

Linzer biol. Beitr.	50/2	1213-1228	17.12.2018
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Updated checklist of the wild bees of the Madeira Archipelago and the Selvagens Islands (Hymenoptera: Apoidea: Anthophila)

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A b s t r a c t : A checklist of wild-bee species of the Madeira Archipelago and the Selvagens Islands is presented. Until yet, twenty species have been detected in the Madeira Archipelago (Madeira Island: sixteen species, Porto Santo: nine species, Desertas: four species). Eight species are endemic to the Madeira Archipelago: seven on species rank, one on subspecies rank. Within the Madeira Archipelago, Madeira Island is characterised by the highest number of (probably) introduced species ($n = 6$), and Porto Santo has only one introduced species; the Desertas Islands are free from bee introductions. One species was detected on the Selvagens Islands. All wild-bee species will be briefly commented on.

K e y w o r d s : Hymenoptera, Apoidea, Anthophila, commented checklist, nomenclature, endemisms, introduced species, island biogeography, Madeira Archipelago, Selvagens Islands.

Introduction

The first checklist of the wild bees of the Madeira Archipelago was published by FELLENDORF et al. (1999), which was later supplemented and corrected by KRATOCHWIL et al. (2008). Further contributions were made by KRATOCHWIL & SCHEUHL (2013), KRATOCHWIL et al. (2014), and KRATOCHWIL (2018). KRATOCHWIL & SCHWABE (2018a) gave an overview of the wild-bee fauna of Porto Santo, including distribution maps of six species and an analysis of the bee–plant network. A comprehensive monograph of the wild bees of the Madeira Archipelago (taxonomy, historical aspects, species distribution, phenology, flower-visiting and ecological behaviour) is in preparation: KRATOCHWIL et al. (in prep.). Until now, we have been able to detect only one wild-bee species on the Selvagens Islands.

New insights from the last ten years make it necessary to update the checklist in advance and to highlight the bee fauna of the Madeira Archipelago and Selvagens Islands, compared with those of the other Macaronesian islands (KRATOCHWIL & SCHWABE 2018b).

Methods

The checklist is primarily based on a databank of about 2,000 observations/specimens of Apoidea by A.F. Aguiar, A. Kratochwil, and J. Smit. Several museum collections were checked (e.g., Museu de História Natural do Funchal, Madeira, Portugal; Biology Centre Museum Linz, Austria; Übersee-Museum Bremen, Germany), and type specimens of

some endemic species were validated (Department of Entomology, Smithsonian Institution, Washington, DC, USA; Hope Entomological Collections, Oxford University Museum of Natural History, United Kingdom; Department of Entomology, California Academy of Sciences, San Francisco, CA, USA; Natural History Museum, London, United Kingdom). All species were checked by the authors or validated by other specialists.

The semi-domesticated honeybee *Apis mellifera* LINNAEUS, 1758, is present (Madeira Island and Porto Santo), but was not included on the list. Also excluded from the list is *Hoplitis (Hoplitis) ochraceicornis* (FERTON, 1902), see FELLENDORF et al. (1999), because the specimen could not be checked (van der Zanden Collection: one female, 10.05–28.05.1989, Caniçal, ca. 25 m a.s.l.). In MÜLLER (2018), the occurrence of this species is provided with a question mark, but if true, it is a recent introduction (Ebmer pers. comm.).

Results and discussion

1. Species of Madeira Island, Porto Santo, Desertas Islands, and Selvagens Islands

Table 1 summarises the detected species of Madeira Island, Porto Santo, the Desertas Islands, and the Selvagens Islands. Twenty species occur in the Madeira Archipelago, and one species was detected on the Selvagens Islands.

Madeira Island is characterised by sixteen species, Porto Santo by nine species, and the Desertas Islands by four species. Eight species are endemic to the Madeira Archipelago (Table 1): seven on species rank, one on subspecies rank (*Anthophora quadrifasciata maderae*; see comment). The endemic (sub)species *Hylaeus maderensis*, *Lasioglossum wollastoni*, and *Anthophora quadrifasciata maderae* occur on all islands of the archipelago.

Madeira Island has seven endemic taxa, of which three endemic species occur exclusively here (*Andrena wollastoni*, *Halictus frontalis*, *Osmia madeirensis*), and *Andrena maderensis* is restricted to Madeira Island and the Desertas Islands. Porto Santo is characterised by five endemic taxa, including two endemic Porto Santo-specific species: *Andrena dourada* and *A. portosanctana*. A key factor for understanding the existence and island-specific distribution of endemic species within the Archipelago of Madeira is the geological history of each island.

Porto Santo has an age of 11.1 to 14.3 Ma and was always separated from Madeira Island by an ocean bed more than 2000 m deep (GELDMACHER et al. 2005, COOK 2008). In contrast, Madeira Island has an age of only 4.6 million years (GALOPIM DE CARVALHO & BRANDÃO 1991, GELDMACHER et al. 2005). Due to the islands' different ages and the small distance of 45 km between them, there are taxonomically related endemic species pairs between Porto Santo and Madeira Island. The phylogenetically older species are those of Porto Santo. Obviously, founder individuals reached Madeira Island from Porto Santo and developed new endemic species. The species pairs are as follows (Porto Santo/Madeira Island): *Andrena dourada* – *A. wollastoni*; *Andrena portosanctana* – *A. maderensis*; *Osmia latreillei iberoafricana* (not endemic, also found, e.g., in Spain) – *O. madeirensis* (KRATOCHWIL & SCHEUCHL 2013, KRATOCHWIL et al. 2014, KRATOCHWIL 2018, and KRATOCHWIL & SCHWABE 2018a).

Table 1: Species list of the wild bees of the Madeira Archipelago and the Selvagens Islands, including species status. Concerning the Desertas Islands, further information on wild-bee species on Deserta Grande, Bugio, and Ilhéu Chão is attached within the species comments.

Status: end. = endemic, intr. = introduced, nat. = native, nat.? = probably native, intr.? = probably introduced.

	Madeira Island	Porto Santo	Desertas Islands	Selvagens Islands	Status
COLLETIDAE					
<i>Hylaeus maderensis</i> (COCKERELL, 1921)	X	X	X		end.
<i>Hylaeus pictipes</i> NYLANDER, 1852		X			intr.
<i>Hylaeus s. signatus</i> (PANZER, 1798)	X				intr.
ANDRENIDAE					
<i>Andrena dourada</i> KRATOCHWIL & SCHEUCHL, 2013		X			end.
<i>Andrena wollastoni</i> COCKERELL, 1922	X				end.
<i>Andrena maderensis</i> COCKERELL, 1922	X		X		end.
<i>Andrena portosanctana</i> COCKERELL, 1922		X			end.
HALICTIDAE					
<i>Halictus frontalis</i> SMITH, 1853	X				end.
<i>Lasioglossum morio cordiale</i> (PÉREZ, 1903)				X	nat.
<i>Lasioglossum v. villosulum</i> (KIRBY, 1802)	X	X	X		nat.?
<i>Lasioglossum wollastoni</i> COCKERELL, 1922	X	X			end.
MEGACHILIDAE					
<i>Hoplitis acuticornis</i> (DUFOUR & PERRIS, 1840)	X				intr.
<i>Megachile versicolor</i> SMITH, 1844	X				intr.?
<i>Megachile pusilla</i> PÉREZ, 1884	X				int.
<i>Osmia latreillei iberoafricana</i> (PETERS, 1975)		X			nat.
<i>Osmia madeirensis</i> VAN DER ZANDEN, 1991	X				end.
<i>Osmia niveata</i> (PANZER, 1798)	X				nat.
<i>Stelis ornatula</i> (KLUG, 1807)	X				intr.
ANTHOPHORIDAE					
<i>Amegilla quadrifasciata maderae</i> (SICHEL, 1868)	X	X	X		end.
APIDAE					
<i>Bombus terrestris lusitanicus</i> KRÜGER, 1956	X	X			nat.
<i>Bombus r. ruderatus</i> (FABRICIUS, 1775)	X				intr.?

Porto Santo is an example of the geological phenomenon of an old, already strongly eroded island. This has resulted in losses of altitude, habitats, and area and therefore also in a decreasing number of wild-bee species (KRATOCHWIL & SCHWABE 2018a).

The Desertas Islands (Deserta Grande, Bugio, and Ilhéu Chão) have an age of 3.6 Ma. During the last glacial period (18,000 years BP), a land bridge connected Madeira with the Desertas (BREHM et al. 2003). Today, the depth of the sea between Ponta de São Lourenço peninsula (eastern tip of Madeira) and Ilhéu Chão is about 90 m.

Native and unintentionally introduced species of the Madeira Archipelago show predominantly Western Palaearctic–Mediterranean distribution. *Lasioglossum villosulum*, *Osmia latreillei iberoafricana*, *O. niveata*, and *Bombus terrestris lusitanicus* are actually considered native. Certainly introduced species are *Hylaeus pictipes*, *Hylaeus signatus*, and *Megachile pusilla*; with high probability, this is also true for *Hoplitis acutiformis*, *Stelis ornatula*, and *Megachile versicolor*. These species are stem nesting, which favours a man-made introduction but also a natural introduction. The individual numbers of these (probably) introduced species are very low, which would indicate that they will not have a long-term establishment. *Bombus ruderatus* was probably also introduced. We give a detailed species analysis in section 2.

Within the archipelago, Madeira Island is characterised by the highest number of (probably) introduced species ($n = 6$), and Porto Santo has only one introduced species; the Desertas are free from introductions.

With an age of 27 Ma, the Selvagens Islands, located 296 km south of and politically associated with the Madeira Archipelago, form the oldest archipelago of the Macaronesian Islands. This strongly eroded archipelago has a total land area of only 2.73 square kilometres. Only one bee species, *Lasioglossum morio cordiale*, could be detected until yet; it is also native in the Canary Islands, southern Spain, and North Africa (EBMER 1988).

2. Species comments

***Hylaeus (Paraprosopis) maderensis* (COCKERELL, 1921):** COCKERELL (1921) described a female collected by T.V. Wollaston. The type is deposited in the Hope Entomological Collections (Oxford University). This specimen is mounted on a square of cardboard (yellowed by age), with wings spread out and is in good condition. The cardboard is colour-coded red, indicating the female specimen comes from Deserta Grande, collected during Wollaston's second visit (MACHADO 2006). This locality was not recorded by SAUNDERS (1903). COCKERELL (1921) characterised Madeira Island as type locality, but this is incorrect. High-resolution photos of the type were analysed by A. Kratochwil (KRATOCHWIL 2018).

H. maderensis is not common in the Madeira Archipelago; there are data from Deserta Grande ($n = 1$) and Madeira Island ($n = 15$). Until yet, there was only one detection of this species in Porto Santo: one male collected by G. Jaeschke (1940–1995; Berlin), surroundings of Hotel Luamar, 21.03.1994, det. H.H. Dathe (Senckenberg German Entomological Institute, Müncheberg, Germany).

***Hylaeus (Paraprosopis) pictipes* NYLANDER, 1852:** There is only one detection within the Madeira Archipelago, on Porto Santo. A male was collected by W. Barkemeyer (Oldenburg), Pedras Pretas, dune wall, 10.06.1987, deposited in the collection of the

Übersee-Museum (Bremen, Germany); pers. comm. H.H. Dathe (Senckenberg German Entomological Institute, Müncheberg, Germany). No further specimens could be detected. There is no doubt that the detection of this Western Palaearctic species on Porto Santo is based on an unintentional introduction by man, which is not unusual for stinging bee species. According to DATHE et al. (2016), the native range of *H. pictipes* is restricted to northern parts of Europe, extending east to the Caucasus and south to the Iberian Peninsula. As with other *Hylaeus* species reaching the New World by introduction (*H. hyalinatus* SMITH, 1842, ASCHER 2001; *H. punctatus* (BRULLÉ, 1832), SHEFFIELD et al. 2011; *H. communis* NYLANDER, 1852, MARTINS et al. 2017), the first records of *H. pictipes* for North America were recently reported by GIBBS & DATHE (2017).

***Hylaeus (Prosopis) s. signatus* (PANZER, 1798):** This species, oligolectic on *Reseda* and widely distributed on the mainland (e.g., North Africa, Central Europe, Asia Minor, the Caucasus, Turkmenistan, Uzbekistan; DATHE 1980, SCHEUCHL & WILLNER 2016), is currently restricted within the archipelago on Madeira Island, detected near Funchal in 1998, 5 km from the harbour (SMIT & SMIT 2003). H.H. Dathe (Senckenberg German Entomological Institute, Müncheberg) identified the specimens as subsp. *signatus*. Under natural conditions, given the potential colonising abilities of the species, we would expect the colonisation of subsp. *berlandi* (BENOIST, 1943), distributed, e.g., on the Iberian Peninsula and southern Europe. *H. signatus* is also detected on the Azores and characterised as introduced (first record 2001; WEISSMANN et al. 2017).

***Andrena (Micrandrena) dourada* KRATOCHWIL & SCHEUCHL, 2013:** COCKERELL (1922) described the endemic *A. wollastoni*, analysing specimens from Madeira Island and Porto Santo. KRATOCHWIL & SCHEUCHL (2013) described *A. dourada*, endemic to Porto Santo, as a new species differing in numerous morphological and morphometric characteristics from *A. wollastoni* (Madeira Island). According to several morphological features, *A. dourada* shows a close relation to *A. tiaretta* WARNCKE, 1974 (KRATOCHWIL 2015). Further extensive information about morphology, morphometrics, relation to species of the *A. tiaretta* agg., and biology (flower visiting, habitats) is given in KRATOCHWIL & SCHEUCHL (2013) and (KRATOCHWIL 2015). *Andrena dourada* is polylectic.

***Andrena (Micrandrena) wollastoni* COCKERELL, 1922:** Six syntypes of *A. wollastoni*, collected by T.V. Wollaston or one of his fellow collectors, were detected in the Natural History Museum of London (NHMUK). The female specimen characterised by Cockerell with a type label was designated as lectotype, the five other females as paralectotypes (KRATOCHWIL 2018). Where these specimens came from is still an open question, although they are provided with register labels. Some historical aspects concerning the discovery of *A. wollastoni* are analysed in KRATOCHWIL (2018).

This endemic species is restricted to Madeira Island, occurring in high abundance and reaching the highest altitudes of the island (1750 m a.s.l.). *Andrena wollastoni* is polylectic. The status of *A. w. acuta* WARNCKE, 1968 (Tenerife, La Palma), *A. w. gomerensis* WARNCKE, 1993 (La Gomera, El Hierro), and *A. w. catula* WARNCKE, 1968 (Gran Canaria), should be re-evaluated. This can be shown by morphological, morphometric, and molecular analyses (KRATOCHWIL in prep.). We hypothesise that the endemic *A. dourada*, which colonised Madeira Island from Porto Santo, developed into the endemic *A. wollastoni* (KRATOCHWIL & SCHEUCHL 2013).

***Andrena (Suandrena) maderensis* COCKERELL, 1922:** COCKERELL (1922) described *A. maderensis* as endemic to Madeira Island. The types of the description (four females and two males) are deposited in the Natural History Museum of London (NHMUK) (GUSENLEITNER & SCHWARZ 2002). In the Entomology Collection Data Base (<http://www.nhm.ac.uk/research-curation/scientific-resources/collections>), only four syntypes and one possible syntype (primary type number 17a.2820) are listed. The sixth possible syntype seems to be lost. The differences in the taxonomical evaluation (WARNCKE 1968) are discussed in KRATOCHWIL et al. (2014). The main distribution centre of *A. maderensis* is in the south and south-eastern region of Madeira Island. The range of altitudes extends from sea level up to 950 m a.s.l. In the old entomological collection of the Diocesan Seminary (Funchal, Madeira), founded by Father Ernst (Ernesto) Schmitz (1845–1922), a female specimen of *A. maderensis* was detected, collected on Deserta Grande, 8 May 1938 (unknown collector); AGUIAR & CARVALHO (2016).

A. maderensis is specialised in collecting pollen from Brassicaceae species, which is characteristic for *Suandrena* species.

***Andrena (Suandrena) portosanctana* COCKERELL, 1922:** COCKERELL (1922) described another *Suandrena* species endemic to Porto Santo. According to GUSENLEITNER & SCHWARZ (2002), *A. portosanctana* is a synonym for *A. maderensis*; see also in Fauna Europaea (DE JONG 2013). In contrast, WARNCKE (1967, 1968) gave *A. portosanctana* subgenus status and defined *A. m. maderensis* as a nominotypical subspecies. Eighty-nine years after the description by COCKERELL (1922), two females of *A. portosanctana*, collected by G. Jaeschke (Berlin), were detected in 2011 in the private collection of C. Saure (Berlin, Germany). We discovered two of the three syntypes of *A. portosanctana* (one female deposited in the California Academy of Science, San Francisco, California, USA; one female in the Department of Entomology, NMNH, Smithsonian Institution, Washington, DC, USA). Morphological and morphometric analyses demonstrate that both are different species (KRATOCHWIL et al. 2014). Both species are characterised in detail by KRATOCHWIL et al. (2014); see also KRATOCHWIL (2014). *Andrena portosanctana* is widely distributed on Porto Santo and prefers Brassicaceae species but also visits species of other plant families.

We hypothesised that *A. portosanctana* is the ancestor of *A. maderensis* and that *A. portosanctana* and *A. notata* WARNCKE, 1968 (Canary Islands), descended from the mainland species *A. fratella* WARNCKE, 1968 (Morocco), or an ancestor of this species (KRATOCHWIL 2014).

***Halictus (Halictus) frontalis* SMITH, 1853:** In 1847, T.V. Wollaston collected two females and one male on Madeira Island. SMITH (1853) presented a species description at the base of specimens from the Natural History Museum of London (NHMUK), but he erroneously cited 'Africa' as the type locality. SAUNDERS (1903) studied the three specimens collected by Wollaston that were deposited in the Oxford University Museum of Natural History (OUMNH) as part of the Wollaston Madeira collection, which was purchased between 1860 and 1862 by Frederick William and Ellen Hope and donated to the Oxford University Museum of Natural History (OUMNH) (SMITH 1986). SAUNDERS (1903) found that one female and one male were labelled as *H. quadristrigatus* LATREILLE, 1805, which is a synonym for *H. quadricinctus* (FABRICIUS, 1776). In his opinion, it was not clear whether males and females belong to the same species. Concerning the bad condition of the female, Saunders abandoned describing a new species

based only on one male. A further female was labelled as *H. zebrus* (WALCKENAER, 1817). COCKERELL (1921) described *H. sepositus* as new species at the base of the specimens of the OUMNH. *Halictus sepositus* COCKERELL, 1921, is placed in synonymy with *H. frontalis*. *Halictus zebrus* is placed in synonymy with *H. scabiosae* (ROSSI, 1790); see EBMER (1988). A detailed analysis of the specimens of the NHMUK and the OUMNH is pending.

More than all other wild-bee species of the Madeira Archipelago, *H. frontalis* is a species of the Laurisilva region on more or less open sites (woodland edges, clearings), with a preference for Asteraceae. *Halictus frontalis*, but also *Andrena wollastoni*, reaches the highest altitudes of Madeira Island (1750 m a.s.l.).

It is hypothetically supposed that *H. frontalis* developed from an ancestor of the two continentally distributed halictids *H. fulvipes* (KLUG, 1817) and *H. resurgens* NURSE, 1903 (EBMER 1974, 1988). Ebmer (pers. comm.) supposed that *H. frontalis* split long before the diversification of *H. fulvipes* in a western Mediterranean taxon and *H. resurgens* in an eastern Mediterranean taxon.

***Lasioglossum (Evylaeus) morio cordiale* (PÉREZ, 1903):** The two males and two females collected by Nelio Freitas (01.06.2004) are the first records for a bee species from Selvagem Grande (det. A.W. Ebmer). We classify these species as native on Selvagem Grande. This southwestern subspecies of the widespread Western Palaearctic *L. morio* (FABRICIUS, 1793) is also distributed on the Canary Islands (there is a distance of about 180 km) and not rare on Tenerife, Gran Canaria, Lanzarote, and Fuerteventura (HOHMANN et al. 1993). *Lasioglossum m. cordiale* was also recorded in Morocco, is rare in Algeria south to Hoggar, Tunisia, and is rare in the south of Spain (Malaga, Cadiz, Benidorm); see EBMER (1988).

The record of *L. m. cordiale* indicates the close relationship to the Canarian bee fauna. On the Canary Islands, the altitudinal distribution of this bee species reaches from sea level up to more than 2200 m a.s.l. (HOHMANN et al. 1993).

***Lasioglossum (Evylaeus) v. villosulum* (KIRBY, 1802):** We suppose that this Trans-Palaearctic species (SCHEUCHL & WILLNER 2016) is native to the Madeira Archipelago. In contrast to WEISSMANN et al. (2017), we hypothesise that *L. villosulum* was introduced to the Azores in accordance with SCHEUCHL & WILLNER (2016). *Lasioglossum villosulum* is common on Madeira Island, but detections on Porto Santo are rare (one female, collected by P. Wirtz, 20.05.1993, det. M. Fellendorf, collection of the Museu Municipal do Funchal, Madeira, photo checked by A. Kratochwil; one female, collected by P. Wirtz, 20.05.1993, det. M. Fellendorf, deposited in the Stuttgart State Museum of Natural History and checked by H.-R. Schwenninger; one female, collected by D. Erber, 16.03.1982, west coast of Deserta Grande, on *Senecio*, checked by J. Smit).

There is a preference for pollen collection from Asteraceae (50 observations in our dataset). For the whole distribution area, SCHEUCHL & WILLNER (2016) stated a polylectic behaviour with a preference for Asteraceae.

***Lasioglossum (Evylaeus) wollastoni* COCKERELL, 1922:** GRIBODO (1883) reported on a collected male and a female characterised as *Halictus morio* (FABRICIUS, 1793). SAUNDERS (1903) described specimens collected by Reverend Alfred Edwin Eaton (one female, Monte, Funchal, collected on *Sonchus oleraceus*, 27.02.1902). SAUNDERS (1903) assigned two males and two females collected by T.V. Wollaston to '*Halictus* n. sp.

allied *morio*'. COCKERELL (1922) described *Halictus wollastoni* based on several males and females collected by T.V. Wollaston. This species endemic to the Madeira Archipelago is widely distributed on the islands (Madeira Island, Porto Santo, Desertas: Deserta Grande, and recently discovered, Bugio) and occurs locally in high numbers.

WARNCKE (1974) stated the relationship to *L. morio*, declaring only the rank of a subspecies, *L. morio wollastoni* (WARNCKE, 1975), which implies that the continental ancestor is *L. morio morio* (FABRICIUS, 1793). Analogously, WARNCKE (1974) described for the Canary Islands (Tenerife, Furteventura) *Halictus morio* subsp. *soror* SAUNDERS, 1901, as a distinct subspecies. This caused much confusion.

L. soror SAUNDERS, 1901, is the valid name for *L. atrovirens* (PÉREZ, 1903), and it occurs in the Western Palaearctic–Mediterranean region. However, the ancestor of *L. wollastoni* is not *L. morio*, as is stated by WARNCKE (1974), but the North African *Lasioglossum* (*Evyllaesus*) *collopiense* (PÉREZ, 1903), occurring in the species group of *Lasioglossum morio* (A.W. Ebmer pers. comm.). As shown by EBMER (1988), *L. soror* auctorum nec SAUNDERS, 1901, is synonymous to *L. collopiense*. *Lasioglossum collopiense* is known from Morocco and Algeria (Hoggar); see EBMER (1976, 1988). The only *L. morio* subspecies recorded in Morocco is *L. morio cordiale* (PÉREZ, 1903) (EBMER 1988).

***Hoplitis* (*Alcidamea*) *acuticornis* (DUFOUR & PERRIS, 1840):** There are only a few records from Madeira Island: one female and one male collected by O. Lundblad, 17.07–04.08.1935 near Rabaçal (1080 m a.s.l.), and one female and one male collected by J. Smit, 15.07.1997, Fontes (1250 m a.s.l.) and Lombada dos Marinheiros (700 m a.s.l.). J. Smit collected in the same locality (Fontes) and at the same time (15.07.1997) *Stelis ornatula* (KLUG, 1807), which is a cuckoo bee specialised on *Hoplitis* and *Osmia*. In the literature, in the case of Central Europe, *H. claviventris* (THOMSON, 1872) serves as the main host, and *H. tridentata* (DUFOUR & PERRIS, 1849) and *O. maritima* FRIESE, 1885, as accessory hosts (literature in WESTRICH 1989). According to AMIET et al. (2004), other host species are *H. acuticornis* (DUFOUR & PERRIS, 1840) and *Pseudoanthidium scapulare* (LATREILLE, 1809). So, we assume that on Madeira Island, the host of *S. ornatula* is *H. acuticornis*.

It is interesting that *H. acuticornis* pars parte, but also *S. ornatula* and *M. versicolor* (see below), occurs at an altitude of about 1,100 to 1,700 m a.s.l. This situation could be interpreted as a colonisation event via passat wind drift, but this is not evident. This region is dominated by afforestations and by cattle-grazed areas with plant introductions of mainland species. Up to an altitude of 800 to 1,000 m a.s.l., afforestations of *Pinus pinaster* (Mediterranean) and *Eucalyptus globulus* (Australian), introduced in the nineteenth century, were realised following *Castanea sativa* plantings. Pastures are dominated by *Ulex europaeus* and *Cytisus scoparius* (introduced in the nineteenth century) and *Pteridium aquilinum*. Furthermore, *Quercus robur* was introduced from Portugal. Considering that these three bee species are stem nesting, there was with high probability an unintended introduction by man. The co-occurrence of a host species and this specialised cuckoo bee supports this hypothesis.

***Megachile* (*Megachile*) *versicolor* SMITH, 1844:** SAUNDERS (1903) analysed a male, collected by T.V. Wollaston on Madeira and stated a close relationship to *M. versicolor*. But referring to the bad condition of preservation, he classified the specimen only as '*Megachile* sp.?'. Nevertheless, COCKERELL (1921) described this male as *M. semispleta*.

He recognised a close relationship to *M. versicolor* too. ALFKEN (1940) assigned the specimen to *M. versicolor*, referring to SAUNDERS (1903). *Megachile semiplea* is placed in synonymy with *M. versicolor* (PRAZ 2017). Note that neither PRAZ (2017) nor we have examined the type specimen of *M. semiplea*; in this group males are notoriously difficult to identify and the presence of females of *M. versicolor* (which can be identified with certainty) renders the synonymy with *M. versicolor* very likely.

In our database, there are two males and three females, collected by Jan Smit (11.07.1997, Parque Ecológico, near Poço da Neve; 1,650 m a.s.l., grazed ruderal site). We classify *M. versicolor* as introduced (see comments on *Hoplitis acuticornis*).

***Megachile (Eutricharaea) pusilla* PÉREZ, 1884:** One male was collected by Miguel Andrade on flowers of *Euphorbia hypericifolia* (11.09.2017, central municipal gardens in Funchal, 32.6477903 N, -16.9111319 E, 28 m a.s.l.). C. Praz sequenced the DNA barcoding fragment of the mitochondrial gene cytochrome oxidase I for this specimen and found 100% similarity with specimens of *M. pusilla* from southern Europe. The sequence is published online (GenBank: www.ncbi.nlm.nih.gov/genbank/), and the specimen is deposited in the research collection of C. Praz (Neuchâtel, Switzerland). *Megachile pusilla* has a Western Mediterranean distribution (SOLTANI et al. 2017). The first record for the Azores is mentioned in ORNOSA et al. (2007) as *M. atratula* REBMANN, 1968, published by WEISSMANN et al. (2017) as *M. concinna* SMITH, 1879 (= *M. atratula*, with reference to GONZALEZ et al. 2010). The specimens from the Azores are assigned to *M. pusilla*. This species is also distributed on the Canary Islands (Gran Canaria, Tenerife), published by HOHMANN et al. (1993) as *M. albohirta* (BRULLÉ, 1839), a species that has since then been demonstrated to belong to a different subgenus (PRAZ 2017). On the Macaronesian Islands, *M. pusilla* is with high probability introduced. Its invasive capabilities are also documented by introductions to North America, Argentina, Hawaii, and Japan (SOLTANI et al. 2017).

***Osmia (Helicosmia) latreillei iberoafricana* (PETERS, 1975):** VAN DER ZANDEN (1983) and FELLENDORF et al. (1999) pointed out the distribution of this species on Madeira Island and Porto Santo. Based on our research, this species is only distributed on Porto Santo. It is remarkable that in 1998, seven years after his first description of *O. madeirensis*, van der Zanden determined two females (collection A.F. Aguiar) as *O. latreillei iberoafricana* (PETERS, 1975). Our analysis showed, that both are females of *O. madeirensis*.

O. latreillei (SPINOLA, 1806) is characterised by two colour forms considered as subspecies (PETERS 1975, WARNCKE 1988): *O. l. latreillei* (brown-haired, spreading from the north (east) Mediterranean to Switzerland, including Italy and Crete but not the Iberian Peninsula) and *O. l. iberoafricana* (light-haired, found in North Africa from Morocco to Israel, the Iberian Peninsula, Western Mediterranean islands, Malta, Cyprus, and Turkey). Remarkable is the occurrence of both subspecies on the Canary Islands (western islands: *O. l. latreillei*, eastern islands: *O. l. iberoafricana*; see discussion PETERS 1975).

***Osmia (Helicosmia) madeirensis* VAN DER ZANDEN, 1991:** In the collection of the Natural History Museum Berlin (ZMHB) there is one female, 'Madeira, leg. Th. Becker, sign. Alfken', and one female, 'Madeira, leg. Langerhaus, 21785', labelled by Friese as *O. latreillei* and by Bischoff as '*Osmia (Chalc.) maderensis* Bischoff n. sp.'. In the Biology Centre of the Upper Austrian Provincial Museum Linz (Collection of Warncke)

we detected in the series of *O. latreillei iberoafricana* one female with a printed label reading 'Madeira, Ribeira Brava 2, V. Storå' (without year), '1257'; a handwritten label in blue ink reading '*Osmia* (Chalc.) *maderensis* n. sp. Bischoff'; and a red label reading 'Paratypus', with no label of Warncke. Obviously, this is a specimen in the series of Bischoff (ZMHB). Because a correct species description is missing for the specimens labelled by Bischoff, the name '*Osmia maderensis*' is not valid.

In VAN DER ZANDEN (1983), there are one female and one male (10.04.1970, Funchal), labelled as *O. latreillei iberoafricana*, but with the advice that the female is characterised by a swollen tubercle in the clypeus region. This is the first indication of a characteristic morphological feature noted by van der Zanden. In VAN DER ZANDEN (1991), a description of the new species *O. madeirensis* is given. One female is dedicated as the holotype, collected by H.G.M. Teunissen, 10.05–28.05.1989, 'Cenigel' (correct toponym: Caniçal). Three further females, dedicated as paratypes, are labelled analogously to the holotype and were obviously collected at the same locality. VAN DER ZANDEN (1991) did not refer to VAN DER ZANDEN (1983), although the female mentioned there is *O. madeirensis*.

O. madeirensis is widely distributed on Madeira Island from the coast up to altitudes of 1,200 m a.s.l. It shows a pollen-collecting preference for Asteraceae.

O. madeirensis developed from an ancestor of the mainland-distributed *Osmia latreillei* (information by letter; A.W. EBMER). We consider *O. l. iberoafricana* from Porto Santo as the ancestor of *O. latreillei*. For further comments, see under *O. l. iberoafricana*.

***Osmia* (*Helicosmia*) *niveata* (PANZER, 1798):** Primarily, this species got the name *Osmia fulviventris* PANZER, 1798. WARNCKE (1988) characterised a nominotypical subspecies *O. f. fulviventris* (PANZER, 1798) with a European distribution (including the Canary Islands and Madeira) reaching eastwards to Uzbekistan. According to WARNCKE (1988), the subspecies *O. fulviventris niveata* (FABRICIUS, 1804) is distributed throughout North Africa (from Morocco to Egypt), the Balearic Islands, Corsica, and Sardinia, and the subspecies *O. fulviventris sieversi* MORAWITZ, 1886, on Turkey. Because *Apis fulviventris* PANZER, 1798, describes a primary homonym of *Apis fulviventris* SCOPOLI, 1763, the taxon name *O. niveata* (FABRICIUS, 1804) is valid. The name *O. niveata fulviventris* (PANZER, 1798) sensu FELLENDORF et al. 1999 is not valid.

Within the Madeira Archipelago, *O. niveata* is only distributed on Madeira Island. In Macaronesia, it occurs also on the Canary Islands (La Palma, Tenerife, Gran Canaria; see HOHMANN et al. 1993). WEISSMANN (2017) synonymized *O. niveata* with *O. emarginaria* ST. FARG., which was cited in GODMAN (1870). It is obviously a typographical error; in GODMAN (1870), it must be called '*emarginata*'. 'ST. FARG.' stands for Lepeletier. So, the name in GODMAN (1870) refers to *O. emarginata* LEPELETIER, 1841.

There are no verifiable specimens of *O. emarginata* from the Azores, so this species must be cancelled from the checklist of the Azores (WEISSMANN et al. 2017), together with *O. niveata*.

***Stelis* (*Stelis*) *ornatula* (KLUG, 1807):** See comments on *Hoplitis acuticornis*.

***Amegilla* (*Amegilla*) *quadrifasciata maderae* (SICHEL, 1868):** Based on males and females, *A. maderae* has been validly described by SICHEL (1868). According to DOURS (1869), the specimens from Madeira are only a variety (*maderae*) of *A. quadrifasciata*

(DE VILLERS, 1798). ALFKEN (1940) accepted the species status, but LIEFTINCK (1956, 1958) referred to the species as *A. quadrifasciata* (DE VILLERS, 1798).

There are certain morphological differences: In *A. quadrifasciata*, the tergite bands are wider than the tergite terminal part. Tergite 1 has light hairs in the centre. In *A. maderae* the tergite bands are narrow, and tergite 1 has dark to black hairs in the centre (checked by A.W. Ebmer). H.-R. Schwenninger (Natural Museum of Stuttgart) analysed the genitalia of specimens from France (Agay, Saint Raphaël, Côte d'Azur), Lanzarote (Playa Blanca), and Madeira (Cabo Girão, Câmara de Lobos). Certain differences can be detected; however, there is morphological variation, so no clear separating characteristics could be found. Because of the lack of differences in the genital structures, the actual status is *A. quadrifasciata maderae*. Further morphological, morphometric, and molecular investigations will be necessary.

***Bombus (Bombus) terrestris lusitanicus* KRÜGER, 1956:** The *Bombus* taxon 'maderensis' has been regarded as a species of its own by some authors (ERLANDSSON, 1979, RASMONT, 1984). This was not accepted by RASMONT et al. (2008) and WILLIAMS et al. (2012). We will follow RASMONT et al. (2008), who assigned the specimens of the Madeira Archipelago to *B. terrestris lusitanicus*; see also COPPÉE (2012). The morphological characteristics of the former *B. canariensis* PÉREZ, 1895, are not strongly divergent from the broad variation of *B. terrestris* s.l. However, a molecular genetic analysis by WIDMER et al. (1998) supported the distinctness of the Canary Island populations from the European mainland populations of *B. terrestris*. This indicates that they have a longer genetic separation on the archipelago and underlines that the populations are native.

Specimens from Madeira show genetic similarities to mainland populations of *B. terrestris lusitanicus* from the Iberian peninsula (WIDMER et al. 1998). The variability at microsatellite loci is similar to that of Mediterranean island populations and larger than on the Canary Islands. The authors concluded that the occurrence of the mainland and Mediterranean mtDNA haplotype A on Madeira Island is indicative of a different evolutionary history. We classify *B. terrestris lusitanicus* as native and not introduced (see also comments concerning *Bombus r. ruderatus*).

***Bombus (Megabombus) r. ruderatus* (FABRICIUS, 1775):** This species was described by Fabricius in 1775 based on specimens collected by Joseph Banks (first expedition of the Endeavour led by Captain James Cook) on the stop they made in Madeira in September 1768 (FABRICIUS 1775, BOEIRO et al. 2015). The locus typicus of *B. r. ruderatus* is therefore Madeira Island. *Bombus r. ruderatus* is also distributed on the Iberian Peninsula. The central European subspecies is *B. r. eurynotus* (DALLA TORRE, 1882).

According to RASMONT (1983), *B. r. ruderatus* is distributed on the Azores too (see also YARROW 1967), and was introduced in the Azores (WEISSMANN et al. 2017), firstly recorded in 1865 (GODMAN 1870). On Tenerife, *B. ruderatus* is actually an invader (PÉREZ & MACÍAS-HERNÁNDEZ 2012).

Already in the fourteenth century, ships regularly docked on Madeira Island on their return from the Canaries. In our opinion we cannot exclude a man-made unintentional introduction. If we compare the distribution with that of *B. t. lusitanicus* on Madeira, *B. ruderatus* is restricted to lower altitudes, and the preferred habitats are rural sites, and the preferring flowering resources are rural plant species. This is not the case for *B. t. lusitanicus*, which is also common on Porto Santo, has a habitat preference for the trade

wind zone, and is characterised by visiting the flowers of many native plant species (especially *Echium*); see KRATOCHWIL & SCHWABE (2018a). We studied the flower-visiting behaviour of *B. t. lusitanicus* intensively on Porto Santo.

Further investigations (especially population genetic analyses) are necessary to determine the rank of ‘native’ or ‘introduced’.

Acknowledgements

We thank cordially for cooperation: Pater Andreas Werner Ebmer (Puchenau, Austria), Holger H. Dathe (German Entomological Institute, Müncheberg, Germany), Patricia Gentili-Poole and Brian Harris (Department of Entomology Smithsonian Institution, Washington DC, USA), Ysabel Gonçalves (Museu de História Natural do Funchal, Madeira, Portugal), Fritz Gusenleitner (Biology Centre Museum Linz, Austria), James Hogan (Hope Entomological Collections, Oxford University, United Kingdom), Vincent F. Lee (Department of Entomology, California Academy of Sciences, San Francisco, CA, USA), Volker Lohrmann and Herbert Hohmann (Übersee-Museum Bremen, Germany), David Notton (Natural History Museum, London, United Kingdom), Christophe Praz (Université de Neuchâtel, Neuchâtel, Switzerland), Hans-Richard Schwenninger (Natural Museum of Stuttgart, Germany), Erwin Scheuchl (Ergolding, Germany). Special thanks go to the facilities and authorities in the Madeira Archipelago for possibilities of access and for collection permits.

Zusammenfassung

Eine dem neuesten Stand entsprechende Checkliste der Wildbienenarten des Madeira-Archipels und der Selvagens-Inseln wird vorgestellt. Bisher konnten im Madeira-Archipel 20 Arten nachgewiesen werden (Madeira: 16 Arten, Porto Santo: 9 Arten, Desertas: 4 Arten). Acht Arten sind für den Madeira-Archipel endemisch, sieben davon haben Art-Rang, eine Unterart-Rang. Innerhalb des Madeira-Archipels zeichnet sich die Insel Madeira durch die höchste Anzahl (wahrscheinlich) eingeführter Arten aus (n = 6), Porto Santo hingegen besitzt nur eine eingeführte Art. Auf den Desertas Inseln kommen derzeit keine eingeführten Wildbienenarten vor. Eine Art wurde auf den Selvagens Inseln nachgewiesen. Alle Wildbienenarten werden kurz kommentiert.

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