1 \bigcirc ; Aïn Takhninjoute, 17/V/2014, 31 \bigcirc \bigcirc ; Stream at 1 km from Sidi Yahya Aârab, 25/IV/2015, 2 \bigcirc \bigcirc , 3 \bigcirc \bigcirc ; Oued Jnane Niche, 16/III/2014, 1 \bigcirc , 25/IV/2015, 1 \bigcirc , 1 \bigcirc ; Dam Smir, 27/IV/2014, 1 \bigcirc ; Oued Boumarouil, 10/V/2014, 1 \bigcirc ; Daya Jbel Zemzem, 23/IV/2014, 1 \bigcirc , 3 \bigcirc \bigcirc , 17/IV/2014, 6 \bigcirc \bigcirc , 3 \bigcirc \bigcirc ; Oued Majjou (Hafa meqlouba), 10/V/2014, 1 \bigcirc , 27/IV/2015, 1 \bigcirc ; Meadow Fahs Lmhar, 15/IV/2018, 1 \bigcirc , sweep net, leg. Sahib and Belqat. Douar Kitane, 21/IV/2018, 1 \bigcirc , reared by Sahib and Belqat; Forest El Mahfoura, 13/V/2018, 12 \bigcirc \bigcirc , 7 \bigcirc \bigcirc , sweep net, leg. Sahib and Belqat. Middle Atlas: Douar Zaouiat Cheikh, 19/III/2008, 1 \bigcirc , sweep net, leg. A. van Eck. High Atlas: Vicinity of Asni, 6/VI/2014, 1 \bigcirc ; Vicinity of Ijoukak, 17/VI/2014, 1 \bigcirc , sweep net, leg. Bot; Lac Oukaïmeden, 18/VI/2014, 1 \bigcirc , sweep net, leg. Bot.

Distribution. Palaearctic, Afrotropical Region, and Taiwan.

Eupeodes latifasciatus (Macquart, 1829)

Literature records. Anti Atlas (Séguy 1949: 156, Séguy 1953: 84, as *Syrphus latifasciatus*). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 89, 236 (as *Metasyrphus latifasciatus*)).

New sites. Rif: Douar Kitane, 2/V/2014, 13, 299; Forest house, 18/V/2014, 13; Oued Ametrasse, 27/IV/2015, 13, sweep net, leg. Sahib and Belqat.

Comment. New record for the Rif.

Distribution. Holarctic and India.

Eupeodes luniger (Meigen, 1822)

Literature records. Central Plateau (Gil Collado 1929: 406, as *Syrphus luniger*. Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 90, 237 (as *Metasyrphus luniger*)).

New sites. Rif: Oued Majjou (Hafa meqlouba), 10/V/2014, 333; Oued Martil, 13/XII/2013, 19; Belyounech, 9/VI/2013, 19, sweep net, leg. Sahib and Belqat; Douar Kitane, 24/IV/2017, 19, malaise trap, leg. Sahib and Belqat. Middle Atlas:

Douar Ben Smim, 08/VI/2014, 1°_{\circ} , sweep net, leg. Bot. High Atlas: Vicinity of Asni, 6/VI/2014, 1°_{\circ} , sweep net, leg. Bot.

Comments. New records from the Rif, the Middle Atlas and the High Atlas. **Distribution.** Palaearctic and northern India.

Eupeodes nuba (Wiedemann, 1830)

Literature records. High Atlas (Claussen 1989b: 359, 372). Cited (Bigot 1884: 88, as *Syrphus rufinasutus*, Séguy 1961: 107, as *Syrphus rufinasutus*, Speight 2018: 108). Distribution map (Dirickx 1994: 90, 238 (as *Metasyrphus nuba*)).

Distribution. Palaearctic.

Genus ISCHIODON Sack, 1913

Ischiodon aegyptius (Wiedemann, 1830)

Literature records. Central Plateau (Gil Collado 1929: 406, Timon-David 1951: 145). Anti Atlas (Timon-David 1951).

Distribution. Afrotropical Region, Mediterranean Basin, and Canary Islands.

Genus LAPPOSYRPHUS Dusek and Laska 1967

Lapposyrphus lapponicus (Zetterstedt, 1838)

Literature records. Rif (Becker and Stein 1913: 88, as *Syrphus arcuatus*). Listed (Claussen 1989b: 372, as *Eupeodes lapponicus*). Distribution map (Dirickx 1994: 89, 236 (as *Metasyrphus lapponicus*)).

Distribution. Palaearctic, northern America from Alaska to California.

Genus MELISCAEVA Frey, 1946

Meliscaeva auricollis (Meigen, 1822)

Literature records. Rif (Becker and Stein 1913: 89, as *Syrphus auricollis*, Gil Collado 1929: 406, as *Syrphus auricollis*). Central Plateau (Timon-David 1951: 145, as *Epistrophe auricollis*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 76, 219).

New sites. Rif: Aïn El Ma Bared, 27/IV/2013, 1 \bigcirc ; Daya El Ânassar, 24/V/2013, 1 \Diamond ; Belyounech, 9/VI/2013, 1 \bigcirc ; Oued Mezine, 11/VI/2013, 1 \Diamond ; Dam Moulay Bouchta, 5/IV/2014, 1 \bigcirc ; Aïn Afersiw, 11/VI/2013, 3 $\Diamond \Diamond$, 7 $\bigcirc \heartsuit$; Dam Entrasol, 14/XI/2014, 1 \bigcirc ; Oued 15 km from Fifi, 6/V/2014, 1 \bigcirc ; Jumb Kitane, 10/III/2015, 1 \bigcirc ; Oued Majjou (Hafa meqlouba), 10/V/2014, 1 \bigcirc ; Douar Kitane, 2/II/2015, 1 \bigcirc ; Oued Sahel, 5/IV/2014, 1 \bigcirc . Middle Atlas: Aïn Ouilili, 18/II/2016, 2 $\bigcirc \heartsuit$, sweep net, leg. Sahib and Belqat.

Comment. New record for the Middle Atlas. **Distribution.** Western Palaearctic.

Meliscaeva cinctella (Zetterstedt, 1843)

Literature records. Middle Atlas (Séguy 1934: 161, as *Syrphus cinctellus*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 77, 219).

Distribution. Holarctic.

Genus SCAEVA Fabricius, 1805

Scaeva albomaculata (Macquart, 1842)

Literature records. Rif (Gil Collado 1929: 405, as *Lasiopticus albomaculata*). Central Plateau (Timon-David 1951: 145, as *Lasiopticus albomaculata*). Middle Atlas (Leclercq 1961: 241, Claussen 1989b: 359). Listed (Séguy 1961: 94, Claussen 1989b: 373). Cited (Speight 2018: 225). Distribution map (Dirickx 1994: 115, 275).

New sites. Rif: Belyounech, 9/VI/2013, 1, sweep net, leg. Sahib and Belqat. High Atlas: Aïn Zarka of Meski, 20/III/2008, 1, sweep net, leg. AvEck; Lac Oukaïmeden, 19/VI/2014, 1, sweep net, leg. Bot.

Comment. New records for the High Atlas. **Distribution.** Palaearctic.

Scaeva dignota (Rondani, 1857)

Literature records. Middle Atlas (Claussen and Hauser 1990: 436). Distribution map (Dirickx 1994: 116, 275).

New sites. Rif: Oued Majjou (Hafa meqlouba), 27/IV/2015, 1♀; Daya Mtahen, 26/III/2016, 1♂, sweep net, leg. Sahib and Belqat.

Comment. New records for the Rif.

Distribution. Western Palaearctic.

Scaeva mecogramma (Bigot, 1860)

Literature records. Rif (Kassebeer1998a: 23). Middle Atlas (Kassebeer1998a: 23). High Atlas (Kassebeer1998a: 23).

Distribution. Spain, Southern France, Corsica, Italy, Switzerland, and Morocco.

Scaeva pyrastri (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 88, as *Catabomba pyrastri*, Gil Collado 1929: 405). Central Plateau (Gil Collado 1929: 405, as *Lasiopticus pyrastri*, Timon-David 1951: 145, as *Lasiopticus pyrastri*). Middle Atlas (Séguy 1930: 128,
as *Lasiopticus pyrastri*, Timon-David 1951: 145). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 116, 276).

New sites. Rif: Daya Jbel Zemzem, 23/IV/2014, 1, Stream at 1 km from Oued Sidi Yahya Aârab, 25/IV/2015, 1, sweep net, leg. Sahib and Belqat. Anti Atlas: 1 km before Douar Aïn Lahmar, 10/IV/2015, 1, sweep net, leg. Schmid-Egger.

Comment. New record for the Anti Atlas.

Distribution. Holarctic and India.

Scaeva selenitica (Meigen, 1822)

Literature records. High Atlas (Séguy 1930: 128, as *Lasiopticus selenitica*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 116, 276). Distribution. Palaearctic.

Genus SPHAEROPHORIA Lepeletier and Serville, 1828

Sphaerophoria interrupta (Fabricius, 1805)

Literature records. Rif (Becker and Stein 1913: 87, as *Sphaerophoria menthastri*, Kanervo 1939: 3). Central Plateau (Kanervo 1939: 3, as *Sphaerophoria menthastri*, Timon-David 1951: 145, as *Sphaerophoria menthastri*). Middle Atlas (Kanervo 1939, Timon-David 1951). High Atlas (Kanervo 1939). Anti Atlas (Timon-David 1951). Cited (Séguy 1961: 109, as *Sphaerophoria menthastri*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 118).

Comment. *S. interrupta* records in Morocco need confirmation. **Distribution.** Western Palaearctic and Siberia.

Sphaerophoria rueppelli (Wiedemann, 1830)

Literature records. Rif (Kanervo 1939: 4). Central Plateau (Timon-David 1951: 145, Kanervo 1939). High Atlas (Kanervo 1939, Timon-David 1951, Claussen 1989b). Anti Atlas (Timon-David 1951). Cited (Séguy 1961: 110). Listed (Claussen 1989b: 359, 373). Distribution map (Dirickx 1994: 119, 278).

New sites. Rif: Tributary Tarmast, 26/VI/2013, 1♂; Oued Sidi Ben Sâada, 6/V/2015, 2♂♂; Daya Amsemlil, 7/V/2015, 1♂. Eastern region: Farm Saf-Saf, 14/VI/2013, 4♂♂, sweep net, leg. Sahib and Belqat. Middle Atlas: Oued d'Ifrane: 10/VI/2014, 1♂, sweep net, leg. Bot.

Comment. New records for the Eastern region and the Middle Atlas. **Distribution.** Palaearctic and Afrotropical regions.

Sphaerophoria scripta (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 87, Gil Collado 1929: 406, Kanervo 1939: 4). Central Plateau (Kanervo 1939, Timon-David 1951: 145). Middle Atlas

(Séguy 1930: 129, Kanervo 1939, Timon-David 1951, Leclercq 1961: 241, Claussen 1989). High Atlas (Kanervo 1939, Claussen 1989b: 359). Listed (Claussen 1989b: 359, 373). Distribution map (Dirickx 1994: 119, 278).

Comment. New records for the Eastern region and the Anti Atlas. **Distribution.** Palaearctic, Greenland, Nepal, and Kashmir.

Sphaerophoria taeniata (Meigen, 1822)

Literature records. Central Plateau (Timon-David 1951: 10, as *Sphaerophoria menthastri* var. *taeniata*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 119, 279).

Distribution. Palaearctic.

Genus SYRPHUS Fabricius, 1775

Syrphus ribesii (Linnaeus, 1758)

Literature records. Rif (Kassebeer 1998a: 23).

New site. Rif: Douar Kitane, 30/I/2014, 1° , sweep net, leg. Sahib and Belqat. **Distribution.** Holarctic.

Syrphus vitripennis Meigen, 1822

Literature records. Rif (Gil Collado 1929: 406). Listed (Claussen 1989b: 374). Distribution map (Dirickx 1994: 125, 286).

Distribution. Palaearctic, western North America, and Taiwan.

Genus XANTHOGRAMMA Schiner, 1860

Xanthogramma dives (Rondani, 1857)

Literature record. High Atlas (Ebejer et al. 2019) **Distribution.** Europe and Morocco.

Xanthogramma evanescens Becker, 1913

Literature records. Rif (Becker and Stein 1913: 87). Listed (Claussen 1989b: 374). Distribution map (Dirickx 1994: 128).

Comment. Endemic to Morocco.

Distribution. Morocco.

Xanthogramma marginale (Loew, 1854)

Literature records. Rif (Becker and Stein 1913: 86, as *Xanthogramma marginale* var. *morenae*), Gil Collado 1929: 406, as *Xanthogramma marginale* var. *morenae*), Kanervo 1939: 4). High Atlas (Kanervo 1939). Middle Atlas (Claussen and Hauser 1990: 436). Cited (Séguy 1961: 113, Speight 2018: 258). Listed (Claussen 1989b: 374). Distribution map (Dirickx 1994: 129, 291).

New sites. Rif: Village Sebt Zinate, 15/III/2008, 19, sweep net, leg. AvEck; Oued Majjou (Hafa meqlouba), 10/V/2014, 13; Oued Ametrasse, 18/IV/2015, 13, sweep net, leg. Sahib and Belqat; Douar Kitane, 7/IV/2017, 13, malaise trap, leg. Sahib and Belqat.

Distribution. Western part of the Mediterranean Basin.

Xanthogramma pedissequum (Harris, 1776)

Literature records. Rif (Gil Collado 1929: 406, as *Xanthogramma ornatum*). Listed (Claussen 1989b: 374). Distribution map (Dirickx 1994: 129, 292).
 Comment. X. pedissequum records in Morocco need confirmation.
 Distribution. Europe and Morocco.
 Subfamily ERISTALINAE Rondani, 1845

Tribe CALLICERINI Brues and Melander, 1932 Genus *CALLICERA* Panzer, 1806

Callicera fagesii Guérin-Méneville, 1844

Literature record. High Atlas (Kassebber 1998a: 22). Distribution. Europe and Morocco.

Callicera rufa Schummel, 1842

Literature records. Rif (Gil Collado 1929: 414). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 23, 139).

Distribution. Western Palaearctic.

Tribe CERIOIDINI Wahlgren, 1909 Genus *CERIANA* Rafinesque, 1815

Ceriana conopsoides (Linnaeus, 1758)

Literature records. Middle Atlas (Séguy 1930: 131, as *Cerioides conopsoides*). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 23, 140).

Distribution. Palaearctic.

Ceriana vespiformis (Latreille, 1804)

Literature records. Rif (Becker and Stein 1913: 88, as *Cerioides vespiformis*, Gil Collado 1929: 414). Central Plateau (Séguy 1930: 131, as *Cerioides vespiformis*, Leclercq 1961). Middle Atlas (Séguy 1930, Kanervo 1939: 5, Leclercq 1961: 242, as *Cerioides vespiformis*). High Atlas (Gil Collado 1929, as *Cerioides vespiformis*, Kanervo 1939, Claussen 1989b: 365, 372). Cited (Séguy 1961: 210, Speight 2018: 21). Distribution map (Dirickx 1994: 23, 140).

New sites. Rif: 1 km after Derdara, 11/VI/2013, 1Å; Meadow Mizoghar, 6/V/2014, 1Å; Oued Achekrade, 31/V/2014, 1Å, sweep net, leg. Sahib and Belqat.

Distribution. Western Palaearctic.

Tribe CHEILOSINI Williston, 1885 Genus *CHEILOSIA* Meigen, 1822

Cheilosia brunnipennis Becker, 1894

Literature records. High Atlas (Kanervo 1939: 2, as *Chilosia flavipes*, Kassebeer 1998c: 58, 59). Cited (Séguy 1961: 38, 39, Speight 2018: 29). Listed (Claussen 1989b: 372, as *Cheilosia flavipes*).

Distribution. Western Palaearctic.

Cheilosia grossa (Fallén, 1817)

Literature record. Hight Atlas (Kassebeer 1998c: 59). Cited (Speight 2018: 35). Distribution. Palaearctic and India.

Cheilosia latifrons (Zetterstedt, 1843)

Literature records. Rif (Becker 1894: 395, as *Chilosia marokkana*, Becker and Stein 1913: 87, as *Chilosia maroccana*, Gil Collado 1929: 405, Kassebeer 1998c: 60). Middle Atlas, High Atlas (Kassebeer 1998c). Cental Plateau (Timon-David 1951: 144, as *Chilosia intonsa*). Cited (Séguy 1961: 43, as *Chilosia maroccana*). Listed (Claussen 1989b: 372, as *Cheilosia maroccana*). Distribution map (Dirickx 1994: 34, 36, 159). New site. Rif: Oued Sidi Yahya Aârab, 25/IV/2015, 13, sweep net, leg. Sahib and Belqat.

Distribution. Palaearctic.

Cheilosia paralobi Malski, 1962

Literature records. Rif (Gil Collado 1929: 405, as *Cheilosia longula*). Middle Atlas (Claussen 1989b, Claussen and Hauser 1990: 436, Kassebeer 1998c: 61). High Atlas (Kassebeer 1998c: 61). Listed (Claussen 1989b: 372). Cited (Speight 2018: 44). Distribution map (Dirickx 1994: 38, 163).

Distribution. Portugal, Spain, Algeria and Morocco.

Cheilosia parva Kassebeer, 1998

Literature record. Middle Atlas (Kassebeer 1998c: 62). Comment. Endemic to Morocco. Distribution. Morocco.

Cheilosia rodgersi Wainwright, 1911

Literature records. Rif (Becker and Stein 1913: 88, Claussen 1989a: 283, Claussen 1989b: 372). Listed (Claussen 1989b: 372). Cited (Speight 2018: 48). Distribution map (Dirickx 1994: 40, 166).

Distribution. Portugal, southern Spain, and Morocco.

Cheilosia ruffipes (Zetterstedt, 1843)

Literature records. Middle Atlas (Claussen and Hauser 1990: 436 as *Cheilosia soror*, Kassebeer 1998c: 65, as *Cheilosia rufipes*). Distribution map (Dirickx 1994: 42, 169). Distribution. Palaearctic.

Cheilosia scutellata (Fallén, 1817)

Literature records. Rif (Gil Collado 1929: 405, Kassebeer 1998c: 65). Middle Atlas (Kassebeer 1998c: 65). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 42, 169).

Distribution. Palaearctic.

Cheilosia variabilis (Panzer, 1798)

Literature record. Middle Atlas (Kassebeer 1998c: 65). Cited (Speight 2018: 52). Distribution. Palaearctic.

Genus FERDINANDEA Rondani, 1844

Ferdinandea fumipennis Kassebeer, 1999

Literature records. Middle Atlas (Kassebeer 1999c: 153–162). High Atlas (Kassebeer 1999c). Cited (Speight 2018: 110).

Distribution. Portugal, Spain, France, Tunisia, and Morocco.

Tribe CHRYSOGASTERINI Shannon, 1922 Genus *BRACHYOPA* Meigen, 1822

Brachyopa atlantea Kassebeer, 2000

Literature record. High Atlas (Kassebeer 2000: 141–148). Cited (Speight 2018: 9). Distribution. Southern Spain and Morocco.

Genus CHRYSOGASTER Meigen, 1803

Chrysogaster basalis Loew, 1857

Literature records. Middle Atlas (Claussen and Hauser 1990: 436, Kassebeer 1999b: 156). Distribution map (Dirickx 1994: 45, 173).

New site. High Atlas: Lac Oukaïmeden, 18/VI/2014, 1♂, sweep net, leg. Bot. Comment. New record for the High Atlas. Distribution. Western and Central Palaearctic.

Genus IGHBOULOMYIA Kassebeer, 1999

Ighboulomyia atlasi Kassebeer, 1999

Literature record. Middle Atlas (Kassebeer 1999a: 11–24).

New site. Middle Atlas: Oued d'Ifrane, 10/VI/2014, 8♂♂, 3♀♀, sweep net, leg. Bot. **Comments.** Monotypic genus *Ighboulomyia* with *Ighboulomyia atlasi*, described by Kassebeer (1999a). The genus *Ighboulomyia* was placed in the tribe Brachyopini. The genus is endemic to Morocco.

Distribution. Morocco.

Genus MYOLEPTA Newman, 1838

Myolepta difformis Strobl, 1909

Literature records. High Atlas (Dirickx 1994: 93, as *Myolepta philonis*, Reemer et al. 2004: 558, 567). Cited (Speight 2018: 162).

Distribution. Portugal, Spain, Algeria, Tunisia, and Morocco.

Genus NEOASCIA Williston, 1886

Neoascia clausseni Hauser and Kassebeer 1998

Literature records. Rif (Gil Collado 1929: 40, as *Neoascia podagrica*). Central Plateau (Părvu et al. 2006: 275). High Atlas (Hauser and Kassebeer 1998: 38–42). Listed (Claussen 1989b: 373, as *Neoascia podagrica*). Distribution map (Dirickx 1994: 94, 244).

New sites. Rif: Oued Jnane Niche, 14/VI/2013, 1° ; Oued Majjou (Hafa meqlouba), 10/V/2014, 1° , sweep net, leg. Sahib and Belqat.

Distribution. Algeria, Tunisia, and Morocco.

Genus ORTHONEVRA Macquart, 1829

Orthonevra bouazzai Kassebeer, 1999

Literature record. Middle Atlas (Kassebeer 1999a: 158–161). Comment. Endemic to Morocco. Distribution. Morocco.

Orthonevra brevicornis (Loew, 1843) (Fig. 2)

New record. Rif: Aïn Afersiw (Fig. 3), 11/VI/2013, 1♀, sweep net, leg. Sahib and Belqat.
Comment. New record for Morocco. In North Africa, the species was known only from Algeria (Djellab et al. 2013: 6). It prefers forests and wet woodland, standing-water bodies and flushes among *Quercus* forest, humid *Pinus sylvestris* forest and wet *Salix* woodland. It visits flowers such as Apiaceae, *Cornus, Crateagus, Malus, Pyrus communis, Ranunculus, Rorippa, Salix* (Speight 2018) in sunlit glades among woodland. The species is collected in the present study in a pond surrounded by Conifer reforestation, with the edges overgrown by grasses and herbaceous vegetation including fern, *Rubus* and *Cistus monspeliensis*.

Distribution. Western and Central Palaearctic.

Orthonevra elegans (Meigen, 1822)

Literature records. Rif (Becker and Stein 1913: 87). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 96, 246).

Distribution. Palaearctic.

Orthonevra schachti Claussen, 1989

Literature records. High Atlas (Claussen 1989b, Dirickx 1994: 97, Kassebeer 1999a: 160).

Comments. Endemic to Morocco. **Distribution.** Morocco.



Figure 2. Orthonevra brevicornis, female, lateral view.

Genus RIPONNENSIA Maibach, Goeldin and Speight 1994

Riponnensia longicornis (Loew, 1843)

Literature records. Central Plateau (Séguy 1961: 23, as *Orthonevra longicornis*). High Atlas (Kanervo 1939: 2, as *Orthonevra longicornis*, Kassebeer 1999a: 162). Middle Atlas (Kassebeer 1999a: 162). Cited (Speight 2018: 224). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 97, 247).

Distribution. Mediterranean Basin.

Riponnensia splendens (Meigen, 1822)

Literature records. Rif (Gil Collado 1929: 405, as *Chrysogaster splendens*). Middle Atlas (Kassebeer 1999a). High Atlas (Claussen 1989b, as *Orthonevra splendens*, Kassebeer 1999a: 162). Recorded and listed (Claussen 1989b: 363, 373). Distribution map (Dirickx 1994: 97, 248 (as *Orthonevra splendens*)).

New site. Middle Atlas: Douar Zaouiat Cheikh, 19/III/2008, 2♂♂, sweep net, leg. A. van Eck.

Distribution. Western Palaearctic.

Tribe ERISTALINI Newman, 1834 Genus *ANASIMYIA* Schiner, 1864

Anasimyia contracta Claussen and Torp, 1980

Literature record. Middle Atlas (Kassebeer 1998a: 22). Distribution. Western Palaearctic.



Figure 3. Habitat of Orthonevra brevicornis: Aïn Afersiw environment.

Genus ERISTALINUS Rondani, 1845

Eristalinus aeneus (Scopoli, 1763)

Literature records. Rif (Becker and Stein 1913: 86, as *Lumpetia aenea*, Gil Collado 1929: 406, 407 (as *Eristalis aeneus*), Leclercq 1961: 242, as *Eristalis aeneus*. Central Plateau (Timon-David 1951: 146, as *Lathyrophtalmus aeneus*, Gil Collado 1929, Séguy 1930: 129, as *Lathyrophtalmus aeneus*. High Atlas (Kanervo 1939: 5, as *Lathyrophtalmus aeneus*, Gill Collado 1929). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 53, 54, 190).

New sites. Rif: Jumb Kitane, 05/IV/2015, 1° , sweep net, leg. Sahib and Belqat. High Atlas: Vicinity of Asni, 05/VI/2014, 1° , sweep net, leg. Bot.

Distribution. Holarctic, Afrotropical, Oriental, and Australasian regions.

Eristalinus megacephalus (Rossi, 1794)

Literature records. Rif (Becker and Stein 1913: 85, as *Eristalis quinquelineatus*, Gil Collado 1929: 407, as *Eristalis quinquelineatus*). Central Plateau (Séguy 1930: 129, as *Lathyrophthalmus quinquelineatus*). Cited (Séguy 1961: 200). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 54, 190).

Distribution. Western Palaearctic and Afrotropical regions.

Eristalinus sepulchralis (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 85, as *Eristalis sepulchralis*, Gil Collado 1929: 406, as *Eristalis sepulchralis*). Central Plateau (Gil Collado 1929). High Atlas (Claussen 1989b: 366, 372). Distribution map (Dirickx 1994: 54, 191).

Distribution. Palaearctic and India.

Eristalinus taeniops (Wiedemann, 1818)

Literature records. Rif (Becker and Stein 1913: 85, as *Eristalis taeniops*). Central Plateau, High Atlas (Séguy 1930: 130). Middle Atlas (Leclercq 1961: 243). Listed (Claussen 1989b: 372). Cited (Speight 2018: 79). Distribution map (Dirickx 1994: 55, 191).

New sites. Rif: Oued Martil, 13/XII/2013, 1 \bigcirc ; Halouma Kitane, 1/I/2015, 1 \bigcirc , sweep net, leg. Sahib and Belqat; Oued Sidi Yahya Aârab, 3/II/2015, 2 \bigcirc \bigcirc , 1 \bigcirc . Middle Atlas: Bridge Oued Oum Er-rabie (Douar Ahl Souss), 17/V/2017, 1 \bigcirc , reared by Sahib and Belqat.

Distribution. Palaearctic, Oriental, and Afrotropical regions.

Genus ERISTALIS Latreille, 1804

Eristalis arbustorum (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 85, Gil Collado 1929: 407, Kanervo 1939: 4). Central Plateau (Timon-David 1951: 146). Middle Atlas (Claussen 1989b: 366, Timon-David 1951: 146, Séguy 1930: 129). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 55, 192).

New sites. Rif: Aïn Sidi Brahim Ben Arrif, 25/IV/2014, 1 \bigcirc , sweep net, leg. Sahib and Belqat. Middle Atlas: Vicinity of Ifrane, 7/VI/2014, 1 \bigcirc , sweep net, leg. Bot. High Atlas: Vicinity of Asni, 05/VI/2014, 2 \bigcirc \bigcirc , 07/VI/2014, 1 \bigcirc ; Lac Oukaïmeden, 18/VI/2014, 3 \bigcirc \bigcirc , 19/VI/2014, 1 \bigcirc , 1 \bigcirc , sweep net, leg. Bot. Anti Atlas: Douar Issafen, 12/IV/2015, 1 \bigcirc ; Douar Issafen, 14/IV/2015, 2 \bigcirc \bigcirc , sweep net, leg. Schmid-Egger.

Comment. New records for the High Atlas and the Anti Atlas.

Distribution. Holarctic and Oriental regions.

Eristalis pertinax (Scopoli, 1763)

Literature records. Central Plateau, Middle Atlas, High Atlas (Séguy 1930: 130). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 56, 194).

Distribution. Western Palaearctic.

Eristalis similis (Fallén, 1817)

Literature records. Rif (Gil Collado 1929: 407, as *Eristalis pratorum*). High Atlas (Claussen 1989b: 366, 372). Cited (Séguy 1961: as *Eristalis pratorum*). Distribution map (Dirickx 1994: 56, 195).

New sites. Rif: Forest house, 18/V/2014, 13, 299, sweep net, leg. Sahib and Belqat. High Atlas: Douar Zaouiat Cheikh, 19/III/2008, 13, sweep net, leg. AvEck; Lac Oukaïmeden, 19/VI/2014, 19, sweep net, leg. Bot.

Distribution. Palaearctic.

Eristalis tenax (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 85, as *Erystalomyia tenax*, Gil Collado 1929: 407, Kanervo 1939: 5, Leclercq 1961: 242). Central Plateau (Gil Collado 1929: 407, Timon-David 1951, as *Erystalomyia tenax*). Middle Atlas (Kanervo 1939, Timon-David 1951: 146, Leclercq 1961). High Atlas (Gil Collado 1929, Kanervo 1939, Timon-David 1951). Anti Atlas (Séguy 1949: 156, Timon-David 1951: 146). Cited (Séguy 1930: 130). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 57, 195).

New sites. Rif: Village Sebt Zinnat, 15/III/2008, 1 \bigcirc ; Belyounech, 9/V/2013, 1 \bigcirc ; Aïn Takhninjoute, 17/V/2014, 2 \bigcirc \bigcirc ; Forest house, 18/V/2014, 1 \bigcirc ; Jumb Kitane, 18/IV/2018, 1 \bigcirc ; Meadow Fahs Lmhar, 15/IV/2018, 2 \bigcirc \bigcirc , sweep net, leg. Sahib and Belqat. High Atlas: Douar Zaouiat Cheikh, 19/III/2008, 1 \bigcirc , sweep net, leg. AvEck; Vicinity of Asni, 05/VI/2014, 1 \bigcirc , sweep net, leg. Bot; Lac Oukaïmeden, 18/VI/2014, 2 \bigcirc \bigcirc , sweep net, leg. Bot.

Distribution. Cosmopolitan, except Antarctica.

Genus HELOPHILUS Meigen, 1822

Helophilus trivittatus (Fabricius, 1805)

Literature records. Rif (Becker and Stein 1913: 86, Gil Collado 1929: 407). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 70, 209).

Distribution. Palaearctic.

Genus MALLOTA Meigen, 1822

Mallota cimbiciformis (Fallen, 1817)

Literature records. Rif (Becker and Stein 1913: 85, as *Mallota eristaloides*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 73, 213).

Distribution. Western and Central Palaearctic.

Mallota dusmeti Andreu, 1926

Literature records. High Atlas (Kassebeer 1998a: 23). Distribution. Portugal, central Spain, Tunisia, and Morocco. Genus *MELANOGASTER* Róndani, 1857

Melanogaster lindbergi Kassebeer, 1999

Literature records. Rif (Becker and Stein 1913: 87, as *Chrysogaster macquarti*). Middle Atlas (Kanervo 1939: 2, as *Chrysogaster viduata*, Kassebeer 1999a: 158). Cited (Séguy 1961: 27, 28 (as *Chrysogaster viduata*)). Listed (Claussen 1989b: 372, as *Chrysogaster lucida*). Distribution map (Dirickx 1994: 46, 175 (as *Chrysogaster viduata*)).

Comment. Endemic to Morocco.

Distribution. Morocco.

Genus MYATHROPA Rondani, 1845

Myathropa florea (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 85, Gil Collado 1929: 407). Middle Atlas (Séguy 1930, Claussen 1989b: 366). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 92, 240).

New site. Rif: Oued 15 km from Fifi, 6/V/2014, 1° , sweep net, leg. Sahib and Belqat. **Distribution.** Palaearctic.

Genus PARHELOPHILUS Girschner, 1897

Parhelophilus versicolor (Fabricius, 1794)

Literature records. Central Plateau (Gil Collado 1929: 407, as *Helophilus versicolor*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 104, 258). Distribution. Palaearctic.

Tribe EUMERINI Smirnov, 1924 Genus *EUMERUS* Meigen, 1822

Eumerus amoenus loew, 1848

Literature records. Cited (Séguy 1961: 207, Speight 2018: 87). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 57, 196).

New sites. High Atlas: Douar Aourir, 8/IV/2015, 233. Anti Atlas: Beach of Tamelallt, 9/IV/2015, 13, sweep net, leg. Schmid-Egger.

Comment. New records for the Anti Atlas.

Distribution. Palaearctic.

Eumerus barbarus (Coquebert, 1804)

Literature records. Rif (Gil Collado 1929: 412, as *Eumerus australis*, Becker and Stein 1913: 86). Middle Atlas (Claussen 1989b: 363). High Atlas (Gil Collado 1929: 412). Cited (Séguy 1961: 208, Speight 2018: 88). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 58, 196).

Distribution. Mediterranean Basin.

Eumerus basalis Loew, 1848

Literature records. Middle Atlas (Séguy 1930: 130, as *Eumerus angusticornis*). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 58, 197). Distribution. Western Palaearctic.

Eumerus caballeroi Gil-Collado, 1929

Literature records. Central Plateau (Gil Collado 1929: 412–414). Listed Claussen (1989b: 372). Cited (Speight 2018: 89). Distribution map (Dirickx 1994: 59, 197). Distribution. Spain and Morocco.

Eumerus hungaricus Szilády, 1940

Literature record. Cited (Speight 2018: 92). **Distribution.** Mediterranean Basin.

Eumerus lunatus (Fabricus, 1794)

Literature records. Rif (Becker and Stein 1913: 86, as *Eumerus lunalatus*, Leclercq 1961: 243). Listed (Claussen1989b: 372). Cited (Speight 2018: 94). Distribution map (Dirickx 1994: 62, 200).

Distibution. Afrotropical Region, Morocco. The Europe records require confirmation.

Eumerus melotus (Séguy, 1941)

Literature records. High Atlas (Séguy 1941: 13, as *Lampetia melota*). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 62).

Comments. Endemic to Morocco. **Distribution.** Morocco.

Eumerus nudus Loew, 1848

Literature records. Rif (Becker and Stein 1913: 86). Cited (Speight 2018: 95). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 64, 201).

Distribution. Mediterranean Basin, Romania, and former Yugoslavia.

Eumerus obliquus (Fabricius, 1805) (Fig. 4)

New records. Rif: Oued Jnane Niche (Fig. 5), 25/IV/2015, 1³, sweep net, leg. Sahib and Belqat. Eastern region: Oued El Khemis (Fig. 6), 11/IX/2013, 1³, sweep net, leg. Sahib and Belqat.

Comments. New to Morocco. *E. obliquus* was recorded from Egypt (Steyskal and El-Bialy 1967, Peck 1988). The species is found in open ground, thinly vegetated, semi-arid dry grassland, often along the margins of seasonal rivers; it feeds from the juice of ripe, fallen fruits of *Opuntia* (Speight 2018). In Morocco, we collected adults by sweeping the vegetation around lotic habitats. As stated in the literature, we found the species in the margins of a temporary river. The wet section was reduced to a thin layer of water. Riparian vegetation consisted primarily of *Opuntia ficus indica* (Fig. 5), of *Nerium oleander*, and herbaceous vegetation. The second habitat was also a river flowing towards oued Moulouya with predominant vegetation consisted of *Olea europea*, *Citrus sinensis*, *Citrus reticulata*, *Punica granatum*, and *Eucalyptus*.

Distribution. Mediterranean Basin, the Canaries, Afrotropical, Malagasy, Australasian regions.

Eumerus ornatus Meigen, 1822

Literature records. Middle Atlas (Séguy 1930: 130). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 64, 202).



Figure 4. Eumerus obliquus, male, lateral view.



Figure 5. Habitat of *Eumerus obliquus*: Oued Jnane Niche environment.

Distribution. Western Palaearctic.

Eumerus pulchellus Loew, 1848

Literature records. Cited (Séguy 1961: 211). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 65, 203). Distribution. Western Palaearctic.

Eumerus punctifrons Loew, 1857

Literature records. Rif (Leclercq 1961: 243). Listed (Claussen 1989: 372). Distribution map (Dirickx 1994: 65, 203).

Distribution. Afrotropical Region, southern part of the Mediterranean Basin.

Eumerus pusillus Loew, 1848

Literature records. High Atlas (Claussen 1989b: 363, 372). Distribution map (Dirickx 1994: 66, 203).

Distribution. Mediterranean Basin.



Figure 6. Habitat of Eumerus obliquus: Oued El Khemis environment.

Eumerus sabulonum (Fallén, 1817)

Literature records. Cited (Séguy 1961: 212). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 66, 204).

Distribution. Western Palaearctic.

Eumerus schmideggeri Van Steenis, Hauser and Van Zuijen, 2017

Literature record. Anti Atlas (Van Steenis et al. 2017: 155–158). Distribution. Algeria, Tunisia, and Morocco.

Eumerus strigatus (Fallén, 1817)

Literature records. Rif, High Atlas (Kanervo 1939: 5). Central Plateau (Timon-David 1951: 147). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 67, 205). Distribution. Palaearctic, North America, Australia, and New Zealand.

Eumerus subornatus Claussen, 1989

Literature records. High Atlas (Claussen 1989b: 364, 365, 372). Cited (Speight 2018: 100). Distribution map (Dirickx 1994: 68). Distribution. Portugal, France, Spain, and Morocco.

Eumerus truncatus Rondani, 1868

Literature records. Anti Atlas (Van Steenis et al. 2017: 160). Cited (Speight 2018: 102).

Distribution. Portugal, Spain, Greece, Italy, Tunisia, and Morocco.

Genus PLATYNOCHAETUS Wiedemann, 1830

Platynochaetus rufus Macquart, 1835

Literature records. Central Plateau (Gil Collado 1929: 407). Distribution map (Dirickx 1994: 113, 271).

Distribution. Maltese islands, Algeria, and Morocco.

Platynochaetus setosus (fabricius, 1794)

Literature records. High Atlas (Gil Collado 1929: 407). Listed (Claussen 1989b: 373). Cited (Speight 2018: 217). Distribution map (Dirickx 1994: 114, 272). Distribution. Western part of the Mediterranean Basin.

Tribe MERODONTINI (Edwards, 1915) Genus *MERODON* Meigen, 1803

Merodon aberrans Egger, 1860

Literature records. Cited (Séguy 1961: 174, as *Lampetia aberrans*, Speight 2018: 132). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 77, 220). Distribution. Western Palaearctic.

Merodon arrasus Beck, 1921

Literature records. Rif (Becker 1921: 54, 55). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 78, 222).

Distribution. Tunisia, Algeria, and Morocco.

Merodon bequaerti Hurkmans, 1993

Literature records. Middle Atlas; Eastern region (Vujić et al. 2020: 98).

Comments. *Merodon bequaerti* belongs to the *Merodon serrulatus* species group (Vujić et al. 2020: 81); this species could be *Merodon alexeji* (Hurkmans 1993: 163). **Distribution.** Algeria, Tunisia, Libya, and Morocco.

Merodon biarcuatus Curran, 1939

Literature records. Central Plateau (Curran 1939: 6, 7). Listed (Claussen 1989b: 373). Cited (Speight 2018: 137). Distribution map (Dirickx 1994: 79). Distribution. France, Italy, Greece, Turkey, and Morocco.

Merodon cabanerensis Marcos-García, Vujić and Mengual, 2007

Literature records. High Atlas (Vujić et al. 2018: 113, 114, 135). Cited (Speight 2018: 137).

Distribution. Spain and Morocco.

Merodon chalybeus Wiedemann in Meigen, 1822

Literature records. Central plateau (Timon-David 1951: 146, as *Lampetia spicata*). Cited (Claussen 1989b: 365, 373 (as *Merodon spicatus*), Marcos-García et al. 2007: 546, Speight 2018: 138). Cited (Speight 2018: 138). Distribution map (Dirickx 1994: 87, 233).

Distribution. Mediterranean Basin.

Merodon clavipes (Fabricius, 1781)

Literature records. Cited (Hurkmans 1993: 178, 230, Marcos-García et al. 2007: 548, Speight 2018: 138).

Distribution. Western Palaearctic.

Merodon constans (Rossi, 1794)

Literature records. Rif (Becker and Stein 1913: 86, as *Lampetia constans*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 81, 226).

Distribution. Western Palaearctic.

Merodon distinctus Palma, 1863

Literature records. Middle Atlas, Central Plateau (Timon-David 1951: 146, as *Lampe-tia distincta*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 81, 226). Distribution. Mediterranean Basin.

Merodon elegans Hurkmans, 1993

Literature records. Central Plateau (Hurkmans 1993: 195). Cited (Speight 2018: 141). Distribution. Western part of Mediterranean Basin.

Merodon eques Fabricius, 1805

Literature records. Cited (Séguy 1961: 178, as *lampetia eques*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 81, 227).

Distribution. Mediterranean Basin.

Merodon equestris (Fabricius, 1794)

Literature records. Central Plateau (Fabricius 1805: 240, as *Eristalis ferrugineus*). Cited (Séguy 1961: 178, 179 (as *Lampetia equestris*)). Listed (Claussen 1989: 373). Distribution map (Dirickx 1994: 81, 227).

Distribution. Holarctic.

Merodon escalerai Gil Collado, 1929

Literature records. Central Plateau (Gil Collado 1929: 408, 409). Listed (Claussen 1989b: 373). (Dirickx 1994: 82).

Distribution. Spain and Morocco.

Merodon geniculatus Strobl, 1909

Literature records. Rif (Gil Collado 1929: 408). Listed (Claussen 1989b: 365, 373). Cited (Speight 2018: 144). Distribution map (Dirickx 1994: 83, 229).

New Site. High Atlas: Lac Oukaïmeden, 18/VI/2014, 233, 19, 19/VI/2014, 633, sweep net, leg. Bot.

Comment. New record for the High Atlas. **Distribution.** Mediterranean Basin.

Merodon ibericus Vujíc, 2015

Literature records. Rif (Becker and Stein 1913: 86, as *Lampetia spinipes*, Gil Collado 1929: 409, as *Merodon spinipes* var. *avidus*, Kanervo 1939: 5). Central Plateau (Séguy 1930: 130, Timon-David 1951: 146, as *Lampetia spinipes*). Middle Atlas (Séguy 1930: 130, Kanervo 1939: 5, as *Lampetia spinipes* var. *avida*, Popović et al. 2015: 796, Acanski et al. 2016: 3). High Atlas (Gil Collado 1929, Claussen 1989b). Cited (Séguy 1961: 176, as *Lampetia avida*, Speight 2018: 145). Listed (Claussen 1989: 365, 373). Distribution map (Dirickx 1994: 79, 223).

New site. High Atlas: Lac Oukaïmeden, 18/VI/2014, 13, 19, 19/VI/2014, 13, sweep net, leg. Bot.

Distribution. Portugal, Spain, and Morocco.

Merodon italicus Rondani, 1845

Literature records. Middle Atlas (Claussen and Hauser 1990: 437, as *Merodon longicornis*). Distribution map (Dirickx 1994: 84, 230).

Distribution. Mediterranean Europe, southern Russia, Lebanon, and Morocco.

Merodon maroccanus Gil Collado, 1929

Literature records. Central Plateau (Gil Collado 1929: 410, 411). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 84).

Comments. Endemic to Morocco. **Distribution.** Morocco.

Merodon minutus Strobl, 1893

Literature records. Middle Atlas (Séguy 1961: 180, as *lampetia minutus*). Listed (Claussen 1989b: 373). Cited (Speight 2018: 149). Distribution map (Dirickx 1994: 84, 230).

Distribution. Southern France around the Mediterranean coast to the Balkan Peninsula.

Merodon murorum (Fabricius, 1794)

Literature records. Central Plateau (Fabricius 1794: 288, as *Syrphus murorum*, Meigen 1830: 354, as *Merodon auripilus*). High Atlas (Séguy 1941: 13, as *Lampetia auripila*). Cited (Séguy 1961: 176). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 79, 222).

Comments. Revised by Vujić et al. (2018: 123–125). *Merodon auripilus* is a junior synonym of *M. murorum*.

Distribution. Algeria, Tunisia, and Morocco.

Merodon pruni (Rossi, 1790)

Literature records. Rif (Becker and Stein 1913: 86, as *Lampetia pruni*, Gil Collado 1929: 407, 408 (as *Merodon pruni* var. *obscurus*)). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 85, 231).

Distribution. Western Palaearctic, including Turkmenistan and Iraq.

Merodon pumilus Macquart, 1849

Literature records. Rif (Becker and Stein 1913: 86, as *Lampetia aenea*, Kanervo 1939: 5, as *Lampetia aenea*, Ebejer et al. 2019: 150). Central Plateau (Gil Collado 1929:

407). Middle Atlas (Séguy 1930: 130). Cited (Séguy 1961: 174). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 77, 220).

Distribution. Spain, Algeria, and Morocco.

Merodon rufus Meigen, 1838

Literature records. Rif (Becker and Stein 1913: 86, as *Lampetia rufa*). Listed (Claussen 1989b: 373). Distribution (Dirickx 1994: 86, 232).

Distribution. Western and Central Palaearctic.

Merodon segetum (Fabricius, 1794)

Literature records. Cited (Peck 1988: 173). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 86, 232).

Distribution. Spain, Gibraltar, Macedonia, Crete, Algeria, and Morocco.

Merodon sophron Hurkmans, 1993

Literature records. Middle Atlas (Hurkmans 1993: 168, Vujic et al. 2020: 135–137). Comment. Endemic to Morocco. *Merodon sophron* is one of the 13 species belonging to the *Merodon serrulatus* species group. It is redefined and redescribed by Vujic et al. (2020) on the material from the type locality of Azrou.

Distribution. Morocco.

Merodon tangerensis Hurkmans, 1993

Literature record. Rif (Hurkmans 1993: 172). Comment. Endemic to Morocco. Distribution. Morocco.

Merodon tricinctus Sack, 1913

Literature records. High Atlas, Anti Atlas (Kassebeer 1998a: 24). Middle Atlas (Timon-David 1951: 146, as *Lampetia tricincta*). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 88, 234).

Distribution. Western Palaearctic.

Merodon unguicornis Strobl 1909 (Fig. 7)

Literature record. Middle Atlas (Ebejer et al. 2019: 150).

New site. Rif: Forest house, 17/V/2014, 1° , sweep net, leg. Sahib and Belqat. **Comment.** New record for the Rif. *M. unguicornis* was cited for the first time in Mo-

rocco by Ebejer et al. (2019). In the present work, the female was collected at the locality of Forest house environment (Fig. 8), crossed by a spring and a brook and where the most



Figure 7. Merodon unguicornis, female, lateral view.

predominant vegetation was formed by *Abies marocana*, *Pinus negra*, *Pinus pinaster*, *Cedrus atlantica* and *Berberis hispanica*. Collected on a misty day, as visualized in Figure 8.

Distribution. Spain and Morocco.

Genus PSILOTA Meigen, 1822

Psilota atra (Fallén, 1817)

Literature records. High Atlas (Kassebeer 1995b: 395–400, as *Psilota toubkalana*). Cited (Smit and Vujić 2008: 350, Speight 2018: 220).

New Site. Middle Atlas: Douar Zaouiat Cheikh, 19/III/2008, 1 \bigcirc , sweep net, leg. A. van Eck.

Comment. New record for the Middle Atlas. **Distribution.** Europe and Morocco.

Tribe VOLUCELLINI Newman, 1834 Genus *VOLUCELLA* Geoffroy, 1762

Volucella inanis (Linnaeus, 1758)

Literature records. Middle Atlas (Claussen and Hauser 1990: 436). Distribution map (Dirickx 1994: 126, 289).



Figure 8. Habitat of Merodon unguicornis: Forest house environment.

Distribution. Palaearctic.

Volucella liquida Erichson in Wagner, 1841

Literature records. Rif (Gil Collado 1929: 406, Leclercq 1961: 242). Central Plateau (Timon-David 1951: 146, Séguy 1930: 129). Middle Atlas (Kanervo 1939: 4, Timon-David 1951: 146, Séguy 1953: 84, Leclercq 1961). High Atlas (Séguy 1930: 129). Listed (Claussen 1989b: 374). Distribution (Dirickx 1994: 127, 289).

New site. Rif: Jumb Kitane, 19/IX/2017, 1^{\bigcirc} , sweep net, leg. Sahib and Belqat. **Distribution.** Algeria and Morocco.

Volucella zonaria (Poda, 1761)

Literature records. Central Plateau (Séguy 1930: 129). Listed (Claussen 1989b: 374). Distribution map (Dirickx 1994: 127, 290).

Distribution. Palaearctic.

Tribe XYLOTINI Bigot, 1883 Genus *BRACHYPALPUS* Macquart, 1834

Brachypalpus valgus (Panzer, 1798)

Literature records. High Atlas, Middle Atlas (Kassebeer 1998a: 22). Distribution. Western Palaearctic.

Genus MILESIA Latreille, 1804

Milesia crabroniformis (Fabricius, 1775)

Literature records. Middle Atlas (Claussen and Hauser 1990: 437). Distribution map (Dirickx 1994: 92, 240).

Distribution. Europe, Turkey, Georgia, and Morocco.

Genus SPILOMYIA Meigen, 1803

Spilomyia maroccana Kuznetsov, 1997

Literature records. Rif (Becker and Stein 1913: 86, as *Spilomyia digitate*, Kuznetzov 1997: 203–205). High Atlas (Claussen 1989b: 366). Listed (Claussen 1989b: 373, as *Spilomyia digitata*). Distribution map (Dirickx 1994: 123, 283 (as *Spilomyia digitata*)). Distribution. Algeria and Morocco.

Genus SYRITTA Lepeletier and Serville, 1828

Syritta flaviventris Macquart, 1842

Literature records. Central Plateau (Claussen 1989b: 366). Listed (Claussen 1989b: 373). Distribution map (Dirickx 1994: 123, 284).

New site. Eastern region: Farm Saf-Saf, 14/VI/2013, 1 \bigcirc , 1 \bigcirc , sweep net, leg. Sahib and Belqat.

Comment. New record for the Eastern region.

Distribution. Mediterranean Basin, Nearctic, Neotropical, Afrotropical regions, Madagascar and the Mascarene islands.

Syritta pipiens (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 88, Gill Collado 1929: 412, Kanervo 1939: 5). Central Plateau (Séguy 1930: 130, Timon-David 1951, Pârvu et al. 2006: 275). Middle Atlas (Séguy 1930). High Atlas (Timon-David 1951: 146, Claussen 1989b: 366). Listed (Claussen 1989b: 373). Distribution map (Dirickx 994: 124, 285).

New sites. Rif: Bni Maaden, 5/XI/2013, 13; Dam Moulay Bouchta, 5/IV/2014, 19; Oued El Koub, 30/V/2014, 13, 19; Douar Kitane, 18/VI/2014, 299; Oued Majjou (Hafa meqlouba), 27/IV/2015, 13, sweep net, leg. Sahib and Belqat. Eastern region: Farm Saf-Saf, 14/VI/2013, 433, sweep net, leg. Sahib and Belqat. Middle Atlas: Vicinity of Ifrane, 09/VI/2014, 19, sweep net, leg. Bot. High Atlas: Vicinity of Asni, 07/VI/2014, 533; Tizi N'Test, 15/VI/2014, 13, sweep net, leg. Bot. Anti Atlas: Oued Assa, 21/V/2015, 13, sweep net, leg. Sahib and Belqat.

Comment. New records for the Eastern region and the Anti Atlas. **Distribution.** Holarctic, South America, and Indomalayan Region.

Genus TEMNOSTOMA Lepeletier and Serville, 1828

Temnostoma bombylans (Fabricius, 1805)

Literature records. Middle Atlas (Séguy 1961: 155). Listed (Claussen 1989b: 374). Distribution map (Dirickx 1994: 125, 286).

Distribution. Palaearctic.

Genus XYLOTA Meigen, 1822

Xylota segnis (Linnaeus, 1758)

Literature records. Rif (Becker and Stein 1913: 86, as *Zelima (Xylota) segnis*, Gil Collado 1929: 412, Leclercq 1961: 243). High Atlas (Timon-David 1951: 147). Listed (Claussen 1989b: 372). Distribution map (Dirickx 1994: 130, 293).

New site. Rif: Aïn El Maounzil, 17/V/2014, 1; Oued El Koub, 30/V/2014, 1; Oued Sidi Ben Sâada, 6/V/2015, 1, sweep net, leg. Sahib and Belqat. High Atlas: Vicinity of Asni, 07/VI/2014, 1, sweep net, leg. Bot.

Distribution. Palaearctic and eastern North America.

Subfamily *PIPIZINAE* Mengual, Santos and Rojo 2015 Tribe PIPIZINI Williston, 1885 Genus *HERINGIA* Rondani, 1856

Heringia heringi (Zetterstedt, 1843)

Literature records. High Atlas, Middle Atlas (Kassebeer 1998a: 23). Distribution. Palaearctic.

Genus PIPIZELLA Rondani, 1856

Pipizella thapsiana Kassebeer, 1995

Literature records. High Atlas (Kassebeer 1995a: 261–263). Cited (Speight 2018: 199).

New site. Middle Atlas: Douar Zaouiat Cheikh, 19/III/2008, 1⁽²⁾, sweep net, leg. A. van Eck.

Comment. New record for the Middle Atlas. **Distribution.** Portugal and Morocco.

Genus TRIGLYPHUS Loew

Triglyphus escalerai Gil Collado, 1929

Literature records. Rif (Gil Collado 1929: 404). Cited (Speight 2018: 253). Distribution map (Dirickx 1994: 125).

Distribution. Portugal, Croatia, Montenegro, and Morocco.

Discussion

The present work provides an important contribution to the Moroccan hoverfly fauna with two species recorded for the first time for Morocco: *Eumerus obliquus* (Fabricius, 1805) and *Orthonevra brevicornis* (Loew, 1843); nine new records are provided for the Rif, five for the Middle Atlas, and seven species are recorded for the first time for the Hight Atlas, the Anti Atlas, and the Eastern Region for which we have enlarged the distribution area. The 150 Moroccan species belong to three subfamilies, 14 tribes, and 49 genera (30 genera of Eristalinae, 16 of Syrphinae, and 3 of Pipizinae).

Knowledge of the hoverfly diversity of Morocco is unequal among regions. For instance, the Middle Atlas and the High Atlas have the same number of species (69), the Rif has 68 species, the Anti Atlas has 18 species, while the Eastern region has only seven species.

Four very common Palaearctic species were collected abundantly: *Episyrphus balteatus* (156 specimens), *Sphaerophoria scripta* (146 specimens), *Eupeodes corollae* (86 specimens) and *Melanostoma mellinum* (78 specimens).

Morocco is home to 12 endemic species: two are endemic to the Rif, four to the Middle Atlas (including both an endemic genus and species (*Ighbouloumia atlasi*)), three to the High Atlas, one to the central plateau, and two species, *Platycheirus atlasi* and *Melanogaster lindbergi*, to the Middle Atlas plus the High Atlas, and to the Rif plus the Middle Atlas, respectively.

Morocco with the greatest number of total species (150), has 75% of the North African syrphid fauna. Algeria, with 91 species, has 46% of the total fauna. Tunisia, with 69, has 35% of the fauna, whereas Egypt and Libya have 51 species (26%) and 34 species (17%), respectively.

Algeria, Tunisia, Libya, and Egypt share with Morocco 71, 55, 25, and 30 species, respectively, but these numbers are likely to change and a detailed comparison must await a systematic sampling of the whole region.

Of the two Iberian Peninsula countries, Spain has the best known Syrphiidae fauna with 417 species whereas Portugal has only 195 species (Marcos-Garcia et al. 2002, Speight 2015, van Eck 2011, 2016).

These new data on the Moroccan hoverfly fauna reflect the variety of suitable habitats and suggest that many more species can yet be found in Morocco, that provides a wide variety of geographical and climatic properties. New species are also likely to be discovered by genomic prospecting using molecular approaches.

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MONOGRAPH



The world Polleniidae (Diptera, Oestroidea): key to genera and checklist of species

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Abstract

A key to the world genera and a checklist of the world species for the family Polleniidae, including distributions, are provided. The following taxonomic and nomenclatural changes are proposed: *Nitel-lia hermoniella* Lehrer, 2007 = *Pollenia mediterranea* Grunin, 1966, **syn. nov.**, *Pollenia bentalia* Lehrer, 2007 = *Pollenia semicinerea* Villeneuve, 1911, **syn. nov.**, *Dasypoda angustifrons* Jacentkovský, 1941 = *Pollenia tenuiforceps* Séguy, 1928, **syn. nov.**; *Anthracomyza* Malloch, 1928, **resurrected name** (mono-typic; type species *Anthracomyza atratula* Malloch) is considered a valid name and tentatively assigned to Polleniidae, giving *Anthracomyza atratula* (Malloch, 1927) as a **resurrected combination**; *Morinia crassitarsis* (Villeneuve, 1936), **stat. rev.** is considered a valid species, and *Micronitellia* Enderlein, 1936, **stat. nov.** is considered an available name.

Keywords

Calliphoridae, Calyptratae, catalogue, cluster flies, key, parasitoids, taxonomy

Introduction

The family Polleniidae (cluster flies) is a small group of oestroid flies comprising 147 species (Cerretti et al. 2019 and present paper). The family group name was originally proposed by Brauer and Bergenstamm (1889) to include the single genus *Pollenia* Robineau-Desvoidy. Later, the Old World *Pollenia sensu lato* (i.e., including the morphologically diverging New Zealand *Pollenia* species), the Oriental genera *Dexopollenia* Townsend and *Xanthotryxus* Aldrich, and the Nearctic genus *Melanodexia* Williston were treated in Calliphoridae as composing the subfamily Polleniinae (or tribe Polleniinii) (e.g., Hall 1965; Dear 1986; Schumann 1986; Kurahashi 1989). The group was then re-circumscribed by Rognes (1991a) to include *Morinia* Robineau-Desvoidy, *Nesodexia* Villeneuve and (tentatively) *Wilhelmina* Villeneuve, the latter being reassigned to the calliphorid subfamily Phumosiinae by Rognes (2011), which is followed here. More recently, Cerretti et al. (2019) elevated the group to full family rank and gave morphological and molecular evidence to support both the monophyly of the Polleniidae and the inclusion of six taxa previously assigned to the Rhinophoridae, namely *Alvamaja chlorometallica* Rognes and five Afrotropical species moved from the genus *Phyto* Robineau-Desvoidy into *Morinia* (Cerretti et al. 2020).

During the last few years molecular data consistently retrieved the Polleniidae (almost always represented only by Pollenia) as sister to the Tachinidae and phylogenetically distant from the 'core' Calliphoridae (e.g., Singh and Wells 2013; Winkler et al. 2015; Cerretti et al. 2017; Blaschke et al. 2018; Kutty et al. 2019; Stireman et al. 2019) but this sister group relationship has remained practically without support from morphological evidence: the currently most convincing non-molecular synapomorphy could well be the breeding habit as parasitoids of soil-dwelling invertebrates. Tachinids are parasitoids of other arthropods, and groups near the base of the family develop on soil-dwelling insect larvae (Cerretti et al. 2014; Stireman et al. 2019); the natural history and host range information of polleniids is limited to a handful of *Pollenia* species (Keilin 1915; Tawfik and El-Husseini 1971; Yahnke and George 1972; Rognes 1991a; Szpila 2003; Grzywacz et al. 2012; El Husseini 2019), and all of these develop as endoparasitoids in earthworms. Marshall (2020) observed a native New Zealand *Pollenia* displaying what can only be interpreted as oviposition behaviour, extending the ovipositor into a mixture of loose soil and organic debris. Recent field observations of adults of an unidentified species of *Melanodexia* revealed that females have a similar behaviour to that observed for several Pollenia and other parasitoids of soil-dwelling organisms: they can be seen walking frenetically on bark lying on the ground, keeping wings folded on their back (SG pers. obs. 2019, California).

We recognise 147 species of Polleniidae classified into eight genera (Fig. 1). *Pollenia* is the most species-rich and widespread genus, with 95 species described from the Palaearctic, Oriental and Australasian regions [and seven species known from the Nearctic Region as introductions (Rognes 1991a; Whitworth 2006; Jewiss-Gaines et al. 2012, Bowser 2015)] (Fig. 2). The remaining seven genera are considerably less diverse: the single species assigned to *Alvamaja* Rognes (*A. chlorometallica* Rognes) is recorded from a few localities in southeastern Europe, *Dexopollenia* comprises 21 species from the southeastern Palaearctic and the Oriental Region, the Nearctic endemic genus *Melanodexia* includes eight species, *Morinia* contains 13 species from the Afro-



Figure 1. Representative species for all genera of Polleniidae. A Alvamaja chlorometallica Rognes [Romania] B Dexopollenia cf. flava (Aldrich) [Japan: Honshu] C Melanodexia satanica Shannon [USA: California] D Morinia tsitsikamma Cerretti et al. [South Africa] E Pollenia sp. [Italy] F Xanthotryxus mongol Aldrich [China]. Photographs: Cerretti et al. (2019) (A), K. Oomori (B), P. Cerretti (E), K. Szpila (F).

tropical and Palaearctic regions and *Xanthotryxus* includes seven species from southeastern Palaearctic and the Oriental Region. The remaining genera, the monotypic Australian *Anthracomyza* Malloch and the Palaearctic *Nesodexia* Villeneuve, are here tentatively assigned to the family. Remarkably, there are no Polleniidae recorded from the Neotropical Region, neither native nor introduced. Many regional catalogues and keys to polleniid genera (and species) have been published in the recent decades (e.g., Hall 1948; James 1955, 1970, 1977; Lehrer 1972; Pont 1980; Shewell 1987; Rognes 1991a, 1998; Kurahashi 1995; Jewiss-Gaines et al. 2012; Pape et al. 2015), and an incomplete key to genera is available from Peris (2004). The aim of the present paper is to lay the foundation for future taxonomic and phylogenetic studies by producing a key to the world genera of the family Polleniidae and a checklist of the world species.

Materials and methods

Key to genera

A dichotomous key to the adults of both sexes was constructed to contain the genera here considered members of the Polleniidae. This means that we are excluding the monotypic genera *Wilhelmina* Schmitz & Villeneuve, 1932 and *Nepenthomyia* Kurahashi & Beaver, 1979, both associated with pitcher plants of the genus *Nepenthes* and not considered polleniids. *Wilhelmina* was considered a possible member of Polleniidae (or Polleniinae, or Polleniini) by Schmitz and Villeneuve (1932), Fan (1965, 1992,



Figure 2. Diversity of the genus *Pollenia*. **A** *Pollenia pediculata* Macquart [New Zealand] **B** *Pollenia pernix* (Hutton) [New Zealand] **C** *Pollenia* nr. *pernix* [New Zealand] **D** *Pollenia uniseta* Dear [New Zealand]. Photographs: S. Kerr (**A**, **B**, **D**), S. Marshall (C).
1997) and Rognes (1991a), but we follow Rognes (2011) in suggesting its reassignment to Phumosiinae. *Nepenthomyia* was considered "closely related" to *Wilhelmina* by Kurahashi and Beaver (1979), although with no indication of subfamily assignment, and a position within the Polleniinae was not accepted by Rognes (1991a). The key was constructed through direct examination of available material and from literature data. No specimens of *Anthracomyza* were examined and characters for it were derived from the original description by Malloch (1927).

Digital images of the specimens shown in Fig. 1C, D were taken using a Canon EOS 6D camera equipped with Canon Photo lens MP-E 65 mm 1.2.8 and processed by Canon Digital Photo Professional (Canon: Ōta, Tokyo, Japan), Combine ZM by Alan Hadley and GIMP 2.10.4 by Alexandre Prokoudine.

World checklist

The world checklist is based on original literature, though following the papers by Rognes (1987b, 1991a, 1998, 2010), Evenhuis et al. (2004, 2010, 2015, 2016), O'Hara et al. (2011), Cerretti et al. (2019) and literature therein. It lists all currently valid nominal genera and species of the family Polleniidae including their synonyms and associated nomina nuda. Incorrect subsequent spellings have been entered to the extent they have come to our knowledge. Valid names of taxa are arranged alphabetically according to genus and species (no subfamilial or tribal classification is recognised here). Each genus-group name is listed with author, year, page, type species with author and date, and form of type fixation with author and date. Each type species is given in its original binomen (ICZN 1999; recommendation 67B), and if that name is a junior synonym it is followed by the valid name of the species in square brackets. Each species-group name is listed with author, year, page, type locality in standardised modern spelling (original quote in parenthesis if needed to avoid confusion), and relevant nomenclatural details (homonymy, lectotype designations, etc.). Unavailable names are listed with an explanation as to their unavailability, and incorrect subsequent spellings are given with the relevant reference. New specific synonyms are based on comparisons of the original descriptions of the nominal species in question with material (specimens, photos, illustrations) available to the authors. Additional information may be given under "Remarks". Distributional data are based on the literature and online databases (Fauna Europaea [Pape et al. 2015] for Palaearctic species) but we do not refer all records to their original sources. Records have been entered to the extent they have come to our knowledge and they are reported for countries and major islands, except that larger countries are recorded at the level of state or province.

Caveat for key users

Notwithstanding strong molecular evidence suggesting the monophyly of Polleniidae, members of the group apparently do not share any unique morphological apomorphy. For this reason, it is not possible to provide a simple and clear-cut diagnosis of this oestroid family since several exceptions have to be taken into account once given a common set of characters. Therefore, we refer to Cerretti et al.'s (2019) diagnosis of the Polleniidae, though highlighting all the uncertainties related to it.

Diagnosis. Small to medium-sized oestroid flies varying from yellow to black in ground colour. Facial sclerite at least weakly carinate [with few exceptions, e.g. *Pollenia griseotomentosa* (Jacentkovský)]. Stem vein bare dorsally. Anal vein not reaching wing margin. Posterodorsal margin of hind coxa bare. Prosternum and proepisternal depression bare. Postalar wall setose (occasionally bare in small specimens of *Morinia*). Female: ovipositor sclerite length moderate; sternite 8 of ovipositor elongate with posterior margin entire; cerci long and narrow. Male: ventral and ventrolateral surface of distalmost parts of distiphallus smooth.

A comprehensive phylogeny including all the eight genera recognised as cluster flies is still awaiting, as well as a thorough revision of the family, therefore generic boundaries within this family are still labile due to the absence of molecular evidence and strong morphological characters. For these reasons, we are here applying a traditional generic division without proposing any subfamilial or tribal classification nor any new generic synonyms. We anticipate future rearrangements, such as *Dexopollenia* synonymised with *Pollenia*, or the exclusion of *Nesodexia*. Moreover, the New Zealand *Pollenia* are still entirely untouched in a phylogenetic context.

Results

Key to genera

1	Simultaneously: body ground colour entirely or largely yellow or testaceous;
	thorax (occasionally also abdomen) with sparse golden crinkly hair-like setae;
	parafacial bare below anteriormost frontal seta; subcostal sclerite with only a
	few pale setulae or without setulae among micropubescence; lower calypter
	broad Dexopollenia Townsend [in part]
_	Body ground colour prevalently black, sometimes with metallic reflec-
	tions; if abdomen largely yellow, then parafacial bare. Other combination
	of characters
2	Simultaneously: body ground colour black with metallic green or bronze-vi-
	olet reflections; parafacial bare; thorax without sparse golden crinkly hair-like
	setae; lower calypter narrow, tongue-shaped; anterior and posterior fringes
	of metathoracic spiracle subequal in size; node at base of R ₄₊₅ with 1–3 fine
	setulae; slender bodied flies
_	Body colouration without metallic reflections; if body black with bronze, green,
	blue or violet metallic reflections then other combination of characters
3	Thorax with numerous golden crinkly hair-like setae in addition to
	ground setulae
-	Thorax without golden crinkly hair-like setae7

4 Simultaneously: scutum usually with 1 + 2 intra-alar setae [0 + 2 in some New Zealand species]; hind tibia with posterodorsal preapical seta not differentiated. Parafacial setulose on nearly whole length. Body ground colour varying from metallic or non-metallic black [Palaearctic species] to metallic green/blue or violet [New Zealand species], rarely abdomen yellow [P. bicolor Robineau-Desvoidy]. Lower calypter broad. Subcostal sclerite usually with a bundle of long black or yellow setae among the micropubescence [usually absent in New Simultaneously: scutum with 0 + 2 intra-alar setae; hind tibia with anterodorsal, dorsal and posterodorsal preapical setae subequal in size. Parafacial setulose or bare. Body colouration not metallic. Lower calvpter broad or narrow. Subcostal sclerite with or without a bundle of long black or yellow setae Parafacial entirely setulose..... 5Pollenia Robineau-Desvoidy [in part, Australia] Parafacial bare or with at most a few setulae in the upper half [Palaearctic and 6 Parafacial bare except for the extreme uppermost part where a few short setulae are usually present below the anteriormost frontal seta. One or 2 presutural acrostichal setae. Two to 4 postpronotal setae. Subcostal sclerite with numerous black or yellow setulae among the micropubescence. Coxopleural streak absent. Lappets of metathoracic spiracle dark brown. Large-sized species [except for X. ludigensis Fan]......Xanthotryxus Aldrich Parafacial entirely bare below anteriormost frontal seta. One presutural acrostichal seta. Two postpronotal setae. Subcostal sclerite bare or at most with a few pale setulae among micropubescence. Coxopleural streak absent or present. Lappets of metathoracic spiracle yellow or dark. Small to medium-sized species Dexopollenia Townsend [in part] 7 Node at base of $R_{4,5}$ bare dorsally. [Lower calypter narrow. Scutum with 0 + 2 intra-alar setae. Hind tibia with 3 preapical setae (i.e., anterodorsal, dorsal and posterodorsal), all approximately the same size]......9 8 Parafacial bare. Scutum with 1 + 3 intra-alar setae and 4 postsutural acrostichal setae. Large, robust species with white microtomentose stripes on thorax and a chequered abdomen..... Nesodexia Villeneuve [tentatively assigned to Polleniidae, see below] Parafacial setulose. Scutum with 0-1 + 2 intra-alar setae, 2 or 3 postsutural acrostichal setae. Thorax and abdomen shiny black. Small to medium sized species..... ...Anthracomyza Malloch [tentatively assigned to Polleniidae, see below] 9 Two marginal scutellar setae [Old World]...... Morinia Robineau-Desvoidy Three to 5 marginal scutellar setae [New World] Melanodexia Williston

World checklist

Family Polleniidae Brauer & Bergenstamm, 1889

Polleniidae Brauer & Bergenstamm, 1889: 85 (17). Type genus *Pollenia* Robineau-Desvoidy, 1830. Without description or definition, but available "by an indication" i.e., by being formed before 1931 "from an available generic name" (ICZN 1999; articles 12.1 and 12.2.4).

Moriniini Townsend, 1919: 546. Type genus *Morinia* Robineau-Desvoidy, 1830. Melanodexiini Hall, 1948: 351. Type genus *Melanodexia* Williston, 1893.

Genus Alvamaja Rognes, 2010

Alvamaja Rognes, 2010: 4. Type species: *Alvamaja chlorometallica* Rognes, 2010, by original designation.

Alvamaja chlorometallica Rognes, 2010

- *Alvamaja chlorometallica* Rognes, 2010: 4. Type locality: Serbia, Pčinja District, Vranjska Banja.
- Distribution. Palaearctic Romania, Serbia.

Genus Dexopollenia Townsend, 1917

Dexopollenia Townsend, 1917: 201. Type species: *Dexopollenia testacea* Townsend, 1917, by original designation.

Dexopollenia aurantifulva Feng, 2004

Dexopollenia aurantifulva Feng, 2004: 806. Type locality: China, Sichuan, Ya'an, Mt. Zhougong, 1760 m.

Distribution. Palaearctic – China (Sichuan).

Dexopollenia bicolor Malloch, 1935

Dexopollenia bicolor Malloch, 1935: 671. Type locality: Malaysia, Perak, Bukit Larut (Larut Hills).

Pollenia mallochi Blackith, 1991: 271. Unnecessary new replacement name for Dexopollenia bicolor Malloch, 1935.

Distribution. Oriental – Malaysia (West Malaysia), Thailand.

Dexopollenia bicoloripes Malloch, 1931

Dexopollenia bicoloripes Malloch, 1931: 199. Type locality: Malaysia, Selangor, Bukit Kutu.

Distribution. Oriental – Malaysia (West Malaysia).

Dexopollenia chrysothrix Bezzi, 1927

Dexopollenia chrysothrix Bezzi, 1927: 231. Type locality: Australia, New South Wales, Kiuskin [sic] (locality not found).

Distribution. Australasian – Australia (New South Wales).

Dexopollenia disemura Fan & Deng, 1993

Dexopollenia disemura Fan & Deng in Fan, Feng & Deng, 1993: 201. Type locality: China, Sichuan, Mt. Emei, Jinding.

Distribution. Palaearctic – China (Sichuan).

Dexopollenia fangensis Kurahashi, 1995

Dexopollenia fangensis Kurahashi, 1995: 141. Type locality: Thailand, Fang, Doi Huai Hwer, 1231 m.

Distribution. Oriental – Thailand, Vietnam.

Dexopollenia flava (Aldrich, 1930)

Lispoparea flava Aldrich, 1930: 5. Type locality: China, Sichuan, Mt. Emei.

Distribution. Oriental – India, Taiwan. Palaearctic – China (Sichuan), Japan (Honshu).

Dexopollenia geniculata Malloch, 1935

Dexopollenia geniculata Malloch, 1935: 671. Type locality: China, Sichuan, Mt. Emei.

Distribution. Oriental – China (Yunnan), Laos. Palaearctic – China (Sichuan).

Dexopollenia hirtiventris Malloch, 1935

Dexopollenia hirtiventris Malloch, 1935: 669. Type locality: Malaysia, Pahang, Bukit Fraser (= Fraser's Hill).

Distribution. Oriental – Malaysia (West Malaysia).

Dexopollenia luteola (Villeneuve, 1927)

Pollenia luteola Villeneuve, 1927: 393. Type locality: Taiwan, Kosempo and Taihorinsho.

Distribution. Oriental – Taiwan.

Dexopollenia maculata (Villeneuve, 1933)

Lispoparea maculata Villeneuve, 1933b: 196. Type locality: China, Sichuan, Mt. Emei.

Distribution. Oriental – Taiwan. Palaearctic – China (Sichuan).

Dexopollenia monsdulitae (Senior-White, Aubertin & Smart, 1940)

Pollenia monsdulitae Senior-White, Aubertin & Smart, 1940: 131. Type locality: Malaysia, Sarawak, Mt. Dulit, 1219 m.

Distribution. Oriental – Malaysia (Sabah, Sarawak).

Dexopollenia nigra Kurahashi, 1987

Dexopollenia nigra Kurahashi, 1987: 66. Type locality: Papua New Guinea, Southern Highlands, Margarima, Walk River.

Distribution. Australasian – Papua New Guinea.

Dexopollenia nigriscens Fan, 1992

Dexopollenia nigriscens Fan, 1992: 530. Type locality: China, Xizang, Bomi, Yegong, 3050 m.

Distribution. Oriental – Nepal. Palaearctic – China (Xizang).

Dexopollenia papua Kurahashi, 1987

Dexopollenia papua Kurahashi, 1987: 64. Type locality: Papua New Guinea, Southern Highlands, Margarima ("Margarima Farm"), 2000 m.

Distribution. Australasian – Papua New Guinea.

Dexopollenia sakulasi Kurahashi,1987

- *Dexopollenia sakulasi* Kurahashi, 1987: 68. Type locality: Papua New Guinea, Sandaun Province (= West Sepik Province), Torricelli Mts, 900 m.
- **Distribution.** Australasian Papua New Guinea.

Dexopollenia testacea Townsend, 1917

Dexopollenia testacea Townsend, 1917: 201. Type locality: India, Assam, Mangaldai District, Assam-Bhutan Frontier, Jany [sic] (locality not found).

Distribution. Oriental – India, Nepal.

Dexopollenia tianmushanensis Fan, 1997

Dexopollenia tianmushanensis Fan in Fan (Ed.), 1997: 430. Type locality: China, Zhejiang, Mt. Tianmushan.

Distribution. Palaearctic – China (Zhejiang).

Dexopollenia trifascia (Walker, 1861)

Musca trifascia Walker, 1861: 245. Type locality: Indonesia, Western New Guinea (= Irian Jaya), Dorey.

Distribution. Oriental – Indonesia (Western New Guinea).

Dexopollenia uniseta Fan, 1992

Dexopollenia uniseta Fan in Fan (Ed.), 1992: 529. Type locality: China, Xizang, Cuona. *Dexopollenia wyatti* Kurahashi, 1992: 24. Type locality: Malaysia, Sabah, Mt. Kinabalu, Lumu Lumu, 152 m.

Distribution. Oriental – Malaysia (Sabah). Palaearctic – China (Xizang).

Dexopollenia yuphae Kurahashi, 1995

Dexopollenia yuphae Kurahashi, 1995: 140. Type locality: Thailand, Kanchana Buri, near Sai Yok.

Distribution. Oriental – Laos, Thailand, Vietnam.

Genus Melanodexia Williston, 1893

Melanodexia Williston, 1893: 256. Type species: *Melanodexia tristis* Williston, 1893, by monotypy.

Melanodexiopsis Hall, 1948: 351. Type species: *Melanodexiopsis tristina* Hall, 1948, by original designation.

Mellanodexmia: Sidhu et al. (2018: 22). Incorrect subsequent spelling of *Melanodexia* Williston, 1893.

Melanodexia californica Hall, 1948

Melanodexia californica Hall, 1948: 354. Type locality: USA, California, Placerville.

Distribution. Nearctic – USA (California).

Melanodexia glabricula (Bigot, 1887)

Nitellia glabricula Bigot, 1887: clxxiv. Type locality: USA, California.

Distribution. Nearctic – USA (California).

Melanodexia grandis (Shannon, 1926)

 Melanodexiopsis grandis Shannon, 1926: 138. Type locality: USA, California, Monterey County.
 Melanodexiopsis pacifica Hall, 1948: 359. Type locality: USA, California, Monterey County, Pacific Grove.

Distribution. Nearctic – USA (California).

Melanodexia idahoensis (Hall, 1948)

Melanodexiopsis idahoensis Hall, 1948: 357. Type locality: USA, Idaho, Genesee.

Distribution. Nearctic – USA (Idaho).

Melanodexia nox (Hall, 1948)

Melanodexiopsis nox Hall, 1948: 358. Type locality: USA, Oregon, Hood River.

Distribution. Nearctic – USA (California, Oregon, Washington).

Melanodexia satanica Shannon, 1926

Melanodexia satanica Shannon, 1926: 138. Type locality: USA, California, Fresno County, Los Gatos Canyon.

Distribution. Nearctic – USA (California, Washington).

Melanodexia tristina (Hall, 1948)

Melanodexiopsis tristina Hall, 1948: 359. Type locality: USA, California, San Bernardino County.

Distribution. Nearctic – USA (California, Colorado).

Melanodexia tristis Williston, 1893

Melanodexia tristis Williston, 1893: 257. Type locality: USA, California, "southern California" and Monterey County.

Distribution. Nearctic – USA (California).

Genus Morinia Robineau-Desvoidy, 1830

- Morinia Robineau-Desvoidy, 1830: 264. Type species: Morinia velox Robineau-Desvoidy, 1830 [= Musca doronici Scopoli, 1763], by subsequent designation (Rondani, 1862: 159).
- *Calobatemyia* Macquart, 1855b: 33. Type species: *Calobatemyia nigra* Macquart, 1855b [= *Musca doronici* Scopoli, 1763], by original designation.
- Anthracomya Rondani, 1856: 87. Type species: Anthracomya geneji Rondani, 1856 [= Musca doronici Scopoli, 1763], by original designation.
- *Morjnia* Rondani, 1862: 151. Unjustified emendation of *Morinia* Robineau-Desvoidy, 1830, *teste* O'Hara et al. (2011).
- Antracomya Lioy, 1864: 881. Unjustified emendation of Anthracomya Rondani, 1856.

Anthracomyia Rondani, 1868: 50. Unjustified emendation of Anthracomya Rondani, 1856.

- Disticheria Enderlein, 1934: 188. Nomen nudum. [Type species given as Musca melanoptera Fallén, 1817, but no description.]
- Anthromyia: Sidhu et al. (2018: 22). Incorrect subsequent spelling of Anthracomya Rondani, 1856.

Morinia argenticincta (Senior-White, 1923)

Idiopsis argenticincta Senior-White, 1923: 48. Type locality: India, Himachal Pradesh, Shimla.

Distribution. Oriental – India, Nepal. Palaearctic – Japan (Honshu)

Morinia carinata (Pape, 1987)

Phyto carinata Pape, 1987: 378. Type locality: South Africa, Western Cape, Cape Point Nature Reserve.

Distribution. Afrotropical – South Africa.

Morinia doronici (Scopoli, 1763)

Musca doronici Scopoli, 1763: 333. Type locality: Slovenia [as "Carniola"].

Musca melanoptera Fallén, 1817: 253. Type locality: Sweden, Östergötland or Västergötland. [Lectotype designated by Rognes (1991a: 211).] Junior primary homonym of Musca melanoptera Gmelin, 1790: 2833 [Bombyliidae]. *Morinia velox* Robineau-Desvoidy, 1830: 265. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye.

Morinia fuscipennis Robineau-Desvoidy, 1830: 265. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye.

Anthracomya geneji Rondani, 1856: 87 [as Genèji]. Type locality: Italy.

Calobatemyia nigra Macquart, 1855b: 34. Type locality: Switzerland.

Distribution. Palaearctic – Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine.

Morinia crassitarsis (Villeneuve, 1936)

Anthracomyia crassitarsis Villeneuve, 1936: 7. Type locality: China, Sichuan. Stat. rev. [as var. of *Anthracomyia melanoptera* (Fallén, 1817). Subspecific status according to ICZN 1999; article 45.6.4.]

Distribution. Palaearctic – China (Sichuan).

Remarks. The name-bearing type of *M. crassitarsis* has not been located, but unpublished studies (by TP) of Chinese specimens matching the original description would seem to support a status for this nominal species as valid.

Morinia lactineala (Pape, 1997)

Phyto lactineala Pape, 1997: 160. Type locality: South Africa, Western Cape, 10 km S Citrusdal, Koornlandskloof.

Distribution. Afrotropical – South Africa.

Morinia longirostris (Crosskey, 1977)

Phyto longirostris Crosskey, 1977: 44. Type locality: South Africa, Western Cape, Cape Town, Table Mountain, slopes above cable house.

Distribution. Afrotropical – South Africa.

Morinia nigerrima (Herting, 1961)

Anthracomyia nigerrima Herting, 1961: 9. Type locality: Japan, Hoshi-Gunma [sic] (likely Gunma prefecture, locality not found).

Anthromyia nigrerrima: Sidhu et al. (2018: 22). Incorrect subsequent spelling of Anthracomyia nigerrima Herting, 1961.

Distribution. Palaearctic – Japan (?Honshu).

Morinia piliparafacia Fan, 1997

Morinia piliparafacia Fan in Fan et al. 1997: 438. Type locality: China, Sichuan, Mt. Gongga, 2500 m.

Distribution. Palaearctic – China (Sichuan).

Morinia proceripenisa Feng, 2004

Morinia proceripenisa Feng, 2004: 806. Type locality: China, Sichuan, Mt. Erlang, 2670 m.

Distribution. Palaearctic – China (Sichuan).

Morinia royi (Pape, 1997)

Phyto royi Pape, 1997: 163. Type locality: South Africa, Western Cape, Overberg District, De Hoop Nature Reserve.

Distribution. Afrotropical – South Africa.

Morinia skufyini Khitsova, 1983

Morinia skufyini Khitsova, 1983: 1588. Type locality: Russia, Krasnodar Krai, Caucasus Nature Reserve, Kozlinaya balka [sic] (locality not found).

Distribution. Palaearctic – Russia (Krasnodar).

Morinia stuckenbergi (Crosskey, 1977)

Phyto stuckenbergi Crosskey, 1977: 44. Type locality: South Africa, Western Cape, Bredasdorp District, Arniston coastal dunes.

Distribution. Afrotropical – South Africa.

Morinia tsitsikamma Cerretti, Stireman, Badano, Gisondi, Rognes, Lo Giudice & Pape, 2019

Morinia tsitsikamma Cerretti, Stireman, Badano, Gisondi, Rognes, Lo Giudice & Pape, 2019: 964. Type locality: South Africa, Western Cape, Bloukrans Pass.

Distribution. Afrotropical – South Africa.

Genus Pollenia Robineau-Desvoidy, 1830

- *Pollenia* Robineau-Desvoidy, 1830: 412. Type species: *Musca rudis* Fabricius, 1794, by original designation.
- Nitellia Robineau-Desvoidy, 1830: 417. Type species: Musca vespillo Fabricius, 1794, sensu Coquillett [misidentification, = Musca atramentaria Meigen, 1826 teste Rognes (1991a: 215)], by designation of Coquillett (1910: 576). Remarks. The type species has been misidentified, and we here follow ICZN 1999 (Code Article 70.3.2) and designate the taxonomic species actually involved in the misidentification.
- *Cephysa* Robineau-Desvoidy, 1863: 655, 677. Type species: *Cephysa muscidea* Robineau-Desvoidy, 1863, by monotypy.
- *Orizia* Robineau-Desvoidy, 1863: 655, 678. Type species: *Orizia conjuncta* Robineau-Desvoidy, 1863, by subsequent designation (Townsend, 1916: 8).
- Chaetopollenia Enderlein, 1936: 211 [as Chaetopollénia]. Type species: Musca vespillo Fabricius, 1794, sensu Enderlein [misidentification, = Musca amentaria Scopoli, 1763 teste Rognes (1991a: 218)], by monotypy. Remarks. The type species has been misidentified, and we here follow ICZN 1999 (Code Article 70.3.2) and designate the taxonomic species actually involved in the misidentification.
- *Micronitellia* Enderlein, 1936: 211 [as *Micronitéllia*]. Type species: *Musca varia* Meigen, 1826, by monotypy. Stat. nov. *Remarks*. We here consider Enderlein's (1936) type fixation for *Micronitellia* valid, therefore we do not regard Lehrer (1967) as the first reviser as previously suggested by Rognes (1991a).
- *Trichopollenia* Enderlein, 1936: 211 [as *Trichopollénia*]. Type species: *Musca vagabunda* Meigen, 1826, by monotypy.
- Polleniella Jacentkovský, 1941a: 15, 16. Nomen nudum. [No description.]
- *Buresiella* Jacentkovský, 1941b: 21, 22 [as *Burešiella*]. Type species: *Pollenia pallida* Rodendorf, 1926, by monotypy.
- Dasypollenia Jacentkovský, 1941b: 20, 22. Nomen nudum. Remarks. Genus-group name proposed after 1930 without designation of type species from four included species.
- Polleniella Jacentkovský, 1941b: 20, 22. Type species: Polleniella distincta Jacentkovský, 1941 [= Pollenia mayeri Jacentkovský, 1941], by monotypy. Unavailable name; type species a nomen nudum. Validated by Jacentkovský (1942).
- *Polleniomyia* Jacentkovský, 1941b: 20, 23. *Nomen nudum. Remarks*. Genus-group name proposed after 1930 without designation of type species from two included species.

- *Pseudopollenia* Jacentkovský, 1941b: 21, 22. Type species: *Pollenia vera* Jacentkovský, 1936, by monotypy.
- *Bureschiella* Jacentkovský, 1941c: 31. Unjustified emendation of *Buresiella* Jacentkovský, 1941. Type species: *Pollenia pallida* Rohdendorf, 1926, automatic.
- Chaetopollenia Jacentkovský, 1941c: 31. Nomen nudum. [No description.]
- Dasypollenia Jacentkovský, 1941c: 31. Nomen nudum. [No description. No type species designated.]
- *Polleniomyia* Jacentkovský, 1941c: 31. *Nomen nudum*. [No description. No type species designated.]
- *Polleniella* Jacentkovsky, 1942: 209 (17). Type species: *Pollenia mayeri* Jacentkovský, 1941a: 14.
- *Dasypollenia* Jacentkovský, 1942: 210 (18). *Nomen nudum. Remarks*. Genus-group name proposed after 1930 without designation of type species from four included species.
- *Polleniomyia* Jacentkovský, 1942: 220 (28). Type species: *Pollenia labialis* Robineau-Desvoidy, 1863, by original designation.
- Polleniomyma Jacentkovský, 1944b: 119. Unnecessary new replacement name for Polleniomyia Jacentkovský, 1942.
- *Eupollenia* Lehrer, 1963: 290. Type species: *Musca rudis* Fabricius, 1794, by original designation.
- Jacentkovskyiomyia Lehrer, 1963: 292. Type species: Polleniella griseotomentosa Jacentkovský, 1944a, by original designation.
- *Mariomyia* Lehrer, 1963: 292. Type species: *Pollenia mayeri* Jacentkovský, 1941, by original designation.
- *Parapollenia* Lehrer, 1963: 290. Type species: *Pollenia dasypoda* Portschinsky, 1881, by original designation.
- Rohdendorfiomyia Lehrer, 1963: 292. Type species: Musca vespillo Fabricius, 1794 sensu Lehrer [misidentification, = Musca amentaria Scopoli, 1763 teste Rognes (1991a: 218)], by original designation. Remarks. The type species has been misidentified, and we here follow ICZN 1999 (Code Article 70.3.2) and designate the taxonomic species actually involved in the misidentification.
- Sachtlebeniola Lehrer, 1963: 291, 300. Nomen nudum. Remarks. Genus-group name proposed after 1930 without designation of type species from five included species.
- Seguyiomyia Lehrer, 1963: 293 [as Séguyiomyia]. Type species: Musca vagabunda Meigen, 1826, by original designation.
- *Zumptiomyia* Lehrer, 1963: 292. Type species: *Pollenia bisulca* Pandellé, 1896, by original designation.
- *Dasypollenia* Lehrer, 1967: 256. Type species: *Pollenia dasypoda* Portschinsky, 1881, by original designation.
- Sepimentum Hutton, 1901: 66. Type species: Sepimentum fumosum Hutton, 1901, by designation of Townsend (1916: 8).
- *Huttonophasia* Curran, 1927: 354. Type species: *Gymnophania pernix* Hutton, 1901, by original designation.

Pollenia advena Dear, 1986

Pollenia advena Dear, 1986: 32. Type locality: New Zealand, Three Kings Islands, Great Island, Castaway Camp.

Distribution. Australasian – New Zealand.

Pollenia aerosa Dear, 1986

Pollenia aerosa Dear, 1986: 33. Type locality: New Zealand, South Island, Westland District, Lake Paringa.

Distribution. Australasian – New Zealand.

Pollenia agneteae Rognes, 2019

Pollenia agneteae Rognes, 2019: 380. Type locality: Armenia, Aragatsotn, River Kasakh between Alagyaz and Aparan.

Distribution. Palaearctic – Armenia.

Pollenia alajensis Rohdendorf, 1926

- *Pollenia alajensis* Rohdendorf, 1926: 101 [as subspecies of *Pollenia rudis* (Fabricius, 1794)]. Type locality: Kyrgyzstan, Alayskiy Range (Alai or Alay Mts), Fergana ("Kchi Alai") [given by Rohdendorf (1928: 338), see Rognes (1987a).]
- *Pollenia sytshevskajae* Grunin, 1970: 480. Type locality: Kyrgyzstan, Terskey-Alatau Range, Chon-kyzylsu River, 2650 m.
- *Pollenia sytshevskiae*: Schumann (1986: 47). Incorrect subsequent spelling of *Pollenia* sytshevskajae Grunin, 1970.

Distribution. Palaearctic – Kyrgyzstan.

Pollenia amentaria (Scopoli, 1763)

- *Musca amentaria* Scopoli, 1763. Type locality: Slovenia, road below Kranjska Gora and Tolbin. [Neotype designated by Rognes (1991a: 218).]
- *Pollenia micans* Robineau-Desvoidy, 1830: 416. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye.

- *Musca nigrina* Meigen, 1838: 305. Type locality: Germany, Nordrhein-Westfalen, probably Stolberg, near Aachen [as "Hiesige Gegend"]. Junior primary homonym of *Musca nigrina* Fallén, 1817 [Tachinidae]. [Lectotype designated by Rognes (1991a: 221; as "holotype").]
- *Musca nitens* Zetterstedt, 1845: 1340. Type locality: probably Denmark. Junior primary homonym of *Musca nitens* Villers, 1789: 549 [Syrphidae]. [Lectotype designated by Rognes (1991a: 221).]
- *Chaetopollenia soudeki* Jacentkovský, 1941b: 21, 22. Type locality: Czech Republic, Brno, Skolny Statek Adamov, Kanice. [Lectotype designated by Rognes (1991a: 221).]

Distribution. Palaearctic – Albania, Andorra, Armenia, Austria, Belgium, Bulgaria, China (Xinjiang), Croatia, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Iran, Ireland, Italy, Macedonia, Morocco, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, Yugoslavia.

Pollenia angustigena Wainwright, 1940

Pollenia angustigena Wainwright, 1940: 444 [as subspecies of *Pollenia rudis* (Fabricius, 1794)]. Type locality: England, Worcestershire, Abberley Hill. [Lectotype designated by Rognes (1987b: 482).]

Distribution. Nearctic [introduced] – Canada (British Columbia, Ontario, Quebec); USA (California, Colorado, Idaho, Maine, New Jersey, North Carolina, Ohio, Oregon, South Dakota, Utah, Virginia, Washington, Wisconsin). Oriental [introduced] – China (Guangdong). Palaearctic – Andorra, Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Italy, Netherlands, Norway, Poland, Portugal (Madeira, mainland), Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine.

Pollenia antipodea Dear, 1986

Pollenia antipodea Dear, 1986: 34. Type locality: New Zealand, South Island, Southland District, Tiwai Point.

Distribution. Australasian – New Zealand.

Pollenia astrictifrons Dear, 1986

Pollenia astrictifrons Dear, 1986: 34. Type locality: New Zealand, South Island, Nelson District, Mt. Murchison, 1350–1440 m.

Distribution. Australasian – New Zealand.

Pollenia atramentaria (Meigen, 1826)

Musca atramentaria Meigen, 1826: 65. Type locality: Austria. *Pollenia levis* Rondani, 1862: 195. Type locality: Italy, Parma or Lombardy [as "Insubria"]. [Lectotype designated by Rognes (1991c: 365).]

Distribution. Palaearctic – Andorra, Austria, Belarus, Czech Republic, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Romania, Russia, Slovakia, Spain, Switzerland, Ukraine.

Pollenia atricoma Dear, 1986

Pollenia atricoma Dear, 1986: 34. Type locality: New Zealand, South Island, Buller District, Lewis Pass, 1050 m.

Distribution. Australasian – New Zealand.

Pollenia atrifemur Malloch, 1930

Pollenia atrifemur Malloch, 1930: 321. Type locality: New Zealand, South Island, Mid Canterbury District, Upper Hororata.

Distribution. Australasian – New Zealand.

Pollenia bartaki Rognes, 2016

Pollenia bartaki Rognes, 2016: 572. Type locality: Jordan, NW Ajlun, 32°19.877'N, 35°43.110'E, 850 m.

Distribution. Palaearctic – Jordan.

Pollenia bezziana Rognes, 1992

Pollenia bezziana Rognes, 1992: 98. Type locality: Italy, Novara, Masera Commune, Rogna Hamlet.

Distribution. Palaearctic – Italy.

Pollenia bicolor Robineau-Desvoidy, 1830

- *Pollenia bicolor* Robineau-Desvoidy, 1830: 415. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye.
- *Pollenia guernica*: Lehrer (2007c: 21). Unavailable name; proposed without a statement that the name-bearing type will be (or is) deposited in a named collection, here listed under *Pollenia bicolor* Robineau-Desvoidy, 1830.

Distribution. Palaearctic - Andorra, France, Morocco, Portugal, Spain.

Pollenia bulgarica Jacentkovský, 1939

Pollenia bulgarica Jacentkovský, 1939: 190. Type locality: Bulgaria, Sliven and Kloster Bachkovo.

Distribution. Palaearctic – Armenia, Azerbaijan, Bulgaria, Greece, Hungary, Iran, Moldova, Poland, Romania, Slovakia, Turkey, Ukraine.

Pollenia calamisessa Hardy, 1932

Pollenia calamisessa Hardy, 1932: 340. Type locality: Australia, Queensland, Brisbane.

Distribution. Australasian – Australia (Queensland).

Pollenia chotei Kurahashi & Tumrasvin, 1979

Pollenia chotei Kurahashi & Tumrasvin, 1979: 303. Type locality: Thailand, Nakhon Nayok Province, Khao Yai.

Distribution. Oriental – Thailand.

Pollenia commensurata Dear, 1986

Pollenia commensurata Dear, 1986: 35. Type locality: New Zealand, South Island, Mid Canterbury District, Mt. Somers.

Distribution. Australasian – New Zealand.

Pollenia consanguinea Dear, 1986

Pollenia consanguinea Dear, 1986: 35. Type locality: New Zealand, South Island, Central Otago District, Old Man Range, Hyde Rock, 1550–1650 m.

Distribution. Australasian – New Zealand.

Pollenia consectata Dear, 1986

Pollenia consectata Dear, 1986: 35. Type locality: New Zealand, North Island, Auckland District, Huia.

Distribution. Australasian – New Zealand.

Pollenia contempta Robineau-Desvoidy, 1863

Pollenia contempta Robineau-Desvoidy, 1863: 676. Type locality: France, Var, Callian. [Neotype designated by Rognes (1992: 109).]

Distribution. Palaearctic – France, Italy, Portugal, Spain, Tunisia.

Pollenia cuprea Malloch, 1930

Pollenia cuprea Malloch, 1930: 323 [as var. of *demissa* Hutton, 1901]. Type locality: New Zealand, North Island, Whanganui District, Whanganui.

Distribution. Australasian – New Zealand.

Pollenia dasypoda Portschinsky, 1881

Pollenia dasypoda Portschinsky, 1881: 143. Type locality: Georgia, Mtskheta. Dasypollenia landrocki Jacentkovský, 1941b: 20, 22 [key]. Type locality: Czech Republic, Lednice [Eisgrub].

Distribution. Oriental – India, Pakistan. Palaearctic – Austria, Bulgaria, Czech Republic, Egypt, Georgia, Germany, Greece, Hungary, Iran, Israel, Italy, Kazakhstan,

Lebanon, Moldova, Poland, Romania, Russia, Saudi Arabia, Slovakia, Syria, Tajikistan, Turkey, Ukraine, West Bank.

Pollenia demissa (Hutton, 1901)

- Sepimentum demissa Hutton, 1901: 67. Type locality: New Zealand, North Island, Wellington.
- *Pollenia minor* Malloch, 1930: 323 [as var. of *demissa* Hutton, 1901]. Type locality: New Zealand, North Island, Whanganui District, Whanganui.

Distribution. Australasian – New Zealand.

Pollenia dysaethria Dear, 1986

Pollenia dysaethria Dear, 1986: 37. Type locality: New Zealand, North Island, Auckland District Titirangi.

Distribution. Australasian – New Zealand.

Pollenia dyscheres Dear, 1986

Pollenia dyscheres Dear, 1986: 37. Type locality: New Zealand, South Island, Nelson District, Mt. Owen, 1500 m.

Distribution. Australasian – New Zealand.

Pollenia enetera Dear, 1986

Pollenia enetera Dear, 1986: 38. Type locality: New Zealand, South Island, Fiordland District, Fiordland National Park, Milford.

Distribution. Australasian – New Zealand.

Pollenia erlangshanna Feng, 2004

Pollenia erlangshanna Feng, 2004: 803. Type locality: China, Sichuan, Mt. Erlang, 2750 m.

Distribution. Palaearctic – China (Sichuan).

Pollenia eurybregma Dear, 1986

Pollenia eurybregma Dear, 1986: 38. Type locality: New Zealand, South Island, Central Otago District, Old Man Range, Hyde Rock, 1550–1650 m.

Distribution. Australasian – New Zealand.

Pollenia flindersi Hardy, 1932

Pollenia flindersi Hardy, 1932: 338. Type locality: Australia, Victoria, Flinders.

Distribution. Australasian – Australia (Victoria).

Pollenia fulviantenna Dear, 1986

Pollenia fulviantenna Dear, 1986: 38. Type locality: New Zealand, South Island, Buller District, Nelson Lakes National Park, west side of Lake Rotoit.

Distribution. Australasian – New Zealand.

Pollenia fulvipalpis Macquart, 1835

Pollenia fulvipalpis Macquart, 1835: 270. Type locality: France, Gironde, Bordeaux.
 Pollenia bisulca Pandellé, 1896: 152. Type locality: France, Hautes-Pyrénées, Tarbes.
 Pollenia flavipalpis: Rondani (1862: 202). Incorrect subsequent spelling of Pollenia fulvipalpis Macquart, 1835.

Distribution. Palaearctic - Channel Islands, France, Slovakia, Spain, Switzerland.

Pollenia fumosa (Hutton, 1901)

Sepimentum fumosum Hutton, 1901: 67. Type locality: New Zealand, South Island, "Christchurch or Ashburton".

Distribution. Australasian – New Zealand.

Pollenia griseotomentosa (Jacentkovský, 1944)

Polleniella griseotomentosa Jacentkovský, 1944a: 45. Type locality: Poland, Struga. [Neotype designated by Rognes (1991a: 225).]

Distribution. Nearctic [introduced] – Canada (British Columbia, Ontario); USA (New York, Western Virginia). Palaearctic – Andorra, Austria, Belarus, Belgium, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Italy (mainland, Sardinia), Latvia, Netherlands, Poland, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine.

Pollenia grunini Rognes, 1988

Pollenia grunini Rognes, 1988: 318. Type locality: Russia, Karachay-Cherkess Republic (Karachayevo-Cherkesskaya Respublika), 5 km S Teberda.

Distribution. Palaearctic – Armenia, Georgia, Russia.

Pollenia haeretica Séguy, 1928

Pollenia haeretica Séguy, 1928: 374. Type locality: Algeria, Skikda ("Philippeville"). [Lectotype designated by Rognes (2010: 46).]

Distribution. Palaearctic – Algeria, Tunisia, Italy (Sardinia).

Pollenia hazarae (Senior-White, 1923)

Dexopollenia hazarae Senior-White, 1923: 51. Type locality: Pakistan, Abbottabad, 1256 m.

Distribution. Oriental – India, Pakistan.

Pollenia hirticeps Malloch, 1927

Pollenia hirticeps Malloch, 1927: 318. Type locality: Australia, New South Wales, Blue Mts.

Distribution. Australasian – Australia (New South Wales, South Australia).

Pollenia hispida Dear, 1986

Pollenia hispida Dear, 1986: 39. Type locality: New Zealand, South Island, Central Otago District, Old Man Range, Hyde Rock, 1550–1650 m.

Distribution. Australasian – New Zealand.

Pollenia huangshanensis Fan & Chen, 1997

Pollenia huangshanensis Fan & Chen in Fan et al. 1997: 415. Type locality: China, Anhui, Huangshan Mt., 850 m.

Distribution. Palaearctic – China (Anhui).

Pollenia hungarica Rognes, 1987

Pollenia hungarica Rognes, 1987b: 483. Type locality: Hungary, Albertirsa.

Distribution. Palaearctic – Austria, China (Shanghai) [introduced], Czech Republic, Finland, France, Germany, Hungary, Italy, Latvia, Netherlands, Norway, Poland, Russia, Saudi Arabia, Slovakia, Sweden, Switzerland, Ukraine, Yugoslavia.

Pollenia ibalia Séguy, 1930

Pollenia ibalia Séguy, 1930: 148. Type locality: Morocco, Moyen Atlas, Ras el Ksar, 900 m. *Pollenia rungsi* Séguy, 1953: 88. Type locality: Morocco, Rabat.

Pollenia funebris Villeneuve, 1933a: 284. Type locality: Morocco, Marrakech. Junior primary homonym of *Pollenia funebris* Robineau-Desvoidy, 1863 [*nomen dubium*, *teste* Schumann, 1986].

Distribution. Nearctic [introduced] – Alaska. Palaearctic – Morocco.

Pollenia immanis Dear, 1986

Pollenia immanis Dear, 1986: 40. Type locality: New Zealand, South Island, Central Otago District, Old Man Range, 1550–1650 m.

Distribution. Australasian – New Zealand.

Pollenia insularis Dear, 1986

Pollenia insularis Dear, 1986: 40. Type locality: New Zealand, Stewart Island, Table Hill, 425–715 m.

Distribution. Australasian – New Zealand.

Pollenia japonica Kano & Shinonaga, 1966

Pollenia japonica Kano & Shinonaga, 1966: 223. Type locality: Japan, Honshu, Miyagi Prefecture, Mt. Zao.

Distribution. Palaearctic – Japan (Honshu, Kyushu).

Pollenia labialis Robineau-Desvoidy, 1863

- *Pollenia labialis* Robineau-Desvoidy, 1863: 67. Type locality: France, Yvelines, Rambouillet. [Neotype designated by Rognes (1991a: 228).]
- *Pollenia excarinata* Wainwright, 1940: 442. Type locality: United Kingdom, Wales, Tan-y-Bwlch.

Distribution. Nearctic [introduced] – Canada (British Columbia, Ontario, Quebec); USA (Colorado, Indiana, Maine, Michigan, New Hampshire, New Mexico, Oregon, Pennsylvania, Vermont, Washington). Palaearctic – Andorra, Austria, Belgium, Bosnia and Herzegovina, China (Anhui, Henan) [introduced], Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine.

Pollenia lativertex Dear, 1986

Pollenia lativertex Dear, 1986: 41. Type locality: New Zealand, Stewart Island, Table Hill, 425–715 m.

Distribution. Australasian – New Zealand.

Pollenia leclercqiana (Lehrer, 1978)

Nitellia leclercqiana Lehrer, 1978: 139. Type locality: Spain, Madrid, Valdemoro.

Distribution. Palaearctic – France, Spain (Balearic Islands, mainland), Morocco.

Pollenia limpida Dear, 1986

Pollenia limpida Dear, 1986: 41. Type locality: New Zealand, South Island, Southland District, Mt. Barber, 1155 m.

Distribution. Australasian – New Zealand.

Pollenia luteovillosa Rognes, 1987

Pollenia luteovillosa Rognes, 1987b: 490. Type locality: Morocco, Haut Atlas, Jbel Ayachi, Mikdane.

Distribution. Palaearctic – Algeria, Morocco, Portugal, Spain.

Pollenia mayeri Jacentkovský, 1941

 Pollenia mayeri Jacentkovský, 1941a: 14. Type locality: Czech Republic, Brno-Bystrec, Lednice (Eisgrub).
 Polleniella distincta Jacentkovský, 1941b: 20, 22. Nomen nudum.

Distribution. Palaearctic – Belarus, Czech Republic, Germany, Hungary, Netherlands, Poland, Romania, Slovakia, Ukraine.

Pollenia mediterranea Grunin, 1966

- *Pollenia mediterranea* Grunin, 1966: 899. Type locality: Italy, "Vittoria-Liguria" [possibly = Nostra Signora della Vittoria, Appennino Ligure, Liguria].
- Nitellia hermoniella Lehrer, 2007a: 24. Type locality: Israel, Mt. Hermon, 1600–2000 m. Syn. nov.

Distribution. Palaearctic – Israel, Italy.

Pollenia mesopotamica Mawlood & Abdul-Rassoul, 2009

Pollenia mesopotamica Mawlood & Abdul-Rassoul, 2009: 59. Type locality: Iraq.

Distribution. Palaearctic – Iraq.

Pollenia moravica (Jacentkovský, 1941)

- *Chaetopollenia moravica* Jacentkovský, 1941b: 21. Type locality: Czech Republic, Brno, Skolny Statek Adamov, Hády.
- *Chaetopollenia pseudobisulca* Jacentkovský, 1941b: 21, 23 [key]. Type locality: Czech Republic, Brno.

Distribution. Palaearctic – Austria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, Ukraine, Yugoslavia.

Pollenia moretonensis Macquart, 1855

Pollenia moretonensis Macquart, 1855a: 136. Type locality: Australia, Queensland, Moreton Bay.

Distribution. Australasian – Australia (Queensland).

Pollenia mystica Rognes, 1988

Pollenia mystica Rognes, 1988: 322. Type locality: Georgia, Tskhratskaro, 2460 m.

Distribution. Palaearctic – Armenia, Georgia.

Pollenia nigripalpis Dear, 1986

Pollenia nigripalpis Dear, 1986: 41. Type locality: New Zealand, Three Kings Islands, Great Island.

Distribution. Australasian – New Zealand.

Pollenia nigripes Malloch, 1930

Pollenia nigripes Malloch, 1930: 320. Type locality: New Zealand, South Island, Westland District, Kumara.

Distribution. Australasian – New Zealand.

Pollenia nigrisquama Malloch, 1930

Pollenia nigrisquama Malloch, 1930: 319. Type locality: New Zealand, South Island, Westland District, Kumara.

Distribution. Australasian – New Zealand.

Pollenia nigrita Malloch, 1936

Pollenia nigrita Malloch, 1936: 22. Type locality: Australia, New South Wales, Yaouk, 1067 m.

Distribution. Australasian – Australia (New South Wales).

Pollenia notialis Dear, 1986

Pollenia notialis Dear, 1986: 43. Type locality: New Zealand, Stewart Island, Table Hill, Hut Creek, 300 m.

Distribution. Australasian – New Zealand.

Pollenia opalina Dear, 1986

Pollenia opalina Dear, 1986: 43. Type locality: New Zealand, South Island, Nelson District, Takaka Hill, 610 m.

Distribution. Australasian – New Zealand.

Pollenia oreia Dear, 1986

Pollenia oreia Dear, 1986: 43. Type locality: New Zealand, South Island, Central Otago District, Dunstan Range, summit, 1590–1650 m.

Distribution. Australasian – New Zealand.

Pollenia paragrunini Rognes, 1988

Pollenia paragrunini Rognes, 1988: 325. Type locality: Azerbaijan, Syunik, Betschenagsku Pass.

Distribution. Palaearctic – Armenia, Azerbaijan.

Pollenia paupera Rondani, 1862

Pollenia paupera Rondani, 1862: 196, 200. Type locality: Malta and Gozo. [Lectotype designated by Rognes (1991c: 366).]*Pollenia longitheca* Rognes, 1987b: 487. Type locality: Cyprus, Amathus.

Distribution. Palaearctic – Algeria, Cyprus, France (Corsica), Greece (Crete, Dodekanisos, mainland), Iran, Israel, Italy (mainland, Sardinia, Sicily), Malta, Turkey, Ukraine.

Pollenia pectinata Grunin, 1966

Pollenia pectinata Grunin, 1966: 899. Type locality: Russia, Primorskiy Kray, east slope of Sikhote-Alin, valley of Sankhobe River.

Distribution. Palaearctic – China (Liaoning), Mongolia, Poland, Russia.

Pollenia pediculata Macquart, 1834

- *Pollenia pediculata* Macquart, 1834: 19(155). Type locality: France, Nord, near Lille. *Remarks.* Rognes (1991a: 234) acted as First Reviser giving *pediculata* precedence over *coerulescens*.
- *Pollenia coerulescens* Macquart, 1834: 17(153) [as *cœrulescens*]. Type locality: France, Nord, near Lille.

Pollenia obscura Bigot, 1887: 173. Type locality: North America. Junior secondary homonym of *Musca obscura* Fabricius, 1794: 315 (= *Musca rudis* Fabricius, 1794).
 Pollenia pseudorudis Rognes, 1985: 90. New replacement name for *P. obscura* Bigot, 1887.

Distribution. Afrotropical [introduced] – South Africa. Australasian [introduced] – New Zealand. Nearctic [introduced] – Canada (British Columbia, Ontario, Quebec, Saskatchewan); USA (Arkansas, California, Colorado, Delaware, Idaho, Illinois, Iowa, Kentucky, Michigan, Minnesota, Missouri, Nebraska, Nevada, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Dakota, Utah, Virginia, Washington, Wisconsin, Wyoming). Neotropical [introduced] – Bahamas. Oriental – India, Pakistan. Palaearctic – Andorra, Armenia, Austria, Belgium, Bosnia and Herzegovina, China (Shanghai, Xinjiang, Zhejiang), Croatia, Cyprus, Czech Republic, Denmark, Finland, France (Corsica, mainland), Germany, Great Britain, Greece, Hungary, Italy, Macedonia, Netherlands, Norway, Poland, Portugal (Madeira, mainland), Romania, Russia, Saudi Arabia, Slovakia, Spain, Sweden, Switzerland, Ukraine, Yugoslavia.

Pollenia pernix (Hutton, 1901)

Gymnophania pernix Hutton, 1901: 61. Type locality: New Zealand, South Island, Mid Canterbury District, Christchurch.

Distribution. Australasian – New Zealand.

Pollenia ponti Rognes, 1991

Pollenia ponti Rognes, 1991b: 457. Type locality: Spain, Granada, 3 km NE Granada.

Distribution. Palaearctic – Italy (mainland, Sicily), Morocco, Portugal, Slovakia, Spain, Ukraine.

Pollenia primaeva Dear, 1986

Pollenia primaeva Dear, 1986: 44. Type locality: New Zealand, South Island, Mid Canterbury District, Mt. Somers.

Distribution. Australasian – New Zealand.

Pollenia pseudintermedia Rognes, 1987

Pollenia pseudintermedia Rognes, 1987a: 382. Type locality: Spain, Granada, Rio Guadalfeo, Orgiva.

Distribution. Palaearctic - Greece, Israel, Italy (Sardinia), Macedonia, Portugal, Spain.

Pollenia pseudomelanurus (Feng, 2004)

Xanthotryxus pseudomelanurus Feng, 2004: 805. Type locality: China, Sichuan, Mt. Erlang, 3100 m.

Distribution. Palaearctic – China (Sichuan).

Pollenia pulverea Dear, 1986

Pollenia pulverea Dear, 1986: 45. Type locality: New Zealand, Stewart Island, Table Hill, 425–715 m.

Distribution. Australasian - New Zealand.

Pollenia rudis (Fabricius, 1794)

- *Musca rudis* Fabricius, 1794: 314. Type locality: Germany, Schleswig-Holstein, Grömitz. [Neotype designated by Rognes (1987b: 498).]
- *Musca obscura* Fabricius, 1794: 315. Type locality: Germany. [See Rognes (1987b: 496) for details.]
- *Musca varia* Meigen, 1826: 66. Type locality: Germany, Nordrhein-Westfalen, probably Stolberg, near Aachen. Junior primary homonym of *Musca varia* Gmelin, 1790: 2843.

Distribution. Australasian [introduced] – New Zealand. Nearctic [introduced] – Bermuda; Canada (British Columbia, Ontario, Quebec, Terranova and Labrador); USA (Arizona, California, Colorado, Delaware, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Tennessee, Utah, Virginia, Washington, Western Virginia, Wisconsin). Oriental [introduced] – China (Guangdong), India, Nepal, Pakistan. Palaearctic – Albania, Algeria, Andorra, Austria, Belarus, Belgium, China (Shanghai) [introduced], Cyprus, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece (Crete, mainland), Hungary, Ireland, Italy (mainland, Sardinia, Sicily), Japan (widespread), Lithuania, Morocco, Netherlands, Norway, Poland, Portugal (Azores Islands, Madeira, mainland), Romania, Russia, Saudi Arabia, Slovakia, Spain (Canary Islands, mainland), Sweden, Switzerland, Turkey, Ukraine, Uzbekistan.

Pollenia ruficrura Rondani, 1862

Pollenia ruficrura Rondani, 1862: 196, 202. Type locality: Italy, Parma.

Nitellia ospedaliana: Lehrer (2007a: 21). Unavailable name; proposed without a statement that the name-bearing type will be (or is) deposited in a named collection, here listed under *Pollenia ruficrura* Rondani, 1862.

Distribution. Palaearctic – France (Corsica), Italy (mainland, Sardinia), Morocco.

Pollenia rufifemorata Rognes & Baz, 2008

Pollenia rufifemorata Rognes & Baz, 2008: 391. Type locality: Spain, Sierra de Guadarrama Mts, Madrid Province, between Lozoya and Puerto de Navafria, 1400 m.

Distribution. Palaearctic – Spain.

Pollenia sakulasi (Kurahashi, 1987)

Dexopollenia sakulasi Kurahashi, 1987: 68. Type locality: Papua New Guinea.

Distribution. Australasian – Papua New Guinea.

Pollenia sandaraca Dear, 1986

Pollenia sandaraca Dear, 1986: 45. Type locality: New Zealand, Stewart Island, Rakeahua Valley.

Distribution. Australasian – New Zealand.

Pollenia scalena Dear, 1986

Pollenia scalena Dear, 1986: 46. Type locality: New Zealand, Snares Islands, Biological Station.

Distribution. Australasian – New Zealand.

Pollenia semicinerea Villeneuve, 1911

Pollenia semicinerea Villeneuve, 1911b: 51. Type locality: Syria, between Homs and Bahret Homs [Quattinah Lake]. [Lectotype designated by Rognes (1988: 333).]
Pollenia bentalia Lehrer, 2007c: 23. Type locality: Israel, Golan Heights, Mt. Hermon, 2000 m. Syn. nov.

Distribution. Palaearctic – Israel, Lebanon, Syria.

Pollenia shaanxiensis Fan & Wu, 1997

Pollenia shaanxiensis Fan & Wu in Fan et al. 1997: 418. Type locality: China, Shaanxi, Huanglong.

Distribution. Palaearctic – China (Shaanxi).

Pollenia sichuanensis Feng, 2004

Pollenia sichuanensis Feng, 2004: 804. Type locality: China, Sichuan, Mao County, 2300 m.

Distribution. Palaearctic – China (Sichuan).

Pollenia similis (Jacentkovský, 1941)

Dasypollenia similis Jacentkovský, 1941b: 20. Type locality: Czech Republic, Brno, Lednice, Ráječek.

Distribution. Palaearctic – Albania, Austria, Czech Republic, Germany, Hungary, Poland, Slovakia, Ukraine.

Pollenia stigi Rognes, 1992

Pollenia stigi Rognes, 1992: 104. Type locality: Morocco, Azzou-Ifrane area.

Distribution. Palaearctic – Morocco.

Pollenia stolida Malloch, 1936

Pollenia stolida Malloch, 1936: 21. Type locality: Australia, New South Wales.

Distribution. Australasian – Australia (New South Wales).

Pollenia tenuiforceps Séguy, 1928

Pollenia tenuiforceps Séguy, 1928: 375. Type locality: not given, probably France. *Dasypoda angustifrons* Jacentkovský, 1941b: 8 (Czech), 58 (German). Type locality: Czech Republic, Brno, Ráječek. Syn. nov.

Distribution. Palaearctic – Algeria, Bosnia and Herzegovina, Czech Republic, France, Hungary, Romania, Slovakia, Slovenia, Switzerland, Ukraine.

Pollenia townsendi Senior-White, Aubertin & Smart, 1940

Pollenia townsendi Senior-White, Aubertin & Smart, 1940: 119. Type locality: India, Himachal Pradesh.

Distribution. Oriental – India.

Pollenia umbrifera (Walker, 1861)

Musca umbrifera Walker, 1861: 267. Type locality: Indonesia, Sulawesi, Tondano.

Distribution. Oriental – Indonesia.

Pollenia uniseta Dear, 1986

Pollenia uniseta Dear, 1986: 46. Type locality: New Zealand, South Island, Central Otago District, Old Man Range, Hyde Rock, 1550–1650 m.

Distribution. Australasian – New Zealand.

Pollenia vagabunda (Meigen, 1826)

Musca vagabunda Meigen, 1826: 72. Type locality: Germany, Nordrhein-Westfalen, probably Stolberg, near Aachen. [Lectotype designated by Rognes (1991a: 238).]
Pollenia pulvillata Rondani, 1862: 195, 198. Type locality: Italy, Parma.
Pollenia hasei Séguy, 1928: 370. Type locality: Spain, Madrid Province, Cercedilla.
Nitellia norwegiana: Lehrer (2007b: 5). Unavailable name; proposed without a statement that the name-bearing type will be (or is) deposited in a named collection, here listed under Pollenia vagabunda (Meigen, 1826).

Distribution. Nearctic [introduced] – Canada (British Columbia, Nova Scotia, Ontario, Prince Edward Island, Quebec); USA (Alaska, Connecticut, Maine, Massachusetts, New Hampshire, New Mexico, New York, Pennsylvania, Virginia). Oriental [introduced] – India. Palaearctic – Andorra, Austria, Belarus, Belgium, China (Shanghai) [introduced], Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Italy, Latvia, Lithuania, Morocco, Netherlands, Norway, Poland, Portugal, Russia, Slovakia, Spain, Sweden, Tunisia, Ukraine.

Pollenia venturii Zumpt, 1956

Pollenia venturii Zumpt, 1956: 79. Type locality: Italy, Florence Province, Tavarnuzze. *Pollenia solitaria* Grunin, 1970: 480. Type locality: Russia, Krasnodar Krai: Lvovskoye, 18 km NNW Severskaya Station.

Distribution. Palaearctic – France, Germany, Greece, Iran, Italy (mainland, Sardinia), Netherlands, Poland, Russia.

Pollenia vera Jacentkovský, 1936

Pollenia vera Jacentkovský, 1936: 114. Type locality: Bulgaria, Vitosha and Sliven. *Pollenia vera* var. *latifrons* Jacentkovský, 1941b: 21. Type locality: not stated, probably Bulgaria, Vitosha and Sliven.

Distribution. Palaearctic – Austria, Bulgaria, Czech Republic, France, Greece, Hungary, Moldova, Poland, Romania, Slovakia, Ukraine, Yugoslavia.

Pollenia verneri Rognes, 1992

Pollenia verneri Rognes, 1992: 98. Type locality: Spain, Jaen, 10 km W La Carolina.

Distribution. Palaearctic – Portugal, Spain.

Pollenia viatica Robineau-Desvoidy, 1830

- *Pollenia viatica* Robineau-Desvoidy, 1830: 413. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye. [Lectotype designated by Rognes (1991b: 486).]
- *Pollenia fulvicornis* Robineau-Desvoidy, 1830: 413. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye.
- *Pollenia vivida* Robineau-Desvoidy, 1830: 413. Type locality: not stated, probably France, Yonne, Saint-Sauveur-en-Puisaye.
- *Pollenia pallida* Rohdendorf, 1926: 103. Type locality: Uzbekistan, Tashkent District, Ak-Tash Mts, 50 km NE Tashkent ["Ak-Tash-Gebirge, Turkestan (50 km nordöstlich von Tashkent)" as given by Rohdendorf (1928: 338)]. [Lectotype designated by Rognes (1991a: 230).]
- *Pollenia luciensis* Mercier, 1930: 320. Type locality. France, Calvados, Luc-sur-Mer. [As subspecies of *Pollenia rudis* (Fabricius, 1794).]
- *Pollenia carinata* Wainwright, 1940: 442. Type locality: United Kingdom, East Sussex, Lewes, Malling Hill. [As subspecies of *Pollenia rudis* (Fabricius, 1794).]

Distribution. Palaearctic – Armenia, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, Great Britain, Greece, Hungary, Iran, Israel, Italy, Jordan, Kazakhstan, Kyrgyzstan, Lebanon, Malta, Moldova, Netherlands, Poland, Romania, Slovakia, Sweden, Syria, Turkey, Ukraine, Uzbekistan, West Bank, Yugoslavia.

Pollenia viridiventris Macquart, 1847

Pollenia viridiventris Macquart, 1847: 100. Type locality: Australia, Tasmania.

Distribution. Australasian – Australia (Tasmania).

Nomen dubium and incerta sedis

Volucella cervina Schrank, 1803: 136. Type locality: near Ingolstadt, Germany.

Genus Xanthotryxus Aldrich, 1930

Xanthotryxus Aldrich, 1930: 3. Type species: *Xanthotryxus mongol* Aldrich, 1930, by original designation.

Xanthotryxus auratus (Séguy, 1934)

Pollenia aurata Séguy, 1934: 22. Type locality: China, Xizang, Moupin.

Distribution. Palaearctic – China (Xizang).

Xanthotryxus bazini (Séguy, 1934)

Pollenia bazini Séguy, 1934: 23. Type locality: China, Jiangxi, Kou-ling.

Distribution. Palaearctic – China (Jiangxi).

Xanthotryxus draco Aldrich, 1930

Xanthotryxus draco Aldrich, 1930: 4. Type locality: China, Sichuan, Yellow Dragon Gorge.

Distribution. Palaearctic – China (Sichuan).

Xanthotryxus ludingensis Fan, 1992

Xanthotryxus ludingensis Fan in Chen, Fan & Fang, 1992: 1204. Type locality: China, Sichuan, Luding.

Distribution. Palaearctic – China (Sichuan).

Xanthotryxus melanurus Fan, 1992

Xanthotryxus melanurus Fan in Chen, Fan & Fang, 1992: 1205. Type locality: China, Sichuan, Mt. Gonggashan, Yanzigou.

Distribution. Palaearctic – China (Sichuan).

Xanthotryxus mongol Aldrich, 1930

Xanthotryxus mongol Aldrich, 1930: 3. Type locality: China, Sichuan.

Distribution. Palaearctic – China (Sichuan), Japan (Kyushu), South Korea (Quelpart Island).

Xanthotryxus uniapicalis Fan, 1992

- *Xanthotryxus uniapicalis* Fan in Chen, Fan & Fang, 1992: 1206. Type locality: China, Yunnan, Weixi.
- **Distribution.** Oriental China (Yunnan).

Taxa tentatively assigned to Polleniidae

Genus Anthracomyza Malloch, 1928, resurrected name

Anthracomyia Malloch, 1927: 319. Type species: *Anthracomyia atratula* Malloch, 1927, by original designation. Junior homonym of *Anthracomyia* Rondani, 1868.

Anthracomyza Malloch, 1928: 360. New replacement name for Anthracomyia Malloch, 1927.

Anthracomyza atratula (Malloch, 1927)

Anthracomyia atratula Malloch, 1927: 319. Type locality: Australia, New South Wales, Killara.

Distribution. Australasian – Australia (New South Wales).

Remarks. The Australian Faunal Directory lists the species as *Anthracomyia atratula* Malloch, 1927 (Elliot 2007), while it is listed as *Morinia atratula* Malloch, 1927 in the Catalogue of Life (Roskov et al. 2019). Malloch (1928: 360) proposed *Anthracomyza*
as a new replacement name for his own *Anthracomyia*, correctly arguing that the latter is "preoccupied by *Anthracomyia* Rondani". *Anthracomyza* was later listed as an unnecessary new name in the catalogue of Australasian Diptera (Kurahashi 1989), probably because Rondani (1856) originally gave the spelling *Anthracomya*, which differs by one letter and therefore does not enter into homonymy (ICZN 1999; article 56.2). However, as given by O'Hara et al. (2011), Rondani (1868) later emended his own spelling to *Anthracomyia*, and although this is now recognised as an unjustified emendation, it is an available name with separate authorship and therefore preoccupies *Anthracomyia* of Malloch (1927).

We here maintain *Anthracomyza* as a valid, monotypic genus; however, a careful examination of male and female terminalia is necessary to ascertain whether *Anthracomyza* belongs to Polleniidae.

Genus Nesodexia Villeneuve, 1911

Nesodexia Villeneuve, 1911a: 123. Type species: *Nesodexia corsicana* Villeneuve, 1911, by monotypy.

Nesodexia corsicana Villeneuve, 1911

Nesodexia corsicana Villeneuve, 1911a: 123. Type locality: France, Corsica, Ajaccio, Campo d'Oro.

Distribution. Palaearctic – France (Corsica).

Remarks. According to Rognes (1991a) *Nesodexia corsicana* has the ventral and lateroventral surface of distalmost parts of acrophallus provided with scale-like spinules (Rognes 1991a), thus the species does not share a key synapomorphic character state supporting monophyly of Polleniidae. Moreover, the general habitus and, in particular, the head profile, characterised by a prominent lower facial margin, of *N. corsicana* are reminiscent of many phumosiine calliphorids. However, unlike all phumosiines, the katatergite of *Nesodexia* is bare (Rognes 1997), and more data are needed to resolve its phylogenetic position.

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