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New data on freshwater psammic Gastrotricha from Brazil

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Abstract

Current knowledge of freshwater gastrotrich fauna from Brazil is underestimated as only two studies are available. The present communication is a taxonomic account of the first-ever survey of freshwater Gastrotricha in Minas Gerais State. Samplings were carried out yielding six species of three Chaetonotidae genera: *Aspidiophorus* cf. *pleustonicus*, *Ichthydium* cf. *chaetiferum*, *Chaetonotus acanthocephalus, C. heideri*, *C.* cf. *succinctus*, *Chaetonotus* sp., and also an undescribed species belonging to the genus *Redudasys* (*incertae sedis*): this is the first finding of specimens of *Redudasys* outside of original type locality. These preliminary observations suggest that the knowledge of the biodiversity of Gastrotricha in the Minas Gerais State, as well as in the whole Brazil, will certainly increase as further investigations are undertaken, and that freshwater Macrodasyida may be more common than previously thought.

Keywords

freshwater Gastrotricha, Macrodasyida, Chaetonotida, biodiversity, meiofauna

Introduction

Gastrotricha are aquatic free-living microinvertebrates (< 1 mm), with a worldwide distribution in freshwater, estuarine, and marine benthic habitats where they are an important component of the benthos and periphyton (Hochberg and Litvaitis 2000; Balsamo and Todaro 2002; Balsamo et al. 2005, 2008). Although many species are common and occasionally abundant, freshwater gastrotrichs are still insufficiently known, possibly due to their microscopical size, body fragility, which make their study very difficult (Hochberg and Litvaitis 2000; Balsamo and Todaro 2002; Balsamo et al. 2005, 2008). However, despite the minute body size, they are recognized to have both a complex anatomy and life cycle (Weiss 2001).

The taxon consists of nearly 750 named species grouped into two orders, Macrodasyida and Chaetonotida (but see Kieneke et al. 2008), which are greatly different in morphology, reproductive biology and ecology (Balsamo and Todaro 2002; Balsamo et al. 2008; Todaro and Hummon 2008). Macrodasyida comprise about 300 worm-like species, all interstitial in marine and estuarine habitats except for the two freshwater ones recorded only from their type locality (Hummon and Todaro, 2010): *Marinellina flagellata* Ruttner-Kolisko, 1955 (Austrian river Ybbs) and *Redudasys fornerisae* Kisielewski, 1987 (Brazilian dam on the savannah near São Carlos city). The roughly 450 species of Chaetonotida are smaller, tenpin-shaped, and colonize marine, brackish and especially freshwater habitats, where two thirds of the species can be found.

The biodiversity of the Gastrotricha fauna in Brazil is still underestimated (Kisielewski 1991; Marques and Lama 2006; Garraffoni and Araujo in press) because, until now, only few studies have focused on the diversity and distribution of this taxon both in fresh waters (Kisielewski 1987, 1991) and in marine waters (Todaro and Rocha 2004, 2005).

Regarding the freshwater habitat, Kisielewski (1991) reported 14 genera (including three new genera), and 59 species (26 of which new species), from various regions of São Paulo State (cities of São Paulo and São Carlos; Juréia Ecological Reserve), of Mato Grosso do Sul State (city of Corumbá), and Pará State (cities of Belém and Benevides), and from different habitats, such as ponds, reservoirs, rivers, puddles in the tropical forest, mangrove and estuaries. In this study, the author stressed that the diversity of Brazilian fauna of inland-water Gatrotricha appears unusually high, and recommended further faunistic, detailed studies. However, no survey was done later on (Garraffoni and Araujo in press).

Thus, the aim of the present study is to provide the first records of the Gastrotricha fauna from the State of Minas Gerais. This is the first of a series of surveys that will be realized as an effort to increase the taxonomic and biogeographic knowledge of the Brazilian Gastrotricha, with special emphasis on the State of Minas Gerais. Furthermore, with the aim to stimulate new research on this group in Brazil, Garraffoni and Araujo (in press) prepared a taxonomic key for all Brazilian freshwater and marine Gastrotricha, and listed the main morphological characters used to identify species as a glossary with terminologies in Portuguese.

Material and methods

Samples of the upper sediment were taken from 7 distinct stations located along two small watercourses and one river near Diamantina city at an altitude of 1300 m: Soberbo (18º11'38.11"S – 43º34'13.03"W), Água Limpa (18º12'51.95"S – 43º37'01.96"W), and Preto River (18º7.50'23"S – 43º20.15'53"W). Other sampling locations were: an unnamed stream in the Itambé Peak (18°23'50"S – 43°19'44"W), at an altitude of

1680 m, and unnamed stream in Cabral Mountains (17°46'03.7"S – 44°17'09.6"W), at an altitude of 1209 m, and an unnamed stream, near Gouveia City, (18°31'48.5"S – 43°53'55.8"W; 18°32'19.2"S – 43°53'52.8"W), at an altitude of 1174 m. Gastrotrichs were extracted after repeated washing of small amounts of sediment with 2% $MgCl_2$ aqueous solution. Living individuals were located by examining the supernatant under an Olympus SZ40 stereomicroscope at 40x magnification, and were removed by micropipette to a glass slide. Further observations and photographies were done under a Zeiss Photomicroscope equipped with differential interference contrast optics (DIC) and an Olympus CH30 microscope without DIC.

The morphological study and the identification of gastrotrichs were performed using the terminologies and identification keys presented in Kisielewski (1987), Balsamo and Todaro (2002), Balsamo et al. (2005) and Todaro and Hummon (2008). The descriptions followed the convention of Hummon et al. (1992), whereas the locations of some morphological characters along the length of the body were given in percentage units (U) measured from anterior to posterior. In-group systematization of *Chaetonotus* and *Ichthydium* followed Balsamo et al. (2009).

Descriptions of putative new taxa are beyond the scope of the present study, and their definitive affiliation will be made at the end of the ongoing taxonomical surveys in forthcoming papers. However, we provide a photograph of each taxon and the measurement of the main structures, for the benefit of researchers working in the same area who might find them in the meantime.

All adult formalin–glycerin whole-mounts specimens are kept in the meiofauna collection of the senior author at the Universidade Federal dos Vales do Jequitinhonha e Mucuri.

Taxonomy

Order Chaetonotida Remane, 1925
Family Chaetonotidae Gosse, 1864

Genus *Aspidiophorus* Voigt, 1904

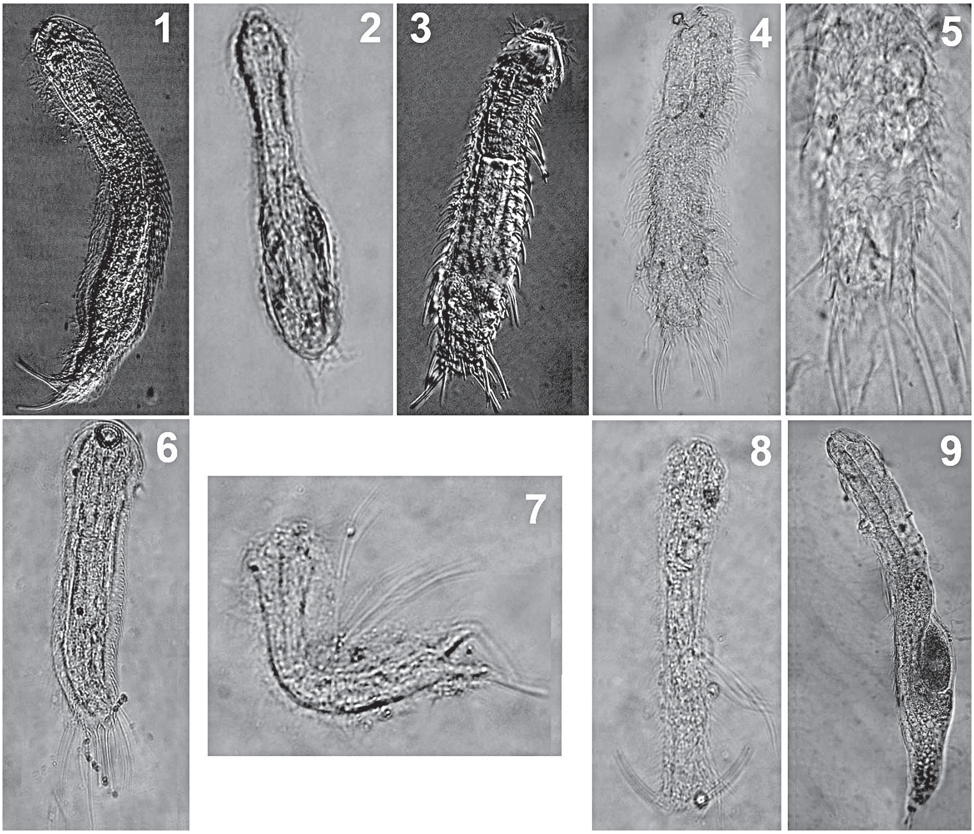
Aspidiophorus cf. *pleustonicus* Kisielewski, 1991

Fig. 1, Table 1

Aspidiophorus pleustonicus – Kisielewski (1991: 79, Figs 85–86, Tab. 36); Balsamo et al. (2009: 08, appendix 1).

Material. Soberbo: 2 specimens, Água limpa: 2 specimens, Preto River: 2 specimens, Gouveia: 2 specimens.

Description. The description is based on a single adult specimen, 212.5 µm in total length. Head with oval edge and body long and wide**.** Body medium-sized, with



Figures 1–9. Freshwater psammic Gastrotricha from Brazil. **1** *Aspidiophorus* cf. *pleustonicus*: ventral view **2** *Ichthydium* cf. *chaetiferum* **3** *Chaetonotus acanthocephalus*: dorsal view **4** *Chaetonotus heideri*: dorsal view **5** *C. heideri*: close-up of the dorsal scales **6** *Chaetonotus* sp. ventral view **7** *Chaetonotus* cf. *succinctus*: lateral view **8** *C.* cf. *succinctus*: dorsal view **9** *Redudasys* sp.: dorso-lateral view.

head and neck weakly defined, but trunk and caudal base clearly distinct. Head with slightly five lobes and two pairs of ciliary tufts. Hypostomion weakly developed as a fine transverse furrow appearing as a thin line. Pharynx 56.25 µm in length from the posterior edge of the mouth to the pharyngo-intestinal junction, that lies at U26. Alternating columns of pedunculated, unkeeled, elongate scales along the body.

Remarks. The genus *Aspidiophorus* counts 30 species in the world with 9 marine species and 21 freshwater (Balsamo et al. 2009) and in Brazil there are five freshwater species (Kisielewski 1991) and three marine (Todaro and Rocha 2004, 2005). Our specimens resemble *A. pleustonicus* Kisielewski, 1991 due to the long body, five-lobed head and shape of pedunculated scales. However, they can be distinguished from *A. pleustonicus*, from the size of the mouth, larger than in the original description (Table 1), and the absence of the cuticular rods internal to the pharynx.

Distribution. Brazil: Diamantina, Gouveia (Minas Gerais State); São Paulo (São Paulo State).

Table 1. Morphometrical features of *Aspidiophorus* cf. *pleustonicus*. N= number of specimens measured.

Features	Range	N	Literature data from Brazil
Body length	212.5–275 µm	6	191–208 µm
Length of adhesive tube	31.25–37.5 µm	6	9.5–11.5 µm
Pharynx length	56.25–93.75 µm	6	22.6–27.2 µm
Diameter of mouth ring	11.25–18.75 µm	6	5 µm
Cephalion length	25.97 µm	6	-
Cephalion width	19.48 µm	1	16 µm

Genus *Ichthydium* Ehrenberg, 1830

Ichthydium cf. *chaetiferum* (Müller, 1786)

Fig. 2, Table 2

Ichthydium chaetiferum – Kisielewski (1991: 81, Figs 87–89, Tab. 37); Hummon (2007: 10); Balsamo et al. (2009: 14, Appendix 1); Kånneby et al. (2009: 35).

Material. Água limpa: 1 specimen.

Description. The description is based on a single adult specimen, 108.49 µm in total length. Head with five lobes and two pair of ciliary tufts, with a pair of large "ocellar" granules. Pharynx 28.30 µm in length from the posterior edge of the mouth to the pharyngo-intestinal junction, that is at U26. 8 Spines present on the ventrolateral body side.

Remarks. The specimens collected in the present study resemble those described in Kisielewski (1991) due to the presence of a bulbous pharynx and "ocellar" granules. However, they can be distinguished from those in Kisielewski (1991) for the absence of the dorsal cephalic sensorial bristle and the number of spines in the ventrolateral body side (8 against 12).

Distribution. Brazil: Diamantina (Minas Gerais State), Juréia Ecological Reserve (São Paulo State).

Genus *Chaetonotus* Ehrenberg, 1830

Subgenus *Primochaetus* Kisielewski, 1997

Chaetonotus (*Primochaetus*) *acanthocephalus* Valkanov, 1937

Fig. 3, Table 3

Chaetonotus acanthocephalus – Kisielewski (1981; 1991:54, Figs 65–68, Tab. 22); Hummon (2007: 5); Balsamo et al. (2009: 12, Appendix 1).

Material. Água Limpa: 2 specimens, Soberbo: 1 specimens, Preto River: 5 specimens.

Table 2. Morphometrical features of *Ichthydium* cf. *chaetiferum*. N= number of specimens measured.

Features	Measures	N	Literature data from Brazil
Body length	108.49 µm	1	107–117 µm
Length of adhesive tube	16.98 µm	1	12.5–14 µm
Pharynx length	28.30 µm	1	25–29 µm
Diameter of mouth ring	4.01 µm	1	3 µm
Cephalion length	4.8 µm	1	8.5–9 µm
Cephalion width	9.6 µm	1	11 µm

Table 3. Morphometrical features of *Chaetonotus acanthocephalus*. N= number of specimens measured.

Features	Range	N	Literature data from Brazil	Literature data from Europe
Body length	169–236 µm	2	123–175 µm	100–148 µm
Length of adhesive tube	27.5–28 µm	2	11–17 µm	14–16 µm
Pharynx length	62.5–65 µm	2	34–54 µm	37–49 µm
Diameter of mouth ring	8–8.75 µm	2	5 µm	6.5–8 µm
Cephalion length	20 µm	1	-	-
Length of neck scales	7 µm	1	6–7 µm	4–7 µm
Length of trunk scales	10 µm	1	5.5–9.5 µm	5.5–8 µm
Maximum length of the neck spines	24–27 µm	2	7.5–19.5 µm	11–15 µm
Maximum length of the trunk spines	30–35 µm	2	12.5–28 µm	16.5–22 µm
Length of terminal spines	19–31.25 µm	2	8–19.5 µm	-
Number of scales in a single longitudinal row	17	2	17	16–18

Description. The description is based on an adult specimen, 236 µm in total length. Head with three lobes and a one pair of ciliary tufts. Five peculiar cephalic scales with long spines present on the head. Two ventral plates at the sides of the hypostomion. Pharynx 65 µm in length from the posterior edge of the mouth to the pharyngo-intestinal junction that is at U27. The general long-spine distribution pattern shows two pairs of conspicuous lateral neck spines. Two pairs of long lateral spines at the furcal base.

Remarks. Kisielewski (1991) reported three distinct morphotypes of *Chaetonotus acanthocephalus* in Brazilian inland waters: two of them were collected in São Carlos city and one in Juréia Reserve. Our specimens appear to be close to one of the morphotypes found in São Carlos due to the presence of two pairs of long spines at the furcal base, and the peculiar transversal row of trunk spines (Kisielewski 1991:54, Figs 65–66). However, the body length, width and the posterior spines of the Diamantina specimens are larger than those observed from São Carlos (Table 3).

Distribution. Brazil: Diamantina (Minas Gerais State); São Carlos (São Paulo State), Juréia Reserve (São Paulo State), Corumbá (Mato Grosso do Sul State); Poland: Lake Piaseczno; Germany; Bulgaria.

Chaetonotus (*Primochaetus*) *heideri* Brehm, 1917

Figs 4–5, Table 4

Chaetonotus heideri – Emberton (1981: 95, Figs 1–2); Balsamo (1990: 173); Kisielewski (1991: 17, Tab. 3); Nesteruk (2004: 444, Tab. 1; 2007: 836, Tab. 1); Grilli et al. (2008: 174, Fig. h).

Material. Água Limpa: 1 specimen, Soberbo: 2 specimens, Preto River: 2 specimens.

Description. The description is based on an adult specimen 137.5 µm in total length. Head with three lobes and two pairs of ciliary tufts. Pharynx 41 µm in length from the posterior edge of the mouth to pharyngo-intestinal junction, that is at U29. Anterior scales rounded and posterior ones pentagon-like shaped. Lateral spine denticle located near to the spine end.

Distribution. Brazil: Diamantina (Minas Gerais State), Juréia Ecological Reserve and São Carlos (São Paulo State), Benevides (Pará State); USA: Ohio; Germany; England; Italy; Poland; Romania; Russia; Czech Republic; Switzerland; France: Gironde.

Subgenus *Lepidochaetus* Kisielewski, 1991 [Balsamo et al. 2009, p.11]

Chaetonotus sp.

Fig. 6, Table 5

Material. Gouveia: 3 specimens.

Description. The description is based on an adult specimen 236.95 µm in total length. Head with three lobes and one pair of ciliary tufts. Pharynx 64.93 µm in length from the posterior edge of the mouth to the pharyngo-intestinal junction (PhIJ), at U27. Hypostomion as a weak transverse furrow. Three pairs of lateral parafurcal spines, the two posteriormost longer than the adhesives tube. Adhesive tubes very long and thin.

Remarks. The genus *Lepidochaetus* was originally described by Kisielewski (1991) to group some *Chaetonotus* species characterized by numerous, rounded, unkeeled

Table 4. Morphometrical features of *Chaetonotus heideri*. N= number of specimens measured.

Features	Range	N	Literature data from Brazil	Literature data from Europe
Body length	137.5–137.96 µm	2	188–196 µm	106–220 µm
Length of adhesive tube	25–38.8 µm	2	22–25 µm	21–32 µm
Pharynx length	41 µm	2	48.5–50 µm	45–56 µm
Diameter of mouth ring	7.55–10.62 µm	2	10–11.5 µm	10.5–13 µm
Length of trunk spines	37.5–37.96 µm	2	22–37 µm	46–68 µm
Length of egg	11 µm	1	-	-

Table 5. Morphometrical features of *Chaetonotus* sp. N= number of specimens measured.

Features	Range	N
Body length	150.76–236.95 µm	3
Length of adhesive tube	26.15–32.46 µm	3
Pharynx length	35.38–63 µm	3
Diameter of mouth ring	10–14 µm	3
Cephalion length	30.96 µm	3
Length of the egg	100 µm	3
Length of rearmost lateral spines	38.46–71.42 µm	3

scales, provided with long and thin spines covering both the dorsal and the ventral body surfaces. However, here we follow Balsamo et al. (2009) who considered this taxon as a subgenus of *Chaetonotus.* Our specimens resemble *C.* (*Lepidochaetus*) *brasilianus* (Kisielewski 1991), due a similar scale shape and distribution, and rearmost lateral spines arranged in three pairs, which gradually grow in length in a caudal direction. However, they can be distinguished from the previously described species by the absence of cuticular rods and the neck sensorial bristles.

Distribution. Brazil: Diamantina, Gouveia (Minas Gerais State).

Subgenus *Zonochaeta* Remane, 1927

Chaetonotus (*Zonocheta*) cf. *succinctus* Voigt, 1902

Figs 7–8, Table 6

Chaetonotus succinctus - Anderson and Robbins (1980: 226); Kisielewski (1991, 60); Hummon (2007: 6); Weiss (2001: 313); Balsamo et al. (2009: 13, Appendix 1).

Material. Cabral Mountains:1 specimen; Gouveia:1 specimen; Preto River: 1 specimen.

Description. The description is based on an adult specimen 201.38 µm in total length. Head with five lobes and two pairs of ciliary tufts. Pharynx 55.48 µm in length from the posterior edge of the mouth to the pharyngo-intestinal junction, lying at U27. On the middle trunk region, a transverse band of five long dorsal spines, all terminally bifurcated, and of equal length (77.6 µm) and thickness. Paired spines at the furca base, not extending beyond the adhesive tube end.

Distribution. Brazil: Diamantina, Cabral Mountains (Minas Gerais State), Belém (Pará State); Poland; Romania; England; Italy; Germany; South Korea.

Remarks. Within the subgenus *Zonochaeta*, four species (*C. bisacer*, *C. cestacanthus, C. dracunculus*, *C. succinctus*) are characterized by the presence of a series of long dorsal spines with concave apices (Balsamo 1990, 1999). In Brazil, only *C. succinctus* and *C. bisacer* were previously identified (Kisielewski 1991), and the main difference between the two species is the presence of a pair of long spines at the furca base, which extend beyond the adhesive tube tip.

Table 6. Morphometrical features of *Chaetonotus* cf. *succinctus*. N= number of specimens measured.

Features	Range	N
Body length	165.27–201.38 µm	2
Length of adhesive tube	41.6–43.05 µm	2
Pharynx length	54.1–55.55 µm	2
Diameter of mouth ring	4.13–6.89 µm	2
Length of trunk "band" spines	71.42–72.6 µm	2

Order *Macrodasyida* Remane, 1925

Genus *Redudasys* Kisielewski, 1987

Redudasys sp.

Fig. 9, Table 7

Material. Água limpa: 8 specimens; Cabral Montains: 4 specimens. Video sequence (format .mov) is available at http://www.megaupload.com/?d=1F7NJ1XI

Description. The description is based on an adult specimen 461.54 µm in total length. Cephalic cilia occur in one transverse dorsal row as well as in irregularly distributed tufts located at the anterolateral head margin. The mouth opening has a diameter of 10.1 µm. Pharynx 153.85 µm in length from the posterior edge of the mouth to the junction with the intestine. Two elongated caudal lobes, 25.64 µm long and 4.76 µm wide. Median caudal cone absent. Only anterior and caudal adhesive tubes are typically present. One anterior tube per side located laterally in the anterior part of the body. Seven tacticle bristles per side along the lateral body and one per side on the caudal end. Two pairs of caudal adhesive tubes. The inner tube (7.14 µm long) is usually 2/5 shorter than the external one (11.9 µm long).

Distribution. Brazil: Diamantina, Cabral Mountains (Minas Gerais State).

Remarks. The specimens found in Minas Gerais State are undoubtedly members of the genus *Redudays*, an *incertae sedis* Macrodasyida taxon recorded from a freshwater environment (Kisielewski, 1987). However, the data gathered in the present study allow to exclude their affiliation to the single species described in this genus so far, *Redudays fornerisae* Kisielewski, 1987. Our specimens presented seven of tactile bristles per side along the body, and one per side on the caudal body end, that is a total of eight bristles per side, and in addition they had one anterior tube per side. Many of the great number of specimens found in our samples showed a large egg in the trunk region. The species *Redudasys fornerisae* presents six tactile bristles per side along the body and one per side on caudal body end, that is a total of seven bristles per side, and in addition they had two anterior tube per side. Furthermore, the description of *Redudasys fornerisae* was based on six adult individuals (Kisielewski, 1987). Indeed, the specimen used for the description was considered an adult individual by the presence of mature oocytes and a mature egg. For this reason, we strongly believe that the specimen here

Table 7. Morphometrical features of *Redudasys* sp. N= number of specimens measured.

Features	Range	N
Body length	280–461.54 µm	14
Pharynx length	87.5–153.85 µm	14
Diameter of mouth ring	10.1–11.0 µm	14
Length of external caudal tube	11.9–17.5 µm	14
Length of inner caudal tube	7.14–12.5 µm	14

described is an adult and cannot be considered as an early stage of development of *Redudasys fornerisae*. Moreover, even in the smaller specimens from the twelve specimens (0,280 mm; Table 7) there are eight tactile bristles per side.

Discussion

The findings presented here allow us to draw some remarks on the Gastrotricha of the State of Minas Gerais. It is worthwhile noting that a poor sampling effort has allowed us to obtain very interesting faunistic data and to identify seven distinct species, which suggest a high biodiversity of Gastrotricha in this State. Up to now, 22 species of Gastrotricha Chaetonotida had been described from Brazilian rivers with slow water current and quiet habitats (Kisielewski 1991).

The most striking result of this study was the report of *Redudasys* specimens from different streams in Minas Gerais State. Thus, the discovery of *Redudasys* specimens outside of the original record is of great biogeographic interest, as the adaptation of this macrodasyidan taxon to the freshwater habitats could have been followed by considerable radiation, mainly in the neotropical region.

Albeit a high diversity of endemic gastrotrich chaetonotidans has been recorded in the Brazilian fauna (e.g. *Undula*, *Arenotus* - Kisielewski 1987, 1991; Balsamo et al. 2008), most of Gastrotricha species and genera found in Brazil have a cosmopolitan distribution. As pointed out by Kisielewski (1987, 1991) and Hummon (2007), species of the Chaetonotidae genera *Aspidiophorus, Chaetonotus, Heterolepidoderma, Ichthydium, Lepidodermella, Polymerurus* have a very wide distribution and are known from Europe, Asia, North and South America (*Chaetonotus* species were also collected in Africa and Oceania, and *Polymerurus* species in Oceania). Furthermore, up to now, 60 Chaetonotida species have been reported in Brazilian inland waters and 34 were also found elsewhere in the world, showing that 57% of the freshwater species have intercontinental or cosmopolitan distribution.

Based on preview studies (Kisielewski 1987, 1991; Todaro and Rocha 2004, 2005) and on our own results, it is important to emphasize that further investigations are needed to increase the knowledge of Brazilian gastrotrich fauna, which likely include a quite higher number of species.

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Parasabella Bush, 1905, replacement name for the polychaete genus *Demonax* Kinberg, 1867 (Annelida, Polychaeta, Sabellidae)

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Abstract

Parasabella Bush, 1905 is reintroduced as a replacement name for *Demonax* Kinberg, 1867 (Annelida: Polychaeta: Sabellidae) which is a junior homonym of *Demonax* Thomson, 1860 (Insecta: Coleoptera: Cerambycidae).

Keywords

Demonax, Parasabella, Sabellidae, fan worms

Introduction

Kinberg (1867) established the new genus *Demonax* for four new species of sabellid polychaetes that were found in Honolulu (Hawaii), San Lorenzo (Perú) and Valparaíso (Chile). This name is a junior homonym of *Demonax* Thomson, 1860, a genus of round necked longhorn beetles (Insecta: Coleoptera: Cerambycidae). The coleopteran name is well entrenched in the literature (Dauber 2006, 2008, Guo and Chen 2005); 60 references found in Zoological Record on 14 June 2010; and recognized in Nomenclator Zoologicus). According to the Article 60 of the ICZN (1999), a junior homonym must be rejected and replaced either by an available and potentially valid synonym (Art. 23.3.5) or, for lack of such name, by a new substitute name. *Parasabella* Bush, 1905 is the oldest available name among the synonyms of *Demonax* Kinberg and here is reintroduced for the replacement of *Demonax* Kinberg, 1867.

Systematics

Parasabella Bush, 1905, reestablished

[=] *Demonax* Kinberg 1867: 354 (not Thomson 1860); 1910: 72.– Johansson 1925: 26–27; 1927: 136.– Knight-Jones 1983: 254.– Perkins 1984: 292–293.– Knight-Jones and Walker 1985: 605.– Fitzhugh 1989: 75–76.– Giangrande 1994: 229–230.
Parasabella Bush 1905: 191, 199–200.– Johansson 1927: 136.
Distylidia Hartman 1961: 129.– Fauchald 1977: 138.– Banse 1979: 870.

Type species: *Demonax krusensterni*, subsequent designation by Bush (1905).

Remarks: Kinberg (1867) described the new genus *Demonax* for four new species: *D. krusensterni* and *D. cooki* from Honolulu, *D. leucaspis* from San Lorenzo and *D. incertus* from Valparaíso, and *D. tilosaulus* (Schmarda, 1861) also from Valparaíso. The specimen reported by Kinberg as *D. tilosaulus* (not *Sabella tilosaula* Schmarda, 1861) is a *Chone* species according to Hartman (1959: 514). As Perkins (1984) noted, designation of *Demonax krusensterni* as the type-species by Bush (1905) was unfortunate since figures of the other three new species were published posthumously in the second part of Kinberg's paper on the polychaetes of the Eugenie Expedition (Kinberg 1910) and the holotype of *D. krusensterni* is in poor condition (Johansson 1925, Perkins 1984).

Johansson (1925) reexamined Kinberg's *Demonax* types and commented that *D. leucaspis*, *D. incertus*, and *D. cooki* and questionable *D. krusensterni* were all exemplars of a single species. In 1927, Johansson included these species in synonymy under *D. leucaspis*, with *D. krusensterni* as a questionable synonym. Hartman (1959), following Johansson (1927), designated *D. leucaspis* as the type-species, a mistake that violates Article 69 of the ICZN (1999). Fauchald (1977) and Banse (1979) followed Hartman (1959) while Knight-Jones (1983), Perkins (1984), Fitzhugh (1989), Giangrande (1994) and Gambi et al. (2001) considered *D. krusensterni* as the type-species of *Demonax*. Knight-Jones (1983) suggested that the syntypes of *D. cooki* could well be juvenile specimens of *D. krusensterni* showing regeneration after damage. Perkins (1984) included *D. incertus*, *D. cooki* and questionably *D. krusensterni* under the name *D. leucaspis*.

Parasabella is currently represented by the following 25 species, 24 of which are new combinations:

Parasabella aberrans (Augener, 1926), comb. n.
Type locality: New Zealand.

Parasabella albicans (Johansson, 1922), comb. n.
Type locality: Japan.
Parasabella aulaconota (Marenzeller, 1884), comb. n.
Type locality: Japan.
Parasabella brevithoracica (Pillai, 1961), comb. n.
Type locality: Nachikuda, Ceylon.
Parasabella cambrensis (Knight-Jones & Walker, 1985), comb. n.
Type locality: Liverpool Bay, UK.
Parasabella columbi (Kinberg, 1867), comb. n.
Type locality: La Plata, Argentina.
Parasabella fernandezensis (Augener, 1922), comb. n.
Type locality: Juan Fernandez Island, Chile.
Parasabella flecata (Hoagland, 1919), comb. n.
Type locality: Puerto Rico.
Parasabella jamaicensis (Augener, 1924), comb. n.
Type locality: Kingston, Jamaica.
Parasabella japonica (Moore & Bush, 1904), comb. n.
Type locality: Japan.
Parasabella krusensterni (Kinberg, 1867), comb. n.
Type locality: Honolulu, Hawaii.
Parasabella lacunosa (Perkins, 1984), comb. n.
Type locality: Hutchinson Island, Florida.
Parasabella langerhansi (Knight-Jones, 1983), comb. n.
Type locality: Madeira.
Parasabella leucaspis (Kinberg, 1867), comb. n.
Type locality: San Lorenzo, Chile.
Parasabella media Bush, 1905.
Type locality: Alaska.
Parasabella microphthalma (Verrill, 1873), comb. n.
Type locality: Vineyard Sound, Massachusetts.
Parasabella oculea (Pillai, 1965), comb. n.
Type locality: Manila Bay, Philippines.
Parasabella pallida (Moore, 1923), comb. n.
Type locality: Santa Cruz, California.
Parasabella polarsterni (Gambi, Patti, Micaletto & Giangrande, 2001), comb. n.
Type locality: Weddell Sea.
Parasabella rufovittata (Grube, 1881), comb. n.
Type locality: Singapore.
Parasabella rugosa (Moore, 1904), comb. n.
Type locality: San Diego, California.
Parasabella saxicola (Grube, 1861), comb. n.
Type locality: Chero, Adriatic Sea, see note below.
Parasabella tenuicollaris (Grube, 1870), comb. n.

Type locality: Adriatic Sea.
Parasabella tommasi (Giangrande, 1994), comb. n.
Type locality: Brindisi, Adriatic Sea.
Parasabella torulis (Knight-Jones & Walker, 1985), comb. n.
Type locality: Liverpool Bay, UK.

Discussion

P. Knight-Jones considered two "types" of *Sabella saxicola*. One (ZMB Q 5198) agrees with Grube's description and his further comment (1870) emphasizing that *S. saxicola* lacked radiolar eyes. This was re-described and illustrated by Knight-Jones (1983) as *Demonax saxicola*. Later, Knight-Jones et al. (1991: 850) suggested the synonym of *D. saxicola* (Grube, 1861) and *D. brachyona* (Claparède, 1870) (as *brachychona*, spelling variation), wrongly preferring the use of Claparède's name. This was later followed by Giangrande (1994: 231). According to the ICZN (1999), Statement of the Principle of Priority (23.3.5), the name *saxicola* has priority over *brachyona*.

The other specimen considered as "type" by P. Knight-Jones (MPW 372) cannot be regarded as a syntype because it has radiolar eyes and is *Pseudopotamilla saxicava* (de Quatrefages, 1866), a species previously synonymized with *Pseudopotamilla reniformis* (Müller, 1771) by McIntosh (1923: 233). At the beginning of 1990's Knight-Jones examined type materials of *P. saxicava* and noted that it had unique characters, making this species distinguishable from *P. reniformis*. As shown in her poster presented during the 8th International Polychaete Conference in Madrid, Dr. Knight-Jones was working on the reestablishment of *P. saxicava*. Unfortunately, she died before a full revision of the genus *Pseudopotamilla* had been completed.

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RESEARCH ARTICLE

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Korean species of *Aleochara* Gravenhorst subgenus *Xenochara* Mulsant & Rey (Coleoptera, Staphylinidae, Aleocharinae)

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Abstract

A taxonomic review of *Aleochara* Gravenhorst subgenus *Xenochara* Mulsant & Rey in Korea is presented. Five species are recognized, with one species, *A.* (*Baryodma*) *intricata* Mannerheim, newly transferred to the subgenus *Xenochara*. *Aleochara* (*X.*) *asiatica* Kraatz and *A.* (*X.*) *peninsulae* Bernhauer are reported for the first time in the Korean peninsula. A key, line drawings of diagnostic characters, and redescriptions of Korean *Xenochara* species are provided.

Keywords

Aleocharini, *Aleochara*, *Xenochara*, redescription, Korea.

Introduction

The staphylinid genus *Aleochara* Gravenhorst includes over 400 species in 19 subgenera worldwide. Fourteen species in six subgenera are recorded in the Korean peninsula (Smetana 2004; Park and Ahn 2009). The subgenera of *Aleochara* have been previously diagnosed using a few characters of the antenna, mesosternal carina, pronotal pubescence and microsculpture, elytral pubescence, maxillary palpi, and genitalia (Klimaszewski 1984). However, the morphologically diverse subgenera such as *Xenochara* are poorly distinguished from other *Aleochara* subgenera by these characters (Klimaszewski 1984).

Therefore, we used characters that are more informative at the subgeneric and species levels. Our character analysis follows the methods of Sawada (1972) and Ashe (1984). The terminology for abdominal segments follows Thayer (2005).

We redescribe five Korean *Xenochara* species herein, and a key and line drawings of diagnostic characters of these species are also provided. The Korean specimens studied are deposited in the Chungnam National University Insect Collection (CNUIC), Daejeon, Korea.

Subgenus *Xenochara* Mulsant & Rey

Xenochara Mulsant & Rey, 1874: 60; Ganglbauer, 1895: 32; Fenyes, 1920: 403; Bernhauer & Scheerpeltz, 1926: 781; Palm, 1972: 426; Seevers, 1978: 137.
Polychara Mulsant & Rey, 1874: 64; Ganglbauer, 1895: 34; Fenyes, 1920: 408; Bernhauer & Scheerpeltz, 1926: 785; Portevin, 1929: 237; Seevers, 1978: 136.
Isochara Bernhauer, 1901: 440, 461.
See Klimaszewski (1984) for complete synonymy and references.

Type species: *Aleochara decorata* Aubé.

Diagnosis. The subgenus *Xenochara* can be distinguished by a combination of the following characters: body compact, robust, pubescent; antennomere 4 usually longer than wide (except *A. tristis*, transverse); carina on each side of midline of ventral surface of head present, attaining or almost attaining gular suture (arrows, Figs 1b, 2b, 3b, 4a, 5a; Klimaszewski 1984: Figs 313, 319, 321); maxillary palpomere 4 usually long (1/3 to 3/4 length of palpomere 3); labral b-seta sharpened or rounded apically (arrows, Figs 1c, 2c, 3c, 4b, 5b); mandibular internal tooth absent or weakly present; β-seta of labial palpi long (Figs 1e, 2e, 3e, 4d, 5d); mesoventrite completely or almost completely carinate (Figs 1a, 2a, 3a); pronotum evenly pubescent; spines of lateral margins of fore- and meso-tibia present but absent in meta-tibia.

Remarks. This diagnosis is modified from Klimaszewski (1984:35). New diagnostic characters based on mouthparts are added, and these are consistent at the subgenus level.

Key to the *Aleochara* (*Xenochara*) species from Korea

1. Elytra with emarginate latero-posterior margins **2**
– Elytra with rounded latero-posterior margins **3**
2. Labral b-seta acute (arrow, Fig. 3c), labium with a pair of distal setae (arrow, Fig. 3d), male abdominal tergite VIII with undulate posterior margin (secondary sexual dimorphism; Fig. 3g), male abdominal sternite VIII with produced posterior margin (secondary sexual dimorphism; arrow, Fig. 3i), paramere with fovea in hinge zone (arrow, Fig. 3k), spermathecal duct not coiled (Fig. 3n) .... ***A. peninsulae* Bernhauer**

– Labral b-seta rounded at tip (arrow, Fig. 4b), labium without distal setae (Fig. 4c), male abdominal tergite VIII without undulate posterior margin (Fig. 4f), male abdominal sternite VIII with rounded posterior margin (Fig. 4g), paramere without fovea in hinge zone (Fig. 4j), spermathecal duct coiled (Fig. 4l) ....***A. puberula* Klug**

3. Antennomeres 5–6 longer than wide, abdominal tergite VIII with deeply emarginate posterior margin (Figs 1g, 1h), male tergite VIII with undulate posterior margin (secondary sexual dimorphism; Fig. 1g) .....***A. asiatica* Kraatz**

– Antennomeres 5–6 transverse, abdominal tergite VIII with weakly emarginate posterior margin (Figs 2g, 5f), male tergite VIII without undulate posterior margin (Figs 2g, 5f) **4**

4. Antennomere 4 longer than wide, labral b-seta rounded at tip (arrow, Fig. 2c), labium without distal setae (Fig. 2d), paramere without fovea in hinge zone (Fig. 2j), median lobe without coiled flagellum (Fig. 2k), spermathecal duct not coiled (Fig. 2m) ....***A. intricata* Mannerheim**

– Antennomere 4 transverse, labral b-seta acute (arrow, Fig. 5b), labium with a pair of distal setae (arrow, Fig. 5c), paramere with fovea in hinge zone (arrow, Fig. 5i), median lobe with coiled flagellum (arrow, Fig. 5j), spermathecal duct coiled (Fig. 5l) ....***A. tristis* Gravenhorst**

***Aleochara* (*Xenochara*) *asiatica* Kraatz**

Fig. 1

Aleochara asiatica Kraatz, 1859: 15; Bernhauer & Scheerpeltz, 1926: 780; Pace, 2001: 35 (mentioned as subgenus *Xenochara*); Smetana, 2004: 356 (mentioned as subgenus *Euryodma*).

Aleochara japonica Sharp, 1874: 8.

Aleochara (*Isochara*) *asiatica* Cameron, 1939: 644.

Redescription. Length 4.5–6.5 mm. Body large and robust; brownish black, antenna and legs black; elytra bicolored. Antennomeres 1–3 elongate, 4–6 longer than wide and 7–10 transverse. *Mouthparts*. Labrum transverse, bearing approximately 11 small, setae, and approximately 21 long setae, a-seta, b-seta, and pores present; b-seta rounded apically (arrow indicates b-seta, Fig. 1c). Labium with pseudopores in median area, approximately 2 real pores and pseudopores present in lateral area; a pair of basal pores present (Fig. 1d). Ligula with approximately 4 pairs of small setae apically (Fig. 1d). Labial palpi with large a-, b-, and f-seta of 12 setae present (a–h, α–δ); long β-seta present in the middle of palpomere 1; d-seta higher than c-seta (Fig. 1e). Mentum transverse, bearing 4 pairs of main setae (b, u, v, w), and 6 extra setae, and pores present (Fig. 1f). *Thorax*. Mesoventrite completely carinate (arrow, Fig. 1a). Elytra with round latero-posterior margin. *Abdomen*. Male and female abdominal tergite VIII with many short setae and pores; posterior

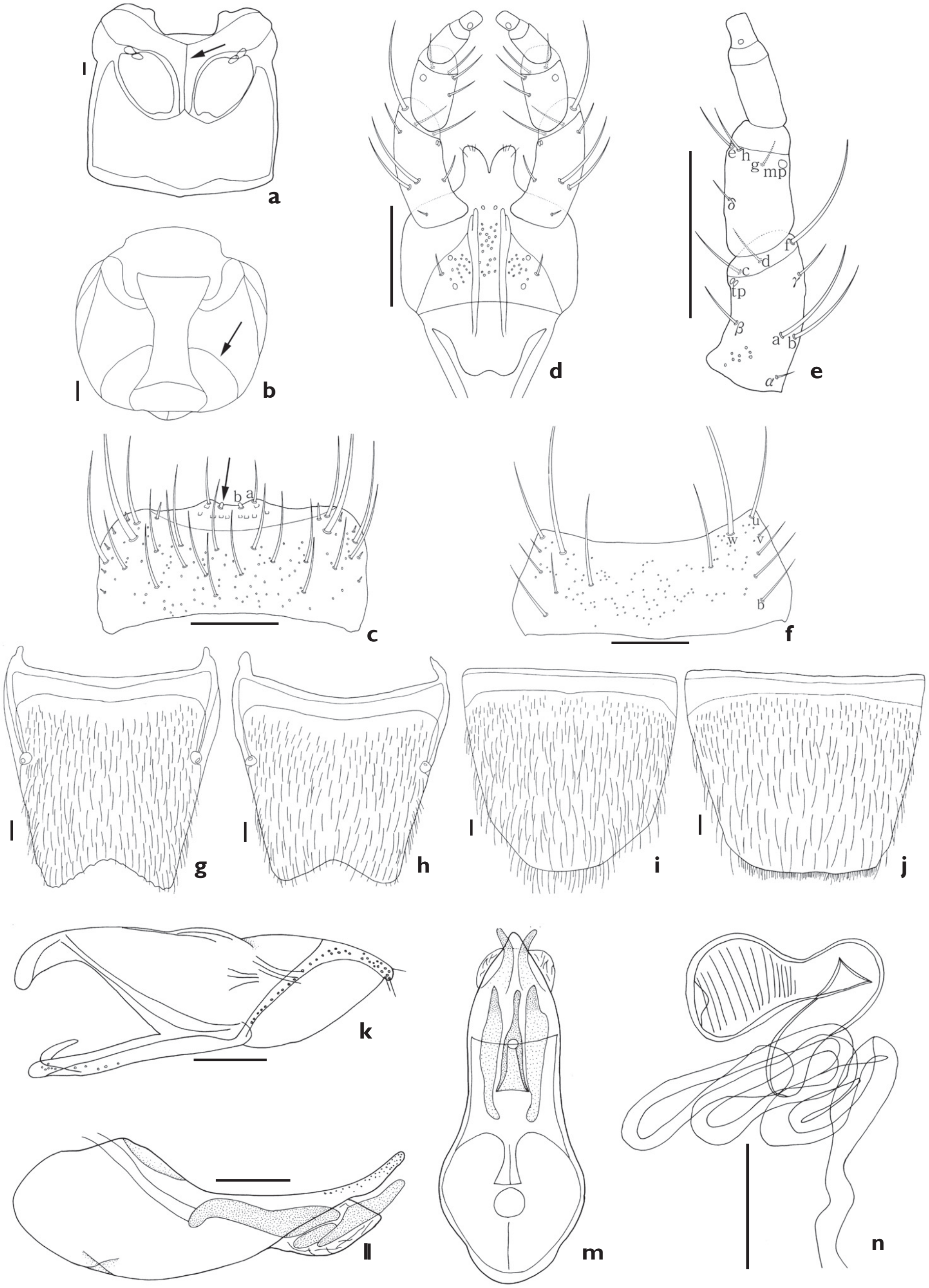

Figure 1. *Aleochara* (*Xenochara*) *asiatica*. **a** meso- and metaventrite, ventral aspect **b** head, ventral aspect **c** labrum, dorsal aspect **d** labium, ventral aspect **e** labial palpus, ventral aspect **f** mentum, ventral aspect **g** male tergite VIII, dorsal aspect **h** female tergite VIII, dorsal aspect **i** male sternite VIII, ventral aspect **j** female sternite VIII, ventral aspect **k** paramere, lateral aspect **l** median lobe, lateral aspect **m** median lobe, dorsal aspect **n** spermatheca. Scale bars = 0.1 mm.

margin deeply emarginate and undulate on male (Fig. 1g, h). Male and female abdominal sternite VIII with many short setae and pores, margin rounded and female with many small setae on posterior margin (Fig. 1i, j). *Genitalia*. Median lobe as in Figs 1l and m. Paramere without fovea in hinge zone (Fig. 1k). Spermatheca with duct coiled (Fig. 1n).

Material examined. 1♂, Daeheungsa-temple, Samsan-myeon, Haenam-gun, Jeonnam Prov., Korea, 23.IV.1983, Y. B. Cho; 4♂♂ 2♀♀, Jeju Prov., Korea, 22.VII.1985, Y.B. Cho (1♂ 1♀, on slide); 1♀, Donnaeko, Sanghyo-dong, Seogwipo-city, Jeju Prov., Korea, 18.X.1985, K.-S. Lee; 1♀, Donnaeko, Sanghyo-dong, Seogwipo-city, Jeju Prov., Korea, 22.X.1985, K.-S. Lee; 1♀, Jeongbangpolpo-waterfall, Donghong-dong, Seogwipo-city, Jeju Prov., Korea, 29.X.1985, K.-S. Lee; 1♂, Gasi-ri, Pyoseon-myeon, Namjeju-gun, Jeju Prov., Korea, 5.V.1985, K.-S. Lee; 2, Japan, G. Lewis, 1910–320, Nagasaki, 22.V–3.VI.81; 2, Japan, G. Lewis, 1910–320, Kumamoto, 23.IV–26.IV.81; 3, Japan, G. Lewis, 1905–313 (1, Holotype of *Aleochara japonica* Sharp, deposited in the Natural History Museum, London); 1, Japan, G. Lewis, 1910–320.

Distribution. China, India, Japan, Korea, Nepal, Taiwan (see Smetana, 2004: 356).

Remarks. This species is a new record for the Korean peninsula.

***Aleochara* (*Xenochara*) *intricata* Mannerheim**

Fig. 2

Aleochara intricata Mannerheim, 1830: 96; Fenyes, 1920: 404; Bernhauer & Scheerpeltz, 1926: 782; Portevin, 1929: 236; Palm, 1972: 428; Lohse, 1974: 296; Welch, 1997: 26; Smetana, 2004: 354; Assing, 2007a: 60; 2007b: 184.
Aleochara terminata Stephens, 1832: 158.
Aleochara celer Stephens, 1832: 161.
Aleochara biguttata Heer, 1839: 315.
Aleochara croatica Penecke, 1901: 12.

Redescription. Length 3.5–6.0 mm. Body large and robust; brownish black; antennomeres 1–3 and legs brown; elytra yellow to yellowish brown and bicolored. Antennomeres 1–3 elongate, 4 longer than wide, 5–8 weakly transverse and 9–10 transverse. *Mouthparts*. Labrum transverse, bearing approximately 8 small, setae, and approximately 26 long setae, a-seta, b-seta, and pores present; b-seta rounded apically (arrow indicates b-seta, Fig. 2c). Labium with pseudopores in median area; approximately 3 real pores and pseudopores present in lateral area; pair of basal pores present (Fig. 2d). Ligula with approximately 4 pairs of small setae apically (Fig. 2d). Labial palpi with large a-, b-, and f-seta of 12 setae (a–h, α–δ) present; β-seta close to twin pores (tp); d- and c-seta at same level (Fig. 2e). Mentum transverse, bearing 4 pairs of main setae (b, u, v, w), and 4 extra setae, and pores present (Fig. 2f). *Thorax*. Mesoventrite completely carinate (arrow, Fig. 2a). Elytra with round latero-posterior margin. *Abdomen*. Abdominal tergite VIII with many short setae and pores; posterior margin weakly emarginate (Fig. 2g). Abdominal sternite VIII with many short setae

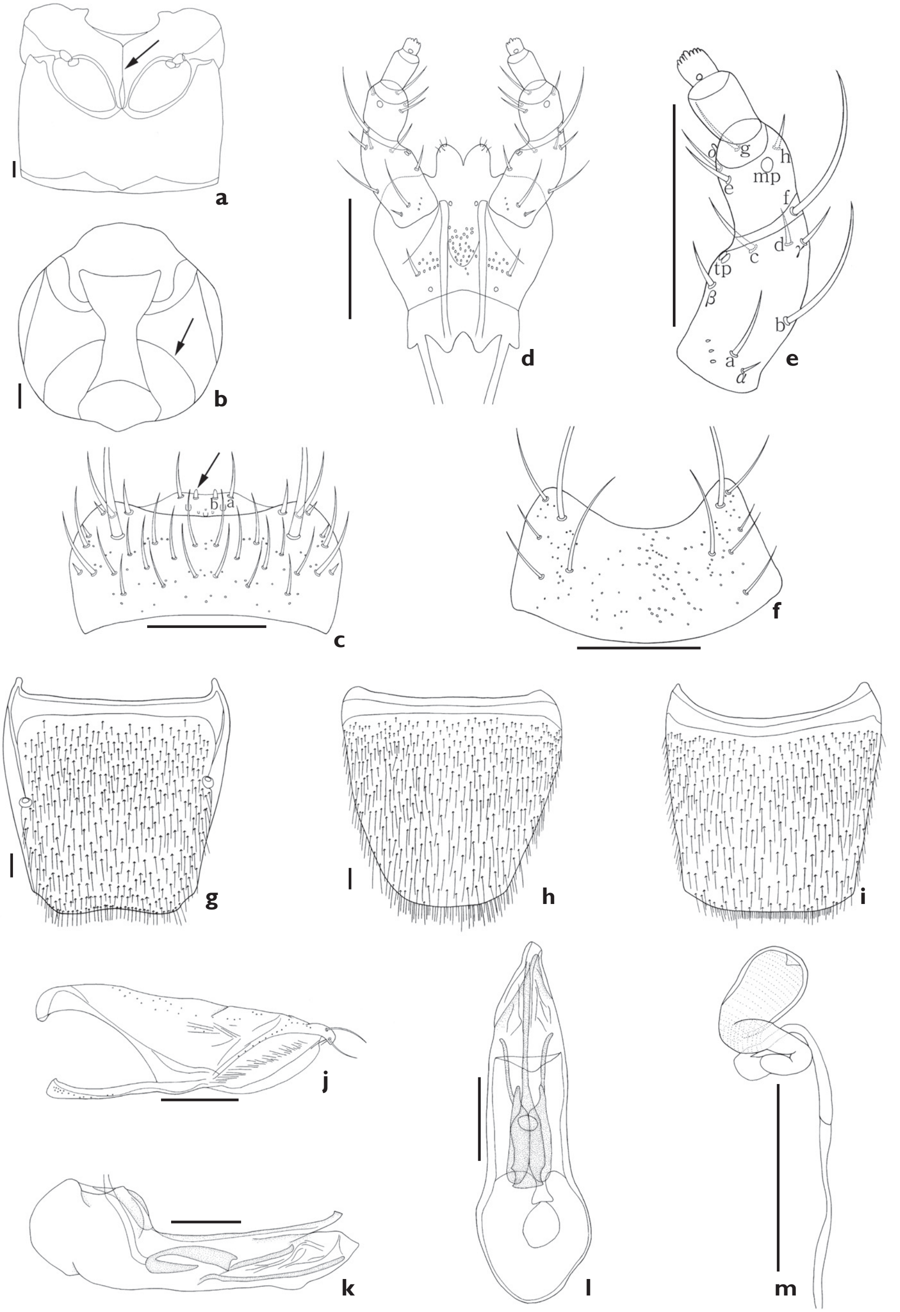

Figure 2. *Aleochara* (*Xenochara*) *intricata*. **a** meso- and metaventrite, ventral aspect **b** head, ventral aspect **c** labrum, dorsal aspect **d** labium, ventral aspect **e** labial palpus, ventral aspect **f** mentum, ventral aspect **g** tergite VIII, dorsal aspect **h** male sternite VIII, ventral aspect **i** female sternite VIII, ventral aspect **j** paramere, lateral aspect **k** median lobe, lateral aspect **l** median lobe, dorsal aspect **m** spermatheca. Scale bars = 0.1 mm.

and pores; posterior margin rounded (Fig. 2h, i). *Genitalia*. Median lobe as in Figs 2k and l. Paramere without fovea in hinge zone (Fig. 2j). Spermatheca as in Fig. 2m.

Material examined. 7, Hol-ri, Ganseong-eup, Goseong-gun, Gangwon Prov., Korea, 31.VIII–1.IX.1984, Y.-S. Kim (2♂♂2♀♀, on slide); 1, Gohan-ri, Sabuk-eup, Gangwon Prov., Korea, 27.IV.1985, J.-I. Kim; 1, Deakwan-ryeong, Gangwon Prov., Korea, 28.VI.1984, Y.-S. Kim; 2, Oigapyeong, Inje-gun, Gangwon Prov., Korea, 26.V.1986, Y.-S. Kim; 1, Baekdamsa-temple, Inje-gun, Gangwon Prov., Korea, 26.V.1986, Y.-S. Kim; 1, Dammaeul, Cheongsong, Gyeongbuk Prov., Korea, 24.VI.1988, K.-S. Jang; 1, Tonghan, Anjeong, Jeonbuk Prov., Korea, 5.VI.1988, Y.-S. Kim; 6, Seilles, carriere 1, 11/19 VIII 1945, G. Fagel; 2, Anseremme car, vers Freyr, 26 VIII 1946, G. Fagel; 2, Abruzzo, A. colomba, Italy, 26.VII.1894, P Fiori; 12, Lazio, Roma, Lirezzi, Italy, A. Fiori.

Distribution. Korea, Asia, Europe, North Africa (see Smetana, 2004: 354).

Remarks. This species is a new record for South Korea.

***Aleochara* (*Xenochara*) *peninsulae* Bernhauer**

Fig. 3

Aleochara peninsulae Bernhauer, 1936: 325; Smetana, 2004: 360.

Holotype examined. Male mounted on card, with mouthparts, aedeagus and abdominal apex (segment VIII+) mounted in balsam on two transparent cards, labeled as follows: "Shimabara Unzen 2200F 2. 8. 34. Suenson" [printed]; "peninsulae Brnh. Typus un. *Polychara*" [handwritten yellow label]; "peninsulae Brnh. Typus unic." [handwritten white label]; "Chicago NHMus M. Bernhauer Collection" [printed]; "HOLOTYPE *Aleochara peninsulae* Bernhauer, 1936 teste Park & Ahn 2007" . Deposited in the Field Museum of Natural History (FMNH), Chicago, USA.

Redescription. Length 3.8–5.4 mm. Body compact and robust; reddish black; antenna, elytra, and legs brownish black; elytra bicolored. Antennomeres 1–3 elongate, 4 longer than wide, 5 subquadrate, and 6–10 transverse. *Mouthparts*. Labrum transverse, bearing approximately 8 small, setae, and approximately 19 long setae, a-seta, b-seta and pores present; b-seta acute (arrow indicates b-seta, Fig. 3c). Labium with pseudopores in median area; approximately 3 pores and pseudopores present in lateral area; a pair of distal setae present (arrow indicates distal seta, Fig. 3d). Ligula with approximately 3 pairs of small setae apically (Fig. 3d). Labial palpi with large a-, b-, and f-seta of 12 setae present (a–h, α–δ); β-seta close to twin pores (tp); d-seta higher than c-seta (Fig. 3e). Mentum transverse, bearing 4 pairs of main setae (b, u, v, w), and approximately 2 extra setae, and pores present (Fig. 3f). *Thorax.* Mesoventrite completely carinate (arrow, Fig, 3a). Elytral latero-posterior margin emarginate. *Abdomen*. Abdominal tergite VIII with many short setae and pores; posterior margin emarginate; undulate on male (Fig. 3g, h). Male abdominal sternite VIII with many short setae and pores; posterior margin produced on male (arrow, Fig. 3i) and rounded

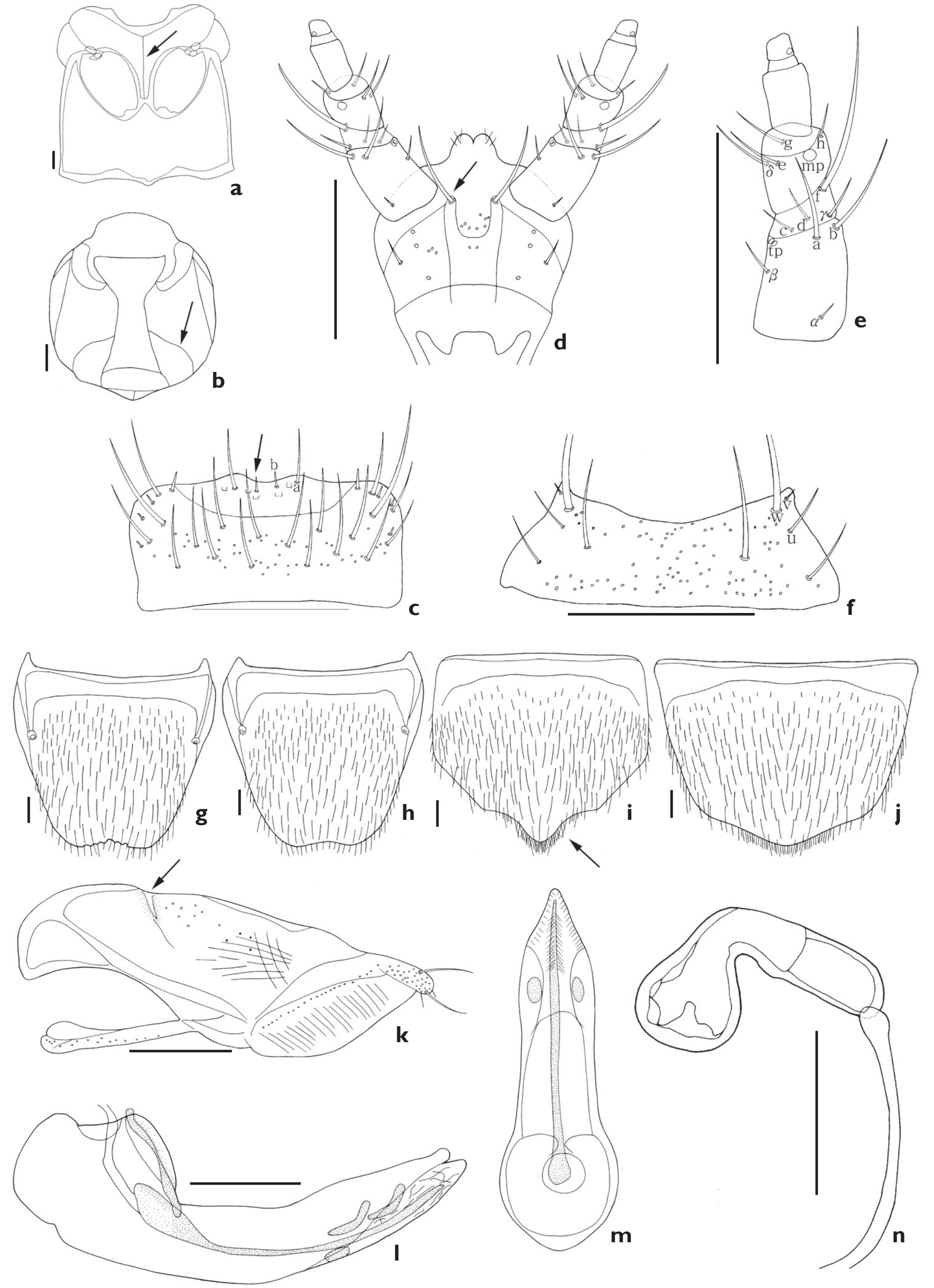

Figure 3. *Aleochara* (*Xenochara*) *peninsulae*. **a** meso- and metaventrite, ventral aspect **b** head, ventral aspect **c** labrum, dorsal aspect **d** labium, ventral aspect **e** labial palpus, ventral aspect **f** mentum, ventral aspect **g** male tergite VIII, dorsal aspect **h** female tergite VIII, dorsal aspect **i** male sternite VIII, ventral aspect **j** female sternite VIII, ventral aspect **k** paramere, lateral aspect **l** median lobe, lateral aspect **m** median lobe, dorsal aspect **n** spermatheca. Scale bars = 0.1 mm.

on female (Fig. 3j). *Genitalia*. Median lobe as in Figs 3l and m. Paramere with fovea in hinge zone (arrow, Fig. 3k). Spermatheca as in Fig. 3n.

Material examined. 2, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 26.III.2003, C.-S. Lim, *ex* bait trap; 2, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 2 VI 2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 27.III.2003, C.-S. Lim, *ex* bait trap; 2, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 22.III.2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 12.III.2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 7.IV.2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 15.III.2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 24.III.2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 29.V.2003, C.-S. Lim, *ex* bait trap; 1, Gyeongsang Univ., Gajoa-Dong, Jinju-city, Gyeongnam Prov., Korea, 30.III.2003, C.-S. Lim, *ex* bait trap; 1, near 1100m Rest Area, Jeju Prov., Korea, 30.V–17.VI.2003, Y.-B. Cho, *ex* bait trap.

Distribution. Japan, Korea.

Remarks. This species is a new record for the Korean peninsula.

***Aleochara* (*Xenochara*) *puberula* Klug**

Fig. 4

Aleochara puberula Klug, 1832: 139; Ganglbauer, 1895: 32; Fenyes, 1920: 403; Bernhauer & Scheerpeltz, 1926: 781; Portevin, 1929: 236; Palm, 1972: 426; Lohse, 1974: 296; Klimaszewski, 1984: 46; Smetana, 2004: 360.
Aleochara vaga Erichson, 1839: 172.
Aleochara deserta Erichson, 1839: 173.
Aleochara decorata Aubé, 1850: 311.
Aleochara armitagei Wollaston, 1854: 559.
Aleochara badia Motschulsky, 1858: 237.
Oxypoda sanguinolenta Motschulsky, 1858: 241.
Oxypoda brunnescens Motschulsky, 1858: 243.
Aleochara dubia Fauvel, 1863: 428.
Oxypoda analis MacLeay, 1873: 135.
Baryodma bipartita Casey, 1894: 287.
Aleochara major Eichelbaum, 1912: 176.
See Klimaszewski (1984) for additional synonymies and references.

Redescription. Length 3.5–5.5 mm. Body reddish brown; antennomeres 1–3, elytra, and legs brown; elytra bicolored. Antennomeres 1–3 elongate, 4 longer than wide, 5 subquadrate, and 6–10 transverse. *Mouthparts*. Labrum transverse, bearing approximately 11 small, setae, and approximately 19 long setae, a-seta, b-seta, and pores present; b-seta

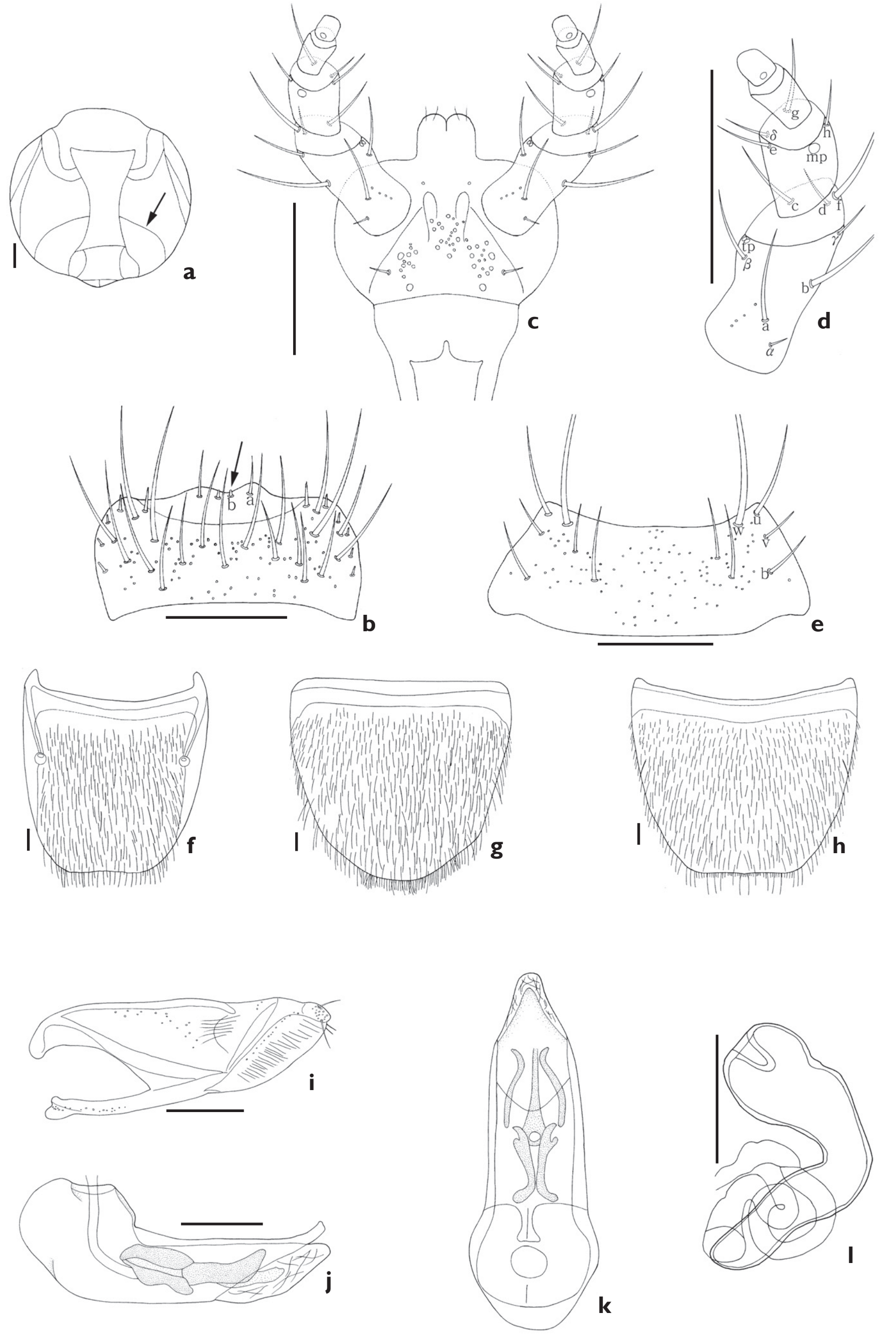

Figure 4. *Aleochara* (*Xenochara*) *puberula*. **a** head, ventral aspect **b** labrum, dorsal aspect **c** labium, ventral aspect **d** labial palpus, ventral aspect **e** mentum, ventral aspect **f** tergite VIII, dorsal aspect **g** male sternite VIII, ventral aspect **h** female sternite VIII, ventral aspect **i** paramere, lateral aspect **j** median lobe, lateral aspect **k** median lobe, dorsal aspect **l** spermatheca. Scale bars = 0.1 mm.

rounded at tip (arrow indicates b-seta, Fig. 4b). Labium with pseudopores in median area; approximately 3 real pores and pseudopores present in lateral area; a pair of basal pores present (Fig. 4c). Ligula with approximately 2 pairs of small setae apically (Fig. 4c). Labial palpi with large a-, b-, and f-seta of 12 setae present (a–h, α–δ); β-seta close to twin pores (tp); c-seta higher than d-seta (Fig. 4d). Mentum transverse, bearing 4 pairs of main setae (b, u, v, w), and 4 extra setae, and pores present (Fig. 4e). *Thorax*. Elytral latero-posterior margin emarginate. *Abdomen*. Abdominal tergite VIII with many short setae and pores; posterior margin weakly emarginate (Fig. 4f). Abdominal sternite VIII with many short setae and pores; apical margin rounded on male (Fig. 4g) and truncated on female (Fig. 4h). *Genitalia*. Median lobe as in Figs 4j and k. Paramere with fovea absent in hinge zone (Fig. 4i). Spermatheca coiled in duct (Fig. 4l).

Material examined. 2, Seoguipo-city, Jeju Prov., Korea, 18.VI.1985, K.-S. Lee; 1, Anseong, Muju-gun, Jeonbuk Prov., Korea, 5.VI.1988, G.-S. Jang; 22, Reunion 22–23.I.1992, Ravine de St. Gilles Bassin Cormoran, J. Janaj lgt; 1, Philippinen, Manila, Luy, 2.XI.1914; 1, Argentina, Prov. Tucuman, 450m, I 1905, Steinbach; 1, N. Palawan, Bakuit, 12.XI–22.XII 1913, Bottcher; 4, Sud algérien: Mrhaier 120 Km S de Biskra, 14.V.1954, G. Fagel; 4, China, B. M. 1980–491, P. M. Hammond, Guangdong, Guangzhou, Baiyunshan, 27.IX.80; 4, China, B. M. 1980–491, P. M. Hammond, Guizhou, 20m, S. Guilin, 22.IX.80; 1, Japan, Honshu, B. M. 1980–492, P. M. Hammond, Nara, ft of Mt. Kasuga, 20.VIII.80; 2, Japan, Sharp Coll., 1905–313; 4, Japan, G. Lewis, 1910–320.

Distribution. Japan, Korea, Asia, Europe, North Africa, North America (see Smetana, 2004: 360).

Aleochara (*Xenochara*) *tristis* Gravenhorst

Fig. 5

Aleochara tristis Gravenhorst, 1806: 170; Mulsant & Rey, 1874: 72; Fowler, 1888: 14; Ganglbauer, 1895: 34; Fenyes, 1920: 405; Bernhauer & Scheerpeltz, 1926: 784; Portevin, 1929: 237; Palm, 1972: 428; Lohse, 1974: 296; Klimaszewski, 1984: 37; Welch, 1997: 26; Smetana, 2004: 361.
Staphylinus bipunctata Olivier, 1795: 31.
Staphylinus geometrica Schrank, 1798: 642.
Aleochara flavomaculata Ménétriés, 1832: 147.
Aleochara bimaculata Stephens, 1832: 158.
Aleochara nigripes Miller, 1853: 27.
Aleochara erectesetosa Jekel, 1873: 41.
Baryodma nigripennis Mulsant & Rey, 1874: 76.
See Klimaszewski (1984) for additional synonymies and references.

Redescription. Length 3.7–6.4 mm. Body black; antenna and legs reddish black; elytra yellow to yellowish brown and bicolored. Antennomeres 1–3 elongate, and 4–

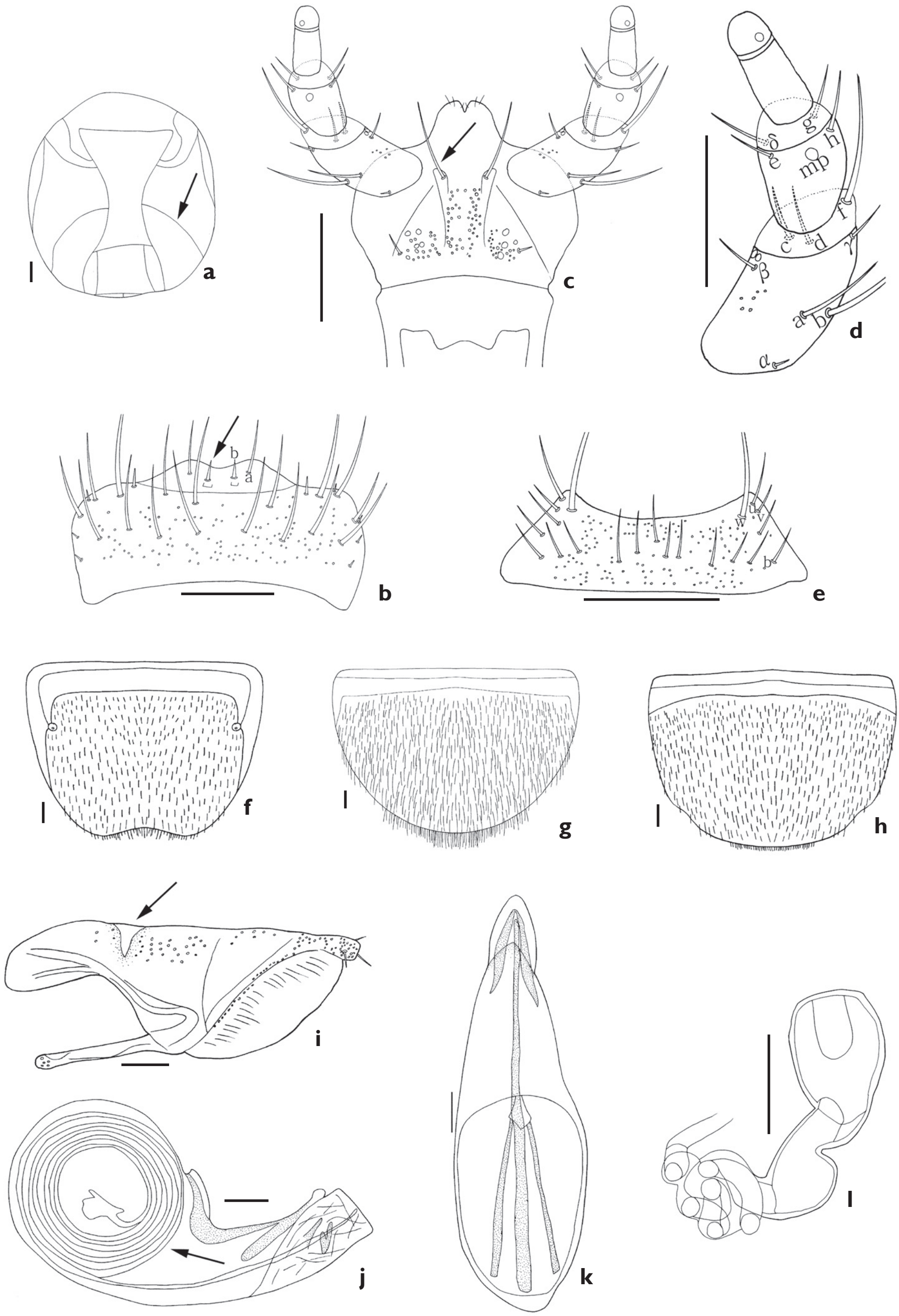

Figure 5. *Aleochara* (*Xenochara*) *tristis*. **a** head, ventral aspect **b** labrum, dorsal aspect **c** labium, ventral aspect **d** labial palpus, ventral aspect **e** mentum, ventral aspect **f** tergite VIII, dorsal aspect **g** male sternite VIII, ventral aspect **h** female sternite VIII, ventral aspect **i** paramere, lateral aspect **j** median lobe, lateral aspect **k** median lobe, dorsal aspect **l** spermatheca. Scale bars = 0.1 mm.

10 transverse. *Mouthparts*. Labrum transverse, bearing approximately 9 small, setae, and approximately 17 long setae, a-seta, b-seta, and pores resent; b-seta acute (arrow indicates b-seta, Fig. 5b). Labium with pseudopores in median area; about 3 real pores and pseudopores present in lateral area; a pair of distal setae present (arrow indicates distal seta, Fig. 5c). Ligula with approximately 3 pairs of small setae apically (Fig. 5c). Labial palpi with large a-, b-, and f-seta of 12 setae present (a–h, α–δ); β-seta close to twin pores (tp); c- and d-seta same level (Fig. 5d). Mentum transverse, bearing 4 pairs of main setae (b, u, v, w), and 13 extra setae, and pores present (Fig. 5e). *Thorax.* Elytra with round latero-posterior margin. *Abdomen*. Abdominal tergite VIII with many short setae and pores; posterior margin emarginate (Fig. 5f). Abdominal sternite VIII with many short setae and pores; apical margin rounded (Fig. 5g, h). *Genitalia*. Median lobe with coiled flagellum (arrow, Figs 5j and k). Paramere with fovea in hinge zone (arrow, Fig. 5i). Spermathecal duct coiled (Fig. 5l).

Material examined. 1, Russia, Tadshikistan, 1981, Duechanbe env, on light, 16–18.VI.1981, K. Majer; 36, Russia, Tadshikistan, Umg. Duechanbe env, 800–1200m, 4–14.IX.1983, U. Arnold.

Distribution. Korea, Asia, Europe, North Africa, North America (see Smetana, 2004: 361).

Remarks. See Klimaszewski (1984: 39) for reason why the older names *Staphylinus bipunctata* Olivier or *S. geometrica* Schrank do not have priority. We used Russian specimens for the redescription.

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A review of the non-metallic *Osmia* (*Melanosmia*) found in North America, with additional notes on palearctic *Melanosmia* (Hymenoptera, Megachilidae)

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Abstract

We review the six species of non-metallic *Osmia* (*Melanosmia*) found in North America, including the description of two new species found in Canada and the northern United States: *Osmia* (*Melanosmia*) *aquilonaria* **sp. n.**, and *Osmia* (*Melanosmia*) *nearctica* **sp. n.**, respectively belonging to the inermis and xanthomelana species groups. We additionally provide keys to the non-metallic *Melanosmia* found in North America, and update keys to the palearctic *Melanosmia* based on study of the type specimens of *Osmia disjuncta* Tkalců, *O. ephippiata* Smith, *O. ishikawai* Hirashima, and *O. pamirensis* Gussakovskij.

Keywords

Bee, Apoidea, Megachilinae, Osmiini

Introduction

This is a treatment of the members of the subgenus *Melanosmia* (*sensu* Michener 2007) that lack any metallic blue or green coloration on the integument of the mesosoma and metasoma (the head also usually lacks metallic blue or green coloration, although there is a hint of such color in the head of some males). For this reason, some workers informally refer to such species as the "dark *Osmia*." As treated herein, the group roughly corresponds to *Melanosmia* s. str. as used by Sandhouse (1939), excluding *O. bucephala* Cresson (1864), which we have excluded based on the slight metallic blue sheen found throughout the body of this species. It is currently unknown if the "dark *Osmia*" as a group has any phylogenetic standing; our decision to assemble and give taxonomic treatment to these species is based solely on the ease of distinguishing its members. In addition, certain species in this group are distributed in both the Eastern and Western Hemispheres, without, as far as we know, having been introduced by human activity. Other holarctic species of *Osmia* are rare and known to be human introductions. With few exceptions, most non-metallic *Melanosmia* are distributed in northern temperate to borealalpine regions, which possibly facilitated the widespread distribution of some species via Beringia.

As currently understood, the "dark *Osmia*" group found in North America is comprised of four holarctic species plus two new species apparently restricted to North America, for a total of six species. In addition, some (but not all) females of *Osmia* (*Melanosmia*) *tersula* Cockerell (1912) mostly lack a metallic blue or green sheen to their integument, and are therefore included in the key to non-metallic *Melanosmia* below.

Given the holarctic distribution of many non-metallic *Melanosmia*, there is a possibility that the two new North American species described herein are already known from the Palearctic. In order to avoid producing new junior synonyms, it is necessary to understand the 20 species of *Melanosmia* known from the Palearctic (Ungricht et al. 2008; Müller 2010) (Table 1). Unfortunately, not all species are well described in the literature and the two species described by Wu (*O. nigroscopula* Wu 1982 and *O. jilinensis* Wu 2004) are unknown to us although we attempted to borrow the holotype material.

Of the remaining 18 species of palearctic *Melanosmia*, three species (*O. alticola* Benoist 1922, *O. maritima* Friese 1885, and *O. xanthomelana* Kirby 1802) were placed in the xanthomelana species group by Tkalců (1983) due to the shared swollen gonoforceps of the males and the shining propodeal triangle (metapostnotum) of the females. Tkalců (1983) recognized a second group of palearctic *Melanosmia*, the inermis species group, whose members have relatively thin gonoforceps in males and dull posterior surface of the propodeum and propodeal triangle in females. The species that have been explicitly placed in the inermis species group (Tkalců 1983; Müller 2002, 2010) are as follows: *O. inermis* (Zetterstedt 1838); *O. laticeps* Thomson 1872; *O. parietina* Curtis 1828; *O. pilicornis* Smith 1846; *O. steinmanni* Müller 2002; *O. svenssoni* Tkalců 1983; and *O. uncinata* Gerstäcker 1869. *Osmia disjuncta* Tkalců 1995, was originally described as closely related to *O. parietina* and *O. laticeps* (as *O. hyperborea*), and upon examination of the female holotype we conclude that it also belongs to the inermis species group.

Table 1. Palearctic species of *Osmia* (*Melanosmia*), with holarctic species in bold.

***O.* (*Melanosmia*) species**	**Species group**	**Integument type[†]**	**Examined material[‡]**
1. *O. alticola* Benoist	xanthomelana, (based on Tkalců, 1983)	faint metallic sheen in ♂ (A. Müller, pers. comm.)	None
2. *O. disjuncta* Tkalců	inermis	non-metallic	♀ Holotype and ♀, ♂ paratypes
3. *O. ephippiata* Smith[§]	xanthomelana? (based on body size and mandible)	non-metallic	♀ Holotype
4. *O. inermis* (Zetterstedt)	inermis	non-metallic	♀, ♂ non-type specimens
5. *O. ishikawai* Hirashima	inermis	non-metallic	♀ Holotype
6. *O. jilinensis* Wu	?	non-metallic (based on Wu, 2005)	None
7. *O. laticeps* Thomson	inermis	non-metallic	♀, ♂ non-type specimens
8. *O. maritima* Friese	xanthomelana	non-metallic	♀, ♂ non-type specimens
9. *O. melanota* Morawitz	?	metallic (based on Morawitz, 1888)	None
10. *O. nigriventris* (Zetterstedt)	nigriventris	non-metallic	♀ specimens compared with syntypes of *O. corticalis* by TG; ♀, ♂ non-type specimens
11. *O. nigroscopula* Wu	?	non-metallic (based on Wu, 2005)	None
12. *O. pamirensis* Gussakovskij	xanthomelana	slight metallic sheen	♀ Syntype
13. *O. parietina* Curtis	inermis	slight metallic sheen	♀, ♂ non-type specimens
14. *O. pilicornis* Smith	inermis	faint metallic sheen in ♂	♀, ♂ specimens compared with syntypes by TG
15. *O. recta* Peréz	?	?	None
16. *O. steinmanni* Müller	inermis	faint metallic sheen in ♂	♀, ♂ Paratypes
17. *O. svenssoni* Tkalců	inermis	non-metallic	♀, ♂ Paratypes
18. *O. thoracica* Radoszkowski	xanthomelana?	non-metallic?	♀ non-type specimen[|]
19. *O. uncinata* Gerstäcker	inermis	non-metallic	♀, ♂ specimens compared with syntypes by TG; ♀, ♂ non-type specimens
20. *O. xanthomelana* (Kirby)	xanthomelana	non-metallic	♀ specimen compared with syntypes by TG; ♀, ♂ non-type specimens

† “Integument type” refers to the presence or absence of metallic blue or green coloration. **‡** “Examined material” gives details of material examined for this study; information gathered from the literature or personal communication, and not based on examined material, is noted with citations in the table. **§** Distinctive characters of the *O. ephippiata* holotype are the following: mesepisternum and metasomal terga (including what is visible on T1) with entirely black hairs; mandible with parallel outer and condylar ridges; mandible with third tooth partially obscured by debris, but apparently more or less triangular between second and fourth teeth. The holotype of *O. ephippiata* has the metasoma glued to the mesosoma, so it is not currently possible to determine the sculpturing of its propodeum or declining anterior surface of T1; also, part of the dorsal surface of T1 is obscured by the glue. However, Tkalců (1983: 155) was able to examine the anterior surface of T1 in 1965, and he commented that it is distinctly shining. This observation was confirmed by George Else in 1977 (ibid). **|** Female specimen of *O. thoracica* Radoszkowsi from Hakkari, Turkey, identified by K. Warncke.

Müller (2010) segregated *O. nigriventris* (Zetterstedt 1838) into a third species group; this classification scheme highlights some unusual characteristics of *O. nigriventris* (e.g., the extremely swollen clypeal margin of the female and laterally reflexed posterior terga of the male). These unusual features are shared with the North American species *O. bucephala*, a species that has further apomorphies that have obscured its taxonomic placement within *Osmia*.

The remaining species of palearctic *Melanosmia* have received less treatment in recent revisions and are thus considerably less well-known. They are *O. ephippiata* Smith 1879, *O. ishikawai* Hirashima 1973, *O. melanota* Morawitz 1888, *O. pamirensis* Gussakovskij 1930, *O. recta* Pérez 1902, and *O. thoracica* Radoszkowski 1874. Of these, we were able to exclude *O. melanota* from consideration as a possible component of the North American fauna due to the original description of the type material as dark metallic blue (Morawitz 1888, p. 243, 244). *Osmia recta* can also be excluded due to the fact that Pérez (1902, p. 63) described the holotype male as having two submedial tufts of long, blackish-grey hairs on T3 and T4; in addition, the species' known distribution is in Algeria, quite unlike the more northern distribution of the known holarctic species.

Of the palearctic *Melanosmia* not treated by Tkalců (1983, 1995) or Müller (2002), we have seen the holotype specimens of *O. ephippiata* and *O. ishikawai*. We have also examined a female syntype of *O. pamirensis*, and one of us (TG) has additionally seen the type series of two males and nine females of *O. pamirensis* at the Russian Academy, St. Petersburg in 1984 (although, according to notes made by TG at the time of his visit, the males of the type series appear not to be conspecific). Tkalců (1983) did not treat females of *O. laticeps* (as *O. hyperborea*) in his revision of palearctic *Melanosmia*; the female of this species was diagnosed by Haeseler (1999). Herein we give further description of the female of *O. laticeps* and include it in an updated key to palearctic *Melanosmia* based on Tkalců (1983, 1995) and Müller (2002).

Materials and methods

The morphological terminology used herein follows that proposed by Michener (2007), with the exception of the following terms: flagellar segment instead of flagellomere, and basitarsal segment instead of basitarsus; in addition, we follow sculpture and punctation terminology proposed by Harris (1979). Mandibular teeth are numbered from ventral-most tooth to dorsal-most tooth. Thus, the ventral-most tooth is the first tooth and the next ventral-most tooth is the second. In the species treated herein, between the second and dorsal-most tooth is a smaller, slightly more inset, cutting edge extending from the dorsal-most tooth, here called the third tooth. The dorsal-most tooth is the fourth tooth.

The following morphological abbreviations are used: flagellar segment (F), metasomal tergum (T), metasomal sternum (S), and ocellar diameter (OD). Measurements are given for the holotype specimen, with the observed range from other specimens following in parentheses.

Full label data are given for all specimens of new species. Label data of examined material for the remaining species were summarized at the county level or its equivalent, along with date, floral record, and altitude (if given). The following abbreviations are used for specimen repositories, with individuals associated with those repositories following in parentheses:

Boulder	University of Colorado, Boulder CO (V. Scott)
Corvallis	Oregon State University, Corvallis OR (C. Marshall)
Davis	University of California, Davis CA (S. Heydon)
Logan	USDA Bee Biology and Systematics Laboratory, Logan UT (T. Griswold, H. Ikerd)
Logan-TG	Personal collection of T. Griswold, Logan UT
Moscow	University of Idaho, Moscow ID (J. B. Johnson, F. M. Merickel)
New York	American Museum of Natural History, New York NY (J. S. Ascher, J. G. Rozen, Jr.)
Ottawa	Canadian National Collection, Ottawa (L. Dumouchel, P. LeClair)
San Francisco	California Academy of Sciences, San Francisco CA (W. Pulawski, R. Zuparko)
St. Charles	Missouri Department of Conservation, St. Charles MO (M. Arduser)
Toronto	Royal Ontario Museum, Toronto Ontario (B. Hubley)
Uppsala	Uppsala University, Sweden (B. G. Svensson)
Victoria	Royal British Columbia Museum, Victoria B. C. (R. Cannings)

Specimens were examined and measured using a Leica MZ12 dissection microscope and ocular micrometer. Photomicrographs were taken using a Keyence Digital Imaging System.

Key to North American Females of Non-Metallic *Osmia* (*Melanosmia*)

[Modified from Tkalců 1983, 1995]

1. Apical margin of clypeus strongly thickened (Figs 11, 12).. ***O. nigriventris*** **(Zetterstedt)**
– Apical margin of clypeus more or less flat (Figs 4, 6).................................. **2**
2. Ventral margin of mandible with distinct tooth (Fig. 52) (propodeal triangle strongly granulose, Fig. 56; mandible with apical margin about a third wider than median width, Fig. 4) .... ***O. inermis*** **(Zetterstedt)**
– Ventral margin of mandible sometimes slightly swollen medially, but lacking distinct tooth.. **3**
3. Propodeal triangle strongly granulose (Figs 16, 56)..................................... **4**
– Propodeal triangle with more or less shining ventral area (Figs 36, 57) (mandible with apical width 1.5 times greater than median width) [xanthomelana species group]... **6**

4. T2–T3 with apical impunctate bands nearly one-third of postgradular width .... ***O. tersula*** **Cockerell (western form)**

– T2–T3 with apical impunctate bands lacking or about one-fifth of postgradular width [inermis species group] **5**

5. Mandible with third tooth broad, neither strongly protruding nor strongly separated from fourth tooth (Fig. 6), with condylar and outer ridges strongly converging apically (Fig. 5); mesepisternum with white to pale yellow hairs; T1 dorsal surface with distinct punctures (Fig. 58) ..... ***O. laticeps*** **Thomson**

– Mandible with third tooth symmetrically triangular, broadly separated from both fourth and second teeth by acute-angled and broad indentation (Fig. 2), with condylar and outer ridges nearly parallel to weakly converging apically (Fig. 1); mesepisternum with hairs predominantly blackish, only on its most anterior and dorsal part with narrow zone bright yellowish-brown; T1 dorsal surface granulose/papillate, with punctures less strongly impressed (Fig. 17) ... . ***O. aquilonaria*** **Rightmyer, Griswold, & Arduser, sp. n.**

6. Mandible with third tooth in same plane as second and fourth teeth, lacking distinct carina separating it from second and fourth teeth (Fig. 10); outer hind tibial spur weakly curved apically; clypeus with apical truncate process with distinct lateral angle, margin lateral of truncation distinctly stairstepped (Fig. 35); hair fringe of galea in dorsal view shorter than width of malar space at mandibular condyle .... ***O. nearctica*** **Rightmyer, Griswold, & Arduser, sp. n.**

– Mandible with third tooth distinctly recessed between second and fourth teeth, with carina separating it from second and fourth teeth (Fig. 8); outer hind tibial spur strongly curved apically; clypeus with apical truncation not distinctly angled laterally, margin lateral of truncation sinuate but not distinctly stairstepped (Fig. 55); hair fringe of galea in dorsal view as long as width of malar space at mandibular condyle .... ***O. maritima*** **Friese**

Key to North American Males of Non-Metallic *Osmia* (*Melanosmia*)

[Modified from Tkalců 1983, 1995; and Müller 2002]

1. T5 and T6 with apicolateral angles strongly reflexed laterally (Fig. 53) .... ***O. nigriventris*** **(Zetterstedt)**

– T5 and T6 with apicolateral angles not or only weakly reflexed laterally **2**

2. Outer margin of gonoforceps preapically with semicircular widening, at this point gonoforceps appearing nearly twice as broad as its narrowest width (Figs 45, 49, 50, 64) [xanthomelana species group] **3**

– Outer margin of gonoforceps preapically not or only weakly widened, at this point gonoforceps at most little broader than at its narrowest width (Figs 26, 30, 31) [inermis species group] **4**

3. Flagellar segments on ventral surface with hairs microscopic; S2 with midapical margin not emarginate.. **O. nearctica* Rightmyer, Griswold, & Arduser, sp. n.***

– Flagellar segments on ventral surface with sparse hairs, their length about half the flagellar segment width; S2 with midapical edge weakly emarginate.................... ***O. maritima* Friese (based on observed palearctic material only)**

4. S4 with hooked bristles both along apical margin and on premarginal area, along apical margin the bristles oriented horizontally and on premarginal area directed increasingly vertically (Figs 24, 25)... ***O. aquilonaria* Rightmyer, Griswold, & Arduser, sp. n.**

– S4 with midapical hairs unmodified, without hooked bristles (Figs 60, 61)..... **5**

5. S4 with apical margin truncate, medially with strong emargination and distinct, rounded lobes lateral to emargination (Fig. 60); declining basal portion of T1 densely shagreened, only with a silky luster.... ***O. inermis* (Zetterstedt)**

– S4 with apical margin more or less evenly convex, lacking strong emargination at midpoint and distinct sublateral lobes (Fig. 61); declining basal portion of T1 shining, at most superficially shagreened in small areas...... ***O. laticeps* Thomson**

Key to Eastern Hemisphere Females of *Osmia* (*Melanosmia*)

[Modified from Tkalců 1983, 1995; Haeseler 1999; and Müller 2002. Species absent from keys in the treatments cited above and for which we have seen no specimens are excluded: *O. jilinensis*, *O. melanota*, *O. nigroscopula*, and *O. recta*. (See Table 1)].

1. Apical margin of clypeus strongly thickened .... ***O. nigriventris* (Zetterstedt)**

– Apical margin of clypeus more or less flat... **2**

2. Propodeum shiny, propodeal triangle nearly completely polished or at least along sides with shiny area. Body length at least 11 mm [xanthomelana species group] **3**

– Propodeum and propodeal triangle completely shagreened and dull; body length at most 10 mm [inermis species group] **6**

3. T2 with impunctate apical margin medially rather broad (ca. length of F10); T4 polished (excluding the shagreened, impunctate apical margin)............. **4**

– T2 with impunctate apical margin narrower; T4 more or less shagreened throughout **5**

4. Integument with weak metallic sheen; mandible with rather weak, nearly absent, carina separating third tooth from second and fourth .... ***O. pamirensis* Gussakovskij**

– Integument lacking metallic sheen; mandible with relatively strong carina separating third tooth from second and fourth.. ***O. maritima* Friese, *O. ephippiata* Smith, and *O. thoracica* Radoszkowski** [see Table 1 for further comments]

5. Mandible with third tooth directed in same plane as second and fourth teeth, not set off from dorsal surface of mandible by carina; T2 with hairs medially on disc relatively long (ca. 640 micrometers), predominantly yellow-brown.... .... ***O. xanthomelana* (Kirby)**

– Mandible with third tooth directed slightly towards inner surface of mandible, set off from dorsal surface of mandible by carina extending from inner margins of second and fourth teeth; T2 with hairs medially on disc relatively short (ca. 400 micrometers), entirely black .... ***O. alticola* Benoist**

6. Declining basal portion of T1 densely shagreened, only with a silky luster....**7**

– Declining basal portion of T1 shining, at most superficially shagreened in small areas...**10**

7. Mandible with third tooth broad, not strongly separated from fourth tooth; forewing with veins cu-v and M intersecting vein M+Cu at the same place...**8**

– Mandible with third tooth more triangular; forewing with cu-v intersecting vein M+Cu at a point distal to that of M **9**

8. Mandible on its inferior inner margin with prominent, asymmetrically triangular tooth; third tooth nearly filling entire space between second and fourth teeth; clypeus in profile only moderately convex .... ***O. inermis* (Zetterstedt) and *O. ishikawai* Hirashima**

– Mandible on its inferior inner margin nearly straight, without tooth; third tooth separated from second by indentation nearly one-third of entire space between second and fourth teeth; clypeus in profile strongly convex............ .... ***O. disjuncta* Tkalců**

9. Mandible with third tooth symmetrically triangular, broadly separated from both fourth and second teeth by acute-angled and broad indentation; mesepisternum with hairs predominantly blackish, only on its most anterior and uppermost part with narrow zone yellowish-brown; T2 with marginal zone not impressed, with punctures of disc basomedially finer, separated by up to three puncture diameters .... ***O. svenssoni* Tkalců**

– Mandible with third tooth asymmetrically triangular, separated from second tooth by acute-angled and broad indentation, from fourth by shallow and rounded indentation; mesepisternum with hairs uniformly white to yellowish-white, sometimes with few intermixed blackish hairs; T2 with marginal zone impressed on its entire width, with punctures of disc basomedially coarser, separated by up to two puncture diameters .... ***O. steinmanni* Müller**

10. Distance between lateral ocellus and preoccipital margin two ocellar diameters; T2 and T3 with relatively well-defined, completely impunctate apical margin; integument with slight blue metallic sheen (especially on head and metasomal terga)... ***O. parietina* Curtis**

– Distance between lateral ocellus and preoccipital margin three ocellar diameters; T2 and T3 with relatively broad apical margins with sparse, unevenly scattered punctures; integument lacking any metallic sheen **11**

11. Galea with short, completely straight hairs; mesepisternum with white to pale yellow hairs; T2 with hairs in the center of disc shorter (ca. 400 micrometers); T1 only with hairs strongly yellow-brown...**12**

– Galea with much longer, incurved setae; mesepisternum with blackish hairs posteroventrally; T2 with hairs in the center of disc longer (ca. 560 micrometers); T1 and T2 with hairs strongly yellow-brown (T2 at the apical edge usually with weak admixture of black hair) ....***O. pilicornis* Smith**

12. Clypeus in profile more convex, with punctures near base and in paraocular area relatively large and shallow (punctures basolaterally on clypeus distinctly larger than punctures basomedially on clypeus); forebasitarsal segment relatively long and thin (length ca. 3.5 times longer than width), length slightly longer than foretarsal segments two to five..............***O. uncinata* Gerstäcker**

– Clypeus in profile less convex, with punctures near base and in paraocular area relatively small and deep (punctures basolaterally on clypeus the same size as those basomedially on clypeus); forebasitarsal segment relatively short and thick (length less than 3.0 times longer than width), length slightly shorter than foretarsal segments two to five......................... ***O. laticeps* Thomson**

Key to Eastern Hemisphere Males of *Osmia* (*Melanosmia*)

[Modified from Tkalců 1983, 1995; Haeseler 1999; and Müller 2002. Species absent from keys in the treatments cited above and for which we have seen no specimens are excluded: *O. ephippiata*, *O. ishikawai*, *O. jilinensis*, *O. melanota*, *O. nigroscopula*, *O. pamirensis*, *O. recta*, and *O. thoracica*. (See Table 1).]

1. T5 and T6 with apicolateral angles strongly reflexed laterally........................ ....***O. nigriventris* (Zetterstedt)**

– T5 and T6 with apicolateral angles not or only weakly reflexed laterally **2**

2. Outer margin of gonoforceps preapically with semicircular widening, at this point gonoforceps appearing nearly twice as broad as its narrowest width; body length at least 11 mm [xanthomelana species group]..........................**3**

– Outer margin of gonoforceps preapically not or only weakly widened, at this point gonoforceps at most little broader than at its narrowest width; body length under 10 mm [inermis species group] **5**

3. Flagellar segments on ventral surface with long, sparse hairs, their length about half the flagellar segment width; gonoforceps with apical tip (apical to juncture with preapical swelling) relatively flattened in lateral view.............**4**

– Flagellar segments on ventral surface with hairs microscopic; gonoforceps with apical tip (apical to juncture with preapical swelling) tapering to a point and not so distinctly flattened in lateral view ....***O. xanthomelana* (Kirby)**

4. Gonoforceps with apical tip (apical to juncture with preapical swelling) enlarged on inner margin, concave and spoon-like in dorsal view; S2 with

midapical edge weakly emarginate; S6 with median truncation moderately emarginate; hind basitarsal segment relatively narrow .... ***O. maritima*** **Friese**

– Gonoforceps with apical tip (apical to juncture with preapical swelling) more or less parallel along length, not so distinctly concave in dorsal view; S2 with midapical margin not emarginate; S6 with median truncation evenly rounded, not emarginate; hind basitarsal segment relatively broad............ ***O. alticola*** **Benoist**

5. S4 with midapical hairs unmodified, without hooked bristles **6**

– S4 with hooked bristles both along apical margin and on premarginal area, along apical margin the bristles oriented horizontally and on premarginal area directed increasingly vertically.. **7**

6. S4 with apical margin clearly forming two lobes; declining basal portion of T1 densely shagreened, only with a silky luster ...... ***O. inermis*** **(Zetterstedt)**

– S4 with apical margin evenly convex; declining basal portion of T1 shining, at most superficially shagreened in small areas............ ***O. laticeps*** **Thomson**

7. Flagellar segments on ventral surface with conspicuous bristles with length 0.2–1.0 times width of flagellar segment... **8**

– Flagellar segments on ventral surface with hairs microscopic..................... **10**

8. Flagellar segments with bristles on the undersurface as long as the flagellar segment width; S6 with median truncation narrow, distally covered with knobbed hairs .... ***O. pilicornis*** **Smith**

– Flagellar segments with bristles on the undersurface only 0.2 times flagellar segment width; S6 with median truncation relatively broad, without knobbed hairs **9**

9. Vertex of head in frontal view relatively strongly ascending, with outline of head thus more quadrangular; T2–T4 with marginal zone weakly impressed, densely shagreened at least on basal half; T2–T4 with hairs bright yellow-brown; S3 with midapical emargination one-fifth as deep as broad; S6 with midapical truncation more than one-half as long as broad; gonoforceps with outer margin preapically distinctly widened, broader than basally on gonoforceps (Fig. 69) .... ***O. svenssoni*** **Tkalců**

– Vertex of head in frontal view relatively weakly ascending, with outline of head thus rounder; T2–T4 with marginal zone strongly impressed on its whole width, polished to superficially shagreened; T2–T4 with hairs yellowish-white; S3 with midapical emargination one-third as deep as broad; S6 with midapical truncation less than one-half as long as broad; gonoforceps with outer margin preapically not widened, about as broad at this point as basally on gonoforceps (Fig. 66)................................ ***O. steinmanni*** **Müller**

10. Hind basitarsal segment relatively short and broad, the basal two-thirds with diverging edges; gonoforceps subapical width (at bend) about the same as portion of gonoforceps immediately basal to it .... ***O. uncinata*** **Gerstäcker**

– Hind basitarsal segment relatively long and slender, the basal two-thirds not diverging; gonoforceps with subapical width (at bend) slightly but distinctly broader than portion of gonoforceps immediately basal to it..................... **11**

11. Hind basitarsal segment with tooth positioned a third from apical margin (measured along length of segment); integument with very clear greenish-blue metallic tinge .... ***O. parietina* Curtis**

– Hind basitarsal segment with tooth positioned ca. half way along length; integument lacking metallic tinge on mesosoma and metasoma.................... .... ***O. disjuncta* Tkalců**

Taxonomy

Osmia (*Melanosmia*) *aquilonaria* Rightmyer, Griswold, & Arduser, sp. n.

urn:lsid:zoobank.org:act:E61F5E16-3FD3-48A3-B6A4-F7C6649DCF37
Figs 1, 2, 13–32

Diagnosis. Males of *O. aquilonaria* are most similar to the palearctic species *O. svenssoni* and *O. steinmanni*, but can be differentiated from them by the shape and pilosity of S4 and gonoforceps (See Table 2). *Osmia aquilonaria* males can be distinguished from all other members of the inermis species group (except *O. svenssoni* and *O. steinmanni*) by the special form of the hairs on S4 (i.e., with two patches of hooked bristles both along apical margin and on premarginal area, along apical margin the bristles oriented horizontally and on premarginal area directed increasingly vertically, Figs 24, 25).

Females of *O. aquilonaria* can be distinguished from the only other nearctic member of the inermis species group, *O. laticeps*, by the more pointed third tooth and the parallel condylar and outer ridges of the mandible (Figs 1, 2; *O. laticeps* with third tooth forming cutting edge extending from fourth tooth, and with apically converging condylar and outer ridges, Figs 5, 6). Females of *O. aquilonaria* are extremely similar to those of the palearctic *O. svenssoni*, and are not readily differentiated from them other than by their respective geographic distributions.

Description. Female. Figs 1, 2, 13–18. Total length: 8.2–11.0 mm; forewing length: 6.4–6.8 mm; length of lateral ocellus to preoccipital margin 0.7 mm; length of lateral ocellus to compound eye 0.6–0.7 mm.

Color: Dark brown to brown-black, sometimes with reddish overtones especially on mouthparts, labrum, mandible, flagellar segments, legs, and apical margins of T1–T5. Wings mostly clear to weakly infuscate, except strongly infuscate along leading edge of forewing, especially along dorsal half of marginal cell.

Pubescence: Clypeus below apical margin with lateral tuft of golden, medially directed hairs. Dark brown, minutely branched hairs on most of body except as follows: pale golden to white, minutely branched hairs interspersed with brown on interantennal area, vertex, posterior surface of propodeum excluding triangle, and dorsal surfaces of T1, T2, T6; almost entirely pale golden to white, minutely branched hairs on mesoscutum, mesoscutellum, and metanotum; dark-brown, simple hairs interspersed with minutely branched hairs on most of body, except simple hairs lacking on dorsal

Figures 1–6. Mandibles of female *Osmia*, left column showing the outer and condylar ridges and overall shape of mandible, right column showing shape and placement of mandibular teeth. **1, 2** *Osmia aquilonaria* **3, 4** *Osmia inermis* **5, 6** *Osmia laticeps*.

mesosoma; dark-brown, simple hairs only (no branched hairs) on all tarsi and scopa; brown, short, simple hairs evenly covering forewing. Galea and basal two labial palpal segments with hairs on lateral margins straight, 0.2–0.5 OD in length. Labrum with long hairs arranged in two curved, transverse rows, along subapical margin and approximately at midpoint, with additional fringe of shorter hairs at apical margin. Clypeus with hairs about as dense as on frons. Hypostomal area with hairs evenly distributed across area, straight to slightly wavy at apical tips, 2.5–4.0 OD in length.

Table 2. Differentiating characters of male *Osmia svenssoni*, *O. steinmanni*, and *O. aquilonaria*.

	O. svenssoni	***O. steinmanni***	***O. aquilonaria***
gonoforceps	Fig. 69; apically evenly tapering, short; preapically with outer margin widened, broader than basally; basally swollen in lateral view; hairs on preapical angle mostly on dorsal surface, relatively sparse	Fig. 66; preapically not widened, about as broad as basally; not swollen in ventral or lateral view; hairs on preapical angle mostly on dorsal surface, moderately dense	Fig. 26; apically long and slender, preapically not swollen in ventral view; basally swollen in lateral view; hairs on preapical angle mostly on lateral surface, relatively dense
S4	Fig. 70; narrower gap between brushes of hairs; brushes of hairs densely setose	Fig. 67; wider gap between brushes of hairs; brushes of hairs sparser	Figs 24, 25; wider gap between brushes of hairs, brushes of hairs densely setose
propodeal triangle	entirely granulose	lower two-thirds shining	Fig. 21; entirely granulose
head	quadrate in outline	round in outline	Fig. 20; semi-quadrate in outline
hind basitarsal segment, tooth placement (measured along length, from apical margin to basal margin)	one-fourth to one-fifth from apical margin	one-third from apical margin	Fig. 22; one-third to one-fourth from apical margin (shorter and broader than in *O. svenssoni*)

Punctation: Head and mesosoma with punctures nearly contiguous, more or less round, and moderately impressed except as follows: labrum mostly impunctate; clypeus with impunctate midapical truncation about length of F2 or little longer (Fig. 15); mesoscutum immediately posterior to median longitudinal sulcus with punctures separated by up to two puncture diameters; mesepisternum with punctures separated by about half a puncture diameter; hypostomal area, pronotum, and legs with punctures shallowly impressed, sometimes elongated into oval shape; tegula with punctures minute, sparse medially and posteriorly, separated by up to four or five puncture diameters; metepisternum, metanotum, and lateral and posterior surfaces of propodeum with punctures very weakly impressed, with background integument strongly granulose, dull; propodeal triangle with dorsal fourth finely areolate to lineate, lower three fourths strongly granulose, dull (Fig. 16). T1 anterior and dorsal surfaces, and T2–T5 strongly shagreened, dull, with small, sparse punctures throughout except for apical margins, these punctures with integument anterior to them slightly raised, papillate; T1–T5 apical impunctate bands with length at midpoint about 4.0–6.0 puncture diameters or little more (Figs 17, 18).

Structure: Labial palpus four-segmented, second labial palpal segment ca. one-third longer than basal-most segment. Mandible with outer and condylar ridges of subequal thickness, parallel along length to very weakly converging apically (Fig. 1); apical margin with four strongly pointed teeth, third separated from second and

Figures 7–12. Mandibles of female *Osmia*, left column showing the outer and condylar ridges and overall shape of mandible, right column showing shape and placement of mandibular teeth. **7, 8** *Osmia maritima* **9, 10** *Osmia nearctica* **11, 12** *Osmia nigriventris*.

fourth by carina, margin of third tooth forming distinct V-shape with adjacent margin of second and slightly smaller V-shape with adjacent margin of fourth, third tooth set back from second and fourth, very slightly directed inwards (Fig. 2); inner, ventral margin of mandible lacking distinct tooth, slightly diverging away from condylar ridge basally; mandible apically widened (1.3 times wider than median width), first tooth slightly longer than other teeth, length between apical tips of second and fourth teeth slightly wider than (ca. 1.2 times) apical tips of first and second teeth (Fig. 2).

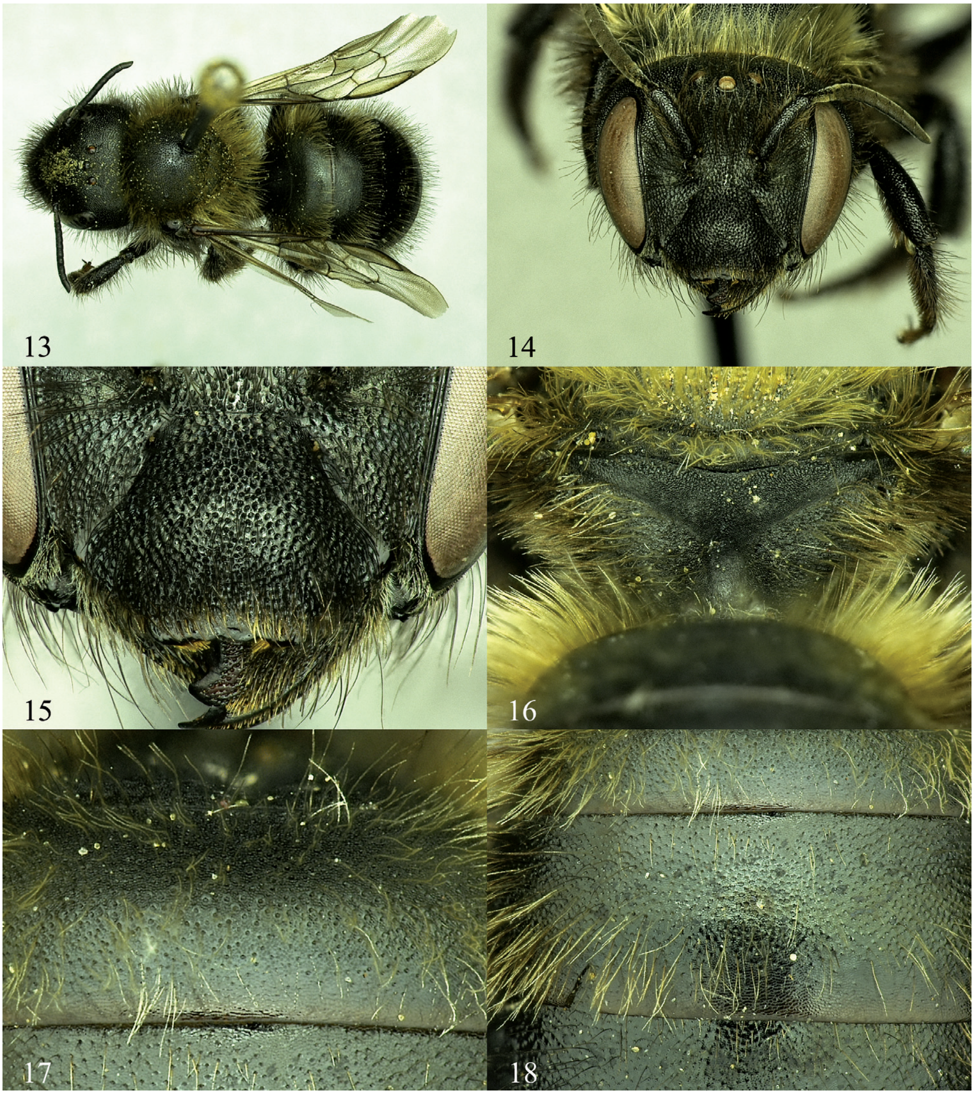
Clypeus with apical margin linear to moderately emarginate medially, with entire apical truncation laterally more or less contiguous with remaining lateral margin of clypeus (not forming 90 degree angle with lateral apical margin of clypeus; Fig. 15). F1 twice length of F2 or slightly more, remaining apical flagellar segments gradually increasing in length such that F10 subequal to F1 or little longer. Vertex behind lateral ocellus 2.5–3.0 OD in length. Genal width 1.5 to nearly 2.0 times that of compound eye in lateral view. Preoccipital margin rounded, not carinate. Hypostomal carina moderately high, highest at about midpoint of hypostomal area posterior to angle and sometimes forming moderate triangular projection at this point, tapering to low carina or near obsolescence at angle. Malus forming pointed apical spine, this spine more or less a continuation of nearby edge of vellum. Foretarsal segments excluding basitarsal and apical-most segments with anterior lobes slightly longer than posterior. Midtarsal segments with anterior and posterior lobes of equal width, slightly swollen; hind tarsal segments not swollen. Hind tibial spurs strongly curved at apical tips, outer spur about one fifth shorter than inner. Hind basitarsal segment with lateral margins of outer surface parallel.

Male. Figs 19–32. Total length: 9.5 mm (8.2–9.5 mm); forewing length: 6.3 mm (5.9–6.3 mm); length of lateral ocellus to preoccipital margin 0.5 mm (0.4–0.5 mm); length of lateral ocellus to compound eye 0.5 mm.

Color: Black to dark brown, sometimes with reddish overtones especially on mouthparts, labrum, mandible, flagellar segments, legs, and apical margins of T1–T6 and S1–S3. Wings mostly clear except weakly infuscate along leading edge of forewing, especially along dorsal half of marginal cell.

Pubescence: White to golden, minutely branched hairs on body except golden to pale golden, stouter hairs on inner surfaces of tarsi, S4, and S6. Labrum covered with hairs on apical third and with hairs forming short fringe at apical margin. S2 with hairs at apical third relatively long (ca. 3.0 OD). S3 with dense, medially directed hairs filling entire emargination (hairs ca. 1.0 OD in length medially, nearly 2.0 OD laterally) (Fig. 24). S4 midapical truncation with two patches of dense, golden, distally hooked hairs, these patches of hairs medially interrupted by nearly 1.0 OD, with hairs distally meeting at midpoint, each patch along apical margin with hairs oriented horizontally and on premarginal area directed increasingly vertically (Figs 24, 25). S6 midapical truncation sparsely covered with short, distally hooked hairs arising from papillate bases (Fig. 28).

Punctation: Head with punctures ovate to nearly circular, separated by one-fourth to one-half puncture diameter and deeply impressed except as follows: labrum mostly impunctate on basal two-thirds; clypeus with impunctate band along apical margin, about one-third length of F1 in length; disc of clypeus, interantennal area, and paraocular area with punctures small, ovate, and nearly contiguous (punctures mostly obscured beneath dense hairs); hypostomal area anteriorly near angle with punctures weakly, shallowly impressed. Mesosoma with punctures more or less round, nearly contiguous to separated by up to a half puncture diameter, deeply impressed except as follows: mesoscutum immediately posterior to median longitudinal sulcus with punc-



Figures 13–18. *Osmia aquilonaria*, female paratypes. **13** Dorsal habitus **14** Face **15** Clypeus **16** Posterior surface of propodeum and propodeal triangle **17** T1 and basal area of T2, showing surface sculpturing **18** Apical area of T1, T2, and basal area of T3.

tures separated by up to one, sometimes as much as three puncture diameters; tegula with punctures minute, sparse medially, separated by up to eight to ten puncture diameters; pronotum, metepisternum and lateral and posterior surface of propodeum strongly shagreened, with weakly, shallowly impressed, larger punctures; metanotum and propodeal triangle strongly granulose, dull (Fig. 21); propodeal triangle lineolate on dorsal fifth; legs with inner surfaces of trochanters, femora, and tibiae shining, with scattered smaller punctures. T1 with anterior surface strongly shagreened, dull;

metasomal terga with dorsal surfaces excluding apical margins strongly shagreened, apical impunctate margins moderately to weakly shagreened (except T7 moderately polished). T1 dorsal surface with punctures minute, moderately distinct and well-impressed, separated from 1.0 to 3.0 puncture diameters; apical impunctate margin medially ca. 10.0 puncture diameters in length, laterally as little as 6.0 puncture diameters. T2–T7 with punctures minute, T2 with punctures separated by ca. 1.0 puncture diameter medially (sparser towards impunctate apical margin on all terga), successively posterior terga with punctures progressively becoming more widely spaced to about 3.0 puncture diameters apart on disc of T7; T2–T6 with apical impunctate margins 6.0–9.0 puncture diameters in length, T7 with apical impunctate margin 4.0–6.0 puncture diameters in length. S1–S3 with punctures weakly, shallowly impressed. S4 with integument granular, dull (Fig. 24). S5–S6 lacking distinct punctures, weakly shagreened.

Structure: Mandible with outer and condylar ridges converging apically; apical margin with two teeth, upper tooth distinctly shorter and slightly wider than lower, upper tooth with inner and dorsal margins forming ca. 70–80 degree angle; inner, ventral margin of mandible weakly diverging away from condylar ridge basally. Clypeus apical margin with irregular tubercles, lacking distinct apical truncation. Flagellar segments subequal in length, except F1 about three-fourths length of F2 and F11 slightly longer than other segments. Vertex behind lateral ocellus 2.0 OD in length or nearly so. Genal width subequal that of compound eye in lateral view (slightly wider dorsally). Preoccipital margin rounded, not carinate. Hypostomal carina moderately high, gradually tapering to near obsolescence at angle, not forming distinct tooth. Malus forming small but distinct apical spine. Foretarsal segments excluding basitarsal and apical-most segments with lobes slightly, equally swollen. Mid- and hind tarsal segments not swollen. Hind tibial spurs curved at apical fifth, outer spur slightly shorter than inner. Hind basitarsal segment with lateral margins of outer surface weakly diverging apically, with strong tooth on inner margin (Fig. 22). T6 midapically with small but usually distinct emargination, forming ca. one-fourth to one-half of circle in outline (Fig. 23); T6 lateroapical margin smoothly, weakly convex, not forming distinct tooth. T7 midapically strongly emarginate, forming semicircle about as wide as deep (ca. 0.5–0.8 OD wide), with spines on either side of emargination weakly pointed, basally nearly as wide as emargination width (Fig. 23). S2 evenly convex, covering most of S3. S3 with midapical emargination relatively wide and shallow (half entire width of sternum, 1.0 OD in length, measuring only apical margin of sternum and not including basal fringe of hairs; Fig. 24). S4 midapically with wide truncation (about half width of entire sternum), medially with shallow but distinct emargination between lateral tufts of hairs (Fig. 24). S5 with apical margin evenly, strongly concave along median half of margin. S6 with strong midapical truncation, slightly less than one-third width of sternum, truncation slightly wider than deep, apical margin of truncation weakly, evenly rounded apically, sometimes with small emargination medially (Fig. 28). S8 as in Fig. 29. Gonoforceps weakly narrowed apical to subapical bend in dorsal, ventral, and lateral views (Figs 26, 27, 30–32).

Figures 19–24. *Osmia aquilonaria*, male holotype. **19** Dorsal habitus **20** Face **21** Posterior surface of propodeum and propodeal triangle **22** Hind basitarsal segment, showing inner tooth **23** T5–T7 and apical tip of gonoforceps **24** S2–S4.

Distribution. Alaska and Northwest Territories south to Wyoming, and east across Canada to Nova Scotia.

Holotype male. "[Canada] N.W.T. [Northwest Territories] km 491, Dempster Hwy, 26.VI.80 [26 June 1980], 1000 m, Wood & Lafontaine//*Osmia svenssoni* Tkalcu ♂ T Griswold det 96// Holotype male *Osmia aquilonaria* Rightmyer, Griswold, & Arduser" (Ottawa)

Paratypes. CANADA: NORTHWEST TERRITORIES, **Inuvik Region**, Aklavik, 25 June 1931, O. Bryant (1♀, Logan), 25 July 1931, 1600 ft (1♀, San Francisco); Black Mountain, SW of Aklavik, 1 August 1931, O. Bryant (1♀, 1♂, Logan); Holman, Victoria Island, 25 June 1952, B. A. Gibbard (1♀, Ottawa); **NOVA SCOTIA**, Cape Breton Highlands National Park, 60°50'W 46°47'N, 22 June 1983, Birch (1♀, Ottawa); **NUNAVUT**, **Kitikmeot Region**, Coppermine, 3 August 1951, S. D. Hicks (1♀, Ottawa); **ONTARIO**, **Cochrane District**, Low Bush, Lake Abitibi, 5 June 1925, N. K. Bigelow (1♀, St. Charles), 18 June 1925, N. K. Bigelow (1♀, St. Charles); **Thunder Bay District**, Silver Island, Sibley Peninsula, 18 July 1961, *Rubus* sp., H. E. Milliron (1♀, Ottawa); **QUEBEC**, **Nord-du-Québec Region**, Highway to James Bay km 66, 50°03'N 77°07'W, 12 June–8 August 1987, Malaise-FIT *Salix* bushes, L. Leblanc (1♀, Ottawa); **YUKON**, Dempster Highway km 465, 23–25 June 1980, 800 m, Wood & Lafontaine (2♀, Ottawa); **USA**: **ALASKA**, **North Slope Borough**, Cape Thompson, 29 June 1961, B. S. Heming (1♀, Ottawa); **Yukon-Koyukuk Census Area**, Kathul Mountain, Yukon River, Steppe, 4 June 1991, *Arnica alpina*, J. A. Bishop (1♀, Davis), 5 June 1991, *Lupinus arcticus* (1♀, Davis); Kathul Mountain, Yukon River, 110 km NW Eagle, Tundra, 16 June 1992, *Lupinus arcticus*, J. A. Bishop (1♀, Davis); **WYOMING**, **Fremont Co.**, Roaring Fork Mountain, Wind River Range, 29 June 1990, 11000–1200 ft, E. A. Sugden (6♀, 3♂, Logan).

Etymology. The name “aquilonaria” is Latin, meaning northern or northerly, and is in reference to the northern distribution of the species in North America.°

Osmia (*Melanosmia*) *inermis* (Zetterstedt)

Figs 3, 4, 52, 56, 60

Anthophora (*Osmia*) *inermis* Zetterstedt 1838: 466 [Lectotype male: Lund]; Tkalců 1983: 153 [Lectotype designation].

Osmia globosa Cresson 1864: 36 [Holotype female: Philadelphia]; Sandhouse 1939: 34 [synonymy]; Ungricht et al. 2008: 166 [preoccupied name, not *Apis globosa* Scopoli 1763].

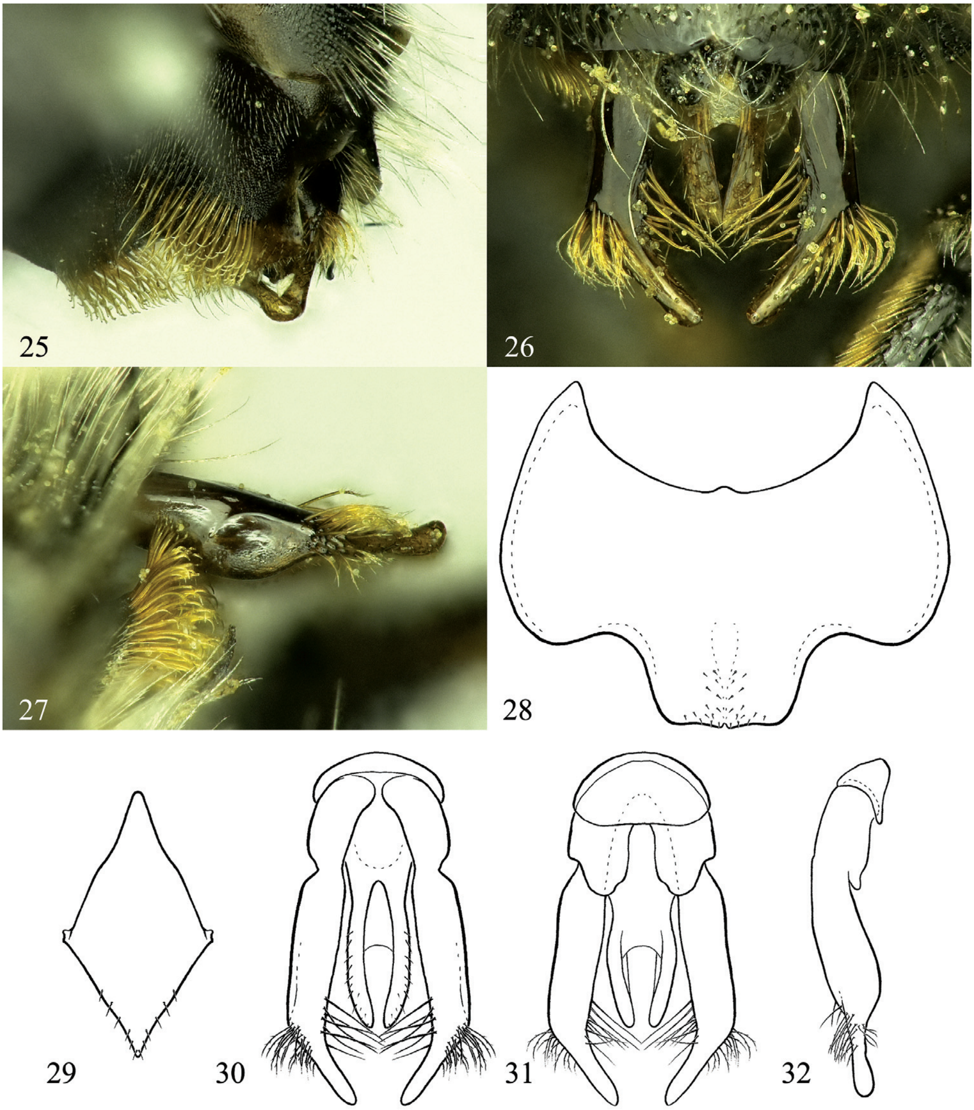
Osmia vulpecula Gerstäcker 1869: 335 [Lectotype female: Berlin]; Thomson 1872: 244 [synonymy]; Tkalců 1983: 153 [Lectotype designation]

Osmia globosiformis Cockerell 1910: 311 [Holotype male: San Francisco]; Sandhouse 1939: 34 [synonymy].

Osmia (*Melanosmia*) *inermis* (Zetterstedt); Friese 1911: 122; Sandhouse 1939: 34–35 [redescription of male and female].

Osmia (*Chenosmia*) *inermis* (Zetterstedt); Sinha 1958: 235.

Diagnosis. Females are known by the slightly acute angle or tooth midway on the ventral margin of the mandible (Fig. 52). Males can be distinguished by the form of the S4, which is strongly truncate and emarginate medially, forming distinct, rounded sublateral lobes (Fig. 60).



Figures 25–32. *Osmia aquilonaria*, male holotype and paratype. **25** Oblique view of S4 **26** Dorsal view of genital capsule **27** Lateral view of gonoforceps and S4 **28** Ventral view of S6 **29** Ventral view of S8 **30** Dorsal view of genital capsule **31** Ventral view of genital capsule **32** Lateral view of genital capsule, excluding penis valve.

Distribution. In the Nearctic, from Sierra Nevada of California north to British Columbia and Alaska, east through Canada to Nova Scotia and Newfoundland south in the United States to Massachusetts, Michigan, the Black Hills of South Dakota, and mountainous areas of Nevada, Utah, and Colorado. In the Palearctic, *O. inermis* is found from Spain, Italy, and Greece north to the United Kingdom, Norway, Sweden, and Finland, and east through Russia and northern China (Müller, 2010). The related, if not synonymous, species *O. ishikawai* is found in Japan.

Comments. *Osmia inermis* has been recorded nesting under stone or in preexisting cavities in rocks and stones, with cells composed of chewed leaves (Lovell 1909; Müller 2010 and references therein). In the Palearctic, *O. inermis* is polylectic with a preference for Fabaceae (Müller 2010 and references therein); however, in Newfoundland, Canada, the species has been shown to be primarily dependent upon Ericaceae (Hicks 2009).

Material examined. 23 April (1♂, Boulder), 30 July 1955 (1♀, Ottawa); **CANADA: ALBERTA**, **Alberta's Rockies Region**, 21 May 1915 (3♂, Ottawa, 1♂, Logan), 25 May 1892 (1♀, New York), 29 May 1922 (1♂, Ottawa), 6 July 1955 (1♀, Ottawa); **Northern Alberta Region**, 29 May 1977 (1♀, Logan); **BRITISH COLUMBIA**, **Central Kootenay**, 3 June 1906 (1♀, Ottawa), 9 June (1♀, Boulder); **Stikine Region**, 6 June 1955, 2200 ft (1♂, Ottawa), 17 June 1955, 2200 ft (1♀, Ottawa); **Okanagan-Similkameen District**, 21 May 1958 (1♂, Ottawa); **MANITOBA**, **Northern Region**, 1 July 1927 (1♀, Ottawa), 11 July 1950 (1♀, Ottawa), 29 July 1949 (1♀, Ottawa); **Parkland Region**, 26 June 1961, 2000 ft (1♀, Ottawa); **NEW BRUNSWICK**, **St. John Co.**, 9 June 1901 (1♀, Logan), 23 June 1901 (1♀, Ottawa); **York Co.**, 29 May 1918 (1♂, Ottawa); **NEWFOUNDLAND AND LABRADOR, Twillingate Islands**, 30 May 1951 (13♀, Ottawa); **NOVA SCOTIA**, **Halifax Co.**, 2 July 1914 (1♀, Ottawa); **Hants Co**., 4 June 1931, *Cornus* sp. (1♂, Ottawa), 22 June 1931 (1♀, Ottawa); **ONTARIO**, **Kawartha Lakes**, 25 May 1964, *Viola adunca* (1♂, Ottawa); **Lennox and Addington Co.**, 12 May 1962, *Chamaedaphne* sp. (1♀, Toronto); **Rainy River District**, 2 July 1960 (1♀, Ottawa); **QUEBEC**, **Capitale-Nationale Region**, 17 May 1914 (2♀, Ottawa), 28 May 1916, *Vaccinium* sp. (2♀, Ottawa); **Nord-du-Québec Region**, 4–12 June 1987 (1♀, Ottawa), 12 June–8 July 1987 (1♀, Ottawa), 18 June 1949 (1♂, Ottawa), 14 August 1949 (1♀, Ottawa), 18 August 1949 (4♀, Ottawa), 23 August 1949 (2♀, Ottawa), 2 September 1949 (8♀, Ottawa), 3 September 1949 (1♀, Ottawa); **Outaouais Region**, 14 May 1916, *Vaccinium* sp. (1♀, 1♂, Ottawa); **YUKON**, 26 May 1951 (1♂, Ottawa), 31 May 1951 (2♂, Ottawa), 5 June 1951 (1♂, Ottawa), 12 June 1960, 3500 ft (1♀, Ottawa), 21 June 1949, 5200 ft (1♀, Ottawa), 2 July 1962, 3500 ft (1♀, Ottawa), 10 July 1985 (1♀, Victoria); **RUSSIA**, **Siberia**, 3 July 1992 (1♀, Davis), 5 July 1992 (1♀, Davis); **SWEDEN:** (1♀, Uppsala), 12–19 June 1972 (1 ♀, Uppsala), **Jönköping Co.**, 12 July 1932 (1♀, Logan); **Norrbotten Co.**, (1♂, Uppsala), 25 August 1975 (1♂, Uppsala); **USA: ALASKA**, **Fairbanks North Star Borough**, 19 May 1987 (1♀, Davis); **Kenai Peninsula**, 20 June 1951 (1♀, Ottawa); **CALIFORNIA**, **Madera Co.**, 19 July 2004, 3315 m, *Phyllodoce breweri* (1♂, Logan); **Mariposa Co.**, 15 June 2004, 3024 m (3♂, Logan), *Phyllodoce breweri* (1♂, Logan), 3215 m (1♂, Logan), 23 June 2004, 3112 m (1♂, Logan), 4 July 2004, 2860 m (1♀, Logan), 2847 m, *Horkelia tridentata* (1♀, Logan), 14 July 2005, 3112 m, (2♂, Logan), *Phyllodoce breweri* (1♂, Logan), 16 July 2004, 2944 m, *Phyllodoce breweri* (1♀, Logan), 14 August 2004, 3189 m, (1♀, Logan), 1 August 2005,

Figures 33–38. *Osmia nearctica*, female paratypes. **33** Dorsal habitus **34** Face **35** Clypeus **36** Posterior surface of propodeum and propodeal triangle **37** T1 and basal area of T2, showing surface sculpturing **38** Apical area of T1, T2, and basal area of T3.

3189 m, (1♂, Logan); **Shasta Co.**, 30 July 1947, 7000 ft (1♀, Logan), **Tuolumne Co.**, 14 July 2004, 3049 m (1♀, Logan), 3114 m (1♂, Logan), *Phyllodoce breweri* (2♀, Logan), 15 July 2004, 3215 m, (3♂, Logan), *Phyllodoce breweri* (1♀, Logan), 17 July 2005, 3215 m (2♂, Logan), 28 July 2006, 3215 m, *Arenaria kingii* var. *glabrescens* (1♀, Logan), *Eriogonum incanum* (1♀, Logan), *Phyllodoce breweri* (1♀, Logan); **COLORADO**, **Boulder Co.**, 18 June 1940 (1♀, Boulder), 20 June 1940 (1♀, Boulder), 27 June 1939 (1♀, Boulder), 8 July 1940 (1♀, Boulder); **Grand**

Co., 22 June 1976 (1♀, Boulder); **Larimer Co.**, 19 June (1♀, Boulder), 25 July (1♀, Boulder); **Mesa Co.**, 10 July 1938 (1♀, Boulder); **Routt Co.**, 21 May 1964, 8500 ft, *Erythronuim* sp. (1♂, Boulder); **Summit Co.**, 29 July 1961, 11700 (1♂, Ottawa); **IDAHO**, **Bear Lake Co.,** 10 August 1972 (1♀, Logan); **Lemhi Co.,** 20 July 1963 (2♀, Moscow); **MAINE**, **Knox Co.,** 28 May 1962, *Vaccinium angustifolium* (1♂, St. Charles); **MASSACHUSETTS**, **Barnstable Co.,** 16 May 1914 (1♂, Logan); **MICHIGAN**, **Alger Co.,** 23 May 1982, *Vaccinium* sp. (1♂, St. Charles), 29 May 1991, *Vaccinium angustifolium* (2♀, St. Charles); **Marquette Co.,** 25 May 1983, *Vaccinium angustifolium* (1♂, St. Charles), 9 June 1985, *Gaylussacia* sp. (1♀, St. Charles), 21 June 1984 (1♀, St. Charles); **MONTANA**, **Carbon Co.,** 10 July 1963, 5900 ft, *Melilotus* sp. (6♀, Boulder), 12 July 1963, 5900 ft, *Melilotus* sp. (1♀, Boulder), 28 July 1975 (1♀, Boulder); **Gallatin Co.,** 1 May 1927 (1♀, Logan), 24 June 2008 (1♂, Logan); **NEVADA**, **Elko Co.,** 9 July 1979 (1♂, Logan), 19 July 1975, 9500 ft (1♂, Logan-TG), 21 July 1976, 9600 ft (2♂, Logan-TG); **OREGON**, **Baker Co.,** 15 July 1930, 7100 ft (1♀, Corvallis); **Wallowa Co.,** 26 July 1929, 7500 ft (1♀, Corvallis); **SOUTH DAKOTA**, **Custer Co.,** 20 June 1955, *Trifolium repens* (1♀, St. Charles); **UTAH**, **Cache Co.,** 7 June 1962, (1♀, Logan), 18 June 1948, *Wyethia* sp (2♂, Logan), 30 June 1976, *Penstemon leonardi* (1♀, Logan), 4 July 1947, *Ranunculus acriformis* var. *montanensis* (1♀, 1♂, Logan), 5 July 1981, 8500 ft (1♀, Logan-TG), 17 July 1995, 8200–8600 ft, *Penstemon* sp. (2♀, Logan), 25 July 1971 (1♂, Logan), 28 July 1975, *Penstemon cyananthus* (1♀, Logan); 1 August 1965 (1♀, Logan), 4 August 1975, *Potentilla fruticosa* (1♀, Logan); **Grand Co.,** 8 June 1963 (1♂, Logan); **Sanpete Co.,** 25 June 1990, 10760 ft, *Astragalus montii* (1♂, Logan); **Weber Co.,** 13 July 1950 (1♂, Logan); **WASHINGTON**, **King Co**. (1♀, 4♂, Boulder); **WYOMING**, **Big Horn Co.,** 6 August 2000, 8975 ft, *Machaeranthera* sp. (1♀, Boulder); **Carbon Co.,** 31 May 1972 (1♂, Boulder); **Fremont Co.,** 10 June 1955 (1♀, Logan), 29 June 1990, 11000–12000 ft (2♂, Logan); **Johnson Co.,** 22 July 1998 (1♀, Logan); **Sheridan Co.,** 26 June 1986 (1♀, Ottawa); **Sublette Co.,** 20 July 1959 (2♀, Logan); **Teton Co.,** July 1937 (1♀, Logan), 4 July 1983, 6700 ft, *Hedysarum boreale* (1♀, Logan), 13 July 1983, 6700 ft, *Hedysarum boreale* (1♀, Logan); 17 July 1983, 6700 ft, *Hedysarum boreale* (1♀, Logan).

***Osmia* (*Melanosmia*) *laticeps* Thomson**

Figs 5, 6, 54, 58, 61

Osmia laticeps Thomson 1872: 242 [Lectotype female: Lund]; Dalla Torre 1896: 414 [synonymy with *O. uncinata* Gerstäcker]; Tkalců 1983: 154 [Lectotype designation]; Nilsson 2009: 51 [rejection of synonymy with *O. uncinata* Gerstäcker].

Osmia (*Melanosmia*) *hyperborea* Tkalců 1983: 156 [Holotype male: Uppsala]; Schwarz et al. 1996: 126 [synonymy with *O. parietina* Curtis]; Haeseler 1999: 454 [rejection of synonymy with *O. parietina* Curtis, diagnosis of female]; Nilsson 2009: 52 [synonymy with *O. laticeps* Thomson].

Figures 39–44. *Osmia nearctica*, male holotype. **39** Dorsal habitus **40** Face **41** Posterior surface of propodeum and propodeal triangle **42** Hind basitarsal segment, showing inner tooth **43** T5–T7 **44** S3 and S4.

Diagnosis. Females of *O. laticeps* are distinguished from all other North American non-metallic *Osmia* by the following characters of the mandible (Figs 5, 6): the apical margin is only slightly broader than the median width, the third tooth is relatively broad and not strongly separated from the fourth tooth, and the condylar and outer ridges converge apically; in addition, they are diagnosed by their strongly granulose propodeal triangle and relatively short apical impunctate bands on T2 and T3.

In the Palearctic, *O. laticeps* is most similar to *O. uncinata*. In addition to the characters mentioned in the key (above), the following characters can be used to distinguish females of the two species (most characters first noticed by Haeseler 1999): in *O. laticeps*, the clypeus has more plentiful pale hairs than black hairs, and these pale hairs are about the same length as the black hairs. In *O. uncinata*, the clypeus has nearly the same amount of black hairs as pale hairs, and the black hairs are distinctly longer than the pale hairs. The malus of the foretibia has the apical tip evenly tapering to a point in *O. laticeps*, while in *O. uncinata* the tip is slightly more blunt. The outer hind tibial spur is more strongly downcurved in *O. uncinata* than in *O. laticeps*. Additionally, the hairs of the hypostomal area are denser and more strongly incurved in *O. laticeps* than in *O. uncinata*.

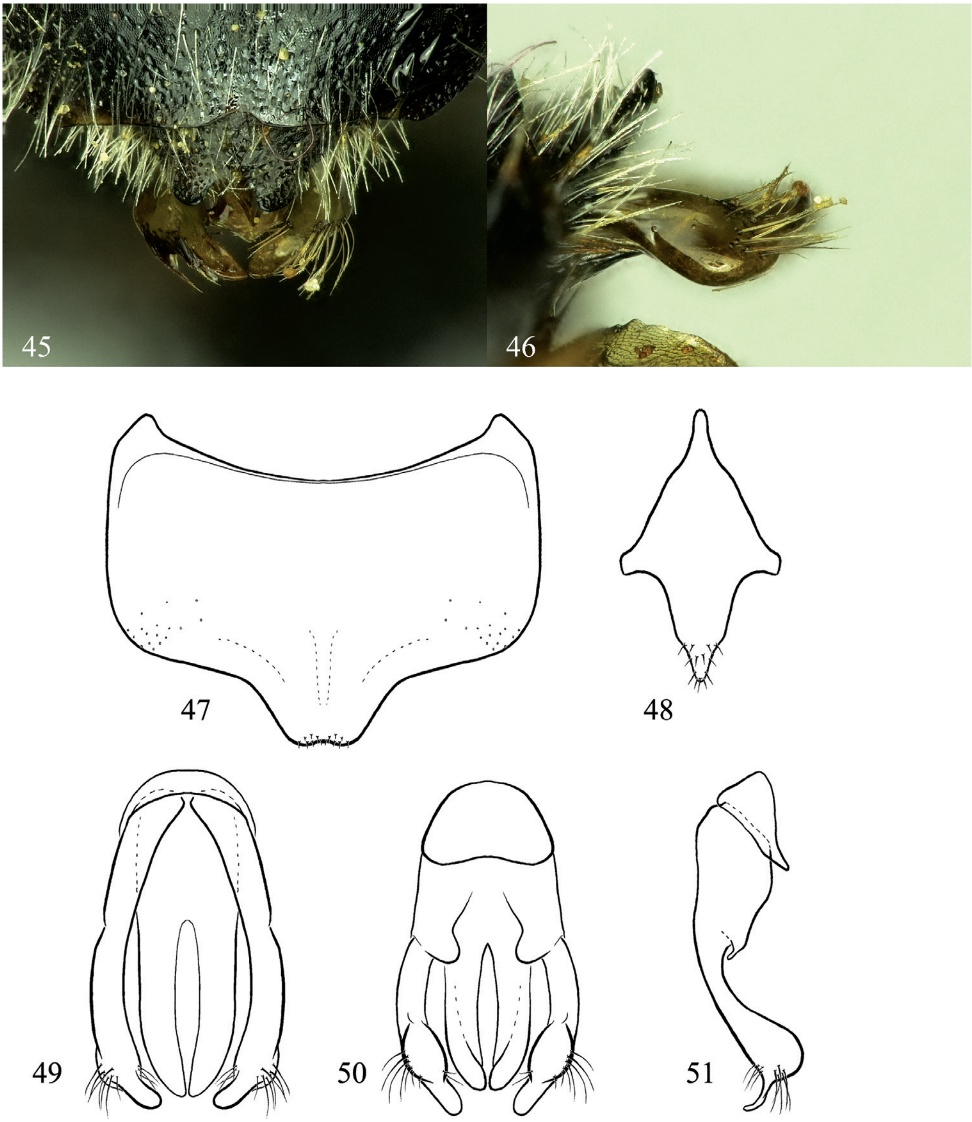
In both the Nearctic and Palearctic, males are known by the non-swollen gonoforceps (outer margin preapically only weakly widened, about the same width as the gonoforceps basal and distal to this preapical point of inflection), and the relatively unmodified S4 (Fig. 61): the apical margin of S4 is evenly convex and midapically on S4 the relatively short, unmodified hairs arise from regularly-spaced tubercles (not forming distinct, sublateral tufts of apically hooked hairs).

Description. Female. Figs 5, 6, 54, 58. Total length: 8.4–9.0 mm; forewing length: 6.0–8.1 mm; length of lateral ocellus to preoccipital margin 0.6–0.7 mm; length of lateral ocellus to compound eye 0.6–0.7 mm.

Color: Dark brown to brown-black, sometimes with reddish overtones especially on mouthparts, labrum, mandible, flagellar segments, legs, and apical margins of T1–T5. Wings mostly clear to weakly infuscate, except moderately infuscate along dorsal half of marginal cell.

Pubescence: Clypeus below apical margin with lateral tuft of golden, medially directed hairs. White to golden, minutely branched hairs on most of body except as follows: brown, simple hairs interspersed with pale, branched hairs on clypeus, sometimes interantennal area and near ocelli, gena ventrally and along compound eye, outer surfaces of femora and tibiae (especially on fore and midlegs); dark-brown, simple hairs only (no branched hairs) on mouthparts, labrum, inner surfaces of legs (golden on tarsi), outer surfaces of hind tibia and all tarsi, T2–T6, and scopa; brown, short, simple hairs evenly covering forewing. Galea and basal two labial palpal segments with hairs on lateral margins straight, 0.2–0.3 OD in length. Labrum with long hairs arranged in two curved, transverse rows, along subapical margin and approximately at midpoint, with additional fringe of minute hairs at apical margin. Clypeus with hairs about as dense as on frons, midapically with some hairs slightly curved at apical tips. Hypostomal area with straight hairs evenly distributed across most of area, 2.0–3.0 OD in length.

Punctation: Head and mesosoma with punctures nearly contiguous, more or less round, and moderately impressed except as follows: labrum mostly impunctate except near fringes of hairs; clypeus with impunctate midapical truncation about length of F2 or little longer (Fig. 54); mesoscutum immediately posterior to median longitudinal sulcus with punctures separated by up to a puncture diameter; mesepisternum with punc-



Figures 45–51. *Osmia nearctica*, male holotype and paratype. **45** Dorsal view of genital capsule, partially covered by T6 and T7 (T7 apical margin is ripped) **46** Lateral view of gonoforceps **47** Ventral view of S6 **48** Ventral view of S8 **49** Dorsal view of genital capsule **50** Ventral view of genital capsule **51** Lateral view of genital capsule, excluding penis valve.

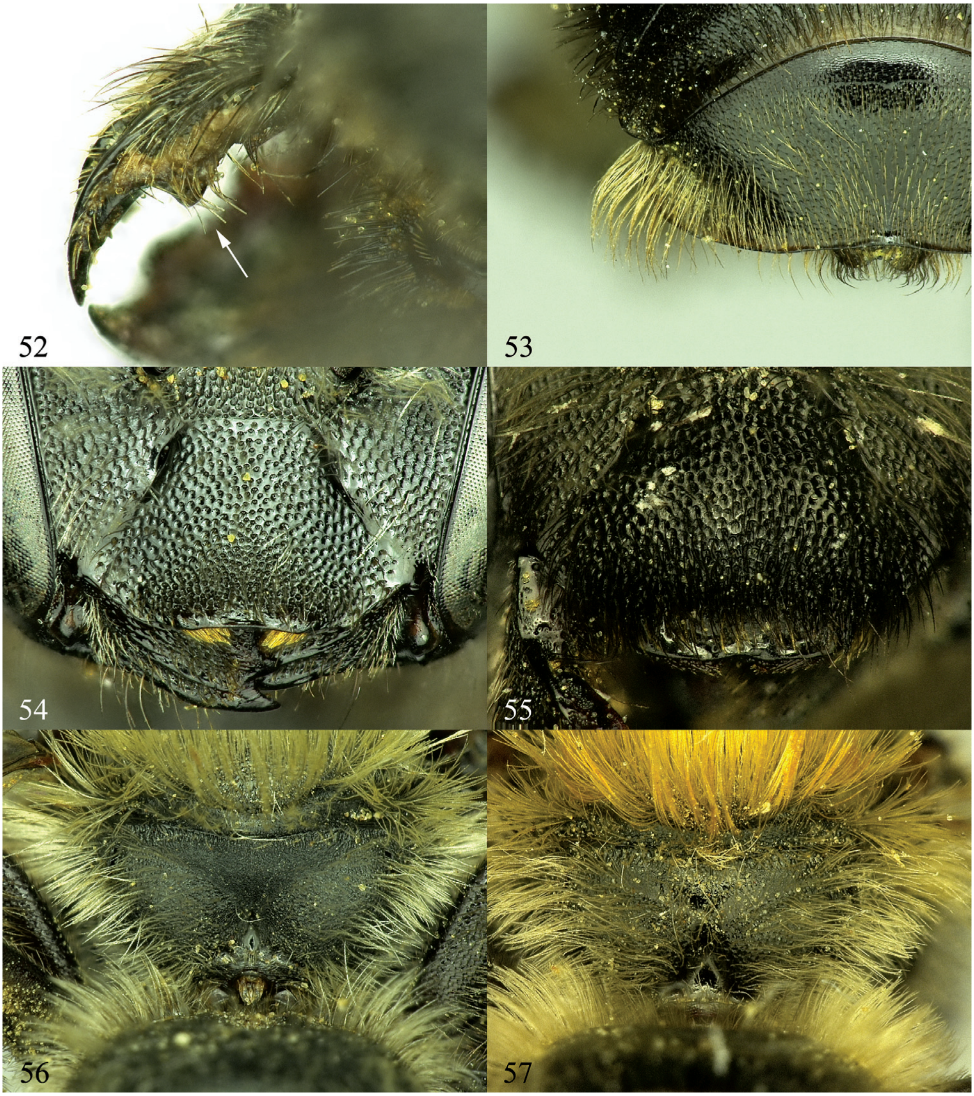
tures separated by about half a puncture diameter; metepisternum with punctures less distinct, separated by up to a puncture diameter; hypostomal area anteriorly near angle, posterior half of gena, and legs with punctures shallowly impressed, sometimes elongated into oval shape; tegula with punctures minute, sparse medially and posteriorly, separated by up to four puncture diameters (up to six puncture diameters in some specimens);

pronotum, metanotum, and lateral and posterior surfaces of propodeum with punctures less distinctly impressed and background integument weakly shagreened; propodeal triangle with dorsal fourth reticulate to lineate, lower three fourths strongly shagreened, dull. T1 anterior surface moderately shagreened, weakly shining, with scattered, sparse, minute punctures throughout; T1–T3 dorsal surfaces weakly shagreened, shining, with small punctures nearly contiguous to separated by 2.0 puncture diameters on basal three-fourths, minute and much more sparsely spaced on apical fourth (4.0–6.0 puncture diameters apart), apical margins with narrow region entirely impunctate (T1 with apical impunctate margin polished, ca. 5.0–6.0, Fig. 58; weakly shagreened, ca. 2.0–5.0 puncture diameters on T2–T3); T4–T5 much more strongly shagreened throughout, with small punctures nearly contiguous to separated by 3.0 puncture diameters on basal three-fourths, minute punctures separated by 2.0–6.0 puncture diameters on apical fourth, with apical impunctate bands ca. 3.0–4.0 puncture diameters in length.

Structure: Labial palpus four-segmented, second labial palpal segment ca. one-fourth longer than basal most segment. Mandible with condylar ridge about twice thickness of outer ridge, strongly converging apically (Fig. 5); apical margin with four distinct teeth, third separated from second and fourth by carina, margin of third tooth forming distinct V-shape with adjacent margin of second and forming weak concavity with margin of fourth, third tooth set back from second and fourth, very slightly directed inwards (Fig. 6); inner, ventral margin of mandible lacking distinct tooth, strongly diverging away from condylar ridge basally; mandible apically only slightly wider than narrowest point medially, first tooth subequal to, or very slightly longer than, second tooth, length between apical tips of second and fourth teeth 1.7 to nearly twice wider than apical tips of first and second teeth (Fig. 6). Clypeus with median truncation at apical margin linear to weakly concave, with truncation laterally weakly set off from remaining lateral margin of clypeus. F1 twice length of F2 or slightly more, remaining apical flagellar segments gradually increasing in length such that F10 about 1.2 times length of F1. Vertex behind lateral ocellus 2.5–3.0 OD in length. Genal width 1.0 to nearly 1.5 times that of compound eye in lateral view (wider dorsally). Preoccipital margin rounded, not carinate. Hypostomal carina moderately high, more or less level along length of head except reduced to obsolescence at angle, sometimes forming weak triangular projection posterior to angle. Malus forming pointed apical spine, this spine more or less a continuation of nearby edge of vellum. Foretarsal segments excluding basitarsal and apical-most segments with anterior lobes slightly longer than posterior. Midtarsal segments with anterior and posterior lobes of equal width, slightly swollen; hind tarsal segments not swollen. Hind tibial spurs slightly curved at apical tips, outer spur about a fifth shorter than inner. Hind basitarsal segment with lateral margins of outer surface parallel along most of length, converging apically.

Distribution. In the Nearctic, *O. laticeps* is known from Yukon east to Nova Scotia, and as far south as Ontario and Michigan. In the Palearctic, *O. laticeps* is known from Germany northwest to Sweden and Finland, east to Latvia and northern Siberian Russia (Müller 2010).

Comments. *Osmia laticeps* is oligoletic on *Vaccinium* (Ericaceae) (Nilsson 2009).



Figures 52–57. 52 *Osmia inermis*, female, ventral view of mandible showing tooth on inner margin of ventral surface **53** *Osmia nigriventris*, male, T5 and T6, showing flange on lateral margins **54** *Osmia laticeps*, female, clypeus with most of covering hairs removed **55** *Osmia maritima*, female, clypeus **56** *Osmia inermis*, female, posterior surface of propodeum and propodeal triangle **57** *Osmia maritima*, female, posterior surface of propodeum and propodeal triangle.

Material examined. CANADA: MANITOBA, **Northern Region**, 12 June 1952 (1♂, Ottawa), 20 June 1930 (2♀, 1♂, Logan); **NOVA SCOTIA**, **Kings Co.**, 24 May 1932, apple (1♂, Ottawa); **ONTARIO**, **Kenora District**, 10 June 1964, *Viola adunca* (1♀, Ottawa); **Ottawa**, 22 May 1973 (1♂, Ottawa); **QUEBEC**, **Abitibi-Témiscamingue Region**, 24 May 1934 (1♀, Toronto); **Nord-du-Québec Region**, 9

June 1956 (1♀, Ottawa); **Bas-Saint-Laurent Region**, 22 June 1916 (2♀, Ottawa); **YUKON**, 22 May 1951 (1♂, Ottawa), 28 May 1951 (3♂, Ottawa), 2 June 1951 (2♀, Ottawa), 12 June 1960, 3500 ft (1♂, Ottawa), 17 July 1981 (1♀, Victoria); **RUSSIA: Siberia**, 11–15 July (1♀, Ottawa); **SWEDEN: Norrbotten Co.**, 6 July 1975 (1♀, Uppsala); **USA: MAINE**, 15 June 1982 (1♀, St. Charles); **MICHIGAN**, **Alger Co.**, 3–11 June 1982, sand pit (1♀, 1♂, New York), 28 June 1982, *Vaccinium myrtilloides* (1♀, St. Charles); **Marquette Co.**, 10 June 1985, *Gaylussacia* sp. (1♂, St. Charles), 18 June 1983 (1♀, St. Charles).

Osmia (*Melanosmia*) *maritima* Friese

Figs 7, 8, 55, 57, 59, 62–65

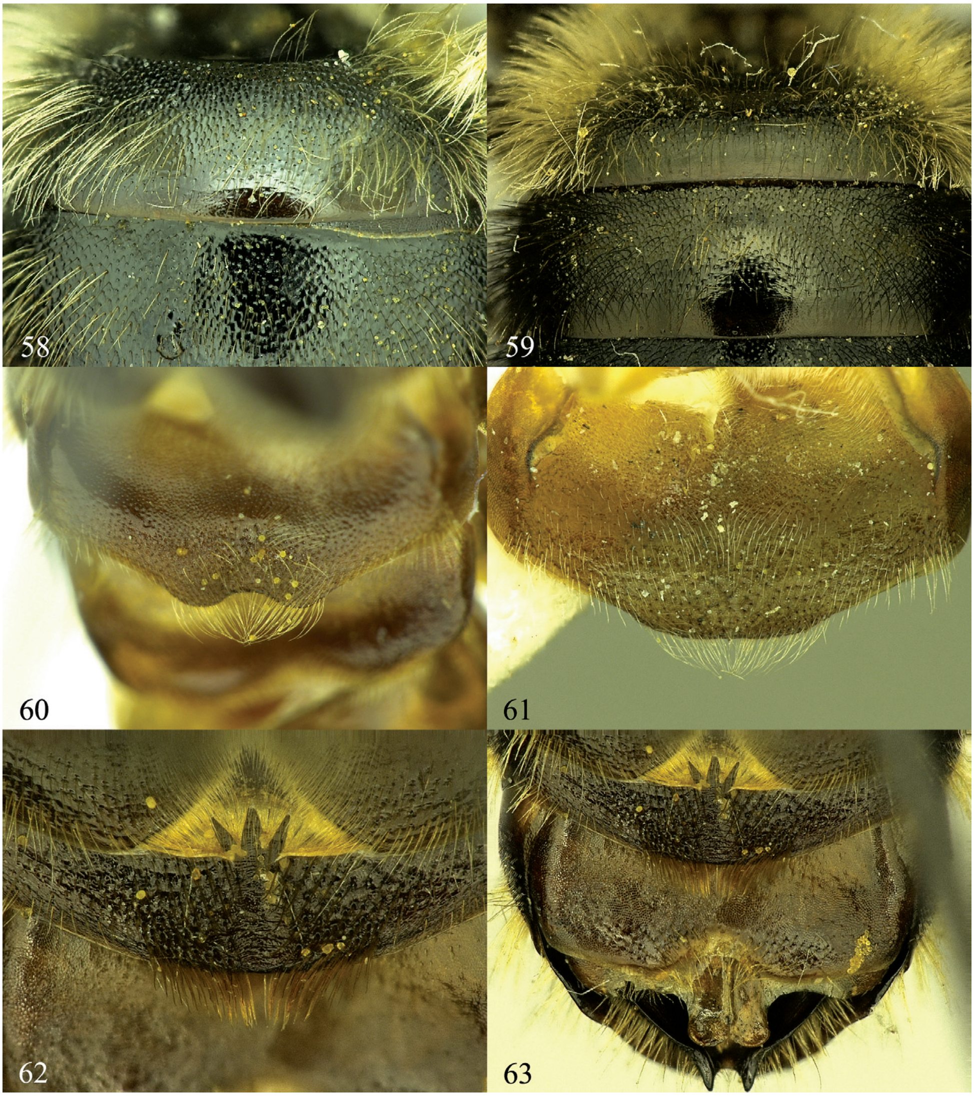
Osmia maritima Friese 1885: 85 [Lectotype female: Berlin]; Tkalců 1983: 152 [lectotype designation].

Diagnosis. *Osmia maritima* is one of two currently known species of the xanthomelana species group in North America (species with more or less shining ventral area of the propodeal triangle, apically widened mandible in females, and distinctly swollen gonoforceps in males). Females of *O. maritima* are distinguished from the other North American xanthomelana species group member, *O. nearctica*, by characteristics of the mandible, outer hind tibial spur, and clypeus: the mandible has a third tooth that is recessed below a distinct carina between the second and fourth teeth (Fig. 8) (*O. nearctica* with the third tooth in the same plane as the second and fourth teeth and no carina, Fig. 10); the outer hind tibial spur is strongly curved apically (*O. nearctica* with outer hind tibial spur weakly curved apically), and the apical truncation of the clypeus is not distinctly set apart from the lateral apical margin of the clypeus, Fig. 55 (*O. nearctica* with the apical truncation forming a 90 degree angle with the lateral apical margin of the clypeus, Fig. 35). Females of *O. maritima* also have almost entirely black pubescence on the clypeus (significant amounts of light hairs throughout the clypeus in *O. nearctica*) and longer hair on the galea in dorsal view.

Males of *O. maritima* are distinguished from *O. nearctica* by their relatively long, sparse hairs on the lower surface of the flagellar segments (*O. nearctica* with these hairs microscopic) and weakly emarginate S2 (*O. nearctica* with S2 midapical margin not emarginate).

Distribution. In the Nearctic, *O. maritima* is known only from the Northwest Territories and Alaska. In the Palearctic, *O. maritima* is known from the Netherlands, Germany, Denmark, Norway, Sweden, and Finland east to Mongolia and through Russia to Far Eastern Siberia (Müller 2010).

Comments. We have not found any male specimens of *O. maritima* in the material of nearctic *Osmia* available to us. It is possible that once male specimens are discovered they may prove to be a distinct species from their palearctic relatives (if, as in *O. aquilonaria*, the novel diagnostic characters of the species are only found in the males);



Figures 58–63. 58 *Osmia laticeps*, female, T1 and T2 **59** *Osmia maritima*, female, T1 and T2 **60** *Osmia inermis*, male, S4 **61** *Osmia laticeps*, male, S4 **62, 63** *Osmia maritima*, male **62** Detailed view of S3 and S4 **63** S3–S6.

however, since a holarctic distribution is well established for other *Osmia* species (e.g., *O. inermis* and *O. nigriventris*), until proven otherwise we conservatively retain the name *O. maritima* for this species. Interestingly, there appear to be two female morphs of *O. maritima*. Specimens from Alaska and the Russian Far East share pale hair on the paraocular area and mesepisternum and scarcely sculptured apical areas on T2 and T3; females from the Northwest Territories and western Europe have dark hair on the paraocular area and mesepisternum and microsculptured apical areas of T2 and T3.

Osmia maritima from the Palearctic is known to be polylectic and nests in sandy soil with cells composed of chewed leaves and sand grains (Müller 2010 and references therein).

Material examined. CANADA: NORTHWEST TERRITORIES, **Inuvik Region**, 17 June 1971 (1♀, Ottawa), 20–25 June 1971 (3♀, Ottawa), 28–30 June 1971 (1♀, Ottawa), 11 July 1948 (1♀, Ottawa); **NETHERLANDS***:* **Terschelling**, 2 June 1969 (1♂, 1♀, Logan); **RUSSIA: Siberia**, 5 July 1992 (1♂, Davis), 12 July 1992 (1♀, Davis); **USA: ALASKA**, **Fairbanks North Star Borough**, 31 July 1985 (1♀, Davis); **Southeast Fairbanks Census Area**, 21 June 1984, *Oxytropis campestris* (3♀, Davis); **Yukon-Koyukuk Census Area**, 17 May 1991, *Dodecatheon frigidum* (1♀, Davis), 19 June 1992, *Penstemon gormanii* (1♀, Davis).

Osmia (*Melanosmia*) *nearctica* Rightmyer, Griswold, & Arduser, sp. n.

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Figs 9, 10, 33–51

Diagnosis. *Osmia nearctica* is one of two members of the xanthomelana species group in North America; characters to distinguish it from the other member of that group, *O. maritima*, are given under that species (see above).

In the Palearctic, *O. nearctica* is most similar to *O. xanthomelana*, but can be differentiated from that species by the following characters: In females, the propodeal triangle is shining but weakly shagreened throughout (Fig. 36) (*O. xanthomelana* with entirely polished, strongly shining lower half of the propodeal triangle), the outer hind tibial spur is only about half the length of the hind basitarsal segment (*O. xanthomelana* with outer hind tibial spur nearly three-fourths length of hind basitarsal segment), and the lower margin of the mandible has a distinct, translucent flange that curves away from the condylar ridge (*O. xanthomelana* with the lower margin of the mandible opaque, forming a ridge that is parallel to the condylar ridge). The hairs of the mesepisternum tend to be dark brown in *O. nearctica*, while in *O. xanthomelana* the hairs tend to be pale yellow to white, and the hairs of the hypostomal area tend to be denser in *O. nearctica* than in *O. xanthomelana*.

In males, the propodeal triangle is weakly shagreened throughout in *O. nearctica* (Fig. 41) (*O. xanthomelana* with entirely polished, strongly shining lower half of the propodeal triangle); the lower tooth of the mandible is only slightly longer than the upper tooth in *O. nearctica* (in *O. xanthomelana* the lower tooth of the mandible is much longer than the upper tooth and the entire apical margin of the mandible is conspicuously wider than the middle, approaching the look of male *Acanthosmioides*); T7 midapically has a shallower emargination in *O. nearctica* (Fig. 43) than in *O. xanthomelana*; the S6 midapical truncation is clearly emarginate in *O. nearctica* (Fig. 47) (*O. xanthomelana* with S6 truncation not emarginate); and the apical tip of the gonoforceps (apical to subapical swelling) is more rounded in *O. nearctica* (Figs 49, 50) (in *O. xanthomelana* the apical tip is more pointed). *Osmia nearctica* can be differentiated from *O. maritima* and *O. alticola* by the microscopic hairs on the underside of the

Figures 64–70. 64, 65. *Osmia maritima*, male, genital capsule **64** Dorsal view **65** Lateral view. **66–68.** *Osmia steinmanni*, male paratype. **66.** Dorsal view of genital capsule **67** S3 and S4 **68** S5 and S6 **69, 70** *Osmia svenssoni*, male paratype. **69** Dorsal view of genital capsule **70** S4 and S6.

flagellar segments (*O. maritima* and *O. alticola* with conspicuous hairs about half the width of the flagellar segments).

Description. Female. Figs 9, 10, 33–38. Total length: 9.0–11.5 mm; forewing length: 6.5–7.2 mm; length of lateral ocellus to preoccipital margin 0.6 mm; length of lateral ocellus to compound eye 0.7 mm.

Color: Dark brown to brown-black, sometimes with reddish overtones especially on mouthparts, labrum, mandible, flagellar segments, legs, and apical margins of

T1–T5. Wings moderately infuscate, more strongly infuscate in marginal cell and distal to cells.

Pubescence: Clypeus below apical margin with lateral tuft of golden, medioposteriorly directed hairs. Brown, minutely branched hairs on most of body except as follows: white to yellow, minutely branched hairs interspersed with brown on outer surface of mandible, face excluding ventral third of clypeus and sometimes on vertex (and gena), and dorsal surfaces of T2, T5, T6; almost entirely white to yellow, minutely branched hairs on vertex (sometimes), mesoscutum, mesoscutellum, metanotum, dorsally on propodeum (excluding triangle), pronotal lobe, and dorsal surface of T1; brown, simple hairs interspersed with minutely branched hairs on most of body, except simple hairs lacking on dorsal mesosoma; simple hairs only (no branched hairs), golden on all tarsi and brown on scopa; brown, short, simple hairs evenly covering forewing. Galea and basal two labial palpal segments with hairs on lateral margins straight, 0.2–0.5 OD in length. Labrum with long hairs arranged in two curved, transverse rows, along subapical margin and approximately at midpoint, with additional fringe of shorter hairs at apical margin. Clypeus with hairs about as dense as on frons. Hypostomal area with hairs densely distributed across area, straight to weakly incurved at apical tips, 3.0–4.0 OD in length.

Punctation: Head and mesosoma with punctures nearly contiguous, more or less round, and moderately impressed except as follows: labrum mostly impunctate except near fringes of hairs; clypeus with impunctate midapical truncation about length of F2 or little longer (Fig. 35); mesoscutum posterior to median longitudinal sulcus with punctures separated by up to a puncture diameter; mesepisternum with punctures less strongly impressed, nearly contiguous to separated by about half a puncture diameter; hypostomal area near angle and legs with punctures shallowly impressed, sometimes elongated into oval shape; tegula with punctures minute, sparser medially and posteriorly, separated by up to three or four puncture diameters; pronotum, metepisternum, metanotum, and lateral and posterior surfaces of propodeum with punctures very weakly impressed, with background integument weakly shagreened; propodeal triangle with dorsal fourth reticulate, lower three fourths shagreened, weakly shining (Fig. 36). T1 anterior surface weakly shagreened, shining, with scattered punctures at dorsolateral angle; T1–T3 dorsal surfaces very weakly shagreened, shining, excluding apical impunctate margins with small punctures nearly contiguous to separated by 1.0 puncture diameter (on T1, Fig. 37) to separated between 1.0 to 3.0 puncture diameters (on T3); apical impunctate bands 2.0–4.0 puncture diameters in length. T4–T5 dorsal surfaces shagreened, weakly shining, excluding apical impunctate bands with punctures nearly contiguous to separated by 2.0 puncture diameters; apical impunctate bands about 5.0–8.0 puncture diameters in length. T6 with punctures minute, nearly contiguous, mostly obscured beneath dense hairs.

Structure: Labial palpus four-segmented, second labial palpal segment subequal to or ca. one-fourth longer than basal-most segment. Mandible with outer and condylar ridges of subequal thickness, parallel along length (Fig. 9); apical margin with four well-developed teeth, lacking carina separating third tooth from second and fourth, margin of third tooth forming distinct V-shape with adjacent margin of second and slightly smaller V-shape with adjacent margin of fourth, third tooth more or less on same plane as second and fourth (Fig 10); inner, ventral margin of mandible lacking distinct tooth, diverging away from condylar ridge basally; mandible apically widened (ca. 1.7 times wider than median width), first tooth longer than other teeth, length between apical tips of second and fourth teeth subequal to slightly wider than apical tips of first and second teeth (Fig. 10). Clypeus apical margin with distinct truncation on middle half, this truncation with lateral corner slightly produced, forming weak protuberance relative to apical margin of truncation and forming ca. 90 degree angle with apical margin of clypeus lateral to truncation (Fig. 35). F1 twice length of F2, remaining apical flagellar segments gradually increasing in length such that F10 subequal to F1 or little longer. Vertex behind lateral ocellus 2.0–2.5 OD in length. Genal width 1.5 to nearly 2.0 times that of compound eye in lateral view. Preoccipital margin rounded, not carinate. Hypostomal carina moderately high, highest at about midpoint of hypostomal area posterior to angle and forming distinct triangular projection at this point, tapering to low carina or near obsolescence at angle. Malus forming pointed apical spine. Foretarsal and midtarsal segments excluding basitarsal and apical-most segments with anterior lobes slightly longer than posterior; hind tarsal segments not swollen. Hind tibial spurs weakly curved, outer spur about a fifth shorter than inner. Hind basitarsal segment with lateral margins of outer surface parallel.

Male. Figs 39–51. Total length: 8.6 mm (8.0–9.1 mm); forewing length: 6.0 mm (6.0–6.5 mm); length of lateral ocellus to preoccipital margin 0.5; length of lateral ocellus to compound eye 0.6 mm.

Color: Black to dark brown, sometimes with reddish overtones especially on mouthparts, labrum, mandible, flagellar segments, legs, and apical margins of T1–T6 and S1–S3. Wings mostly clear except weakly infuscate along leading edge of forewing, especially along dorsal half of marginal cell.

Pubescence: White to pale golden, minutely branched hairs on body except golden to pale golden, stouter, simple hairs on inner surfaces of tarsi, S4, and S6, and intermixed with white, branched hairs on mandible, lower gena, and outer surfaces of tarsi. Labrum with row of hairs across approximate midline, sparsely covered with hairs on apical fourth and with hairs forming short fringe at apical margin. S2 with hairs at apical third ca. 1.5 to 2.0 OD in length. S3 with medially directed hairs filling entire emargination (hairs ca. 1.0 OD in length medially, 2.0 OD laterally) (Fig. 44). S4 with weakly defined, asetose longitudinal strip, otherwise covered with regularly spaced, simple, short, weakly distally hooked, golden hairs arising from papillate bases (Fig. 44). S6 midapical truncation with very sparse, short, simple hairs arising from papillate bases (Fig. 47).

Punctation: Head with punctures ovate to nearly circular, separated by one-fourth to one-half puncture diameter (up to 1.0 puncture diameter posterior to compound eye) and deeply impressed except as follows: labrum mostly impunctate on basal two-thirds; clypeus with impunctate band along apical margin, about one-fourth length of F1; disc of clypeus, interantennal area, and paraocular area with punctures small, ovate, and nearly contiguous (punctures mostly obscured beneath dense hairs); hypostomal area anteriorly near angle with punctures weakly, shallowly impressed. Mesosoma with punctures more or less round, nearly contiguous to separated by up to a half puncture diameter, deeply impressed except as follows: mesoscutum immediately posterior to median longitudinal sulcus with punctures separated by up to one, sometimes as much as two puncture diameters; tegula with punctures minute, sparse medially, separated by up to five puncture diameters; pronotum, dorsal half of metepisternum and lateral and posterior surface of propodeum weakly shagreened, with moderately impressed, larger punctures; ventral half of metepisternum mostly impunctate, weakly shining; propodeal triangle lineolate to reticulate on dorsal third, shagreened and weakly shining on ventral two-thirds; legs with inner surfaces of femora and tibiae shining, with scattered smaller punctures. T1 with anterior surface very weakly shagreened, shining; T1–T2 with dorsal surfaces excluding apical margins weakly shagreened, shining; T3, T6–T7 dorsal surfaces moderately shagreened; T4–T5 dorsal surfaces strongly shagreened, dull; metasomal terga with apical impunctate margins polished. T1 dorsal surface with punctures minute, distinct and well-impressed, nearly contiguous to separated by a puncture diameter; apical impunctate margin ca. 4.0–5.0 puncture diameters in length (sometimes medially as long as 6.0–7.0 puncture diameters in length). T2–T7 with punctures minute, T2 with punctures separated by ca. 1.0 puncture diameter medially, successively posterior terga with punctures progressively becoming more widely spaced to about 3.0 puncture diameters apart on disc of T6; T2–T6 with apical impunctate margins 4.0–8.0 puncture diameters in length, T7 lacking apical impunctate margin. S1–3 with punctures minute, well-impressed, nearly contiguous to separated by ca. 1.0 puncture diameter. S4–S6 lacking distinct punctures, weakly shagreened.

Structure: Mandible with outer and condylar ridges converging apically; apical margin with two teeth, upper tooth distinctly shorter and wider than lower; inner, ventral margin of mandible very weakly diverging away from condylar ridge basally. Clypeus apical margin mostly linear except with weak irregular tubercles above tufts of setae below apical margin at each side. Flagellar segments subequal in length, except F1 slightly shorter than F2 and F11 slightly longer than F10. Vertex behind lateral ocellus 1.5–2.0 OD in length. Genal width in lateral view ventrally subequal to, dorsally ca. 1.3 times wider than, width of compound eye. Preoccipital margin rounded, not carinate. Hypostomal carina relatively short, gradually tapering to near obsolescence at angle, not forming distinct tooth. Malus forming distinct apical spine. Foretarsal segments excluding basitarsal and apical-most segments with anterior lobes slightly more swollen than posterior. Mid- and hind tarsal segments not swollen. Midfemur with swollen projection on ventral surface. Hind tibial spurs weakly curved at apical sixth, outer spur ca. one-fifth shorter than inner. Hind basitarsal segment widening about a third from apical margin, with strong tooth on inner margin at widest point (Fig. 42). T6 midapically with wide, shallow emargination, forming ca. one-fourth of circle in outline (Fig. 43); T6 lateroapical margin slightly concave sublaterally, forming weak lobe. T7 midapically strongly emarginate, forming semicircle about as wide as, or slightly wider than, deep (ca. 1.5 OD wide; Fig. 43), with spines on either side of emargination rounded, basally nearly as wide as emargination width. S2 strongly convex, covering most of S3. S3 with midapical emargination one-third entire width of sternum and nearly as long as wide (Fig. 44). S4 with apical margin evenly convex, with very weakly defined midapical truncation (Fig. 44). S5 with apical margin evenly, weakly concave along median half of margin. S6 with midapical truncation one-fifth width of sternum, truncation slightly wider than deep, apical margin of truncation very weakly emarginate midapically (Fig. 47; S6 sometimes folded along longitudinal length, thus increasing appearance of midapical emargination); S6 with lateral edge strongly folded, bulbous in appearance in ventral view. Gonoforceps strongly swollen subapically, apical to swelling with flattened, narrowed process (Figs 45, 46, 49–51).

Distribution. Canada from Yukon, the Northwest Territories, and Nunavut southeast to Ontario and Quebec.

Holotype male. "[Canada] Norman Wells, N.W.T. [Northwest Territories], 13-VII-1949, W.R.M. Mason// Holotype male *Osmia nearctica* Rightmyer, Griswold, & Arduser" (Ottawa)

Paratypes. CANADA: MANITOBA, Winnipeg Capitol Region, Kettle Rapid, near Winnipeg, 14 July 1917 (1♀, New York) ; **NORTHWEST TERRITORIES**, **Dehcho Region**, Hay River, 5 June 1951, P. R. Ehrlich (2♀, Ottawa); **Inuvik Region**, Reindeer Depot, MacKenzie Delta, 23 June 1948, W. J. Brown (1♀, Ottawa), 16 July 1948, J. R. Vockeroth (1♀, Ottawa); **Sahtu Region**, Norman Wells, 19 May 1953, C. D. Bird (1♀, Ottawa), 27 May 1953, C. D. Bird (1♀, Ottawa), 12 June 1949, W.R.M. Mason (2♀, Ottawa), 3 July 1949, W.R.M. Mason (1♀, Ottawa), 4 July 1949, W.R.M. Mason (1♀, Ottawa); **NUNAVUT**, **Kitikmeot Region**, Coppermine, 3 August 1951, S. D. Hicks (1♀, Ottawa); **ONTARIO**, **Thunder Bay District**, Black Sturgeon Lake, 13 June 1961 (1♂, Ottawa); **QUEBEC**, **Nord-du-Québec Region**, Rupert River, 10 July 1956, J. R. Lonsway (1♂, Ottawa); **YUKON**, Dempster Highway km 465, 15 July 1982, D. Wood (1♀, Ottawa).

Etymology. The name "nearctica" is derived from the Greek *arktikous*, meaning northern or arctic, and is in reference to the known distribution of this species in northern regions of the New World (i.e., Canada).

Osmia (*Melanosmia*) *nigriventris* (Zetterstedt)

Figs 11, 12, 53

Anthophora nigriventris Zetterstedt 1838: 465 [Syntype female: presumed lost (Tkalců 1995: 141)].

Osmia nigriventris (Zetterstedt); Nylander 1848: 260.

Osmia baicalensis Radoszkowski 1867: 80 [Lectotype female: Berlin]; Friese 1909: 126 [synonymy with *O. dimidiata* Morawitz]; Zanden 1991: 353 [Lectotype designation, rejection of synonymy with *O. dimidiata* Morawitz, synonymy with *O. nigriventris* (Zetterstedt)].

Osmia frigida Smith 1853: 142 [Male and female syntype series: London]; Sandhouse 1939: 35 [synonymy].

Osmia hudsonica Cresson 1864: 21 [Holotype male: Philadelphia]; Sandhouse 1939: 35 [synonymy].

Osmia corticalis Gerstäcker 1869: 331 [Lectotype female: Berlin]; Thomson 1872: 244 [synonymy]; Tkalců 1995: 141 [Lectotype designation (but see Nilsson 2009: 50)].

Osmia (*Melanosmia*) *nigriventris* (Zetterstedt); Schmiedeknecht 1885–1886: 79.

Osmia (*Centrosmia*) *nigriventris* (Zetterstedt); Sinha 1958: 244; Sinha and Michener 1958: 284 [revision].

Osmia (*Centrosmia*) *nigriventris frigida* Smith; Tkalců 1995: 141.

Diagnosis. Females of this species are known by the swollen clypeal margin (Figs 11, 12) (approaching the extreme look found in *O. bucephala*, but unlike in that species, there is no metallic coloration in the integument of the meso- and metasomata). Males are known by the strongly reflexed apicolateral angles of T5 and T6 (Fig. 53). Unlike in *O. bucephala*, the midleg tarsal segments 2–4 are not modified or swollen, and S2 is unmodified (S2 of *O. bucephala* with a low tumescence bordered anteriorly and laterally by several rows of erect bristles).

Distribution. In the Nearctic, *O. nigriventris* is known from Oregon, Idaho, Wyoming, and Michigan north to Yukon and the Northwest Territories, east across Canada to Ontario, Quebec, and Newfoundland. In the Palearctic, *O. nigriventris* is known from France, Italy, and Slovakia north to Norway, Sweden, and Finland and east to Mongolia, northern China, and through Russia to Far Eastern Siberia (Müller 2010).

Comments. *Osmia nigriventris* is polylectic, with preference for *Vaccinium* (Ericaceae); it nests in old insect burrows in dead wood and constructs cell partitions and nest plugs with chewed leaves (Müller 2010 and references therein).

Material examined. 19 July 1955 (1♂, Ottawa), 28 July 1955 (2♀, Ottawa); **CANADA: ALBERTA**, **Alberta's Rockies Region**, (1♀, Ottawa), 21 May 1915 (1♀, 3♂, Ottawa), 25 May 1922 (1♀, Ottawa), 3 July 1968, *Dryas drummondii* (1♀, Ottawa), 8 July 1968, *Hedysarum sulphurescens* (1♂, Ottawa), 23 August 1955, 4500 ft (1♀, Ottawa); **Central Alberta**, 8 June 1921 (1♂, Ottawa) **BRITISH COLUMBIA**, **Stikine District**, 6 June 1955, 2200 ft (1♀, Ottawa), 9 June 1955, 2200 ft (2♂, Ottawa), 26 July 1955, 2200 ft (1♀, Ottawa); **Columbia-Shuswap District**, 1 August 1950 (1♀, Ottawa), 1 August 1952, 6000 ft (1♀, Ottawa), 2 August 1952, 6000 ft (1♀, Ottawa); **Peace River District**, 11 June 1948 (1♂, Ottawa), **Thompson-Nicola District**, 8 August 1943 (1♀, Ottawa); **MANITOBA**, **Eastman Region**, June 1966 (1♀, Ottawa); **Northern Region**, 31 May 1949 (1♂, Ottawa), 3 June 1952 (1♂, Ottawa), 12 June 1952 (1♂, Ottawa), 19 June 1949 (1♂, Ottawa), 26 June 1950 (1♂, Ottawa), 29 June 1949 (1♀, Ottawa), 5 July 1950 (1♂, Ottawa), 10 July 1952 (1♀, Ottawa), 13 July 1937 (1♀, Ottawa), 15 July 1949 (1♂, Ottawa), 17 July 1937 (1♀, Ottawa); **NEWFOUNDLAND AND LABRADOR**, **Great Northern Peninsula**, 12 June 1951 (1♀, Ottawa); **NORTHWEST TERRITORIES**, **Dehcho Region**, 31 May 1969 (1♂, Ottawa), 5 June 1951 (2♂, Ottawa), 5 June

1969 (1♀, Ottawa); **Inuvik Region**, 13 June 1956 (1♀, 7♂, Ottawa), 16 June 1956 (1♀, 4♂, Ottawa), 18 June 1956 (2♀, Ottawa), 21 June 1910 (1♂, New York), 22 June 1948 (1♀, 1♂, Ottawa), 22 June 1956 (1♀, Ottawa), 25 June 1948 (1♂, Ottawa), 26 June 1948 (1♀, 1♂, Ottawa), 27 June 1948 (1♀, Ottawa), 28 June 1956 (1♀, Ottawa), 29 June 1956 (1♀, 1♂, Ottawa), 2 July 1948 (2♀, Ottawa), 3 July 1956 (3♀, Ottawa), 7 July 1948 (1♂, Ottawa), 10 July 1948 (1♀, Ottawa), 18 July 1948 (1♀, Ottawa), 25 July 1957 (1♀, Ottawa); **North Slave Region**, 9 July 1949 (1♀, Ottawa); **Sahtu Region**, 9 June 1949 (1♀, 2♂, Ottawa), 12 June 1949 (1♀, Ottawa), 18 June 1948 (1♂, Ottawa), 3 July 1972 (1♀, Ottawa); **ONTARIO**, 17 May 1962, *Chamaedaphne* sp. (1♂, Toronto); **Kawartha Lakes**, 24 May 1964, *Taraxacum officinale* (1♂, Ottawa), 10 June 1964, *Taraxacum officinale* (1♂, Ottawa); **QUEBEC**, **Nord-du-Québec Region**, 12 June–8 August 1987 (1♀, Ottawa), 19 June 1956 (1♀, Ottawa), 25 June 1956 (1♂, Ottawa), 25 July 1954 (1♀, Ottawa); **Côte-Nord Region**, 7 July 1948 (1♂, Ottawa); **YUKON**, 22 May 1951 (1♀, Ottawa), 28 May 1951 (1♀, 3♂, Ottawa), 29 May 1951 (1♀, 1♂, Ottawa), 1 June 1951 (1♀, Ottawa), 2 June 1951 (1♀, Ottawa), 5 June 1951 (1♂, Ottawa), 15 June 1960 (1♂, Ottawa), 15 June 1980 (1♂, Victoria), 17 June 1960, 3200 ft (2♀, Ottawa), 19 June 1960, 3000 ft (1♀, Ottawa), 22 June 1982 (1♀, 2♂, Victoria), 23–25 June 1980, 800 m (1♂, Logan), 27 June 1960, 3300 ft (1♀, Ottawa), 27 June 1984 (1♂, Victoria), 29 June 1984 (1♂, Victoria), 1 July 1949 (1♀, Victoria), 1–4 July 1973 (1♀, Ottawa), 1–5 July 1987, 720 m (1♂, Ottawa), 9 July 1983, 2300 ft (1♀, Victoria), 9 August 1981 (1♀, Victoria); **RUSSIA: Siberia**, 3 July 1992, *Vaccinium vitis-idea* (1♀, Davis); **USA: ALASKA**, **Fairbanks North Star Borough**, 5–13 May 2009 (1♀, Logan), 7 May 1982, *Pulsatilla patens* (1♂, Davis), 5 June 1987, *Hedysarum mackenziei* (1♀, Davis), 28 June 1987, *Hedysarum* sp. (1♀, Davis); **Southeast Fairbanks Census Area**, 22 May 1985, *Arctostaphylos uva-ursi* (1♀, Davis), 27 July 1982, *Aster sibiricus* (1♀, Davis); **Yukon-Koyukuk Census Area**, 30 June 1991, *Hedysarum boreale* (1♀, Davis); **IDAHO**, **Lemhi Co**., 20 July 1963 (1♀, 1♂, Moscow); **MICHIGAN**, **Marquette Co.**, 18 May 1982, *Amelanchier bartramiana* (1♀, St. Charles), 19 May 1982, *Amelanchier bartramiana* (1♂, St. Charles); **MONTANA**, **Carbon Co.**, 22 June 1981, 6200 ft (1♀, Boulder), 11 July 1963, 5200 ft (1♀, Boulder); **OREGON**, **Deschutes Co.**, 19 July 1927, 5500 ft (1♀, Corvallis); **WASHINGTON**, **Okanogan Co.**, 2 July 2004 (1♀, Logan); **WYOMING**, **Fremont Co.**, 28 June 1990, 10400 ft, *Arctostaphylos uva-ursi* (1♂, Logan), 30 June 1990, 10500 ft (1♂, Logan); **Johnson Co.**, 22 July 1998 (1♀, Logan); **Teton Co.**, 14 July 1930 (1♂, New York).

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