Linzer biol. Beitr.	52/1	161-244	31.7.2020

Revision of the *Andrena wollastoni* group (Hymenoptera, Anthophila, Andrenidae) from the Madeira Archipelago and the Canary Islands: upgrading of three former subspecies and a description of three new subspecies

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A b s t r a c t : A revision of taxa of the *Andrena wollastoni* group (Madeira Archipelago, Canary Islands) was carried out. The taxonomical status of *A. wollastoni* WARNCKE, 1968 (Madeira Island), *A. dourada* KRATOCHWIL & SCHEUCHL, 2013 (Porto Santo), and three subspecies of *A. wollastoni* COCKERELL, 1922, from the Canary Islands has been evaluated. Included in the analysis were the following two species that are closely related to the *A. wollastoni* group: *A. lineolata* WARNCKE, 1968 (Tenerife), and the hypothetical ancestor *A. tiaretta* WARNCKE, 1974 (southern Spain, Morocco, Algeria).

Using a qualitative morphological analysis of 40 parameters as well as an analysis of 22 morphometric characters in females and males (univariate analysis; calculation of Pearson product-moment correlation coefficients; multivariate ratio analysis as a tool set, including principal component analysis, linear discriminant analysis, and allometry ratio spectrum), it could be shown that the studied taxa differ in several morphological and morphometric features.

A. wollastoni (Madeira Island) and *A. dourada* (Porto Santo) are species on their own and endemic for the Madeira Archipelago. Both are well differentiated compared to the taxa of the *A. wollastoni* group from the Canary Islands, to *A. lineolata*, and to the mainland species *A. tiaretta* from NW Africa and the Iberian Peninsula.

Three former subspecies of *A. wollastoni* from the Canary Islands were upgraded to species rank: *A. catula* WARNCKE, 1968 (formerly *A. wollastoni catula*; Gran Canaria), *A. gomerensis* WARNCKE, 1993 (formerly *A. w. gomerensis*; La Gomera), and *A. acuta* WARNCKE, 1968 (formerly *A. w. acuta*; Tenerife). The specimens from the island of La Palma (formerly *A. w. acuta*, WARNCKE, 1968) were designated to *A. gomerensis*. Because of morphological and morphometric differences, but with partly overlapping morphological and morphometric features with those of specimens from La Gomera, the specimens of La Palma were assigned to a separate subspecies (*A. g. palmae* nov.ssp.). The specimens from La Gomera belong to the nominal taxon (*A. g. gomerensis* WARNCKE, 1993).

Morphological and morphometric differentiation of *A. acuta* WARNCKE, 1968, revealed a differentiation into three subspecies for Tenerife: *A. a. acuta* WARNCKE, 1968 (Anaga region), *A. a. tenoensis* nov.ssp. (Teno region), and *A. a. wildpreti* nov.ssp. (Dorsal Rift region). *A. lineolata* shows the closest morphological and morphometric relations to *A. tiaretta*, followed by *A. dourada* and *A. catula*.

K e y w o r d s : Andrenidae, Canary Islands, endemism, Hymenoptera, Madeira Archipelago, *Micrandrena*, morphometrics, multivariate ratio analysis, nomenclature, Palearctic distribution.

Introduction

Island archipelagos are excellent model systems for studying biogeographical phenomena and evolutionary processes (GRANT 1998, WHITTAKER & FERNANDEZ-PALACIOS 2006). This is also true for the Madeira Archipelago and the Canary Islands. These volcanic islands have (a) different ages, (b) different stepping-stone conditions from the mainlands of SW Europe and NW Africa (including sunken stepping-stone islands), and (c) different distances from the mainlands (KRATOCHWIL & SCHWABE 2018a). General patterns and processes of colonisation have been discussed in the literature: (a) single colonisation of an ancestor followed by radiation, (b) multiple independent colonisations, and (c) back colonisation to the mainland from island archipelagos and additional colonisations and back colonisations within an archipelago (e.g., KIM et al. 2008).

For the islands in question patterns of evolutionary processes have been shown for plants (e.g., BÖHLE et al. 1996, FRANCISCO-ORTEGA 1996, KIM et al. 1996, JUAN et al. 2000, FRANCISCO-ORTEGA 2002, MORT et al. 2002, PERCY et al. 2002), for vertebrates, such as lizards of the genera *Gallotia* (CANO et al. 1984, GONZALES et al. 1996, CARRANZA et al. 1999, BARAHONA et al. 2000, MACA-MEYER 2003) and *Lacerta* (BREHM et al. 2003); and for many taxonomic groups of invertebrates, such as Gastropoda (HENRIQUEZ et al. 1993), Araneae (WUNDERLICH 1991), Diplopoda (ENGHOFF 1992), Collembola (FJELLBERG 1993), Hemiptera (LINDBERG 1953), and Coleoptera (LINDBERG et al. 1958, DAJOZ 1977).

For the Madeira Archipelago and the Canary Islands, there is a lack of studies that highlight evolutionary processes of endemic wild-bee species (Hymenoptera: Anthophila), although these species are taxonomically differentiated into numerous endemic species and subspecies. The Madeira Archipelago is characterised by twenty wild-bee species with eight endemic species and one endemic subspecies (KRATOCHWIL et al. 2018). The Canary Islands harbour even 124 wild-bee species including 64 endemic species, and 25 subspecies (24 endemic subspecies) (HOHMANN et al. 1993 and cited publications in KRATOCHWIL & SCHWABE 2018a).

A differentiation into subspecies was described by WARNCKE (1968, 1993) for the following *Andrena* species: *A. chalcogastra* BRULLÉ, 1938, *A. maderensis* COCKERELL, 1922, *A. sinuata* PÉREZ, 1895, *A. vulcana* COCKERELL, 1922, and also for *A. wollastoni*. *A. wollastoni* has been separated into one subspecies for the Madeira Archipelago and three subspecies for the Canary Islands.

The aim of this study is to evaluate the *Andrena wollastoni* group. First described by COCKERELL (1922) for the Madeira Archipelago, *A. wollastoni* was also considered an endemic species for the Canary Islands by WARNCKE (1968) and HOHMANN et al. (1993). Based on some morphological features, WARNCKE (1968) differentiated *A. wollastoni* into four subspecies: the nominal taxon *A. w. wollastoni*, COCKERELL, 1922 (Madeira, Porto Santo), and, for the Canary Islands, *A. w. acuta* WARNCKE, 1968 (Tenerife, La Palma), *A. w. gomerensis* WARNCKE, 1993 (La Gomera; for El Hierro, see Chapter 'Historical aspects'), and *A. w. catula* WARNCKE, 1968 (Gran Canaria). WARNCKE (1968) analysed few specimens (e.g., in the case of *A. w. wollastoni* only two females and one male) and detected few differentiating morphological features.

With respect to subspecies differentiation, WARNCKE (1968) discussed (a) either a former existence of *A. wollastoni* on the continent with a later colonisation of the Madeira

Archipelago and the Canary Islands (followed by diversification on subspecies level), or (b) the speciation of *A. wollastoni* after colonisation, followed by a secondary colonisation between both archipelagos.

In 2013, we analysed specimens from Porto Santo (Madeira Archipelago) assigned by COCKERELL (1922) to *A. wollastoni* (KRATOCHWIL & SCHEUCHL 2013). Compared to *A. wollastoni* from Madeira Island, these specimens were found to have numerous distinct morphological differences (females: e.g., body and wing length, pterostigma and propodeum length, basal area length, colour of the pubescence of the head and the tibial scopa, and labrum process morphology; males: e.g., body and wing length, and colour of the pubescence of the head, the mesoscutum and the mesepisternum). Based on these morphological differences, we described the new species *A. dourada* KRATOCHWIL & SCHEUCHL, 2013.

As a consequence of this finding, the status of *A. w. acuta* (Tenerife, La Palma), *A. w. gomerensis* (La Gomera), and *A. w. catula* (Gran Canaria) had to be re-evaluated. In addition to the study of qualitative morphological characteristics, it is useful to combine these features with morphometric data. Besides univariate tests of significance, multivariate morphometric methods (multivariate ratio analysis as a tool set, including principal component analysis, linear discriminant analysis, and allometry ratio spectrum) are successful methods for further taxa differentiation even if there are only a few specimens available or the morphological differences between taxa are very small (BAUR & LEUENBERGER 2011, BAUR et al. 2014). For the differentiation of *A. dourada* and *A. wollastoni* we did not use the morphometric approach until now and will therefore complement the data of KRATOCHWIL & SCHEUCHL (2013).

For the island of Tenerife, I included, in addition to *A. wollastoni acuta* WARNCKE, 1968, *A. lineolata* WARNCKE, 1968, as a further *Micrandrena* species of Tenerife. *A. tiaretta* WARNCKE, 1974, the hypothesised mainland ancestor of the *A. wollastoni* group, has been included in the analyses too (KRATOCHWIL 2014, 2015). In a separate publication, the flower-visiting behaviour of the species of the *A. wollastoni* group will be presented and discussed (KRATOCHWIL & SCHWABE 2020). A molecular genetic analysis of the *A. wollastoni* group is also in preparation.

Historical aspects

(for the abbreviations of the collections see Chapter 2.2)

T. V. Wollaston (1822-1878), an English entomologist and malacologist, or one of his fellow collectors, detected specimens of *Andrena* subgen. *Micrandrena* on the Madeira Archipelago (KRATOCHWIL 2018). Collecting time and localities are unknown. Specimens of the Wollaston collections are deposited in the NHMUK and the OUMNH (KRATOCHWIL 2018). Further specimens were collected by the English clergyman and entomologist A. E. Eaton (1844-1929) in 1902 at Monte, Funchal (Madeira Island). SAUNDERS (1903) characterised all these specimens as *A. minutula* (KIRBY, 1802), but COCKERELL (1922) described these specimens as a species on its own: *A. wollastoni*.

Eaton visited Tenerife in 1904 and collected one male and two females (Cruz de Afur, Anaga, 945-985 m a.s.l., 05.04.1904). SAUNDERS (1904) determined these specimens from

Tenerife as *A. minutula* (KIRBY, 1802). SAUNDERS (1903, 1904) mentioned some distinct morphological differences between Madeirean and Canarian specimens. In the case of the specimens of Madeira he pointed out (SAUNDERS 1903): 'These are I believe referable to *minutula* but belong to the form which has the mesonotum rugulose and with very distant, shallow punctures. We have similarity sculptured specimens in England, but those I possess to the second brood, whereas the males of this collection have the long-haired face of the first brood.' He characterised the specimens of Tenerife as follows (SAUNDERS 1904): 'This is probably a form of *minutula* (*parvula*), with longer black hairs on the head and thorax, and more pronounced rugosities on the abdomen, especially in the male.'

COCKERELL (1922) gave the first description of *A. wollastoni* on the basis of eight specimens collected by Wollaston and Eaton from Madeira Island, as mentioned above. He pointed out a relationship with *A. minutula.* One lectotype and five paralectotypes from the type series were designated by A. Kratochwil and are deposited in the NHMUK (KRATOCHWIL 2018). The whereabouts of the two male syntype specimens of the Eaton collection (SAUNDERS 1903) remain unknown (KRATOCHWIL 2018).

Females and males were differentiated by COCKERELL (1922) only on the basis of some morphological features: 'Female. – Like *Andrena minutula* KIRBY, but area of metathorax dull and granular, with sculptures hardly visible under a lens, mesothorax less punctured; stigma larger and darker. Male. – Recorded by E. Saunders from the Mount, Funchal (Eaton); the specimens are in the British Museum. He remarks that they are apparently *minutula*, a form with the mesonotum rugulose and with very distinct shallow punctures, with the long-haired face characteristic of the first brood.' The description refers only to specimens of the Madeira Archipelago. With high probability, Cockerell never investigated specimens from Canary Islands.

ALFKEN (1940) mentioned four females from Rabaçal, 1080 m a.s.l., 01.07.-04.08.1935 and two females from Caramujo, 1250 m a.s.l., 06.-14.08.1935, collected by Lundblad (Madeira Island). ALFKEN (1940) identified the specimens as *Andrena verticalis* PÉREZ, 1895. In the Bavarian State Collection Munich (ZSM), Germany, a female from this series is deposited (collector's label O. Lundblad, determination label Alfken 1937).

In his preliminary account of the bees of the Canary Islands, LIEFTINCK (1958) mentioned '*Andrena*? *minutula* KIRBY' and cited SAUNDERS (1904): male, female (doubtful record). This checklist is based on the collections of Håkan Lindberg (1898-1966), Zoological Museum, University of Helsinki, and C. O. van Regteren Altena (1907-1976), Rijksmuseum van Natuurlijke Historie, Leiden, proved by R. W. Grünwaldt (about 70 specimens).

WARNCKE (1967) was the first who identified '*Andrena*? *minutula* KIRBY' from the Canary Islands as *A. wollastoni* COCKERELL, 1922. Like LIEFTINCK (1958), he analysed numerous specimens from the collections of Lindberg but also those from Gonzalo Ceballos (1895-1967), College of Forestry of the University of Madrid (WARNCKE 1968). WARNCKE (1968) hypothetically stated the close faunistic relationship between the Madeira Archipelago and the Canary Islands, but only two species with subspecies differentiation in both archipelagos were mentioned: *A. wollastoni* and *A. maderensis* COCKERELL, 1922. Initially, he grouped *A. wollastoni* into three subspecies: *A. w. wollastoni* COCKERELL, 1922, *A. w. acuta* WARNCKE, 1968 (Tenerife, La Palma, La Gomera) and *A. w. catula* WARNCKE, 1968 (Gran Canaria). Based on this differentiation,

BÁEZ & ORTEGA (1978) noted in their preliminary list the two subspecies (*A. w. acuta*, *A. w. catula*) for the Canary Islands.

WARNCKE (1993) described a third subspecies: *A. w. gomerensis* (El Hierro, La Gomera). The occurrence on El Hierro is doubtful; see section '*A. gomerensis*, status'. HOHMANN et al. (1993) adopted the subspecies differentiation of WARNCKE (1968, 1993) and presented a broader database of their distribution (including island-specific grid maps), phenology, and, partly, flower-visiting behaviour.

Material and methods

1. Study area

The study area covers the Madeira Archipelago and the Canary Islands (Fig. 1a). The Madeira Archipelago is differentiated into Madeira Island, Desertas and Porto Santo (Fig. 1b). Tenerife is differentiated into the areas of Anaga, Teno, Las Cañadas/Teide and the Dorsal Rift region (Fig. 1c).

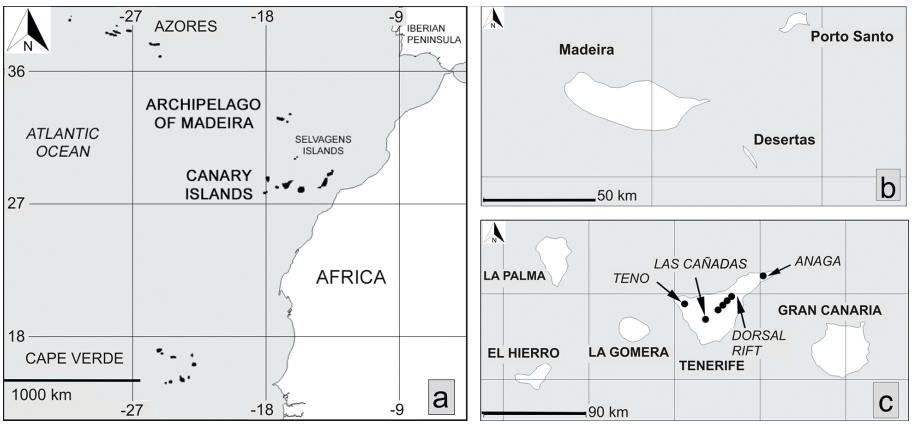


Fig 1: (**a**) Topographical location (with °North and °West of latitude and longitude) of the Azores, the Archipelago of Madeira, the Selvagens Islands, the Canary Islands and Cape Verde. (**b**) Islands of the Madeira Archipelago. (**c**) The Western Canary Islands and four areas of Tenerife (Anaga, Teno, Las Cañadas/Teide and the Dorsal Rift region). Modified according to AGUIAR & KARSHOLT (2006).

2. Material examined

In this study, a total of 435 females and 203 males of the *A. wollastoni* group (including specimens of *A. lineolata* and *A. tiaretta*) were analysed (included are 56 data from KRATOCHWIL & SCHEUCHL 2013 and 22 data from KRATOCHWIL 2015). For morphometric analyses, 304 females and 144 males were available. The analysed specimens are deposited in the following collections (with acronyms of the depository) and individually characterised by an identity code (ID-No):

KR.....collection of the author (n = 372)
UMBB.....Überseemuseum Bremen, Germany (n = 118)

OLML .....Upper Austrian State Museum Linz, Austria (n = 112)
NHMV .....Natural History Museum of Vienna, Austria (n = 8)
MNCN .....Museo Nacional de Ciencias Naturales, Madrid, Spain (n = 8)
NHMUK .....Natural History Museum of London, England (n = 6)
HS .....collection Hans Richard Schwenninger, Stuttgart, Germany (n = 4)
OUMNH .....Oxford University Museum of Natural History, England (n = 3)
SMNS.....Stuttgart State Museum of Natural History, Stuttgart, Germany (n = 1)
USNM.....Smithsonian National Museum of Natural History, Washington D.C., USA (n = 1)
ZSM .....Bavarian State Collection of Zoology, Munich, Germany (n =1)
ZMUH.....Finnish Museum of Natural History, Helsinki, Finland (n = 4).

The following collection has been taken into account, but it was not possible to analyse the specimen:

MCNSC .....Museo Insular de Ciencias Naturales, Santa Cruz, Tenerife, Spain (n = 1).

One problem of Warncke's type material is that he did not indicate in his publications where the type material is deposited. Fortunately, most types were found in the Warncke collection of the OLML. The depositions of some paratypes of the *A. wollastoni* group could not be clarified.

3. Character selection and documentation

Morphological and morphometric features were tested (terms according to MICHENER 2007, TADAUCHI & XU 1995, ARIANA et al. 2009, KRATOCHWIL & SCHEUCHL 2013, KRATOCHWIL et al. 2014, KRATOCHWIL 2015). The specimens of different taxa are characterised by the following information, if available: sex, locality, altitude above sea level, latitude and longitude coordinates, date of collection, collector, and identity number (collection and ID-No).

Qualitative morphology: The following morphological parameters were investigated: structure of vertex surface, eye inner margin, face above antennal fossae, interrugal space, clypeus, labrum process, mesoscutum, scutellum, propodeum; colour of head, flagellum, mandible, thorax, tibia, basitarsus, mediotarsi, tergites; pubescence (mainly colour) of head (clypeus, paraocular area, scapus and antennal socket, genal area, facial fovea), vertex, mesoscutum, scutellum, mesepisternum, propodeal corbiculae, trochanteral and femoral flocculus, tibial scopa, and tergites. Puncture diameter (PD, 100x) and puncture distance (PDI, 100x) are included in the morphological analysis.

The structure of the labrum process can be differentiated into the following types: triangular, trapezoidal, and liguliform types, and intermediate forms (Fig. 2). Several of these types may occur within a taxon; they were calculated as percentages.

Morphometrics: The following characters were chosen (in alphabetical order; in brackets abbreviation and used magnification of measurement): body length (BL, 16.25x): from antennal base to tip of the pygidium; clypeus length (CL, 100x); facial fovea maximal length (FVL, 100x); facial fovea maximal width (FVW, 100x); flagellomeres length 1-3 (FL1-FL3, 100x; measured on ventral surfaces of the flagellomeres when the antenna stretched forward); head length (HL, 40x; from the top of the vertex to the lower margin of the clypeus excluding the process of labrum); head width (HW, 40x); labrum process width (apical process width) at the top (LPW, 100x); mesosomal width (MSW, 40x;

between outer rims of the tegulae); metasomal width (MTW, 40x): maximum width of terga from dorsal view; ocelloccipital distance (OCD, 62.5x); ocellocular distance (OOD, 62.5x); postocular distance (POD, 62.5x); propodeum basal area length (PBAL, 100x); pterostigma length (PSL, 100x); wing length (WL, 16.25x): length of the forewing including the tegula. Furthermore, indices and ratios were calculated (F1:F2:F3, FVL/FVW, HL/HW, OCD:OOD:POD).

The morphological and morphometric studies were carried out with a stereo microscope (Wild M3Z modular stereomicroscope, Heerbrugg, Switzerland, with a 25x eyepiece 16.25x, 40x, 62.5x and 100x). For measurements a micrometer eyepiece of Wild was used.

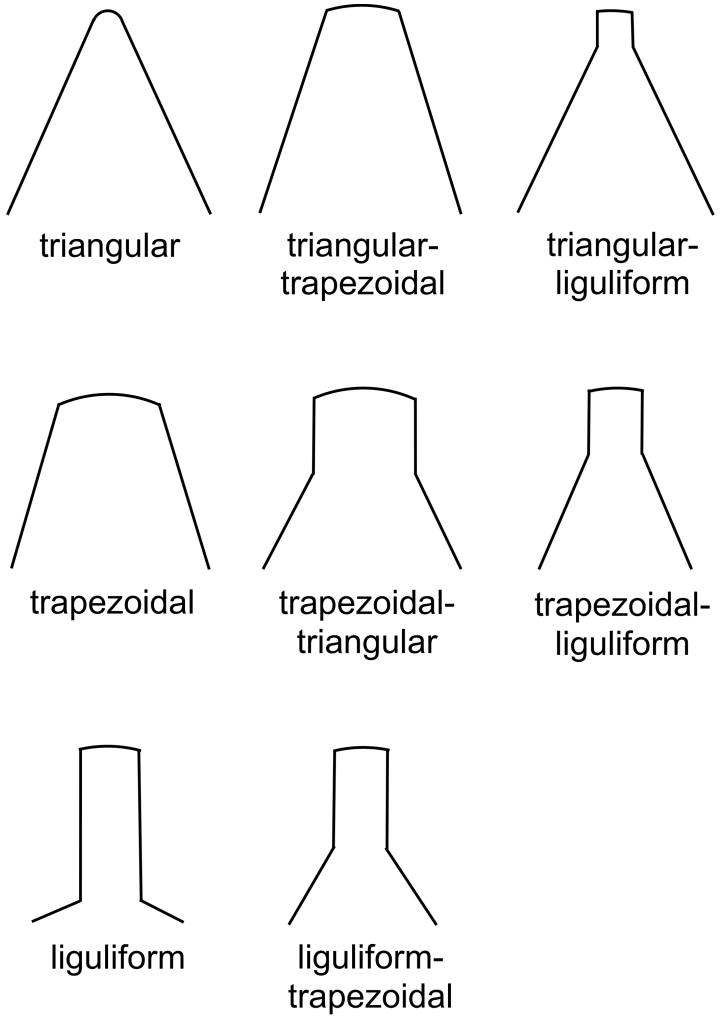


Fig. 2: Labrum process types in the taxa studied.

4. Morphological and morphometric analyses

At the morphological level, 40 morphological parameters were investigated in this study (Table 1).

Morphometric univariate analysis: Differences between taxa were analysed by boxplots (boxplot function; R CORE TEAM 2016, v3.6.0). The bottom and the top of the box are the 25th and the 75th percentile (lower quartile and upper quartile), and the central mark indicates the median (the 50th percentile). The ends of the vertical lines or 'whiskers' indicate the minimum and maximum data values. The outliers are plotted individually with an 'o'. The data were compared with the non-parametric independent two-sample Wilcoxon test to prove statistical significance.

Morphometric multivariate analysis: Before starting the morphometric multivariate analysis, an outlier analysis and a correlation test were conducted. Pearson product-moment correlation coefficients were calculated for all character measurements with the function 'cor ()' in R (R CORE TEAM 2016, v3.6.0) using default settings. The correlation table was ordered according to the increasing number of significant correlations between characters (two-tailed test; $p < 0.10$).

Table 1: Morphological parameters (n = 40) used for the comparative analysis.

antennal socket to fovea area pubescence	paraocular area pubescence
clypeus impunctate line	propodeal corbicula pubescence
clypeus pubescence	propodeum basal lamina length
clypeus puncture diameter	propodeum structure
clypeus puncture distance	pterostigma colour
clypeus puncturing	scapus and antennal socket pubescence
clypeus structure	tergites 2-4 pubescence
clypeus surface	tergites colour
facial fovea pubescence	tergites depression
femoral flocculus pubescence	tergites puncture diameter
flagellum colour	tergites surface
genal area pubescence	tergite 5 pubescence
head vertex pubescence	tergite 6 pubescence
labrum process structure	tibia and basitarsus colour
labrum process type	tibial scopa dorsobasal pubescence
mediotarsi colour	tibial scopa dorsal pubescence
mesepisternum pubescence	tibial scopa ventral pubescence
mesoscutum and scutellum structure	trochanteral flocculus pubescence
mesoscutum pubescence	wing colour
mesosoma puncture diameter	wing vein colour

For morphometric analysis the multivariate ratio analysis (MRA) of BAUR & LEUENBERGER (2011) was applied. MRA offers several tools related to principal component analysis (PCA) and linear discriminant analysis (LDA); see also BAUR et al. (2014) for an application of those tools to some other Hymenoptera taxa. Shape PCA was calculated, and shape PC1 was plotted against shape PC2. Characters with lower correlations were excluded until the scatterplot reached the highest eigenvalue (i.e., the absolute value of variance explained) in the first axis and the clearest compactness of

scatterplots within differentiating groups. Shape PC1 was also plotted against isometric line (the geometric mean of all variables), in order to estimate the amount of allometry in the data. All the results were not influenced by the allometric structure of the specimens. Additionally, the LDA ratio extractor was used to extract the four best ratios of morphometric features. The two best ratios were plotted. The R language was applied for data analysis (R CORE TEAM, 2016, v3.6.0) with slightly modified versions of the R scripts provided by BAUR et al. (2014, 'Supplementary material'). Scatterplots and boxplots were generated with the package 'ggplot2' (WICKHAM 2009). The scatterplots were optimised with EAZYDRAW 9.6.1.

Results

1. The *Andrena wollastoni* group including related species and their diagnostic characteristics

The *A. wollastoni* group and related species include seven species and five subspecies (Table 2). Two species are endemic in the Madeira Archipelago: *A. dourada* KRATOCHWIL & SCHEUCHL, 2013 (Porto Santo), and *A. wollastoni* (Madeira Island). Three species are endemic for the Canary Islands: *A. catula* WARNCKE, 1968 (Gran Canaria), *A. gomerensis* WARNCKE, 1993 (La Gomera: *A. g. gomerensis*; La Palma: *A. g. palmae* nov.ssp.), and *A. acuta* WARNCKE, 1968 (Tenerife Anaga region: *A. a. acuta*; Tenerife Teno region: *A. a. tenoensis* nov.ssp.; and Tenerife Dorsal Rift region: *A. a. wildpreti* nov.ssp.). *A. lineolata* WARNCKE, 1968 (endemic for Tenerife), and the hypothetical mainland ancestor *A. tiaretta* WARNCKE, 1974 (southern Spain, Morocco, Algeria), are closely related to the taxa of the *A. wollastoni* group (KRATOCHWIL & SCHEUCHL 2013), and have been included in the analyses. All these species belong to the subgenus *Micrandrena* ASHMEAD, 1899 (WARNCKE 1974).

Table 2: Species and subspecies of the *A. wollastoni* group including related species and their geographical distribution.

species	subspecies	archipelago	island	area
***wollastoni* group**				
wollastoni		Madeira Archipelago	Madeira	
dourada		Madeira Archipelago	Porto Santo	
acuta		Canary Islands	Tenerife	
acuta	*acuta*	Canary Islands	Tenerife	Anaga
acuta	*tenoensis*	Canary Islands	Tenerife	Teno
acuta	*wildpreti*	Canary Islands	Tenerife	Dorsal Rift
catula		Canary Islands	Gran Canaria	
gomerensis		Canary Islands	La Gomera, La Palma	
gomerensis	*gomerensis*	Canary Islands	La Gomera	
gomerensis	*palmae*	Canary Islands	La Palma	
related species				
lineolata		Canary Islands	Tenerife	Las Cañadas/Teide
tiaretta		continent*		

* southern Spain, Morocco, Algeria, Tunesia

There is no taxon of the *A. wollastoni* group in Fuerteventura, Lanzarote, and La Graciosa, although both islands could have been important as stepping-stone islands. Another *Micrandrena* species that lives there is *A. spreta* PÉREZ, 1895. According to GUSENLEITNER & SCHWARZ (2002), *A. spreta* shows high similarity to *A. tiaretta*. At the moment a comprehensive morphological analysis of *A. spreta* and *A. tiaretta* is lacking.

As mentioned in KRATOCHWIL & SCHEUCHL (2013), the females of the *A. wollastoni* group (including *A. lineolata* and *A. tiaretta*) are characterised by some morphological features similar to those of species of the subgenus *Distandrena* WARNCKE, 1968, which have rugulae (longitudinally grooved structures) in the frons and in the supraclypeal and the paraocular areas (e.g., Fig. 4a), the facial fovea narrows downwards (e.g., Figs. 3d, 4a), and the propodeal triangle has fine structures without obvious laminae (Fig. 4a). More figures of these morphological features are shown in the taxa description. However, all other features show that the specimens of the *A. wollastoni* group belong to the subgenus *Micrandrena*.

The following features characterise the species of the *A. wollastoni* group s.l. (*A. lineolata* and *A. tiaretta* included). In other features there are differences between the taxa of the group (see taxa descriptions). Abbreviations used: PD = puncture diameter, PDI = distance to a nearby puncture, ST = sternite, T = tergite.

F e m a l e : C o l o u r. Head: black integument; mandibles black, distally half reddened (Fig. 4b). Mesosoma: black; wings lightly brownish or brownish toned; pterostigma (dark) yellowish or reddish-brown. Metasoma: T1-T4 black with black to dark reddish-brown depression zone (*A. lineolata* and *A. tiaretta*: reddish-brown depression zone); T5 reddish-brown depression zone.

P u b e s c e n c e. Head: clypeus and supraclypeal area with yellowish-white hairs, no black or brownish hairs intermingled (*A. lineolata* and *A. tiaretta*: white hairs). Mesosoma: mesoscutum and scutellum with yellowish or yellowish-brownish hairs (*A. lineolata* and *A. tiaretta* with white-yellowish hairs); propodeal corbicula, trochanteral flocculus, and femoral flocculus with yellowish-white hairs (*A. lineolata* and *A. tiaretta* with white hairs). Metasoma: tergites scarcely hairy; T2 and T3 (T4) with yellowish-white, fragmentary open hair bands or dense rows of hairs (*A. lineolata* and *A. tiaretta* with white, fragmentary open hair bands); T5 laterally with dense white or yellowish-white hairs, in the centre with reddish-brownish hairs reaching to the pygidium (*A. lineolata* and *A. tiaretta*: yellowish [-reddish] pubescence in the centre, laterally with yellowish-white hairs); T6 with brown to dark brown hairs.

S t r u c t u r e. Head: vertex surface densely granulated; vertex above the ocelli narrow, nearly as half wide as the ocellar diameter; rugulae in the frons and in the supraclypeal area; interrugal area slightly shiny; clypeus convex with exception of *A. lineolata* (strong convex) and *A. tiaretta* (slightly convex); clypeus without impunctate line (*A. lineolata*: impunctate line; *A. tiaretta* and *A. gomerensis palmae* with fragmented or without impunctate line; clypeus surface shagreened (*A. lineolata* more or less shagreened); clypeus PD 28 µm (*A. lineolata*: 14-28 µm, *A. tiaretta*: [14]-28 µm); eye inner margin converging weakly; facial fovea narrowed in the lower part. Mesosoma: mesoscutum and scutellum fine-grained shagreened, shallow and very scattered punctured, especially in the front (*A. lineolata* and *A. tiaretta*: deeper and denser punctured); well developed parapsidal lines; propodeum slightly rugose or rugose, primarily in the basal centre (*A. tiaretta*: in

two-third of the area) and in the dorsolateral area, short basal lamina (ribbed), no lateral boundary line; mesepisternum with a shiny microsculpture. Metasoma: tergites hammerblow-like shagreened and shiny (*A. lineolata* and *A. tiaretta*: rough hammerblow-like shagreened); T1 no or only with a slight posterior depression, T2-T4 with deep depression; (T1) T2-T4; (T1) T2-T4 shallow and very scattered, and not clearly punctured; tergite PD 14 µm (*A. tiaretta* and *A. wollastoni*: 14-28 µm).

M a l e : In contrast to all other species in the subgenus *Micrandrena*, the males of the *A. wollastoni* group (including *A. lineolata* and *A. tiaretta*) have a sharp pointed penis valvae.

C o l o u r . Head: black integument. Mesosoma: thorax black; wings lightly brownish toned (*A. lineolata* and *A. tiaretta*: light toned). Metasoma: T1-T5 black with black, dark brown or reddish-brown depression zone; T6 reddish-brown.

P u b e s c e n c e . Head: clypeus, supraclypeal and paraocular area with yellowish-white or white-yellowish hairs (*A. lineolata* and *A. tiaretta* with white hairs). Mesosoma: yellowish or yellowish-brownish hairs (*A. catula*, *A. dourada*, *A. tiaretta* with white-yellowish hairs, *A. lineolata* with white hairs). Metasoma: base of T1 with some yellowish-white or white-yellowish hairs and scarcely hairy in the centre; T2-T4 depression laterally with yellowish-white or white-yellowish fragmented open hair bands or rows of hairs (*A. lineolata* and *A. tiaretta* with white hairs); T5, T6 with yellowish or yellowish-reddish hairs (*A. tiaretta* with white hairs); ST8 with yellowish or with white-yellowish hairs.

S t r u c t u r e . Head: vertex surface densely granulated; eye inner margin converging weakly; longitudinal rugulae in the frons and in the supraclypeal area; interrugal area slightly shiny; clypeus convex with exception of *A. lineolata* (strong convex) and *A. tiaretta* (slightly convex); clypeus without impunctate line; clypeus surface slightly shagreened, shiny, clearly shagreened at the base and slightly dull (*A. lineolata*: more or less shagreened); eye inner margin converging weakly; labrum process trapezoidal, ends left and right side thickened. Mesosoma: mesoscutum and scutellum fine-grained shagreened, shallow and very scattered punctured especially in the front (*A. lineolata* and *A. tiaretta*: deeper and denser punctured); well developed parapsidal lines; propodeum rugose, primarily in the basal centre (*A. tiaretta*: in the whole area) and in the dorsolateral area; propodeum with short basal lamina (ribbed), laterally no boundary line. Metasoma: tergites hammerblow-like shagreened and shiny; T1 not or only slightly stepped, T2-T4 with deep depression; (T1) T2-T4 shallow and very scattered and not clearly punctured (PD: 14 µm); T1 carinate.

2. Taxa description based on qualitative features: status, former descriptions, and up-to-date diagnosis

Andrena (*Micrandrena*) *acuta* WARNCKE, 1968

Syn. *Andrena wollastoni acuta* WARNCKE, 1968

S t a t u s : WARNCKE (1968) described *A. w. acuta* as endemic to Tenerife, La Gomera, and La Palma. He defined 29 types (holotype, paratypes) of *A. w. acuta* (Tenerife: 6♂♂, 19♀♀; La Palma: 2♂♂ males; La Gomera: 2♂♂). This is in accordance with BLANK & KRAUS (1994) in their catalogue of all taxa of bees described by Warncke. Later, Warncke designated the specimens found on La Gomera to a subspecies on its own (*A. w. gomerensis* WARNCKE, 1993). The distribution of *A. w. acuta* is restricted to Tenerife and La Palma (according to WARNCKE 1993).

In the OLML the holotype and nine paratypes (7♀♀, 3♂♂), in the MNCN seven paratypes (7♀♀, also mentioned by IZQUIERRO & MARTÍN 2010), and in the ZSM one paratype (1♂) are deposited (for information on the specimens, see taxa description of *A. a. acuta*). All these types could be analysed in the OLML, MNCN, and ZMS. These specimens are all provided with a determination label from Warncke.

The deposition of eleven paratypes (5♀♀, 6♂♂) could not be verified. These following specimens are not in the OLML, the MNCN or the ZMS: 1♀ Costa de Santa Cruz, 02.04.1899, collector unknown; 1♀ Bajamar, 12.03.1903, collector unknown; 1♀ El Chorrillo, 20.03.1903, collector unknown; 1♀ Bajamar, 16.05.1904, collector unknown; 1♀ Granadilla, 26.02.1950, leg. Lindberg; 1♂ Tenerife, Valle de Jiménez, 02.02.1899, collector unknown; 1♂ Laguna, 03.05.1921, collector unknown (collection Cabrera). With one exception (locality Granadilla), these specimens have been exclusively detected in the Anaga region. Further five specimens (no paratypes) were found in the OLML (three of them originated from the UMBB). The location of the following four paratypes designated by Warncke is also unknown: 2♂♂ previously dedicated by WARNCKE (1968) as paratypes of *A. w. acuta* for La Gomera (1♂ Isla de la Palma, 1907, leg. Santos; 1♂ supra El Paso, 600 m, 04.04.1950, leg. Lindberg), and 2♂♂ previously dedicated by WARNCKE (1968) as paratypes of *A. w. acuta* for La Gomera (El Cedro, ca. 1000 m, 23.03.1950, leg. Lindberg).

The former *A. w. acuta* WARNCKE, 1968, is now *A. acuta* WARNCKE, 1968. *A. acuta* WARNCKE, 1968, becomes the nominal taxon *A. a. acuta* WARNCKE, 1968. 13♀♀ and 3♂♂ of the type series of WARNCKE (1968) correspond to the newly designated *A. a. acuta* WARNCKE, 1968. 1♀ and 1♂ of the type series of WARNCKE (1968) will be assigned to *A. a. wildpreti* nov.ssp. (see the characterisation of the subspecies).

Former descriptions: WARNCKE (1993) characterised *A. w. acuta* as follows (translated from German): 'Differences to the nominal taxon: labrum process narrower, triangular and acuminate instead of trapezoidal. Puncturing of the thorax lightly stronger. Abdomen much more shagreened and therefore dull. First tergite laterally slightly carinate (similar to *A. strohmella* STÖCKH.). Wing veins brighter.' This characterisation was adopted by GUSENLEITNER & SCHWARZ (2002).

Diagnostic qualitative features: In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. acuta* is characterised by the following specific features:

Female: Colour. Head: flagellum black (67%) or dark brown (33%) (Figs. 3a, c, d). Mesosoma: femur, tibia, and basitarsus black or dark brown; mediotarsi reddish-brown (Fig. 4e); wings brownish toned (Fig. 3a), veins reddish-brown; pterostigma dark yellowish or reddish-brown. Metasoma: T1-4 black with black to dark reddish-brown depression zone (Fig. 3f); T5 depression zone reddish-brown.

Pubescence. Head: clypeus and supraclypeal area with yellowish-white not dense hairs (Fig. 3c); paraocular area with yellowish-white hairs and many brownish (black) hairs between subantennal socket and facial fovea; scapus and antennal socket, dorsally with longer brownish hairs, ventrally with shorter yellowish hairs; genal area with yellowish-white hairs; facial fovea in the upper part with brownish hairs, in the lower part with yellowish hairs (Figs. 3d, 4a); vertex behind the ocelli with longer yellowish-white and

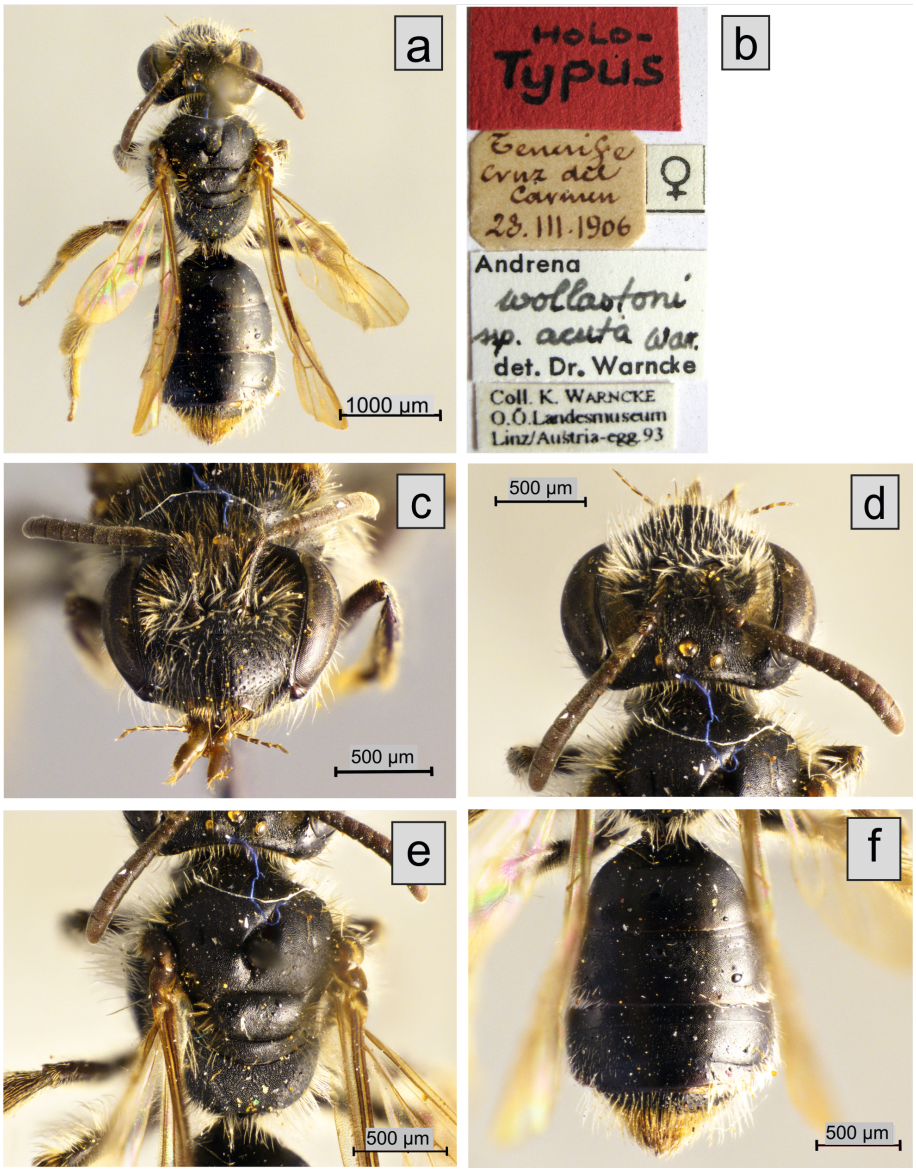


Fig. 3: Type specimen (holotype, female) of *Andrena acuta acuta* WARNCKE, 1968 (OLML Nr. 6952775; ZOBODAT 05.02.2020; biogeographical data set). (**a**) habitus dorsal. (**b**) type label. (**c**) head frontal. (**d**) head dorsal. (**e**) mesosoma. (**f**) metasoma.

brownish hairs (Fig. 3d). Mesosoma: mesoscutum and scutellum with yellowish-brownish hairs, in some cases laterally with some yellowish hairs (Fig. 3e); mesepisternum with yellowish-white hairs; propodeal corbicula with yellowish-white hairs and with some hairs in the centre (rarely white hairs); trochanteral and femoral flocculus well developed with yellowish-white hairs; tibial scopa dorsal with slightly brownish hairs, dorsobasally with reddish-brown hairs, ventrally with yellowish-white hairs (Fig. 4e). Metasoma: tergites scarcely hairy; T2 and T3 (T4) laterally with yellowish-white, fragmentary open hair bands or with dense rows of hairs; T4 with row of hairs between the tergite and the tergite depression, but T2-T4 with fragmentary row of hairs between the tergite and the tergite depression (Fig. 3a); T5 laterally with dense white or yellowish-white hairs, in the centre with reddish-brownish hairs, reaching to the pygidium (Fig. 3f); T6 with dark brown to brown hairs.

Structure. Head: clypeus convex without impunctate line, clearly shagreened, slightly dull, shallow more or less densely punctured (PD: 28 µm, PDI: 14-56 µm) (Fig. 4b); labrum process triangular-trapezoidal, triangular or liguliform, slightly rounded on the top, laterally more or less oblique. Mesosoma: scattered punctured with very shallow punctures, especially in the front (PD: 14-28 µm) (Fig. 4c); propodeum rugose, primarily in the basal centre and in the dorsolateral area, other area fine-grained shagreened (Fig. 4d).

Metasoma: tergites hammertone-like shagreened and shiny (Fig. 4f); T1 with no depression zone or only with a slight depression zone; T2-T4 with deep depression zones, shallow and very scattered but not clearly punctured (PD: 14 µm).

Male: similar to female with following differences: Colour. Head: distal half of the mandible not or slightly reddened; flagellum (light) brown (Fig. 5c, d). Mesosoma: wings lightly brownish toned (Fig. 5a); pterostigma yellowish in the centre, reddish-brown marginated.

Pubescence. Head: clypeus with yellowish-white and with darker hairs at the base (Figs. 5d, 6a); genal area upper part with long brownish hairs (Fig. 5d), lower part with long white-yellowish hairs. Mesosoma: mesepisternum with long yellowish-white hairs. Metasoma: base of T1 with some white-yellowish hairs, scarcely hairy in the centre, T2-T4 depression zones laterally with yellowish-white very fragmented hair bands or dense rows of hairs; T5, T6 with yellowish or with yellowish-reddish hairs (Fig. 5f); ST 8 with long yellowish hairs at the end.

Structure. Head: vertex above the ocelli narrow, as wide as the ocellar diameter; clypeus in the front deeper, in the centre, the base, and (partly) laterally shallow, and not densely punctured (PD: 28 µm, PDI: 14-28 µm) (Fig. 6b); labrum process trapezoidal, emarginated, ends left and right side slightly thickened. Mesosoma: very scattered punctured (PD: 14 µm); Metasoma: T1 carinate; tergites very scattered punctured (PD: 14 µm).

Subspecies differentiation: *A. acuta* can be differentiated into three subspecies with limited distribution to Tenerife: *A. a. acuta* WARNCKE, 1968 (Anaga region), *A. a. tenoensis* nov.ssp. (Teno region), and *A. a. wildpreti* nov.ssp. (Dorsal Rift region). Morphological differences exist in the labrum structure and the colouration of the flagellum as well as in morphometric parameters.

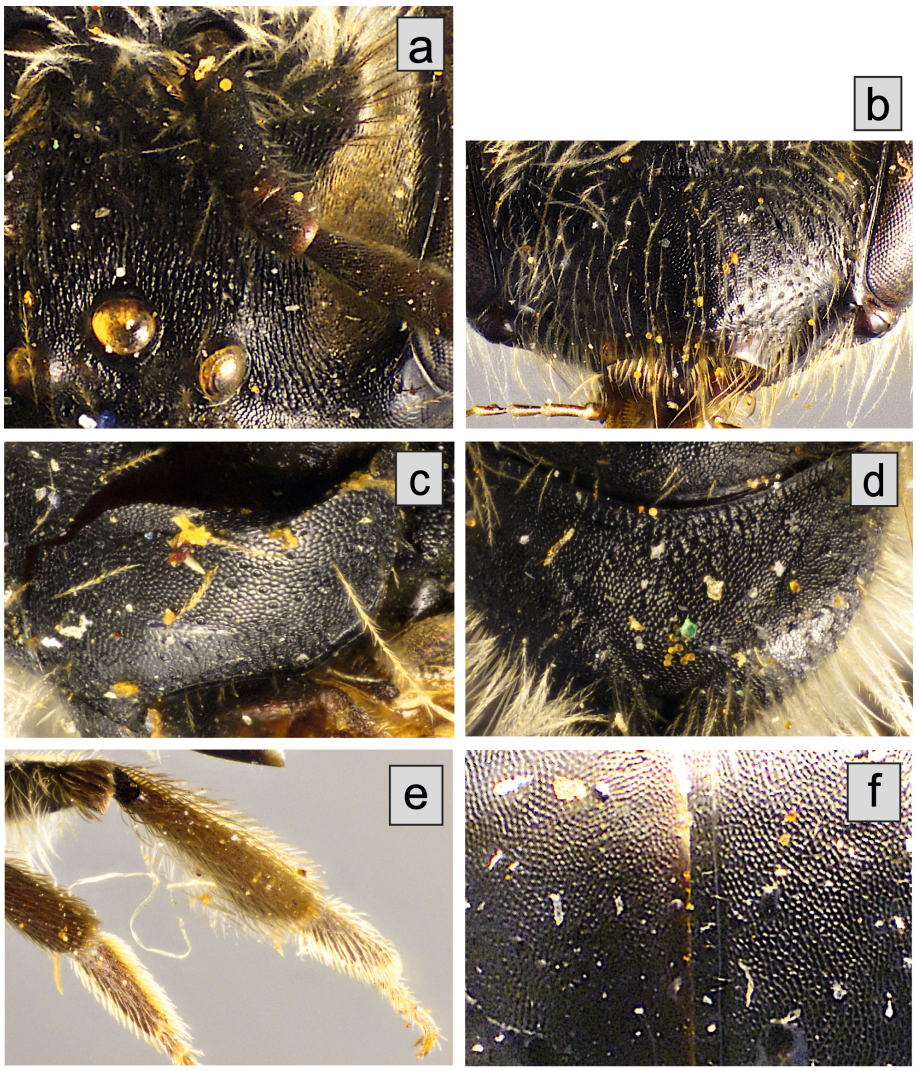


Fig. 4: Type specimen (holotype) of *Andrena acuta acuta* WARNCKE, 1968 (OLML Nr. 6952775; ZOBODAT, 05.02.2020); biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) scutum. (**d**) propodeum. (**e**) scopa. (**f**) metasoma.

Andrena (*Micrandrena*) *acuta acuta* WARNCKE, 1968

Syn. *Andrena wollastoni acuta* WARNCKE, 1968 p.p.

H o l o t y p e : 1♀ Tenerife, Cruz del Carmen, 950 m, 23.03.1906, collector unknown (ID-No OLML44, holotype of *A. w. acuta*).

P a r a t y p e s (paratypes of *A. w. acuta*): 1♀ Tenerife, Barranco Tahodio, 90 m, 31.03.1920, collector unknown (ID-No OLML45); 1♀ Tenerife, Las Montañas, 07.05.1900, collector unknown

(ID-No OLML46); 1♀ Bajamar, 35 m, 27.03.1905 (ID-No OLML49); 1♀ Tenerife, Tahodio, 80 m, 27.03.1927, collector unknown (ID-No OLML50); 1♀ Tenerife, Cruz del Carmen, 950 m, 23.03.1906, collector unknown (ID-No OLML51); 1♀ Tenerife, Montaña de Guerra, 09.07.1928, collector unknown (MNCN); 3♀♀ Tenerife, Tahodio, 21.03.1927, collector unknown (MNCN); 3♀♀ Tenerife, Tahodio, 27.03.1927, collector unknown (MNCN); 1♂ Tenerife, Tahodio, 90 m, 13.03.1927, collector unknown (ID-No OLML52); 1♂ Tenerife, Montaña de Guerra, 400 m, 10.02.1902, collector unknown (ID-No OLML53); 1♂ Tenerife; Monte de las Mercedes, 02.03.1952, leg. J.M. Fernandez (ZMS).

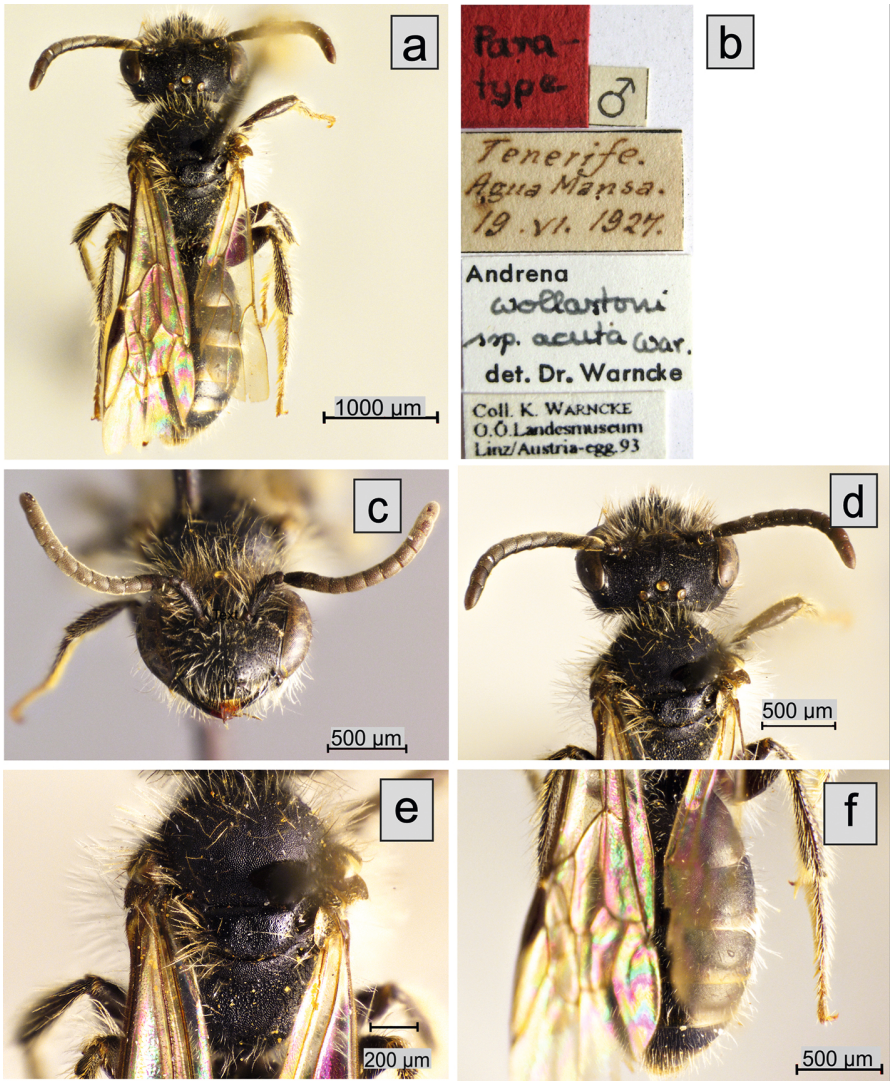


Fig. 5: Type specimen (paratype, male) of *Andrena acuta wildpreti* nov.ssp. (OLML Nr. 6952775; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus dorsal. (**b**) type label. (**c**) head frontal. (**d**) head dorsal. (**e**) mesosoma. (**f**) metasoma.

Diagnostic qualitative features: In addition to the morphological characteristics that are typical for *A. acuta*, *A. a. acuta* is characterised by the following specific features:

Female: Labrum process triangular-trapezoidal (75%), triangular (17%), and liguliform (8 %) similar to *A. a. wildpreti* nov.ssp. (all specimens triangular-trapezoidal) but different from *A. a. tenoensis* nov.ssp. (triangular-liguliform, 85%; triangular-trapezoidal, 15%). Colour of the flagellum black (67%) or dark brown (33%) similar to *A. a. tenoensis* nov.ssp. (black/dark brown) but different from *A. a. wildpreti* nov.ssp. (dark brown, to the end of the flagellum light brown).

Male: Colour of the flagellum (light) brown similar to *A. a. wildpreti* nov.ssp. but different from *A. a. tenoensis* nov.ssp. (brown).

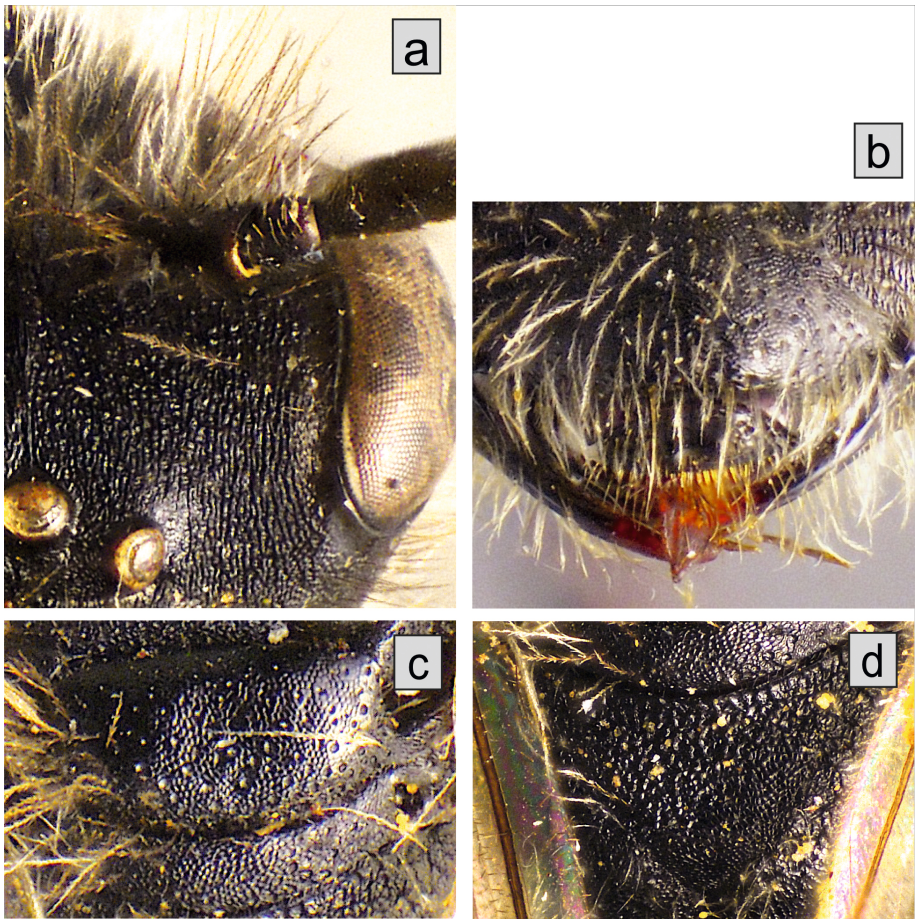


Fig. 6: Type specimen (paratype, male) of *Andrena acuta wildpreti* nov.ssp. (OLML Nr. 6952775; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) scutellum. (**d**) propodeum.

D i s t r i b u t i o n : The distribution of the nominal species is limited to the Anaga region of Tenerife (Fig. 1c). This subspecies covers altitudes mainly from 100 up to 900 m a.s.l.

F l i g h t p e r i o d : from January to May.

F u r t h e r s p e c i m e n s e x a m i n e d : 1♀ Tenerife, Bailadero, 700 m, 09.04.1984, leg. Hohmann (ID-No UMBB1); 2♀♀ Tenerife, Asomada, 800 m, 10.09.1983, leg. Hohmann (ID-No UMBB3, UMBB6); 1♀ Tenerife, San Andrés, 20 m, 30.03.1983, leg. Hohmann (ID-No UMBB5); 2♀♀ Tenerife, Bailadero, 700 m, 24.03.1982 (ID-No UMBB7, UMBB8); 2♀♀ Tenerife, 2 km north of San Andrés, 206 m, 28°31'33.4"N, 16°11'41.1"W, 18.04.2016, leg. Kratochwil (ID-No KR-AN6, KR-AN7); 2♀♀: Tenerife, Bailadero, 680 m, 28°33'00.1"N, 16°12'19.1"W, 22.04.2016, leg. Kratochwil (ID-No KR-AN19, KR-AN20).

Andrena (*Micrandrena*) *acuta tenoensis* nov.ssp.

Syn. *Andrena wollastoni acuta* WARNCKE, 1968 p.p.

H o l o t y p e : 1♀ Tenerife, Santiago del Teide, 900 m, 26.03.1984, leg. Hohmann (ID-No UMBB2)

P a r a t y p e s : 1♀ Tenerife, Erjos, 1000 m, 10.04.1983, leg. Hohmann (ID-No UMBB4); 1♀ El Palmar, 500 m, 20.03.1987, leg. Schwenninger (ID-No HS3); 1♀ Masca, 625 m, 18.04.1992, leg. Kratochwil (ID-No KR-TN77); 1♀ Tenerife, Mirador de La Cruz de Hilda, 780 m, 28°18'51.0"N, 16°50'46.6"W, 21.04.2016, leg. Kratochwil (ID-No KR-TN76); 1♀ Tenerife, north of Santiago del Teide, 1015 m, 28°18'28.6"N, 016°48'41.2"W, 25.05.2019, leg. Kratochwil (ID-No KR-TN4); 2♀♀ Tenerife, south of Erjos, 1090 m, 28°18'45.5"N, 016°48'24.6"W, 25.05.2019, leg. Kratochwil (ID-No KR-TN6, KR-TN7); 1♀ Tenerife, south of Erjos, 1117 m, 28°18'48.9"N, 016°48'22.9"W, 25.05.2019, leg. Kratochwil (ID-No KR-TN8); 3♀♀ Tenerife, San José de Los Llanos, 1081 m, 28°19'03.9"N, 016°48'18.3"W, 25.05.2019, leg. Kratochwil (ID-No KR-TN9-TN11).

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for *A. acuta*, *A. a. tenoensis* nov.ssp. is characterised by the following specific features:

F e m a l e : Labrum process triangular-liguliform (85%) and triangular-trapezoidal (15%), different from *A. a. acuta* and *A. a. wildpreti* nov.ssp. (triangular-trapezoidal). Colour of the flagellum black (dark brown) similar to *A. a. acuta* but different from *A. a. wildpreti* nov.ssp. (dark brown, to the end light brown).

M a l e : Colour of the flagellum brown, different from *A. a. acuta* and *A. a. wildpreti* nov.ssp.

D i s t r i b u t i o n : The distribution of this subspecies is limited to the Teno region of Tenerife (Fig. 1c). *A. a. tenoensis* nov.ssp. occurs very locally but in higher individual numbers compared to *A. a. acuta*. This subspecies covers altitudes from 100 up to 1100 m a.s.l.

F l i g h t p e r i o d : mainly from March to May.

E t y m o l o g y : The specific name of the subspecies derives from the type locality ‘Teno’.

F u r t h e r s p e c i m e n s e x a m i n e d : 1♀ Tenerife, Erjos, 1014 m, 28°19'32.6"N, 16°48'29.3"W, 17.04.2016, leg. Kratochwil (ID-No KR-TE1); 2♀♀ Tenerife, Erjos, 1014 m, 28°19'32.6"N, 16°48'29.3"W, 17.04.2016, leg. Kratochwil (ID-No KR-TE2, KR-TE3); 1♀ Tenerife, Erjos, 1014 m, 28°19'32.6"N, 16°48'29.3"W, 17.04.2016, leg. Kratochwil (ID-No KR-TE4); 1♀ Tenerife, Erjos, 987 m, 28°19'44.9"N, 16°48'20.4"W, 17.04.2016, leg. Kratochwil (ID-No KR-TE5); 11♀♀ Tenerife, Mirador de La Cruz de Hilda, 780 m, 28°18'51.0"N, 16°50'46.6"W, 21.04.2016, leg. Kratochwil (ID-No KR-TE8-TE18); 1♀ Tenerife, Mirador de La Cruz de Hilda, 780 m, 28°18'51.0"N, 16°50'46.6"W, 21.04.2016, leg. Kratochwil (ID-No KR-TE71); 1♂ Tenerife, Santiago

del Teide, 900 m, 26.03.1984, leg. Hohmann (ID-No UMBB12); 2♂♂ Tenerife, Santiago del Teide, 900 m, 20.02.1984, leg. Hohmann (ID-No UMBB13, OLML78); 1♂ Tenerife, Erjos, 1000 m, 10.04.1983, leg. Hohmann (ID-No UMBB14); 2♂♂ Tenerife, Santiago del Teide, 900 m, 20.03.1984, leg. Hohmann (ID-No OLML79, OLML80); 4♂♂ Tenerife, Los Silos, Barranco de Cuevas Negras, 150-600 m, 16.04.1989, leg. B. Moser, M. Schwarz (ID-No OLML146, OLML148-150).

Andrena (*Micrandrena*) *acuta wildpreti* nov.ssp.

Syn. *Andrena wollastoni acuta* WARNCKE, 1968 p.p.

H o l o t y p e : 1♀ Tenerife, Mirador de la Crucita, 1990 m, 28°20'41.6"N, 16°28'56.0"W, 20.05.2019, leg. Kratochwil (ID-No KR-DR19).

P a r a t y p e s : 1♀ Tenerife, Aguamansa, 1000 m, 19.06.1927, collector unknown (ID-No OLML48, fomer paratype of *A. wollastoni acuta*), 1♀ Tenerife, Mirador de la Crucita, 1990 m, 28°20'41.6"N, 16°28'56.0"W, 20.05.2019, leg. Kratochwil (ID-No KR-DR20); 1♀ Tenerife, Mirador de la Crucita, 1990 m, 28°20'41.6"N, 16°28'56.0"W, 21.05.2019, leg. Kratochwil (ID-No KR-DR22a); 1♀ Tenerife, Mirador de la Crucita, 1990 m, 28°20'41.6"N, 16°28'56.0"W, 22.05.2019, leg. Kratochwil (ID-No KR-DR34); 6♀♀ Tenerife, Montaña Ayosa, 1955 m, 28°21'47.1"N, 16°27'55.5"W, 22.05.2019, leg. Kratochwil (ID-No KR-DR38-DR43); 2♀♀ Tenerife, Montaña Ayosa, 1980 m, 28°21'22.5"N, 16°28'04.9"W, 22.05.2019, leg. Kratochwil (ID-No KR-DR45-DR46); 5♀♀ Tenerife, Montaña Ayosa, 1955 m, 28°21'46.5"N, 16°27'55.2"W, 25.05.2019, leg. Kratochwil (ID-No KR-DR1-DR5); 1♀ Tenerife, east of Mirador Montaña de Limón, 1718 m, 28°23'34.4"N, 16°26'11.1"W, 26.05.2019, leg. Kratochwil (ID-No KR-DR22); 1♂ Tenerife, Aguamansa, 1000 m, 19.06.1927, collector unknown (ID-No OLML47, fomer paratype of *A. wollastoni acuta*), 2♂♂ Tenerife, Lomo Pelado, 1007 m, 28°26'04.2"N, 16°22'26.8"W, 23.04.2016, leg. Kratochwil (ID-No KR-DR78-DR79); 5♂♂ Tenerife, Mirador de la Crucita, 1990 m, 28°20'39.7"N, 16°28'57.7"W, 23.04.2016, leg. Kratochwil (ID-No KR-DR80-DR84).

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for *A. acuta*, *A. a. wildpreti* nov.ssp. is characterised by the following specific features:

F e m a l e : Labrum process triangular-trapezoidal, similar to *A. a. acuta* but different from *A. a. tenoensis* nov.ssp. (triangular-liguliform, 85%; triangular-trapezoidal, 15%). Colour of the flagellum dark brown, to the end light brown in contrast to *A. a. acuta* and *A. a. tenoensis*.

M a l e : Colour of the flagellum light brown similar to *A. a. acuta* but different from *A. a. tenoensis* nov.ssp. (brown).

D i s t r i b u t i o n : The distribution of *A. a. wildpreti* nov.ssp. is limited to the Dorsal Rift region of Tenerife (Fig. 1c). This subspecies covers altitudes from 1000 up to 2000 m a.s.l.

F l i g h t p e r i o d : mainly from April to May (June).

E t y m o l o g y : This subspecies is nominated to Wolfredo Wildpret de la Torre, Professor em. of Botany at the University of La Laguna, Tenerife. His scientific work focusses on the study of the flora and vegetation of the Canarian archipelago and he has also great merits for the protection of nature on the Canary Islands.

F u r t h e r s p e c i m e n s e x a m i n e d : 2♀♀ Tenerife, Mirador de la Crucita, 1990 m, 28°20'42.3"N, 16°28'55.0"W, 23.04.2016, leg. Kratochwil (ID-No KR-DR21, KR-DR26); 5♀♀ Tenerife, Mirador de Montaña Grande, 1160 m, 28°25'42.5"N, 16°22'46.8"W, 23.04.2016, leg. Kratochwil (ID-No KR-DR22c, KR-DR25, KR-DR27-29); 2♀♀ Tenerife, Lomo Pelado, 1007 m, 28°26'04.2"N, 16°22'26.8"W, 23.04.2016, leg. Kratochwil (ID-No KR-DR23-DR24); 3♀♀

Tenerife, Mirador de la Crucita, 1990 m, 28°20'39.7"N, 16°28'57.7"W, 23.04.2016, leg. Kratochwil (ID-No KR-DR53-DR55); 7♂♂ Tenerife, Arafo, Rosco de la Esperanza, 1500 m, 10.04.1989, leg. B. Moser, M. Schwarz (ID-No OLML140-145, OLML147), 1♂ Tenerife, Mirador de la Crucita, 1990 m, 28°20'41.6"N, 16°28'56.0"W, 20.05.2019, leg. Kratochwil (ID-No KR-DR19).

Andrena (*Micrandrena*) *catula* WARNCKE, 1968

Syn. *Andrena wollastoni catula* WARNCKE, 1968

H o l o t y p e : 1♀ Gran Canaria, Lagunova, 20.03.1928, collector unknown (ID-No OLML26, former holotype of *A. w. catula*).

P a r a t y p e s (fomer paratypes of *A. w. catula* with the exception of OLML32): 1♀ Gran Canaria, Azuaje, 200 m, 05.05.1934, collector unknown (ID-No OLML27); 1♀ Gran Canaria, Lagunova, 20(?).03.28, collector unknown (ID-No OLML28); 1♀ Gran Canaria, Santa Brígida, 500 m, 15.04.1976, leg. Wolf (ID-No OLML32); 1♂ Gran Canaria, Valle de Tejeda, 1050 m, 28.-29.03.1949, leg. Lindberg (ID-No OLML31); 1♂ Gran Canaria, Gando, 20 m, 23.02.1935, collector unknown (ID-No OLML36).

S t a t u s : WARNCKE (1968) described *A. w. catula* as endemic to Gran Canaria based on nine specimens (holotype: 1♀; paratypes: 5♀♀, 3♂♂). This is in accordance with the information of BLANK & KRAUS (1994). In the OLML, the holotype and four paratypes (2♀♀, 2♂♂) are deposited. The deposition of four paratypes (3♀♀, 1♂) is unknown. The specimens concerned are as follows: 1♀ La Aldea de San Nicolás, 01.03.1949, leg. Lindberg; 1♀ Arucas, 02.03.1949, leg. Lindberg; 1♀ San Bartholomé de Tirajana, 14.03.1950, leg. Lindberg; 1♂ Cruz de Tejeda, 1450 m, 06.-08., 11.-13.03.1950, leg. Lindberg.

A further 17 specimens of *A. catula* were detected in the Warncke collection (OLML). In 1970, 1973, and 1976, WOLF (1980) collected *A. catula* on Gran Canaria (12♀♀, 3♂♂, Maspalomas, 975 m a.s.l., field fringe and Monte-Alto vegetation, 02.04.1970, 13.04.1973). These specimens are all provided with a determination label from Warncke (*A. w. catula*).

The holotype and paratypes of *A. w. catula* were examined in the OLML. The holotype (1♀) and four paratypes (2♀♀, 2♂♂) (WARNCKE 1968) are designated as *A. catula* supplemented by a female collected by Wolf (ID-No OLML32).

F o r m e r d e s c r i p t i o n : WARNCKE (1968) characterised *A. w. catula* as follows (translated from German): 'Differences compared to the nominal taxon: labrum process broader, triangular and flat-topped; clypeus fine punctured and shagreened; scutellum shining; abdomen slightly shagreened and shining, especially on the first tergite; stigma black.' This characterisation was adopted by GUSENLEITNER & SCHWARZ (2002).

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. catula* is characterised by the following specific features:

F e m a l e : C o l o u r . Head: flagellum black (brown) (72%), black (dark brown) (22%) or black (light brown) (6%) (Figs. 7c, d). Mesosoma: femur, tibia, and basitarsus black or dark brown; mediotarsi reddish-brown (Fig. 7a); wings light brownish toned, veins yellowish to reddish-brown (Fig. 7a); pterostigma yellowish and brown marginated (not black as indicated by WARNCKE 1968). Metasoma: T1-4 black with black to dark reddish-brown depression zone (Fig. 7g); T5 with depression zone reddish-brown (Fig. 8e).

Pubescence. Head: clypeus and supraclypeal area with white-yellowish hairs (Figs. 7c, 8a); paraocular area without (71%) or with some brownish hairs (29%) between subantennal socket and the facial fovea; scapus and antennal socket with dorsal longer and ventral shorter white-yellowish hairs; genal area with white hairs (Fig. 7c); facial fovea in the upper part with brownish hairs (Fig. 7d), in the lower part with white-yellowish hairs; vertex behind the ocelli with some longer white-yellowish hairs (Fig. 7c, d). Mesosoma: mesoscutum and scutellum with-yellowish hairs, laterally with longer hairs; mesepisternum with white-yellowish hairs; propodeal corbicula with yellowish-white hairs (Fig. 7e), and some hairs in the centre; trochanteral and femoral flocculus with yellowish

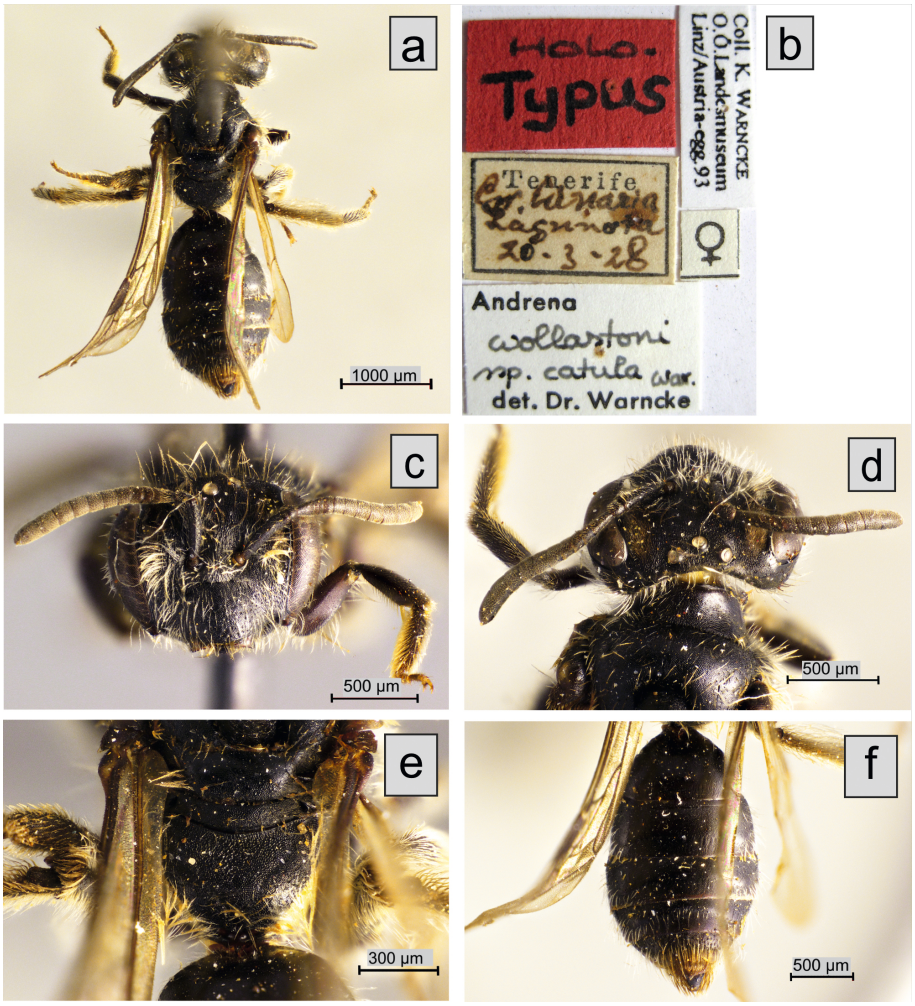


Fig. 7: Type specimen (holotype, female) of *Andrena catula* WARNCKE, 1968 (OLML Nr. 6952777; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view. (**d**) head, dorsal view. (**e**) mesosoma. (**f**) metasoma.

-white hairs; tibial scopa dorsally with yellowish-white hairs, dorsobasally with reddish-brown hairs, ventral with yellowish-white hairs (Fig. 8d). Metasoma: tergites scarcely hairy; T2 and T3 (T4) with lateral white-yellowish, fragmentary open hair bands (dense row of hairs); T4 with row of hairs between the tergite and the tergite depression but T2-T4 with fragmentary rows of hairs between the tergite and the tergite depression; T5 laterally with dense white or white-yellowish hairs, in the centre reddish-brownish hairs, reaching to the pygidium; T6 with (reddish) brown hairs (Fig. 8e).

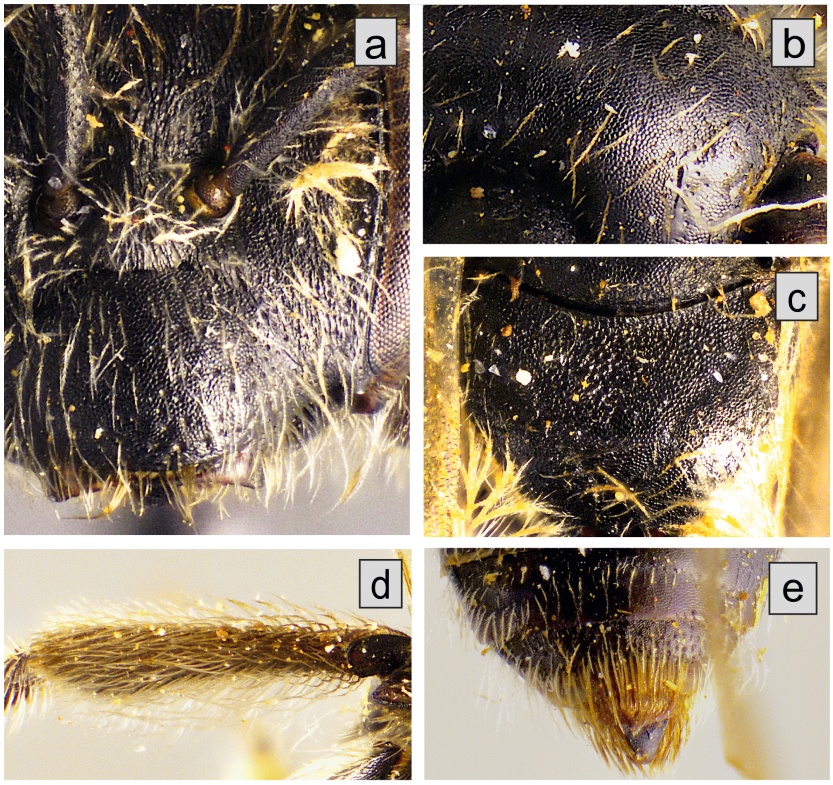


Fig. 8: Type specimen (holotype, female) of *Andrena catula* WARNCKE, 1968 (OLML Nr. 6952777; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) notum. (**c**) scopa. (**d**) T5 and T6.

Structure. Head: clypeus convex without impunctate line, clearly shagreened, slightly dull, shallow more or less densely punctured (PD: 28 µm, PDI: 14-70 [84] µm) (Fig. 8a); labrum process liguliform (74%), or liguliform-trapezoidal (26%), slightly rounded on the top, partly thickened, laterally on the the top more or less parallel. Mesosoma: scattered punctured with very shallow punctures especially in the front (PD: 14 µm) (Fig. 8b); propodeum (slightly) rugose, primarily in the basal centre and in the dorsolateral area (Fig. 8c). Metasoma: tergites hammertone-like shagreened and shiny; T1 no depression zone or only with a slight depression zone; T2-T4 with deep depression zones, shallow and very scattered but not clearly punctured (PD: 14 µm).

M a l e : similar to female with following differences: Colour. Head: distal half of the mandible not reddened; flagellum brown (86%) or light brown (14%) (Figs. 9c, d). Mesosoma: femur, tibia, and basitarsus brown; mediotarsi reddish; wings lightly brownish toned (Fig. 9a); pterostigma yellowish in the centre, reddish-brown marginated.

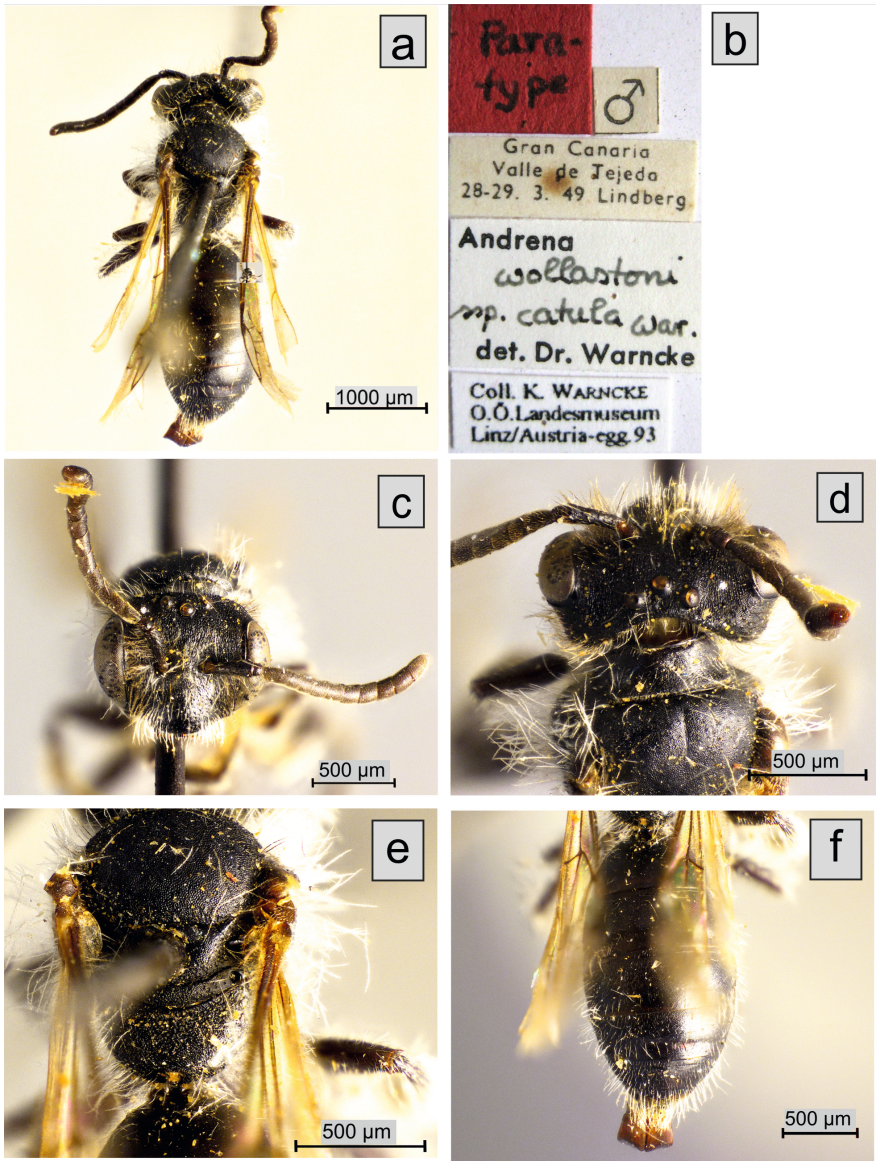


Fig. 9: Type specimen (paratype, male) of *Andrena catula* WARNCKE, 1968 (OLML Nr. 6952776; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view. (**d**) head, dorsal view. (**e**) mesosoma, dorsal view. (**f**) metasoma.

Pubescence. Head: clypeus with white-yellowish but not with dark hairs (Fig. 10b); genal area upper part with brownish hairs, lower part with white-yellowish hairs; paraocular area with white-yellowish hairs with some brownish (78%) or brown (22%) hairs near subantennal socket (Fig. 9d); scapus and antennal socket with dorsal longer and with ventral shorter white-yellowish hairs. Mesosoma: mesoscutum (Fig. 10c) and scutellum with white-yellowish hairs; mesepisternum with white-yellowish hairs. Metasoma: base of T1 with some white-yellowish hairs, scarcely hairy in the centre; T2-T4 depression zones with lateral white-yellowish very fragmented hair bands (dense rows of hairs); T5, T6 with long yellowish-white hairs; ST 8 with long yellowish hairs at the end (Fig. 9f).

Structure. Head: vertex above the ocelli narrow, as wide as half (71%) or as half of the ocellar diameter (29%) (Fig. 9d); clypeus in the front deeper, in the centre and the base shallow, not densely punctured (PD: 14-32 µm) (Fig. 10b); labrum process trapezoidal, emarginated, ends left and right side thickened. Mesosoma: scattered punctured with very shallow punctures, especially in the front (PD: 14 µm) (Fig. 10c); propodeum strongly rugose, primarily in the basal centre and in the dorsolateral area, other area fine-grained shagreened (Fig. 10d). Metasoma: T1 slightly carinate; tergites very scattered punctured (PD: 14 µm).

Distribution: According to HOHMANN et al. (1993) and our data *A. catula* reaches altitudes from (30) 300 to 1800 m a.s.l.

Flight period: from January to June (HOHMANN et al. 1993 and own data).

Further specimens examined: 4♀♀ Gran Canaria, San Bartholomé de Tirajana, 880 m, 13.04.1973, leg. Wolf (ID-No OLML16, OLML19, OLML20, OLML22); 2♀♀ Gran Canaria, San Agustín, ca. 30 m, 27.03.-08.04.1970, leg. Wolf (ID-No OLML17, OLML 21); 1♀ Gran Canaria, Santa Brígida, 500 m, 13.04.1973, leg. Wolf (ID-No OLML18); 1♀ Gran Canaria, Vega de San Mateo, 830 m, collecting time unknown, leg. Suaréz (ID-No OLML33); 1♀ Gran Canaria, Agaëte, El Sao, 520 m, 15.03.1943, collector unknown (ID-No OLML34); 3♀♀ Gran Canaria, Pajonales, 1000 m, 01.04.1984, leg. Hohmann (ID-No UMBB9-UMBB11); 1♀ Gran Canaria, Las Filipinas, 290 m, 27°52'27.5"N, 15°40'20.3"W, 06.02.2014, leg. Kratochwil (ID-No KR-GC57); 1♀ Gran Canaria, Los Llanos, Teror, 647 m, 28°03'28.9"N, 15°33'18.0"W, 09.03.2018, leg. Kratochwil (ID-No KR-GC1); 1♀ Gran Canaria, Agaëte, El Sao, 456 m, 28°03'51.3"N, 15°39'33.0"W, 10.03.2018, leg. Kratochwil (ID-No KR-GC9); 1♀ Gran Canaria, Los Llanos, Teror, 647 m, 28°03'28.9"N, 15°33'18.0"W, 10.03.2018, leg. Kratochwil (ID-No KR-GC10); 2♀♀ Gran Canaria, El Palmar, 567 m, 28°05'08.1"N, 15°32'26.0"W, 10.03.2018, leg. Kratochwil (ID-No KR-GC11, KR-GC12); 3♀♀ Gran Canaria, Los Llanos, Teror, 567 m, 28°05'08.1"N, 15°32'26.0"W, 10.03.2018, leg. Kratochwil (ID-No KR-GC15-KR-GC17); 1♀ Gran Canaria, Los Llanos, Teror, 647 m, 28°03'28.9"N, 15°33'18.0"W, 12.03.2018, leg. Kratochwil (ID-No KR-GC19); 2♀♀ Gran Canaria, Los Llanos, Teror, 647 m, 28°03'28.9"N, 15°33'18.0"W, 12.03.2018, leg. Kratochwil (ID-No KR-GC20, KR-GC21); 5♀♀ Gran Canaria, east of San Isidro, 951 m, 28°01'46.3"N, 15°33'08.1"W, 12.03.2018, leg. Kratochwil (ID-No KR-GC22-KR-GC26); 1♀ Gran Canaria, Vega de San Mateo, Del Molino, 653 m, 28°01'09.4"N, 15°30'51.8"W, 12.03.2018, leg. Kratochwil (ID-No KR-GC18); 2♀♀ Gran Canaria, Tegueste, 634 m, 28°06'20.2"N, 15°38'520.1"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC27, KR-GC29); 1♀ Gran Canaria, Tegueste, 634 m, 28°06'20.2"N, 15°38'20.1"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC28); 1♀ Gran Canaria, Saucillo, 744 m, 28°05'50.6"N, 15°38'26.7"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC30); 1♀ Gran Canaria, Fagajesto, 1024 m, 28°03'41.6"N, 15°38'47.7"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC31); 1♀ Gran Canaria, El Hornillo, 918 m, 28°03'22.7"N, 15°39'16.6"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC32); 1♀ Gran Canaria, El Hornillo, 918 m, 28°03'22.7"N, 15°39'16.6"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC33); 5♀♀ Gran Canaria, San Bartholomé de Tirajana, 886 m, 27°55'17.0"N, 15°34'23.1"W, 16.03.2018, leg. Kratochwil (ID-No KR-GC34-GC38); 4♀♀ Gran Canaria, La Plata, 1207 m, 27°56'8.0"N, 15°36'13.3"W, 16.03.2018, leg. Kratochwil (ID-No

KR-GC39-GC42); 5♂♂ Gran Canaria, Brígida, 15.04.1973, leg. Wolf (ID-No OLML23-OLML25, OLML29, OLML30); 1♂ Gran Canaria, Agaëte El Sao, 10.03.1943, collector unknown (ID-No OLML35); 1♂ Gran Canaria, San Mateo, collecting time unknown, leg. Suaréz (ID-No OLML37); 7♂♂ Gran Canaria, Los Llanos, Teror, 647 m, 28°03'28.9"N, 15°33'18.0"W, 09.03.2018, leg. Kratochwil (ID-No KR-GC2-GC8); 5♂♂ Gran Canaria, Los Llanos, Teror, 647 m, 28°03'28.9"N, 15°33'18.0"W, 10.03.2018, leg. Kratochwil (ID-No KR-GC46-KR-GC50); 2♂♂ Gran Canaria, El Palmar, 567 m, 28°05'08.1"N, 15°32'26.0"W, 10.03.2018, leg. Kratochwil (ID-No KR-GC13, KR-GC14); 1♂ Gran Canaria, El Palmar, 567 m, 28°05'08.1"N, 15°32'26.0"W, 12.03.2018, leg. Kratochwil (ID-No KR-GC51); 1♂ Gran Canaria, east of San Isidro, 951 m, 28°01'46.3"N, 15°33'08.1"W, 12.03.2018, leg. Kratochwil (ID-No KR-GC52); 4♂♂ Gran Canaria, north of Fagajesto, 1019 m, 28°03'46.5"N, 15°38'42.4"W, 13.03.2018, leg. Kratochwil (ID-No KR-GC53-KR-GC56); 3♂♂ Gran Canaria, La Plata, 1207 m, 27°56'8.0"N, 15°36'13.3"W, 16.03.2018, leg. Kratochwil (ID-No KR-GC43-KR-GC45).

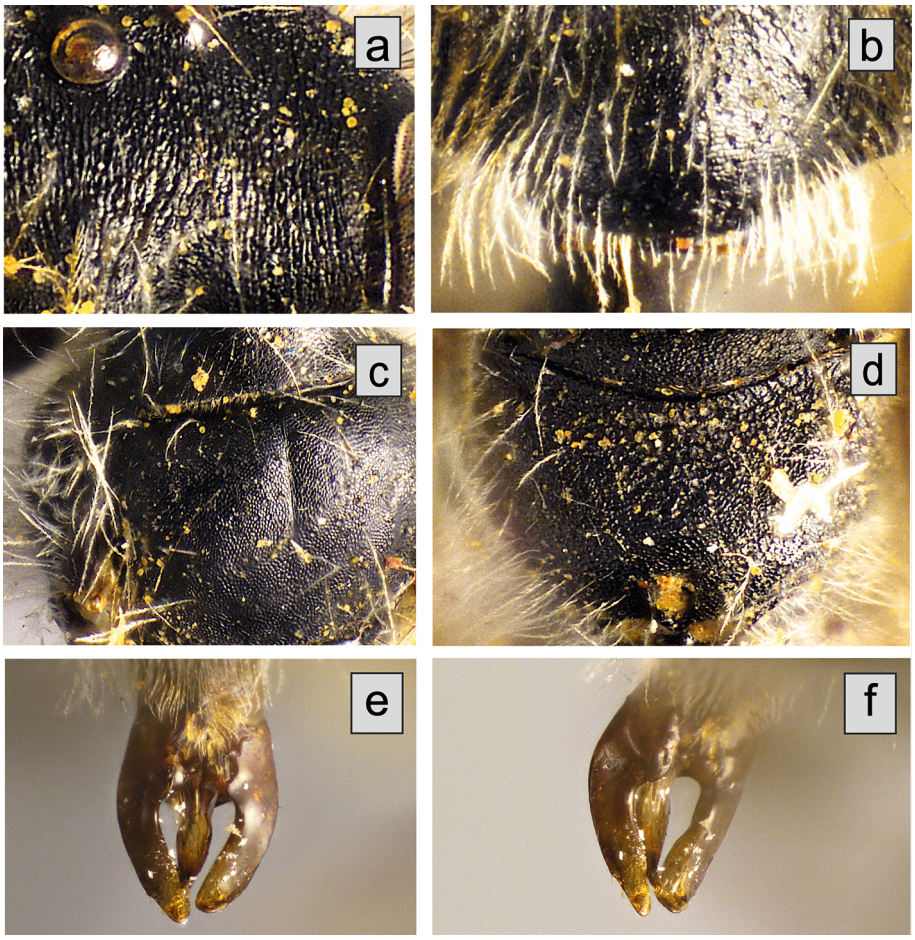


Fig. 10: Type specimen (paratype, male) of *Andrena catula* WARNCKE, 1968 (OLML Nr. 6952776; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) notum. (**d**) propodeum. (**e**) genital, dorsal view. (**f**) genital, ventral view.

Andrena dourada KRATOCHWIL & SCHEUCHL, 2013

Syn. *Andrena wollastoni wollastoni* WARNCKE, 1968 p.p.

H o l o t y p e : 1♀ Porto Santo, near restaurant 'Panorama', above Casinhas, 150 m, 33°04'8.47"N, 16°19'25.57"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/117).

P a r a t y p e s : 1♀ Porto Santo, Vila Baleira, 16.01.1921, leg. W. Porter Cockerell (USNM); 1♀ Porto Santo, Pedregal de Dentro, 220 m, 33°05'38.62"N, 16°19'34.07"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/47); 1♀ Porto Santo, north of Serra de Dentro, 60 m, 33°05'15.36"N, 16°18'33.15"W, 19.03.2012, leg. Kratochwil (ID-No KR-PS12/75); 2♀♀ Porto Santo, Capela da Graça, above Vila Baleira, 160 m, 33°04'24.85"N, 16°19'25.57"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/110, KR-PS12/111); 1♀ Porto Santo, near restaurant 'Panorama', above Casinhas, 150 m, 33°04'8.47"N, 16°19'14.57"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/116); 2♀♀ Porto Santo, near Pico da Cabrita, 230 m, 33°05'42.18"N, 16°19'04.49"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/118, KR-PS12/119); 1♀ Porto Santo, Campo de Baixo, near tennis court, 20 m, 33°02'50.07"N, 16°21'23.35"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/152); 1♀ Porto Santo, Capela de São Pedro, 50 m, 33°02'44.85"N, 16°21'43.82"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/156); 1♂ Porto Santo, southwest of Serra de Fora, 85 m, 33°04'14.74"N, 16°18'53.61"W, 18.03.2012, leg. Kratochwil (ID-No KR-PS12/43); 1♂ Porto Santo, Vereda do Pico Branco, 310 m, 33°05'31.84"N, 16°18'17.16"W, 19.02.2012, leg. Kratochwil (ID-No KR-PS12/81); 2♂♂ Porto Santo, Capela da Graça, above Vila Baleira, 160 m, 33°04'24.85"N, 16°19'25.57"W, 20.03.2012, leg. Kratochwil (ID-No KR-PS12/112, KR-PS12/113). Holotype and paratypes were deposited in the OLML.

S t a t u s : COCKERELL (1922) described *A. wollastoni*, analysing specimens from Madeira Island and Porto Santo. Until 2013, *A. wollastoni* had been reported for both islands (FELLENDORF et al. 1999, KRATOCHWIL et al. 2008). Differing in numerous morphological and morphometric characteristics from *A. wollastoni* (Madeira Island), *A. dourada* was described by KRATOCHWIL & SCHEUCHL (2013) as a new species and endemic to Porto Santo. A single female specimen (collected by Cockerell's wife, W. Porter Cockerell, in 1921 from Porto Santo) was mentioned in the description of COCKERELL (1922). This specimen belongs to the syntype series and is deposited in the USNM, designated as a paratype of *A. dourada* (KRATOCHWIL 2018). Photos of the specimen and of the labels were published in KRATOCHWIL (2018).

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. dourada* is characterised by the following specific features:

F e m a l e : C o l o u r . Head: flagellum black (dark brown) (74%) or black (26%) (Figs. 11a, c, d). Mesosoma: femur, tibia, and basitarsus black (dark brown) (Fig. 11a); mediotarsi reddish-brown (Fig. 11a); wings brownish toned, veins reddish-brown (Fig. 11a); pterostigma dark yellowish or reddish-brown (Fig. 11a). Metasoma: T1-4 black with black to dark reddish-brown depression zone; T5 depression zone reddish-brown.

P u b e s c e n c e . Head: clypeus and supraclypeal area with white-yellowish hairs (Fig. 11d), paraocular area with white-yellowish hairs (Fig. 11c, d) and with some few brownish hairs between subantennal socket and the facial fovea; the scapus and the antennal socket with dorsal longer brownish and with ventral shorter yellowish hairs (Fig. 11c); genal area with white-yellowish hairs (Fig. 11c); facial fovea in the upper part with brownish hairs, in the lower part with white-yellowish hairs (Fig. 11d); vertex behind the ocelli with some longer white-yellowish hairs (Fig. 11c, d). Mesosoma: mesoscutum and scutellum with yellowish hairs, laterally with longer hairs (Fig. 11a, e); mesepisternum with white-yellowish hairs;

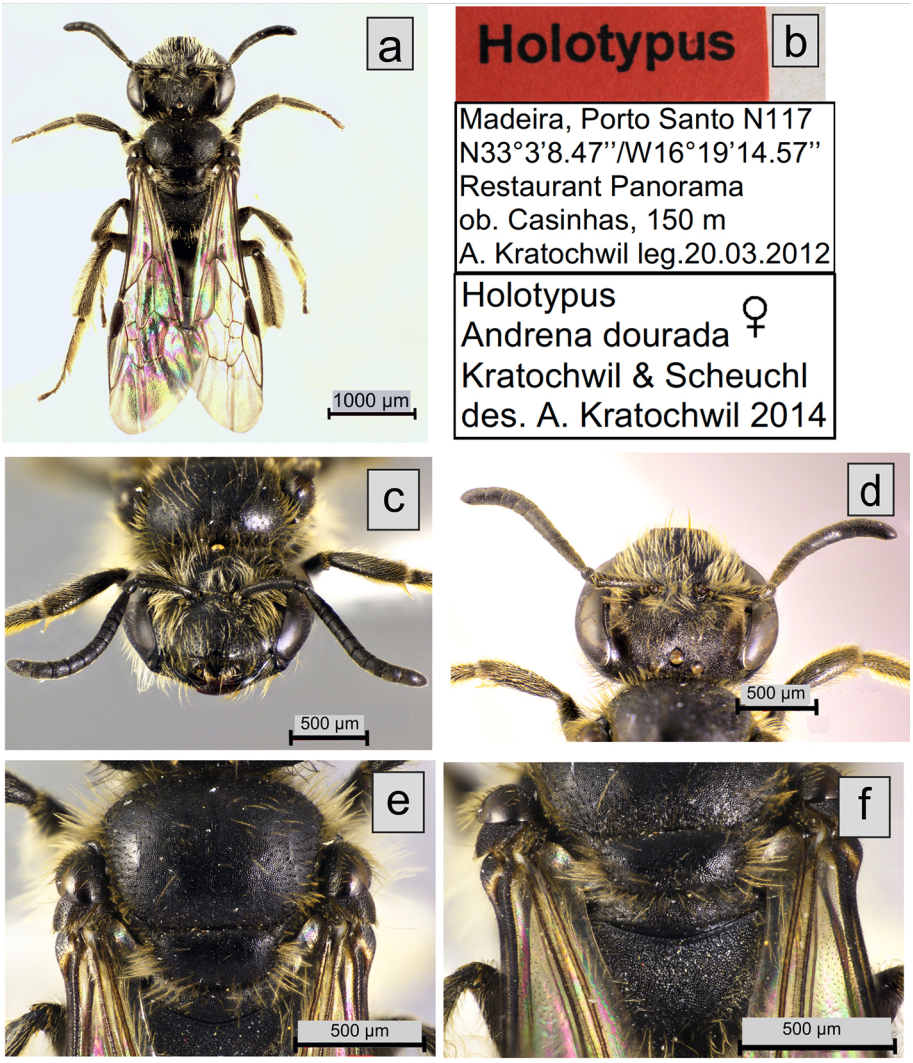


Fig. 11: Type specimen (holotype, female) of *Andrena dourada* KRATOCHWIL & SCHEUCHL, 2014 (OLML Nr. 100415554; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view. (**d**) head, dorsal view. (**e**) mesosoma. (**f**) propodeum.

propodeal corbicula with yellowish-white hairs and with some hairs in the centre; trochanteral and femoral flocculus with yellowish-white hairs; tibial scopa dorsally with yellowish-white hairs, dorsobasally with reddish-brown hairs, ventrally with yellowish-white hairs (Fig. 12e). Metasoma: tergites scarcely hairy; T2 and T3 (T4) with lateral yellowish-white, fragmentary open hair bands (dense rows of hairs); T4 with row of hairs between the tergite and the tergite depression but T2-T4 with fragmentary rows of hairs between the tergite and the tergite depression; T5 laterally with dense white or white-

yellowish hairs, in the centre with reddish-brownish hairs reaching to the pygidium, T6 with brown hairs.

Structure. Head: clypeus convex without impunctate line, clearly shagreened, slightly dull, shallow and more or less densely punctured (PD: 28 µm, PDI: 14-42 µm) (Fig. 12b), labrum process liguliform (61%), liguliform-trapezoidal (26%) (Fig. 12b), trapezoidal (11%) or triangular (2%), slightly rounded on the top, partly thickened, laterally on the top more or less parallel. Mesosoma: scattered punctured with very shallow punctures, especially in the front (PD: 14 µm) (Fig. 12c); propodeum slightly rugose (Fig. 11f). Metasoma: tergites hammertone-like shagreened and shiny; shallow and very scattered but not clearly punctured (PD: 14 µm); T1 no depression zone or only with a slight depression zone, T2-T4: with deep depression zones.

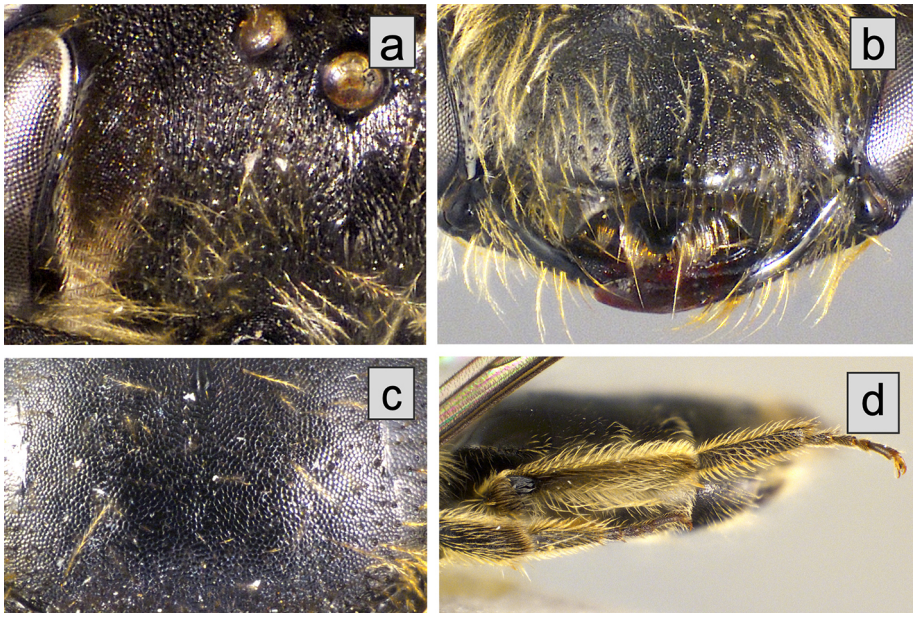


Fig. 12: Type specimen (holotype, female) of *Andrena dourada* KRATOCHWIL & SCHEUCHL, 2014 (OLML Nr. 100415554; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) notum. (**d**) scopa.

Male: similar to female with following differences:

Colour. Head: distal half of the mandible not reddened; flagellum black (Fig. 13a); wings brownish toned; pterostigma brown.

Pubescence. Head: clypeus with white-yellowish hairs but not with darker hairs at the base (Fig. 13a); genal area in the upper part with brownish hairs, in the lower part with white hairs; paraocular area with white-yellowish hairs and with some brownish hairs near the subantennal socket (Fig. 13a); scapus and antennal socket with dorsal longer and ventral shorter yellowish hairs (Fig. 13a). Mesosoma: mesoscutum and scutellum with white-yellowish hairs (Fig. 13b); mesepisternum with white-yellowish hairs. Metasoma: base of T1 with some yellowish-white hairs, scarcely hairy in the centre, T2-T4 depression

zones with lateral yellowish-white and very fragmented hair bands (dense rows of hairs); T5, T6 with long yellowish-white hairs; ST 8: with long white-yellowish hairs at the end.

Structure. Head: vertex above the ocelli narrow, as wide as the ocellar diameter; clypeus shallow and denser punctured (PD: 28 µm, PDI: 14-28 µm) (Fig. 13a); labrum process trapezoidal, emarginated (75%) or not emarginated (25%), ends left and right side thickened. Mesosoma: very scattered punctured (PD: 14 µm) (Fig. 13b); propodeum rugose; Metasoma: T1 slightly carinate, tergites very scattered punctured (PD: 14 µm).

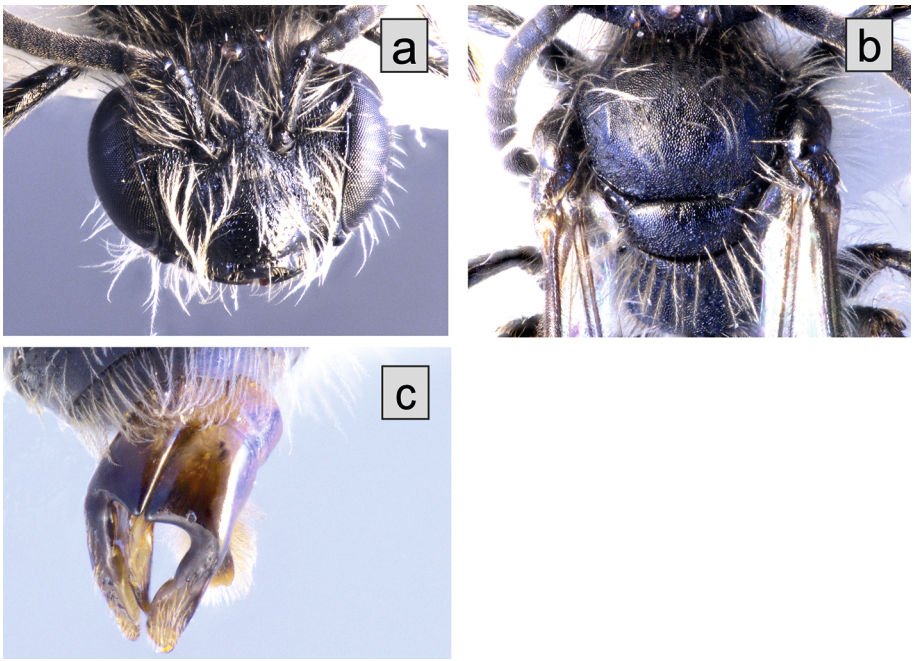


Fig. 13: Male of *Andrena dourada* KRATOCHWIL & SCHEUCHL, 2014 (collection of A. Kratochwil). (**a**) head, frontal view. (**b**) mesonotum and scutellum. (**c**) genital, dorsal view. Photos W. Schwarz (OLML).

Distribution: *Andrena dourada* occurs in different parts of Porto Santo, from sea level to 340 m a.s.l. (see the map in KRATOCHWIL & SCHWABE 2018b). Given to its small population sizes in a small distribution area, this endemic species should be ranked 'vulnerable' (IUCN 2019).

Flight period: There were detections from January to April, but there are not enough data.

Further specimens examined: 1♀ Porto Santo, Campo de Baixo, 20 m, 06.04.1994, leg. Hohmann (ID-No UMBB90); 1♀ Porto Santo, Campo de Baixo, 20 m, 09.04.1994, leg. Hohmann (ID-No UMBB51); 6♀♀ Porto Santo, Pico da Cabrita, 340 m, 07.04.1994, leg. Hohmann (ID-No UMBB63, UMBB64, UMBB91, UMBB92, UMBB96, UMBB97); 7♀♀ Porto Santo, Pico da Cabrita, 340 m, 07.04.1994, leg. Hohmann (ID-No UMBB175-181); 1♀ Porto Santo, north of Morenos, 90 m, 33°02'26.38"N, 16°23'16.39"W, 20.03.2012, Kratochwil (ID-No KR-PS12/137); 1♀ Porto Santo, north of Morenos, 90 m, 33°02'26.38"N, 16°23'16.39"W, 20.03.2012, observed Kratochwil (KR-PS12/139); 1♀ Porto Santo, near restaurant 'Panorama', above Casinhas,

150 m, 33°04'7.9"N, 16°19'13.0"W, 28.03.2012, leg. Kratochwil (ID-No KR-PS12/175); 2♀♀ Porto Santo, east of Capelo de São Pedro, 31 m, 33° 02' 49.5"N, 16° 21' 32.5"E, 21.03.2017, leg. Kratochwil (ID-No KR-PS17/1, KR-PS17/2); 2♀♀ Porto Santo, near restaurant 'Panorama', above Casinhas, 150 m, 33°04'7.9"N, 16°19'13.0"W, 21.03.2017, leg. Kratochwil (ID-No KR-PS17/3, KR-PS17/4); 1♀ Porto Santo, near restaurant 'Panorama' above Casinhas, 150 m, 33°04'7.9"N, 16°19'13.0"W, 25.03.2017, leg. Kratochwil (ID-No KR-PS17/6); 1♀ Porto Santo, north of Serra de Dendro, 70 m, 33°05'14.6"N, 16°18'33.5"W, 25.03.2017, leg. Kratochwil (ID-No KR-PS17/7); 2♀♀ Porto Santo, near restaurant 'Panorama', above Casinhas, 150 m, 33°04'7.9"N, 16°19'13.0"W, 26.03.2017, leg. Kratochwil (ID-No KR-PS17/8, KR-PS17/9); 1♀ Porto Santo, east of Capelo de São Pedro, 31 m, 33°02'49.5"N, 16°21'32.5"W, 28.03.2017, leg. Kratochwil (ID-No KR-PS17/28); 2♀♀ Porto Santo, near restaurant 'Panorama', above Casinhas, 150 m, 33°04'7.9"N, 16°19'13.0"W, 28.03.2017, leg. Kratochwil (ID-No KR-PS17/26, KR-PS17/27); 1♀ Porto Santo, north of Serra de Dendro, 70 m, 33°05'14.6"N, 16°18'33.5"W, 28.03.2017, leg. Kratochwil (ID-No KR-PS17/22); 1♀ Porto Santo, above Fonte da Areia, 160 m, 33°04'47.0"N, 16°21'50.2"W, 29.03.2017, leg. Kratochwil (ID-No KR-PS17/34); 2♀♀ Porto Santo, below Pico de Ana Ferreira, 105 m, 33°02'48.9"N, 16°22'25.3"W, 29.03.2017, leg. Kratochwil (ID-No KR-PS17/31, KR-PS17/32); 6♀♀ Porto Santo, Pico de Ana Ferreira, Basalt Columns, 115 m, 33°02'58.7"N, 16°22'04.3"W, 29.03.2017, leg. Kratochwil (ID-No KR-PS17/33, KR-PS17/35, KR-PS17/36, KR-PS17/46-KR-PS17/48); 1♂ Porto Santo, north of Morenos, 90 m, 33°02'26.38"N, 16°23'16.39"W, 20.03.2012, observed Kratochwil (ID-No KR-PS12/138).

Andrena gomerensis WARNCKE, 1993

Syn. *Andrena wollastoni gomerensis* WARNCKE, 1993 p.p.

S t a t u s : WARNCKE (1993) defined 19 types (10♀♀, 9♂♂). In the OLML, the holotype and seven paratypes (3♀♀, 4♂♂; BLANK & KRAUS 1994) are deposited, and in the MCNSC one paratype (1♀, ORTEGA 2005) is deposited. WARNCKE (1993) described *A. w. gomerensis* for La Gomera and El Hierro. The paratypes of the OLML are characterised in detail below, the female paratype of the MCNSC is labelled (1♀ Montaña de la Zarza, 1000 m, 20 km WNW S. Sebastián, 03.06.1983, leg. Hohmann; MCNSC, HY-7031). It was not possible to analyse the following paratypes of *A. w. gomerensis*, because their deposition is unknown: 4♀♀, 2♂♂ Hermigua El Moralito, 17.03.1990; 1♀, 3♂♂ Vallehermoso, Altos de Argamul, 13.03.1990. All the types from La Gomera have been used for the description of *A. g. gomerensis*.

Initially, WARNCKE (1968) grouped the specimens from La Gomera to *A. w. acuta* WARNCKE, 1968. He explained that in WARNCKE (1968) only males were analysed, and, after studying females and further males, the author concluded that the specimens of La Gomera are not *A. w. acuta* but belong to an own subspecies: *A. w. gomerensis*. Ten females collected by J. A. W. Lucas from La Gomera in 1992 were labelled by Warncke as *A. wollastoni acuta* War. (printed), but this was not corrected in *A. w. gomerensis*. These ten specimens (OLML6-15) are also deposited in the OLML and are now used for the description of *A. g. gomerensis*.

The name *A. w. gomerensis* was first mentioned in the unpublished thesis of LA ROCHE BRIER (1992), but *A. w. gomerensis* WARNCKE, 1992, is a nomen nudum (the description is missing in the publication). The names cited in this thesis were not available at that date according to Articles 8 and 9 (ICZN 1999); see BLANK & KRAUS (1994).

HOHMANN et al. (1993) did not mention that one specimen of *A. g. gomerensis* was also found in El Hierro (paratype: 1♀ El Hierro, Costa de Val Verde, 28.04.1942, collector unknown, ID-No OLML39); checked by A. Kratochwil. Apart from this detection, *A. gomerensis* was never found there again despite intensive personal searching, so this

specimen might have been wrongly labelled. Therefore, I do not list *A. g. gomerensis* for El Hierro.

Former descriptions: WARNCKE (1993): First tergite lateral rounded (in *A. w. acuta* flattened and slightly carinate) and considerably shagreened. In males the first tergite is also rounded, but this is not so apparent by the lesser lateral tergite width. This characterisation was adopted by GUSENLEITNER & SCHWARZ (2002).

Diagnostic qualitative features: In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. gomerensis* is characterised by the following specific features:

Female: Colour. Head: flagellum black or dark brown (Fig. 14d). Mesosoma: femur, tibia, and basitarsus black (dark brown) (*A. g. palmae* nov.ssp. partly reddish in 10%) (Fig. 14a); mediotarsi reddish-brown (Figs. 14a, d); wings brownish toned, veins reddish-brown (Fig. 14f); pterostigma dark yellowish or reddish-brown (Figs. 14a, f). Metasoma: T1-4 black with black to dark reddish-brown or dark brown depression zone; T5 depression zone reddish-brown.

Pubescence. Head: clypeus and supraclypeal area with yellowish-white not dense hairs (Figs. 14c, 14d, 15b); paraocular area with yellowish-white hairs, some brownish (black) hairs between the subantennal socket and the facial fovea; scapus and antennal socket with dorsal longer brownish hairs and ventral shorter yellowish hairs; genal area with white hairs; facial fovea in the upper part with brownish hairs, in the lower part with white-yellowish hairs (Fig. 15a); vertex behind the ocelli with some longer yellowish-white and brownish hairs. Mesosoma: mesoscutum and scutellum with yellowish-brownish hairs, in some cases laterally with few yellowish hairs; mesepisternum with yellowish-white hairs; propodeal corbicula with some yellowish-white hairs and some hairs in the centre; trochanteral and femoral flocculus with yellowish-white hairs; tibial scopa dorsally with brownish hairs (*A. g. palmae* nov.ssp. with dorsoventral slightly brownish hairs), dorsobasally with reddish-brown hairs, tibial scopa ventral with yellowish-white hairs (Fig. 15f). Metasoma: tergites scarcely hairy, T2 and T3 (T4) with laterally yellowish-white, fragmentary open hair bands (dense rows of hairs) or with fragmentary rows of hairs between the tergite and the tergite depression; T4 with row of hairs between tergite and tergite depression; T5 laterally white or yellowish-white hairs, in the centre reddish-brownish hairs, reaching to the pygidium (Fig. 14f), T6: dark brown hairs.

Structure. Head: clypeus convex without (*A. g. gomerensis*) or with fragmented impunctate line (*A. g. palmae* nov.ssp. 71%, *A. g. gomerensis* 29%) (Fig. 15b), clearly shagreened, slightly dull; clypeus with shallow punctures, more or less dense (PD: 28 µm, PDI: 14-56[70] µm) (Fig. 15b); labrum process liguliform-trapezoidal or trapezoidal (*A. g. gomerensis*) (Fig. 15b) or triangular (*A. g. palmae* nov.ssp.), rounded on the top. Mesosoma: scattered punctured with very shallow punctures, especially in front (PD: 14-42 µm) (Fig. 15c); propodeum rugose, primarily in the basal centre and in the dorsolateral area (Fig. 15d). Metasoma: tergites hammertone-like shagreened and shiny; shallow and very scattered but not clearly punctured (PD: 14 µm) (Fig. 15e); T1 no depression zone or only with a slight depression zone, T2-T4 with deep depression zones.

Male: similar to female with following differences:

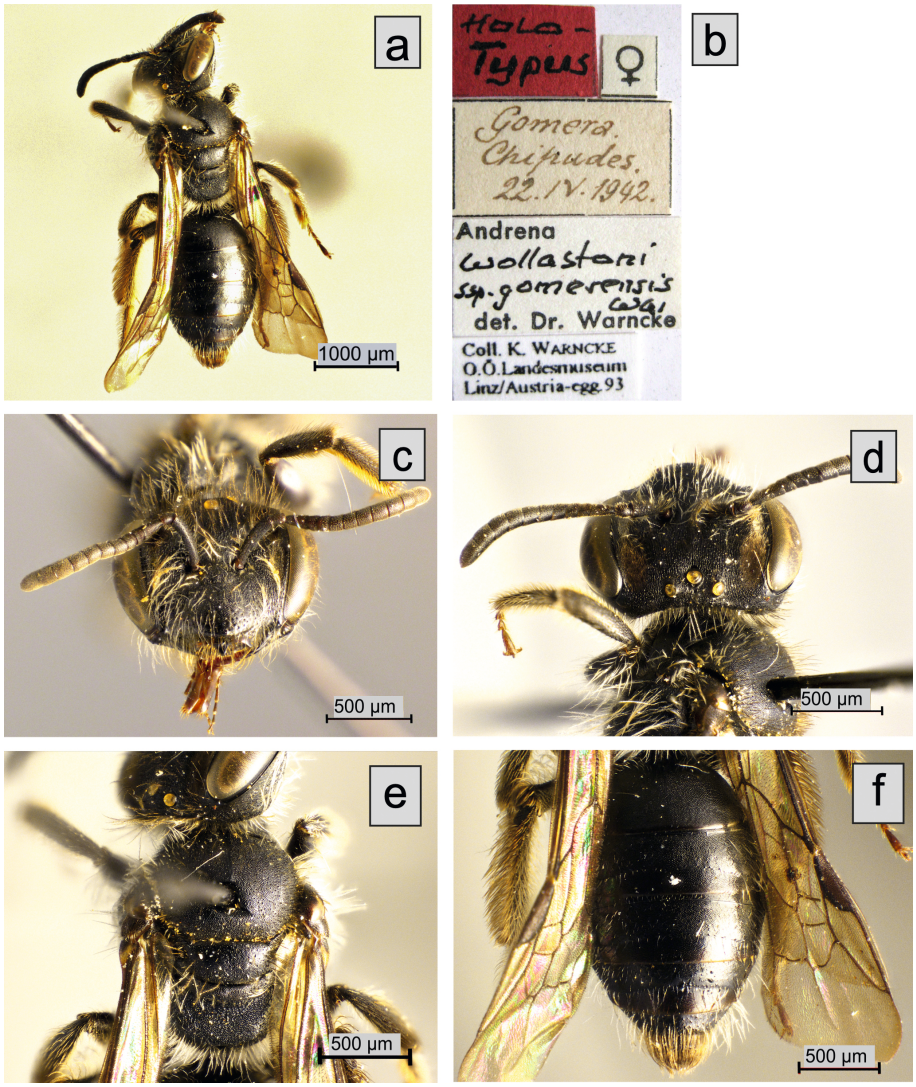


Fig. 14: Type specimen (holotype, female) of *Andrena gomerensis* WARNCKE, 1993 (OLML Nr. 6952779; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view. (**d**) head, dorsal view. (**e**) mesosoma. (**f**) metasoma.

Colour. Head: distal half of the mandible not or partly reddened; flagellum brown or (light) brown (Figs. 16c, d). Mesosoma: mediotarsi reddish-brown or brown (*A. g. gomerensis*) or reddish-brown (*A. g. palmae* nov.ssp.); wings light brownish toned (Fig. 16f); pterostigma yellowish in the centre, reddish-brown marginated.

Pubescence. Head: clypeus yellowish-white with darker hairs at the base (Fig. 17b); paraocular area with yellowish-white hairs, many brownish (black) hairs near subantennal socket; genal area upper part with brownish hairs, lower part with yellowish-white hairs (Fig. 16c, d). Mesosoma: mesepisternum with long yellowish-white hairs (Fig. 16c).

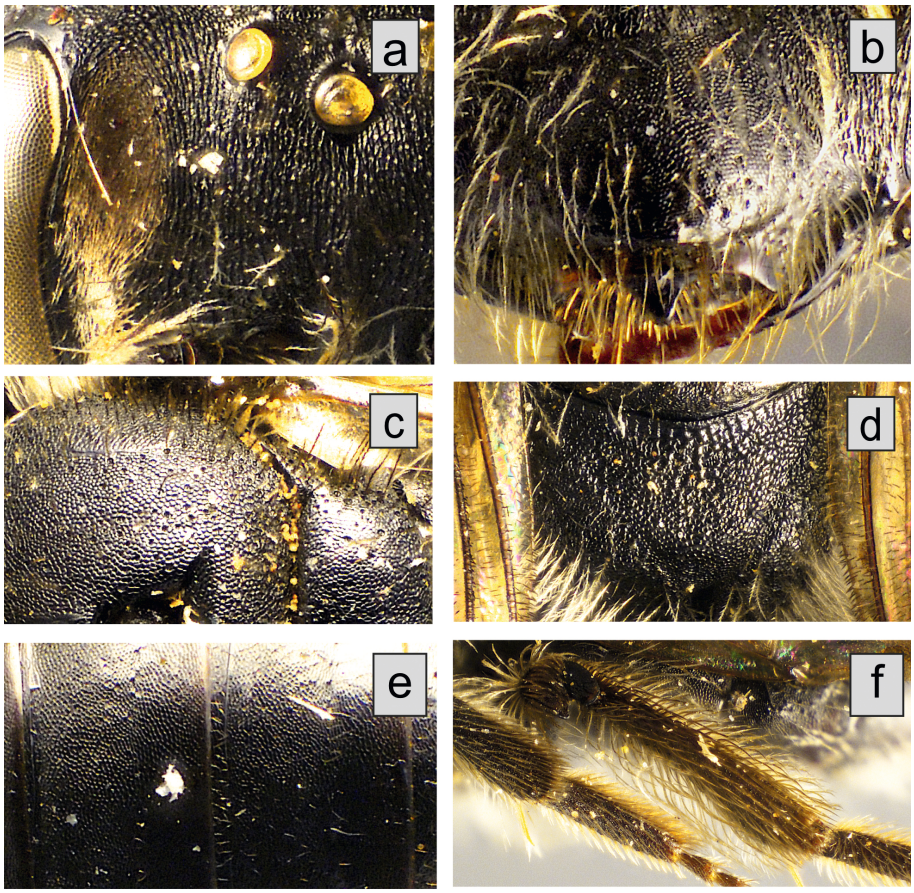


Fig. 15: Type specimen (holotype, female) of *Andrena gomerensis* WARNCKE, 1993 (OLML Nr. 6952779; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) mesonotum. (**d**) propodeum. (**e**) abdomen. (**f**) scopa.

Metasoma: base of T1 with some yellowish-white hairs, scarcely hairy in the centre, T2-T4 depression zones with laterally yellowish-white, strongly fragmented hair bands (dense rows of hairs); T5, T6 with yellowish or yellowish-reddish hairs; ST 8: with long yellowish hairs at the end.

Structure. Head: vertex above ocelli narrow, as wide as ocellar diameter or half of the diameter (Fig. 16d); clypeus in front deeper, in the centre and base shallow and not densely punctured (PD: 28 µm, PDI: 14-28 µm) (Fig. 17b); labrum process trapezoidal,

emarginated, ends left and right side (slightly) thickened (Fig. 17b). Mesosoma: very scattered punctured (PD = 14 µm) (Fig. 17c). Metasoma: T1 slightly carinate, tergites very scattered punctured (PD = 14µm).

Fig. 16: Type specimen (paratype, male) of *Andrena gomerensis* WARNCKE, 1993 (OLML Nr. 6952778; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus dorsal. (**b**) type label. (**c**) head frontal. (**d**) head dorsal. (**e**) mesosoma. (**f**) metasoma.

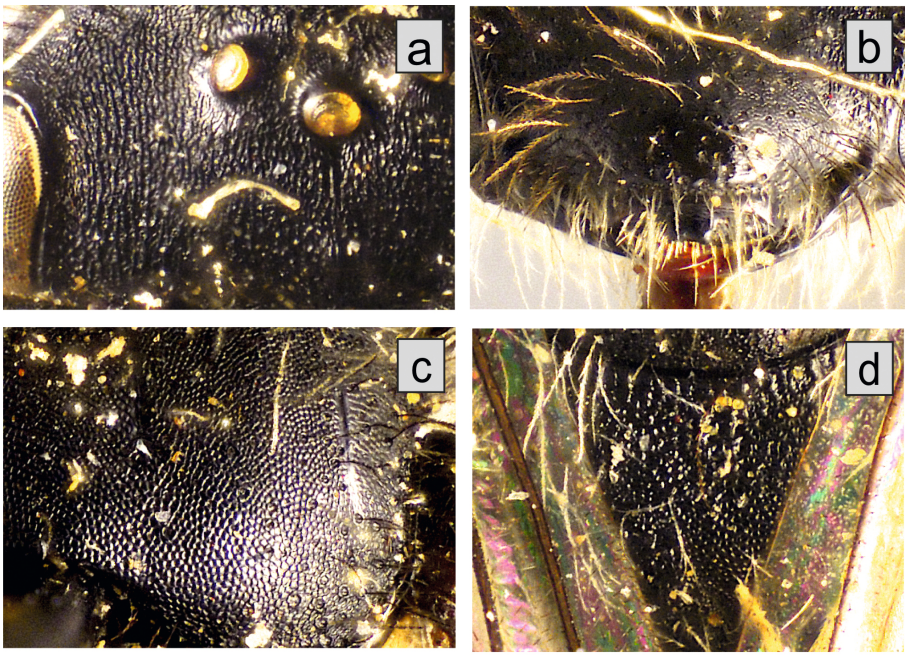


Fig. 17: Type specimen (paratype, male) of *Andrena gomerensis* WARNCKE, 1993 (OLML Nr. 6952778; ZOBODAT, 05.02.2020; biogeographical data set). **a:** upper face with rugulae, **b:** clypeus, **c:** mesonotum, **d:** propodeum.

Subspecies differentiation: *A. gomerensis* is differentiated into two subspecies: *A. g. gomerensis* WARNCKE, 1993 (La Gomera), and *A. g. palmae* nov.ssp. (La Palma). In females, morphological differences exist in the labrum process structure, the mesosoma puncture diameter, partly in the existence of a clypeus impunctate line, partly in the colour of the mediotarsi, and partly in the colour of the tergite depression zone. In males, morphological differences exist in the colouration of the flagellum, in the colour of the pubescence of ST8, partly in the diameter of the vertex width, partly in the colour of the the mediotarsi, and especially in morphometric parameters.

Andrena g. gomerensis WARNCKE, 1993

Syn. *Andrena wollastoni gomerensis* WARNCKE, 1993 p.p.

Holotype: 1♀ La Gomera, Chipude(s), 22.04.1942, collector unknown (ID-No OLML38, former holotype of *A. wollastoni gomerensis*).

Paratypes: 2♀♀ La Gomera, Costa de Chipude(s), 25.04.1942, collector unknown (ID-No OLML44, OLML45, former paratypes of *A. wollastoni gomerensis*); 7♀♀ La Gomera, Degollada de Peraza, 945 m, 12.05.1992, leg. J.A.W. Lucas (ID-No OLML6-OLML12); 3♀♀ La Gomera, Igualero, 1290 m, 15.05.1992, leg. J.A.W. Lucas (ID-No OLML13-OLML15); 1♂ La Gomera, Chipude(s), 22.04.1942, collector unknown (ID-No OLML42, former paratype of *A. wollastoni gomerensis*); 3♂♂ Costa de Chipude(s), 25.04.1942, collector unknown (ID-No OLML40, OLML41, OLML43, former paratypes of *A. wollastoni gomerensis*); 1♀ Montaña de la Zarza, 1000 m, 20 km WNW S. Sebastián, 03.06.1983, leg. Hohmann (MCNSC, HY-7031).

Not chosen as paratypes for *A. g. gomerensis* (locality of deposition unknown) are 2♂♂ dedicated by WARNCKE (1968) as paratypes of *A. wollastoni acuta* for La Gomera (El Cedro, ca. 1000 m, 23.03.1950, leg. Lindberg).

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for *A. gomerensis*, *A. g. gomerensis* is characterised by the following specific features:

F e m a l e : C o l o u r . Mesosoma: femur, tibia, and basitarsus black (dark brown) similar to *A. g. palmae* nov.ssp. but in *A. g. palmae* nov.ssp. there are also few specimens (10%) with partly reddish colour; mediotarsi reddish-brown similar to *A. palmae* nov.ssp. but in *A. g. gomerensis* there are also some specimens (14%) with brown colour. Metasoma: T1-4 black with black to dark reddish-brown depression zone (71%) but there are also specimens (29%) with dark reddish-brown depression zone; T5 depression zone reddish-brown.

P u b e s c e n c e . Mesosoma: tibial scopa dorsally with brownish hairs (*A. g. palmae* nov.ssp. with slight brownish hairs), dorsobasal with reddish-brown hairs, tibial scopa ventral with yellowish-white hairs (Fig. 15f).

S t r u c t u r e . Head: clypeus without impunctate line (Fig. 15b) in contrast to *A. g. palma*e nov.ssp. with fragmented impunctate line (71%) or without impunctate line (29%); shallow more or less densely punctured (PD 28 µm, distance 14-56[70] µm), labrum process liguliform-trapezoidal (56%) (Fig. 15b) or trapezoidal (44%) in contrast to *A. g. palmae* nov.ssp. triangular, rounded on the top, laterally on the top more or less oblique. Mesosoma: scattered punctured with very shallow punctures, especially in front (PD =14 µm) (Fig. 15c).

M a l e : similar to female with following differences:

C o l o u r . Head: flagellum brown (66%) or light brown (33%) (Figs. 16a, c, d) in contrast to *A. g. palmae* nov.ssp. light brown. Mesosoma: mediotarsi reddish-brown (66%) or brown (34%) in contrast to *A. g. palmae* nov.ssp. reddish-brown.

P u b e s c e n c e . Metasoma: ST 8: long yellowish hairs at the end in contrast to *A. g. palmae* nov.ssp. with long white-yellowish hairs.

S t r u c t u r e . Head: vertex above the ocelli narrow, as wide as the ocellar diameter (80%) (Fig. 16e) or half of the diameter (20%) in contrast to *A. g. palmae* nov.ssp. with all specimens with the vertex as wide as the ocellar diameter; labrum process trapezoidal, emarginated, ends left and right side slightly thickened (80%) (Fig. 17b) or thickened (20%) in contrast to *A. g. palmae* nov.ssp. only slightly thickened.

D i s t r i b u t i o n : The distribution of this subspecies is with high probability limited to La Gomera (Fig. 1c). But there is one detection of *A. g. gomerensis* on El Hierro (section '*A. gomerensis*, status'). The specimen (paratype in the OLML) was collected in El Hierro, Costa de Val verde, 28.04.1942, unknown collector). Despite intensive searching, no further specimens could be detected on El Hierro. According to HOHMANN et al. (1993) and our results, *A. w. gomerensis* is widely distributed in La Gomera. This subspecies covers altitudes between sea level (the northern and western coasts) up to 1200 m a.s.l.

F l i g h t p e r i o d : March and April.

F u r t h e r s p e c i m e n s e x a m i n e d : 4♀♀ La Gomera, Ermita de Nuestra Señora de Las Nieves, 1073 m, 28°06'02.5"N, 17°12'13.6"W, 24.04.2016, leg. Kratochwil (ID-No KR-GO30-

KR-GO32, KR-GO35-KR-GO37, KR-GO42); 1♀ La Gomera, east of Temocodá, 1255 m, 28°06'40.4"N, 17°15'44.3"W, 24.04.2016, leg. Kratochwil (ID-No KR-GO34); 6♀♀ La Gomera, east of Temocodá, 1255 m, 28°06'40.4"N, 17°15'44.3"W, 24.04.2016, leg. Kratochwil (ID-No KR-GO34-1, KR-GO38-KR-GO41, KR-GO43); 3♀♀ La Gomera, Las Rosas, 626 m, 28°11'21.5"N, 17°13'15.3"W, 25.04.2016, leg. Kratochwil (ID-No KR-GO44-KR-GO46); 6♀♀ La Gomera, northeast of Ermita de Nuestra Señora de Las Nieves, 615 m, 28°07'56.7"N, 17°12'11.7"W, 26.04.16, 25.04.2016, leg. Kratochwil (ID-No KR-GO47-KR-GO52); 4♀♀ La Gomera, Ermita de Nuestra Señora de Las Nieves, 1073 m, 28°06'02.5"N, 17°12'13.6"W, 24.04.2016, leg. Kratochwil (ID-No KR-GO53-KR-GO56).

Andrena (*Micrandrena*) *gomerensis palmae* **nov.ssp.**

Syn. *Andrena wollastoni acuta* WARNCKE, 1993 p.p.

H o l o t y p e : 1♀ La Palma, Hermosilla Los Roquitos, El Paso, 400 m, 12.02.1990, leg. Schwenninger (ID-No HS1).

P a r a t y p e s : 2♀♀ La Palma, Aguas, Lomo del Caballo, 20.05.1934, collector unknown, det. Warncke (*Andrena wollastoni acuta*) (ID-No OLML82, OLML83); 1♀ La Palma, Hermosilla, Los Roquitos, El Paso, 400 m, 12.02.1990, leg. Schwenninger (ID-No HS2); 1♂ La Palma, Hermosilla, Los Roquitos, El Paso, 400 m, 22.02.1990, leg. Schwenninger (ID-No HS4). 3♀♀ La Palma, south of Tinizara, 860m, 28°44'17.7"N, 17°57'56.8"W, 07.03.2015, leg. Kratochwil (ID-No KR-LP54, KR-LP58, KR-LP60); 1♀ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 07.03.2015, leg. Kratochwil (ID-No KR-LP55); 1♀ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 07.03.2015, leg. Kratochwil (ID-No KR-LP59); 1♀ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 07.03.2015, leg. Kratochwil (ID-No KR-LP56); 5♀♀ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 11.03.2015, leg. Kratochwil (ID-No KR-LP85, KR-LP86, KR-LP88-KR-LP90); 1♀ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 11.03.2015, leg. Kratochwil (ID-No KR-LP95); 1♀ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 11.03.2015, leg. Kratochwil (ID-No KR-LP97); 4♀♀ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 12.03.2015, leg. Kratochwil (ID-No KR-LP100, KR-LP101, KR-LP104, KR-LP112); 5♂♂ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 06.03.2015, leg. Kratochwil (ID-No KR-LP63, KR-LP65, KR-LP70-KR-LP72); 2♂♂ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 07.03.2015, leg. Kratochwil (ID-No KR-LP68, KR-LP69); 1♂ La Palma, south of Lomo de la Crucita, 454 m, 28°49'19.0"N, 17°50'10.0"W, 09.03.2015, leg. Kratochwil (ID-No KR-LP66); 2♂♂ La Palma, east of La Rosa, 849 m, 28°39'14.8"N, 17°51'07.3"W, 10.03.2015, leg. Kratochwil (ID-No KR-LP73, KR-LP74); 2♂♂ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 11.03.2015, leg. Kratochwil (ID-No KR-LP75, KR-LP77); 3♂♂ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 12.03.2015, leg. Kratochwil (ID-No KR-LP62, KR-LP76, KR-LP78).

Not chosen as paratypes for *A. g. palmae*, because the locality of deposition is unknown, are 2♂♂ previously dedicated by WARNCKE (1968) as paratypes of *A. wollastoni acuta* for La Gomera (1♂ Isla de la Palma, 1907, leg. Santos; 1♂ Supra El Paso, 600 m, 04.04.1950, leg. Lindberg).

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for the *A. gomerensis* group, *A. g. palmae* nov.ssp. is characterised by the following specific features:

F e m a l e : C o l o u r. Mesosoma: femur, tibia, and basitarsus black (dark brown) similar to *A. g. gomerensis*, but there are few specimens (10%) with partly reddish colour; mediotarsi reddish-brown similar to *A. g. gomerensis*, but in *A. g. palmae* nov.ssp. some specimens (14%) with brown c o l o u r. Metasoma: T1-4 black with reddish-brown; T5 depression zone reddish-brown.

P u b e s c e n c e . Mesosoma: tibial scopa dorsally with slightly brownish hairs (*A. g. gomerensis* with brownish hairs), dorsobasally with reddish-brown hairs, tibial scopa ventral with yellowish-white hairs.

Structure. Head: with fragmented impunctate line (71%) or without impunctate line (29%), shallow more or less densely punctured (PD: 28 µm, PDI: 14-56 µm), labrum process triangular, rounded on the the top, laterally more or less oblique. Mesosoma: scattered punctured with very shallow punctures especially in the front (PD =14-28 µm).

Male: similar to female with following differences:

Colour. Head: flagellum light brown in contrast to *A. g. gomerensis* brown (66%) or light brown (34%). Mesosoma: mediotarsi reddish-brown in contrast to *A. g. gomerensis* reddish-brown (66%) or brown (34%).

Pubescence. Metasoma: ST 8: long white-yellowish hairs at the end in contrast to *A. g. gomerensis* with long yellowish hairs.

Structure. Head: vertex above the ocelli narrow as wide as the ocellar diameter in contrast to *A. g. gomerensis* as wide as the ocellar diameter (80%) or half of the diameter (20%); labrum process trapezoidal, emarginated, ends left and right side slightly thickened in contrast to *A. g. gomerensis* slightly thickened (80%) or thickened (20%).

Distribution: The distribution of this subspecies is restricted to La Palma (Fig. 1c). This subspecies covers mainly altitudes from 400 up to 900 m a.s.l., in one case (HOHMANN et al. 1993) to 2100 m.

Flight period: from February to May.

Etymology: The specific name of the subspecies derives from the name of the island La Palma.

Further specimens examined: 4♀♀ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 07.03.2015, leg. Kratochwil (ID-No KR-LP79, KR-LP84, KR-LP85-1, KR-LP86-1); 3♀♀ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 11.03.2015, leg. Kratochwil (ID-No KR-LP81-KR-LP83); 3♀♀ La Palma, east of El Paso, 841 m, 28°39'41.7"N, 17°50'58.8"W, 12.03.2015, leg. Kratochwil (ID-No KR-LP63, KR-LP80, KR-LP87); 3♀♀ La Palma, El Paso, 555 m, 28°39'50.9"N, 17°53'41.0"W, 05.03.2015, leg. Kratochwil (ID-No KR-LP1-KR-LP3); 3♀♀ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 06.03.2015, leg. Kratochwil (ID-No KR-LP4, KR-LP8, KR-LP9); 5♀♀ La Palma, south of Tinizara, 860 m, 28°44'17.7"N, 17°57'56.8"W, 06.03.2015, leg. Kratochwil (ID-No KR-LP5-KR-LP7, KR-LP10, KR-LP11); 3♀♀ La Palma, southeast of Gallegos, 467 m, 28°49'19.0"N, 17°50'10.0"W, 09.03.2015, leg. Kratochwil (ID-No KR-LP12-KR-LP14).

Andrena lineolata WARNCKE, 1968

Holotype: 1♀ Tenerife, El Portillo, 18.06.1933, collector unknown.

Paratypes: 1♂ Tenerife, Monte de las Mercedes, 02.03.1952, leg. Fernandez; 1♀ Tenerife, La Laguna, 07.05.1928, collector unknown; 6♀♀, 11♂♂ Tenerife, Las Cañadas, 17.05.1960, leg. Lundblad; 1♀, 1♂ Tenerife, Teide, Las Cañadas, 20.05.1947, leg. Lindberg; 1♂ Tenerife, Izaña, 04.06.1922, leg. Cabrera; 1♀ Tenerife Las Cañadas, 16.06.1903, collector unknown; 1♀ Tenerife, El Portillo, 18.06.1933, collector unknown; 2♀♀, 1♂ Tenerife, Cumbre Roque de Caramuyo, 20.-21.06.1923, 2202 m, collector unknown; 1♀ Tenerife, El Portillo, 02.07.1933, collector unknown.

Status: WARNCKE (1968) described *A. lineolata* as endemic to Tenerife on the basis of 30 specimens (1♀ holotype; 14♀♀, 15♂♂ paratypes). Besides the holotype, 8♀♀ and 6♂♂ of paratypes are deposited in the OLML (see also BLANK & KRAUS 1994). The type specimens in the OLML are all provided with a determination label from Warncke and were analysed in the frame of this study. (holotype: female, El Portillo, 18.06.1933, collector unknown). One paratype of *A. lineolata* (1♂ Tenerife, Las Cañadas, May 1960,

leg. Lundblad) is deposited in the MNCN (1♂ of the same serie, also a paratype, is deposited in the OLML). Three females and one male (all paratypes, with the label Tenerife, Teyde, Cañadas, 20.05.1947, collected by Lindberg) are deposited in the ZMUH and characterised by the labels 'Mus. Zool H: Fors, Spec. typ. No 5525, 5526, 5532, 5533'. Remarkably, only one female is mentioned in the description of WARNCKE (1968). The whereabouts of 10 type specimens (2♀♀, 8♂♂) could not be clarified.

Former descriptions: WARNCKE (1993) compared the morphological features of *A. lineolata* to those of *A. wollastoni* (translated from German) as follows:

Female: hairy gray-white pubescence, only slightly denser and longer hairs than in *A. wollastoni*; tergites 2-4 with open white and narrow hair bands; clypeus clearly bulging, somewhat snout-shaped, slightly coarser and more densely punctured, puncture distance 1-1.5 of the puncture diameter; labrum triangular; thorax in *A. wollastoni* fine scattered and hardly recognizable punctured; strongly grainy shagreened; in *A. lineolata* similar, but denser (1-2 puncture of the diameter distance) and deeper punctured, therefore punctures clearly visible; fine-grained and shagreened but weaker in microsculpture, therefore weakly shiny; scutellum more strongly punctured and not shagreened in the centre, therefore shiny; propodeum rugose at the base, distal part almost grainy without rugulae; sculpture of the abdomen similar to *A. wollastoni*, mesosoma seems broader than in *A. wollastoni*.

Male: with lighter hairs, even the head only next to the antenna base with some interspersed black hairs, otherwise lightly haired; thorax puncture also denser and deeper, scutellum shiny, genitals very similar to *A. wollastoni*.

Diagnostic qualitative features: In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. lineolata* is characterised by the following specific features:

Female: Colour. Head: flagellum dorsal dark brown, ventral light brown (78%) or dorsal black, ventral brown (22%) (Figs. 18a, c, d). Mesosoma: femur, tibia, and basitarsus brown (Fig. 18a); mediotarsi yellowish-reddish; wings light brownish toned (Fig. 18a), veins yellowish-reddish brown; pterostigma yellowish, brown marginated (Fig. 18a). Metasoma: T1-4 black with reddish-brown depression zone (Fig. 18a); T5 depression zone reddish-brown.

Pubescence. Head: clypeus and supraclypeal area with white but not dense hairs; paraocular area with white hairs, no brownish hairs between the subantennal socket and the facial fovea (Fig. 18d); scapus and antennal socket with dorsal longer white-yellowish hairs and ventral shorter white-yellowish hairs (Fig. 18c); genal area with white hairs; facial fovea with white hairs; vertex behind the the ocelli with some long white-yellowish hairs (Fig. 18c). Mesosoma: mesoscutum and scutellum with white-yellowish hairs, laterally in the front with longer hairs; mesepisternum with white hairs; propodeal corbicula with some white hairs and with some hairs in the centre; trochanteral and femoral flocculus with white hairs; tibial scopa dorsally and ventrally with white hairs, dorsobasally slightly reddish, distally with white hairs (Fig. 19d). Metasoma: tergites scarcely hairy, T2 and T3 (T4) with lateral white, fragmentary open hair bands (dense rows of hairs) (Fig. 18a); T4 with row of hairs between tergite and tergite depression; T5 laterally with yellowish-white hairs, in the centre with yellowish (yellowish-reddish) hairs (Fig. 18a); T6: brown hairs.

Fig. 18: Type specimen (holotype, female) of *Andrena lineolata* WARNCKE, 1968 (OLML Nr. 6952456; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view. (**d**) head, dorsal view.

Structure. Head: clypeus strong convex with impunctate line (Fig. 19a), more or less shagreened (Fig. 19a), slightly dull, deeper punctured (PD: 14-28 µm, PDI: 28 µm) (Fig. 19a), labrum process triangular (50%) (Fig. 19a) or triangular-trapezoidal (50%), slightly rounded on the top, laterally more or less oblique. Mesosoma: deeper and denser punctured, especially in the front (PD: 14 µm) (Fig. 19b); propodeum rugose (Fig. 19c). Metasoma: tergites rough hammertone-like shagreened and shiny; shallow and very scattered but not clearly punctured (PD: 14 µm), T1 very slight stepped depression zone, T2-T4 with deeper depression zones (Fig. 18a).

Male: similar to female with following differences:

Colour. Head: distal half of the mandible not or partly reddened (Fig. 21b); flagellum brown (Figs. 20c, d). Mesosoma: wings light toned (Fig. 20f); pterostigma yellowish in the centre, brown marginated.

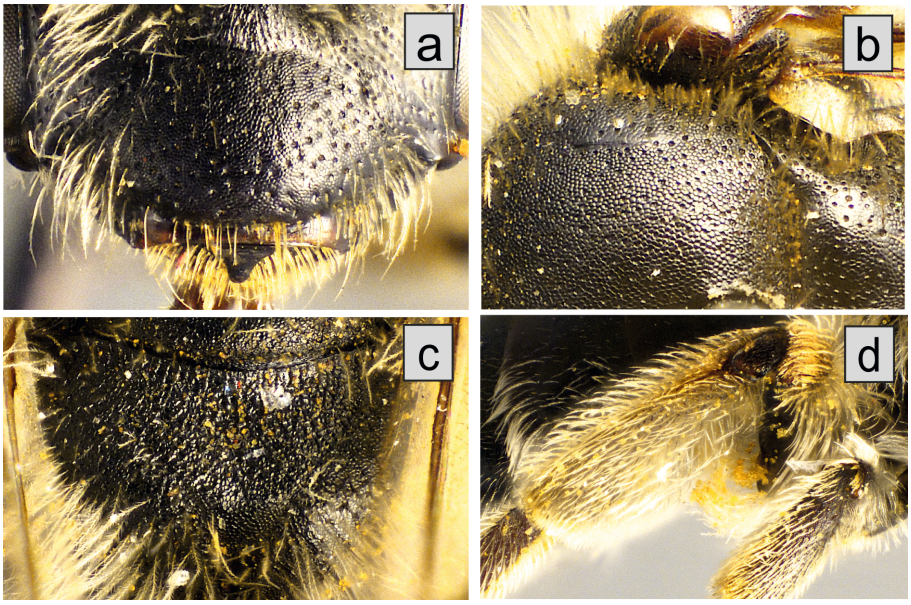


Fig. 19: Type specimen (holotype, female) of *Andrena lineolata* WARNCKE, 1968 (OLML Nr. 6952456; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) clypeus. (**b**) mesonotum. (**c**) propodeum. (**d**) scopa.

Pubescence. Head: clypeus with white hairs but no dark hairs (Fig. 21b); genal area with long white hairs (Fig. 21b). Mesosoma: mesoscutum and mesepisternum with white hairs (Fig. 20d). Metasoma: base of T1 with some white-yellowish hairs, scarcely hairy in the centre, T2-T4 depression zones with laterally white strong fragmented hair bands (dense rows of hairs) (Fig. 20f); T5 with some yellowish hairs; T6 with yellowish and partly reddish hairs in the centre and laterally with yellowish-white hairs (Fig. 20f); ST 8: with long white (yellowish) hairs at the end.

Structure. Head: vertex above the ocelli narrow, as wide as half of the ocellar diameter (Fig. 20e); clypeus larger, deeper, and denser punctured (PD = 14-32 µm); labrum process trapezoidal, emarginated (82%) (Fig. 21b), slightly emarginated (15%), ends left and right side (slightly) thickened (Fig. 21b). Mesosoma: deeper and denser punctured (PD = 14-28 µm); Metasoma: T1 slightly carinate, tergites very shallow and very scattered but not clearly punctured (PD = 14 µm).

Distribution: The main distribution of this endemic species is concentrated in the area Las Cañadas/Teide at altitudes of about 2000 m a.s.l to 3300 m a.s.l. (observations of LARA-ROMERO et al. 2019 about 3300 m a.s.l.). In the literature, some specimens were also detected in the Anaga area at lower altitudes (500-1000 m a.s.l., data from 1928 and 1952); HOHMANN et al. (1993). It was not possible to to prove whether there was any confusion with *A. a. acuta*. Despite intensive screening in March and May, we did not find any individual of *A. lineolata* in the Anaga area.

Fig. 20: Type specimen (paratype, male) of *Andrena lineolata* WARNCKE, 1968 (OLML Nr. 6952455; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus dorsal. (**b**) type label. (**c**) head frontal. (**d**) mesosoma. (**e**) head dorsal. (**f**) metasoma.

F l i g h t p e r i o d : According to HOHMANN et al. (1993), LARA-ROMERO (2019) and own data the flight period is from April to July.

S p e c i m e n s e x a m i n e d : 3♀♀ Tenerife, Caramujo, 2200 m, 28.05.1983, leg. Hohmann (ID-No UMBB210, UMBB214, UMBB215); 1♀ Tenerife, Izaña, 2200 m, 29.06.1982, leg. Hohmann (ID-No UMBB211); 5♀♀ Tenerife, Caramujo, 2200 m, 26.06.1983, leg. Hohmann (ID-No UMBB212, UMBB213, UMBB216-UMBB218); 2♀♀ Tenerife, Las Cañadas, 2400 m, 20.04.1991, leg. Heiss (ID-No OLML151, OLML152); 2♀♀ Tenerife, El Portillo, 1900 m, 15.04.1992, leg. Kratochwil (ID-No KR-CAN60, KR-CAN61); 7♀♀ Tenerife, Izaña, 2292 m, 28°18'8.97"N, 16°30'51.93"W, 20.05.2019, leg. Kratochwil (ID-No KR-CAN1-KR-CAN5, KR-

CAN24, KR-CAN25); 7♀♀ Tenerife, Caramujo, 2216 m, 28°18'24.5"N, 016°32'09.6"W, 21.05.2019, leg. Kratochwil (ID-No KR-CAN29-KR-CAN33, KR-CAN36, KR-CAN37); 1♀ Tenerife, Las Cañadas del Teide, near Restaurant Teide, 2132 m, 28°17'44.9"N, 016°33'56.4"W, 22.05.2019, leg. Kratochwil (ID-No KR-CAN48); 7♀♀ Las Cañadas, Montaña Rajada, 2298 m, 28°15'57.4"N, 016°35'18.3"W, 22.05.2019, leg. Kratochwil (ID-no KR-CAN49-KR-CAN55); 3♀♀ Tenerife, Caramujo, 2200 m, 28.05.1983, leg. Hohmann (ID-No UMBB245-UMBB247); 20♂♂ Tenerife, Izaña, 2200 m, 22.05.1983, leg. Hohmann (ID-No UMBB219-UMBB238); 7♂♂ Tenerife, El Portillo, 1900 m, 22.05.1983, leg. Hohmann (ID-No UMBB239-UMBB244, UMBB248); 2♂♂ Tenerife, Las Cañadas, 2400 m, 20.04.1991, leg. Heiss (ID-No OLML152b, OLML153); 1♂ Tenerife, Las Cañadas, Parador, 2150 m, 19.04.1989, leg. Schwarz (ID-No OLML154); 3♂♂ Tenerife, El Portillo, 2000 m, 15.04.1992, leg. Kratochwil (ID-No KR-CAN58, KR-CAN59, KR-CAN62); 3♂♂ Tenerife, El Portillo, 1900 m, 15.04.1992, leg. Kratochwil (ID-No KR-CAN58, KR-CAN59, KR-CAN62); 9♂♂ Tenerife, Izaña, 2292 m, 28°18'8.97"N, 16°30'51.93"W, 20.05.2019, leg. Kratochwil (ID-No KR-CAN6-KR-CAN10, KR-CAN13-KR-CAN15, KR-CAN23); 4♂♂ Tenerife, Caramujo, 2216 m, 28°18'24.5"N, 016°32'09.6"W, 21.05.2019, leg. Kratochwil (ID-No KR-CAN26-KR-CAN28, KR-CAN35); 1♂ Tenerife, Las Cañadas del Teide, near Restaurant Teide, 2132 m, 28°17'44.9"N, 016°33'56.4"W, 22.05.2019, leg. Kratochwil (ID-No KR-CAN47).

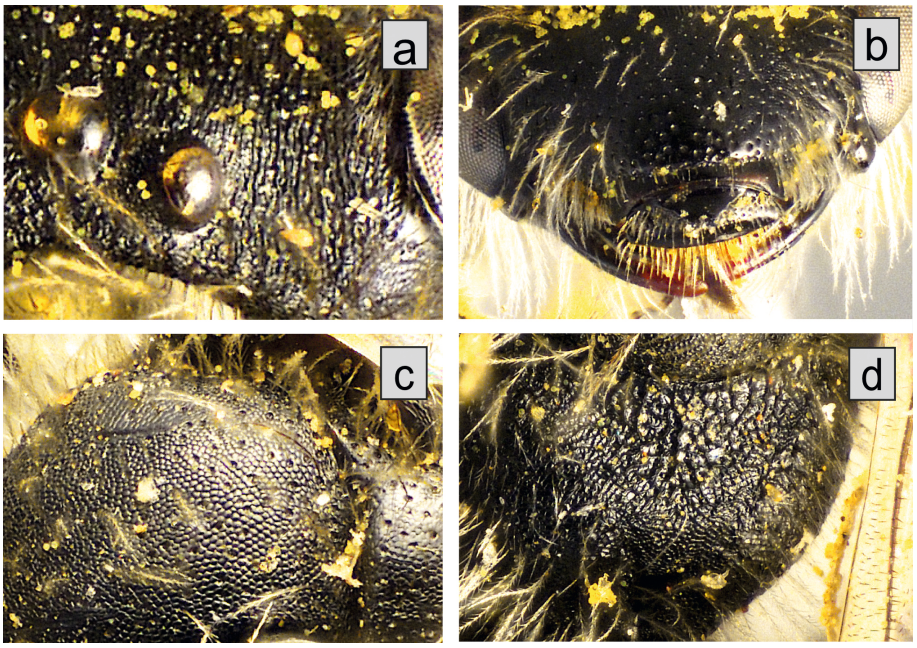


Fig. 21: Type specimen (paratype, male) of *Andrena lineolata* WARNCKE, 1968 (OLML Nr. 6952455; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) mesonotum. (**d**) propodeum.

Andrena tiaretta WARNCKE, 1974

H o l o t y p e : 1♂ Algeria, Tiaret, collecting time and collector unknown (ID-No OLML112).

P a r a t y p e s : 1♀ Morocco, Tanger, collecting time and collector unknown (ID-No OLML110); 1♀ Algeria, Santa Cruz, Oran, collecting time unknown, leg. Dr. J. Bequaert (ID-No OLML111); 1♀ Algeria, Algier, collecting time and collector unknown (ID-No OLML121); 1♀ Algeria, Algier, Forêt de Baïnem, 09.06.1910, leg. Dr. J. Bequaert (ID-No OLML122); 1♀ Algeria, Oran, Noiseux,

19.04.1910, leg. Dr. J. Bequaert (ID-No OLML126); 1♀ Algeria, Algier, 24.05.1910, leg. Dr. J. Bequaert (ID-No OLML129); 2♂♂ Morocco, Tanger, collecting time and collector unknown (ID-No OLML113, OLML114, OLML118); 1♂ Algeria, 28.03.1890, collector unknown (ID-No OLML117); 1♂ southern Algeria, collecting time and collector unknown (ID-No OLML119); 1♂ Algeria, Tiaret, collecting time and collector unknown (ID-No OLML123); 1♂ Morocco, Fez, Djebel Zalagh, 25.03.1923, collector unknown, *A. parvula* det. Schulthess (ID-No OLML124); 2♂♂ Algeria, Algier, Bir Mourad Raïs, 24.03.1910, leg. Dr. J. Bequaert (ID-No OLML130, OLML131); 1♂ Algeria, Algier, Santa Cruz, Oran, collecting time unknown, leg. Dr. J. Bequaert (ID-No OLML131).

S t a t u s : WARNCKE (1974) described *Andrena tiaretta* from Morocco, Algeria, Libya, and Egypt. In the Warncke collection of Linz, the holotype (male) and 29 paratypes (14♀♀, 15♂♂) were deposited (BLANK & KRAUS 1994, KRATOCHWIL 2015). The distribution area of the whole set of specimens (20♀♀, 23♂♂) covers a large area from southern Spain, Morocco, Algeria, Libya, Egypt, and Israel, to western Syria and (with one specimen) to northern Iran. In a revision with morphological and morphometric methods (KRATOCHWIL 2015), the specimens of Spain, Morocco, and Algeria could be assigned to *A. tiaretta* WARNCKE, 1974 (holotype: 1♂; paratypes: 6♀♀, 9♂♂), but the eastern populations were described as a new species: in the case of Lybia as *A. cyrenaica* KRATOCHWIL, 2015, and in the case of Israel and Syria as *A. orientalis* KRATOCHWIL, 2015.

F o r m e r d e s c r i p t i o n s : According to WARNCKE (1974) the species is characterised as follows (translated from German): ‘Females with the clypeus more flattened, completely shagreened, hence dull, evenly punctured, with with impunctate line; mesonotum clearly shagreened, dull, slightly finer punctured; central area of the propodeum granuled shagreened, only on the basal half with rugulae; distal part almost grainy; tergites hammer-like shagreened, only laterally slightly punctured. Males similar to females, 2nd flagellomere much longer than the 4th; the following flagellomeres square; tergites with no significant depression zones.’

D i a g n o s t i c q u a l i t a t i v e f e a t u r e s : In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. tiaretta* is characterised by the following specific features:

F e m a l e : C o l o u r . Head: flagellum dorsal brown, ventral light brown (Figs. 22a, c, d). Mesosoma: tibia mostly black (dark brown), basitarsus mostly reddish-brown, mediotarsi yellowish-reddish (Fig. 22a); wings light brownish toned, veins yellowish-reddish brown (Fig. 22a); pterostigma yellowish, brown marginated (Fig. 22a). Metasoma: T1-4 black with reddish-brown depression zone (Fig. 22a); T5 reddish-brown.

P u b e s c e n c e . Head: clypeus and supraclypeal area with white, not dense hairs; paraocular area with white hairs (Fig. 22d), no dark hairs between subantennal socket and facial fovea; scapus and antennal socket with dorsal longer and ventral shorter white hairs (Fig. 22c); genal area with white (67%) (Fig. 22c) or white-yellowish hairs (33%); facial fovea in the upper part with reddish hairs (Fig. 23a), in the lower part with white hairs (Fig. 22d). Mesosoma: mesoscutum and scutellum with white-yellowish hairs, laterally in the front with longer hairs (Fig. 22e); mesepisternum with white hairs; propodeal corbicula with some white hairs and some hairs in the centre; trochanteral and femoral flocculus with white hairs; tibial scopa dorsally, dorsobasally and ventrally with white hairs (Fig. 23e). Metasoma: tergites scarcely hairy, T2 and T3 (T4) with fragmentary white hair bands (Fig. 22f); T4 with row of hairs between tergite and tergite depression (Fig. 22f); T5

laterally with yellowish-white hairs, in the centre with yellowish or yellowish-reddish hairs (Fig. 22f); T6: with brown hairs.

Structure. Head: clypeus slightly convex with fragmented (50%) (Fig. 23b) or without impunctate line (50%), slightly shagreened, denser shagreened in the front, slightly dull, deeper punctured (PD: 14-28 µm, PDI: 14-42 µm) (Fig. 23b); labrum process liguliform-trapezoidal (Fig. 23b), top rounded, partly thickened, laterally on the top more or less oblique. Mesosoma: deeper and denser punctured, especially in the front (PD: 14-28 µm); propodeum clearly rugose in two third of the area and in dorsoventral area, long basal lamina, other area fine-grained shagreened (Fig. 23d). Metasoma: tergites rough hammertone-like shagreened and shiny; shallow and very scattered but not clearly punctured (PD: 14-28 µm) (Fig. 23f), T1 with very slight stepped depression zone, T2-T4 with deeper depression zones (Fig. 22f).

Male: similar to female with following differences:

Colour. Head: distal half of the mandible not or partly reddened; flagellum brown (Figs. 24a, c, d). Mesosoma: wings light toned (Fig. 24a); pterostigma yellowish (80%), yellowish-reddish (13%) (Fig. 24a), reddish (7%); all reddish-brown marginated (Fig. 24a).

Pubescence. Head: supraclypeal area with white hairs (67%) (Figs. 24c, d) or with some brown hairs (33%); scapus and antennal socket with dorsal longer white-yellowish hairs (71%) or with dorsal longer white hairs (29%) (Fig. 24d), no difference between dorsal or ventral side; genal area with long white-yellowish hairs. Mesosoma: mesoscutum and mesepisternum with white-yellowish hairs. Metasoma: scarcely hairy (Fig. 24e), T2-T3 with laterally longer white hairs, no distinct hair bands (63%) (Fig. 24e) but with fragmentary rows of hairs between the tergite and the tergite depression or with fragmentary white hair bands (37%); T5, T6 with white hairs, slightly yellowish; ST 8 with long white-yellowish hairs at the end.

Structure. Head: vertex above the ocelli narrow, as wide as half of the ocellar diameter (60%) (Fig. 24d) or as a ocellar diameter (40%); clypeus deeper punctured (PD: 28-38 µm, PDI: 14-32 µm) (Fig. 25b), labrum process trapezoidal, ends left and right side slightly thickened (Fig. 25b). Mesosoma: deeper and denser punctured (PD: 14-28 µm) (Fig. 25c), propodeum clearly rugose in the whole area, with short basal lamina (Fig. 25d); Metasoma: T1 slightly carinate, tergites very shallow and very scattered but not clearly punctured (PD: 14 µm) (Fig. 25e).

Distribution: The distribution of this species covers Spain, Morocco, and Algeria (KRATOCHWIL 2015).

Flight period: from March to May.

Further specimens examined: 1♀ Morocco, Fez, 31.03.1980, leg. Warncke (ID-No OLML88); 1♀ Spain, Estepona, 01.-11.04.1985, leg. H. Wolf (ID-No OLML89); 2♂♂ Spain, Estepona, 01.-11.04.1985, leg. H. Wolf (ID-No OLML90, OLML91); 2♂♂ Spain, Province Cádiz, Rio Palmones, Algeciras 07.04.1985, leg. W. Schacht (ID-No OLML93, OLML94).

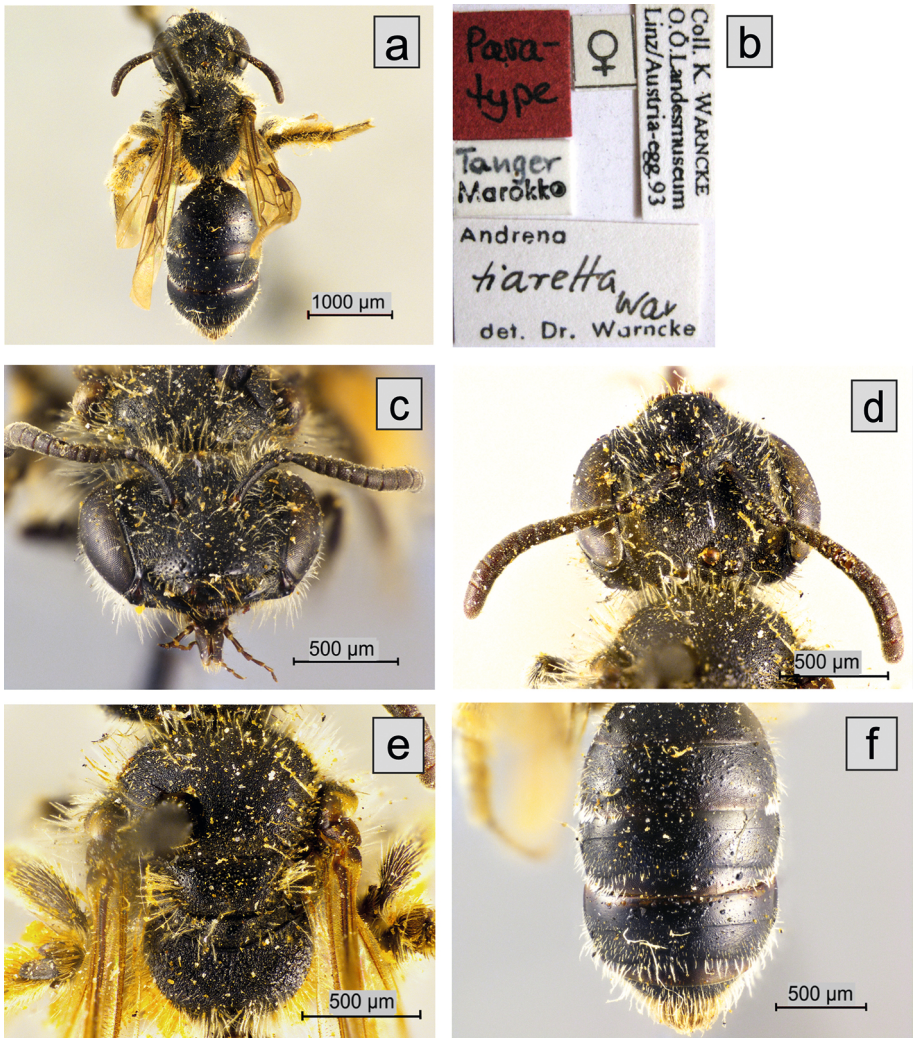


Fig. 22: Type specimen (paratype, female) of *Andrena tiaretta* WARNCKE, 1974 (OLML Nr. 6952717; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view (**d**) head, dorsal view. (**e**) mesosoma. (**f**) metasoma.

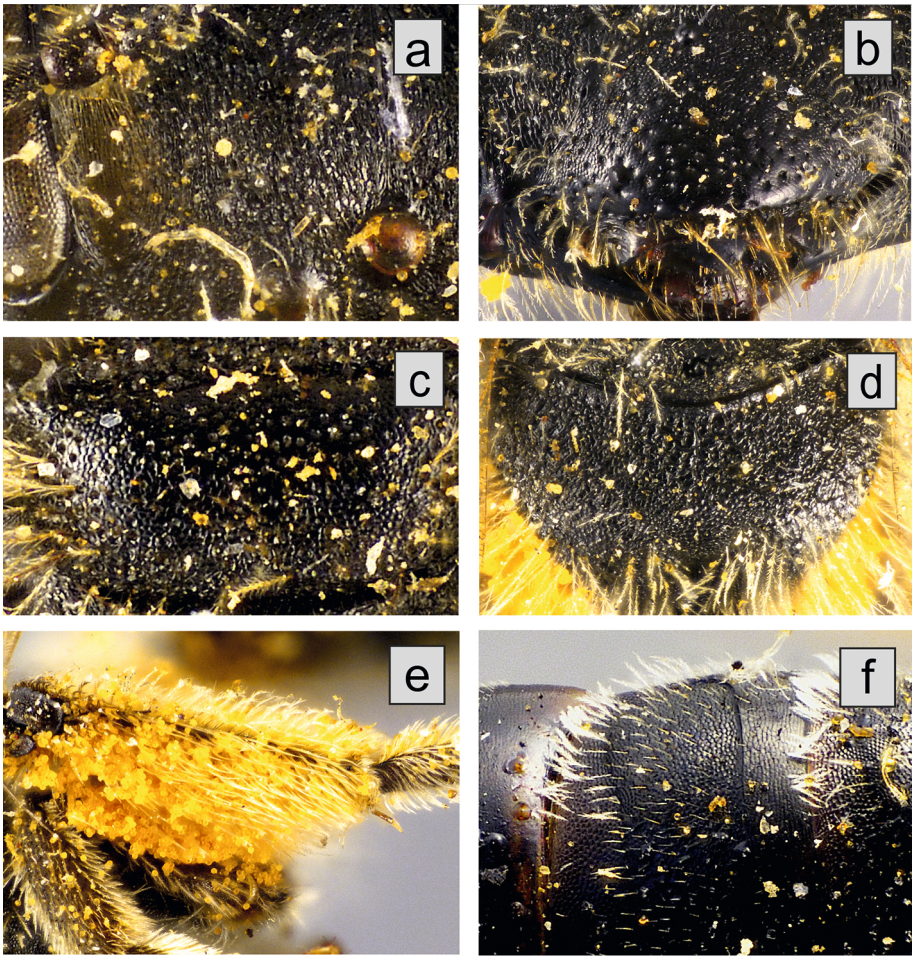


Fig. 23: Type specimen (paratype, female) of *Andrena tiaretta* WARNCKE, 1974 (OLML Nr. 6952717; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) scutellum. (**d**) propodeum. (**e**) scopa. (**f**) metasoma.

Andrena wollastoni COCKERELL, 1922

Syn. *Andrena wollastoni wollastoni* WARNCKE, 1993

L e c t o t y p e : 1♀ Madeira, register label 'Madeira 58-21', handwritten type label by Cockerell '*Andrena wollastoni* Ckll Type', round label with blue margin printed 'Syntype', underneath printed label 'B. M. Type Hym.' and handwritten '17a2645' (registration number of Hymenoptera types of the NHMUK), barcode number NHMUK 012064942; photos of specimens and labels in KRATOCHWIL (2018).

P a r a l e c t o t y p e s : 1♀ Madeira, handwritten with ink on a square cardboard '1165', register label 'Madeira 58-21', label printed 'In B.M. 1967', handwritten '*A. wollastoni* Ckll.? = *minutula*', label printed '*Andrena*', handwritten '*wollastoni*', printed 'det. Dr. Warncke', round label with blue margin printed 'Syntype' (similar to lectotype), barcode number NHMUK (010811987), photos of

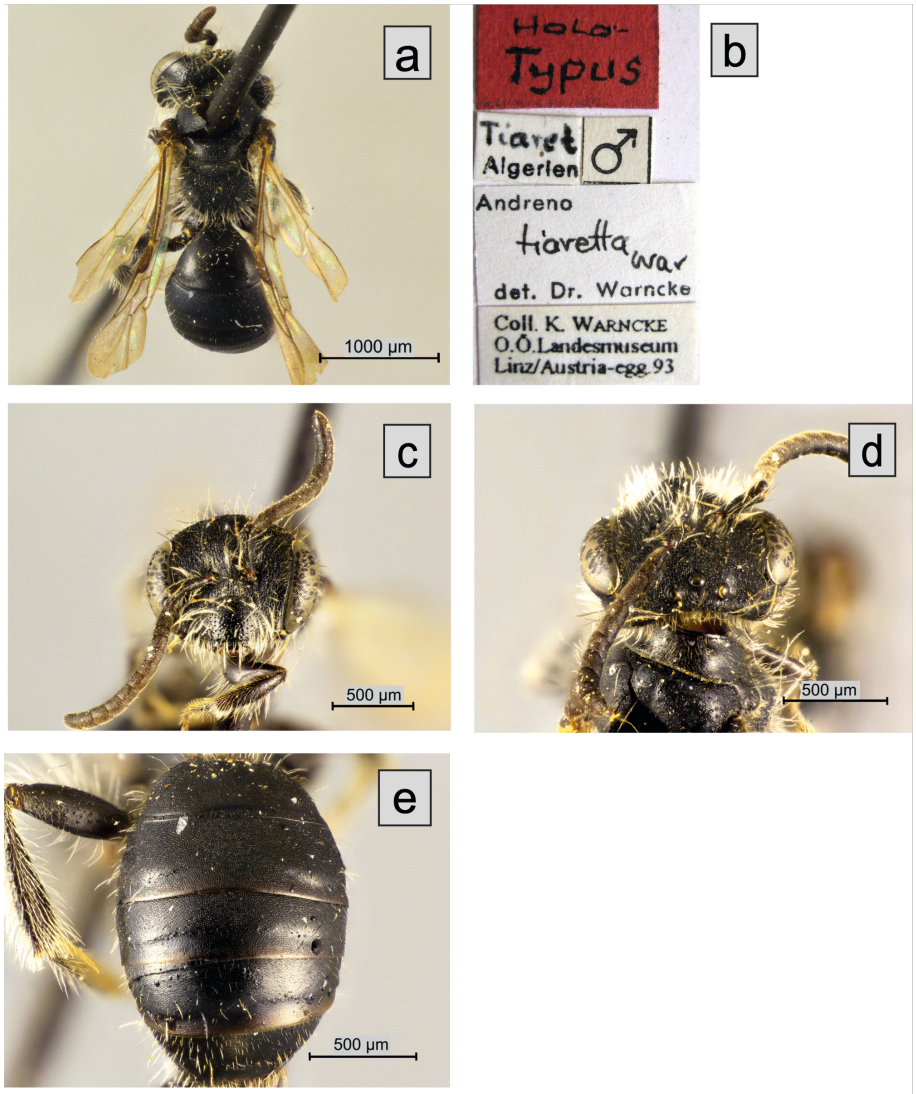


Fig. 24: Type specimen (holotype, male) of *Andrena tiaretta* WARNCKE, 1974 (OLML Nr. 6952716; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) habitus, dorsal view. (**b**) type label. (**c**) head, frontal view. (**d**) head, dorsal view. (**e**) mesosoma. (**f**) metasoma.

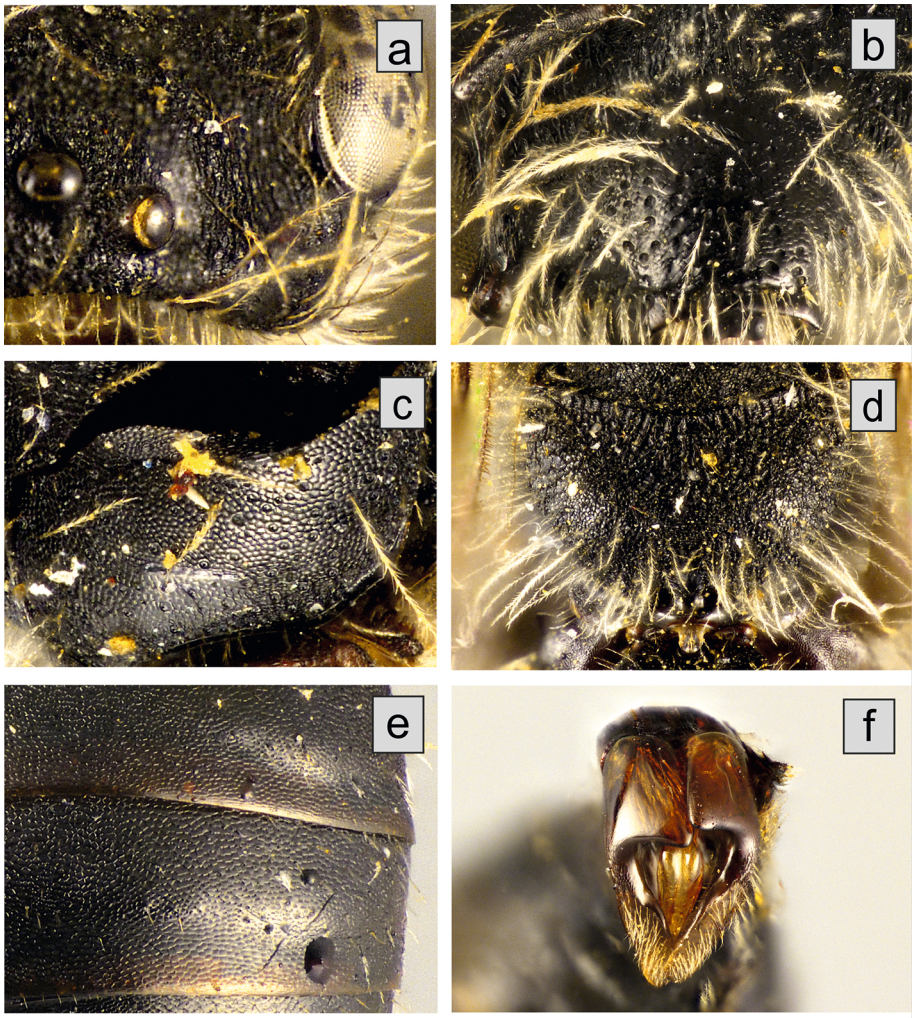


Fig. 25: Type specimen (holotype, male) of *Andrena tiaretta* WARNCKE, 1974 (OLML Nr. 6952716; ZOBODAT, 05.02.2020; biogeographical data set). (**a**) upper face with rugulae. (**b**) clypeus. (**c**) mesonotum. (**d**) propodeum. (**e**) metasoma. (**f**) genital, dorsal view.

specimen and labels in KRATOCHWIL (2018); 1♀ Madeira, handwritten with ink on a square cardboard '1087'; register label 'Madeira 58-21', round label with blue margin printed 'Syntype' (similar to lectotype), barcode number NHMUK 010811988, photos of specimen and labels in KRATOCHWIL (2018); 3♀♀ Madeira, register label 'Madeira 58-21', round label with blue margin printed 'Syntype' (similar to lectotype), barcode numbers NHMUK 010811989, NHMUK 01081199, NHMUK 010811991.

S t a t u s : COCKERELL (1922) described six syntypes of *Andrena wollastoni* from Madeira and Porto Santo, collected by T. V. Wollaston or some of his fellow collectors and deposited in the NHMUK. KRATOCHWIL (2018) designated one female specimen (Fig.

26), characterised by Cockerell, with a type label as a lectotype; the five other specimens (also females) of the series were designated as paralectotypes. COCKERELL (1922) also characterised two further males also as types (collected by Rev. Alfred E. Eaton, Monte, Funchal, Madeira, 06.03.1902, at an altitude of about 11.000 feet). These males should be part of the Eaton collection and were determined by SAUNDERS (1903) as *A. minutula*, KIRB. These specimens should be deposited in the NHMUK (COCKERELL 1922). The whereabouts of the male type specimens of the Eaton collection remain unknown (KRATOCHWIL 2018). The distribution area of *A. wollastoni* covers Madeira Island. In the context of the new description of *A. dourada, A. wollastoni* was described in detail in KRATOCHWIL & SCHEUCHL (2013) concerning status, former descriptions, up-to-date description, historical records, subgenus classification, distribution and habitat characteristics, and flight period (flower visiting behavior in KRATOCHWIL et al. 2019).

Former descriptions: The description of COCKERELL (1922) is based on some morphological features: 'Female. – Like *Andrena minutula* KIRBY, but area of metathorax dull and granular, with sculptures hardly visible under a lens, mesothorax less punctured; stigma larger and darker. Male. – Recorded by E. Saunders from the Mount, Funchal (Eaton); the specimens are in the British Museum. He remarks that they are apparently *minutula*, a form with the mesonotum rugulose and with very distinct shallow punctures, with the long-haired face characteristic of the first brood.' GUSENLEITNER & SCHWARZ (2002) give a more detailed description (translated from the German version): 'Especially characteristic is the fine-grained, nearly unpunctured or weakly punctured mesonotum and the fine tongue-shaped labrum process (variation in subspecies). The central area of propodeum is large, mostly homogeneously grainy shagreened with centrally orientated weakly developed sutural structures. The tergite structure is very variable reaching from clearly shagreened to nearly unshagreened and therefore strongly shining. The depressions of tergite 3 and tergite 4 are clearly deepened. Some specimens show at the margins of tergite 1 the beginning of bar development. Males and females can be characterised by dorsal thorax structure. The smooth surface and borderline of the depressions are conspicuous. The genital structure is not complex similar to *A. minutula* but with some differences in the shape of gonostyli.'

Diagnostic qualitative features: In addition to the morphological characteristics that are typical for the taxa of the *A. wollastoni* group, *A. wollastoni* is characterised by the following specific features:

Female: Colour. Head: flagellum black (dark brown) (Fig. 26a, c). Mesosoma: tibia and basitarsus black (dark brown) (96%) (Fig. 26c), partly reddish-brown (4%); mediotarsi reddish-brown; wings brownish toned (Figs. 26c), veins reddish-brown; pterostigma dark yellowish or reddish-brown (Fig. 26c).

Pubescence. Head: clypeus and supraclypeal area with yellowish-white but not dense hairs (Fig. 26d); paraocular area with yellowish-white hairs (Fig. 26d), many brownish or black hairs between the subantennal socket and the facial fovea; scapus and antennal socket with dorsal longer brownish and ventral shorter yellowish hairs (Fig. 26d); genal area with yellowish-white hairs (Fig. 26c); facial fovea with brown hairs. Mesosoma: mesoscutum and scutellum with yellowish-brownish hairs, in some cases laterally some yellowish hairs; mesepisternum with yellowish-white hairs; propodeal corbicula with some yellowish-white hairs and some hairs in the centre; trochanteral and femoral

flocculus with yellowish-white hairs; tibial scopa with yellowish-white hairs, dorsoventrally with dark brown hairs or hair tips (Fig. 26e). Metasoma: tergites scarcely hairy, T2 and T3 (T4) with laterally yellowish-white, fragmentary open hair bands (dense row of hairs) (Fig. 26c); T4 with row of hairs between tergite and tergite depression; T5 laterally yellowish-white hairs, in the centre reddish-brownish hairs reaching the pygidium (Fig. 26c); T6: dark brown hairs.

Structure. Head: clypeus convex without impunctate line, clearly shagreened, slightly dull, shallow punctured, more or less densely punctured (PD: 28 µm, PDI: 14-84[112] µm) (Fig. 27d), labrum process trapezoidal (86%), trapezoidal-liguliform (7%), liguliform (3.5%) or trapezoidal-triangular (3.5%); trapezoidal form slightly emarginated or emarginated with the ends left and right side thickened or the top rounded, laterally on the top more or less oblique. Mesosoma: shallow and very scattered punctured, denser punctured in the front (PD: 14 µm); propodeum slightly rugose in the basal centre and in dorsoventral area, with short basal lamina, other area fine-grained shagreened. Metasoma: tergites rough hammertone-like shagreened and shiny; shallow and very scattered not clearly punctured (PD: 14 µm), T1 not or very slight stepped depression zone (Fig. 26a), T2-T4 with deeper depression zones (Fig. 26a).

Male: similar to female with following differences:

Colour. Head: distal half of the mandible not reddened; flagellum dark brown (56%) or black (44%). Mesosoma: wings light brownish toned; pterostigma brown (96%) or yellowish (4%).

Pubescence. Head: clypeus with yellowish-white hairs, but no dark hairs; genal area upper part with brownish hairs, lower part with long yellowish-white hairs. Mesosoma: mesoscutum with yellowish-brownish hairs, mesepisternum with yellowish-white (96%) or yellowish (4%) longer hairs. Metasoma: some short hairs, T2 and T3 no distinct hair bands, but rows of hairs between the tergite and the tergite depression, T2, T3 with fragmentary hair bands (52%) or without hair bands (48%); T5 and T6 with longer yellowish-white hairs; ST 8 with long yellowish hairs at the end.

Structure. Head: vertex above the ocelli narrow, as wide as half of the ocellar diameter; clypeus shallow and denser punctured (PD: 28 µm, PDI 14-28 µm), labrum process trapezoidal, emarginated, the ends left and right side thickened. Mesosoma: very shallow scattered punctured, especially in the front (PD: 14 µm), propodeum rugose, primarily in the centre and in the dorsolateral area, with short basal lamina, other area fine-grained shagreened. Metasoma: T1 slightly carinate, tergites shallow and very scattered but not clearly punctured (PD: 14µm).

Distribution: *A. wollastoni* is endemic to Madeira Island. This species occurs from sea level up to altitudes of 1750 m a.s.l.

Flight period: from February to July.

Fig. 26: Type specimen (lectotype) of *Andrena wollastoni* COCKERELL, 1922 (NHMUK). Photos by D. Notton: (**a**) habitus, dorsal view. (**b**) register label, syntype label, lectotype label, type number label, barcode number. (**c**) habitus, lateral view. (**d**) head, frontal view. (**e**) scopa.

Further specimens examined: Females: 4♀♀ Madeira, Castelo, south of Camacha, 500 m, 32°39'51.20"N, 16°50'46.06"W, 09.04.1995, leg. Kratochwil (ID-No KR-MA95/37-KR-MA95/40); 2♀♀ Madeira, Castelo, south of Camacha, 500 m, 32°39'51.20"N, 16°50'46.06"W, 09.04.1995, leg. Kratochwil (ID-No KR-MA95/41, KR-MA95/42); 4♀♀ Madeira, Castelo, south of Camacha, 500 m, 32°39'51.20"N, 16°50' 46.06"W, 09.04.1995, leg. Kratochwil (ID-No KR-MA95/43-KR-MA95/46); 2♀♀ Madeira, Castelo, south of Camacha, 500 m, 32°39'51.20"N, 16°50'46.06"W, 09.04.1995, leg. Kratochwil (ID-No KR-MA95/47, KR-MA95/48); 1♀ Madeira, Ponta de São Lourenço, 71 m, 32°44'35.16"N, 16°42'1.06"W, 10.04.1995, leg. Kratochwil (ID-No KR-MA95/49); 1♀ Madeira, Ponta de São Lourenço, 71 m, 32°44'35.16"N, 16°42'1.06"W, 10.04.1995, leg. Kratochwil (ID-No KR-MA95/50); 1♀ Madeira, Pico do Facho, Machico, 320 m, 32°43'22.49"N, 16°45'30.60'W,10.04.1995, leg. Kratochwil (ID-No KR-MA95/51); 1♀ Madeira, Ponta de São Lourenço, above Rochinha, 80 m, 32°44'40.19"N, 16°43'22.21"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/31); 1♀ Madeira, Ponta de São Lourenço, above Rochinha, 100 m, 32°44'44.01"N, 16°43'20.31"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/33); 1♀ Madeira, Ponta de São Lourenço, 100 m, 32°44'44.01"N, 16°43'20.47"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/34); 1♀ Madeira, Ponta de São Lourenço, 100 m, 32°44'44.01"N, 16°43'20.47"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/35); 1♀ Madeira, Ponta de São Lourenço, 100 m, 32°44'44.0"N, 16°43'20.74"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/39); 5♀♀ Madeira, Ponta de São Lourenço, 70 m, 32°44'42.29"N, 16°43'07.48"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/44-KR-MA05/47, KR-MA05/50); 1♀ Madeira, Eirinha above Serra de Água, 480 m, 32°43'54.22"N, 17°01'30.19"W, 27.03.2005, leg. Kratochwil (ID-No KR-MA05/68); 5♀♀ Madeira, Serra de Água, lookout point, 460 m, 32°43'50.79"N, 17°01'26.59"W, 27.03.2005, leg. Kratochwil (ID-No KR-MA05/70, KR-MA05/71, KR-MA05/78, KR-MA05/84, KR-MA05/85); 2♀♀ Madeira, Serra de Água, lookout point, 460 m, 32°43'50.79"N, 17°01'26.59"W, 27.03.2005, leg. Kratochwil (ID-No KR-MA05/81, KR-MA05/83); 1♀ Madeira, Serra de Água, lookout point, 460 m, 32°43'50.79"N, 17°01'26.59"W, 27.03.2005, leg. Kratochwil (ID-No KR-MA05/91); 1♀ Madeira, Cabo Girão, south of Quinta Grande, 610 m, 32° 39'27.08"N, 17° 00'23.91"W, 28.03.2005, leg. Kratochwil (ID-No KR-MA05/103); 1♀ Madeira, Fayã dos Padres, west of Quinta Grande, 330 m, 32°39'21.12"N, 17°01'04.44"W, 28.03.2005, leg. Kratochwil (ID-No KR-MA05/121); 3♀♀ Madeira, Câmara do Bispo, south of Quinta Grande, 350 m, 32°39'17.50"N, 17°01'02.02"W, 28.03.2005, leg. Kratochwil (ID-No KR-MA05/127-KR-MA05/129); 1♀ Madeira, west of Ponta do Garajau, south of Caniço, 80 m, 32°38'23.20"N, 16°51'13.01"W, 30.03.2005, leg. Kratochwil (ID-No KR-MA05/178); 1♀ Madeira, Funchal, in front of Jardim Botânico, 300 m, 32°39'41.27"N, 16°53'41.25"W, 30.03.2005, leg. Kratochwil (ID-No KR-MA05/188); 1♀ Madeira, above Paul do Mar, ER 212, 30 m, 32°45'29.52"N, 17°13'41.76"W, 03.04.2005, leg. Kratochwil (ID-No KR-MA05/297); 1♀ Madeira, Ponta de São Lourenço, 80 m, 32°44'40.19"N, 16°43'22.21"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/358); 2♀♀ Madeira, south of São Jorge, ER 101, 200 m, 32°49'31.59"N, 16°53'56.82"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/366, KR-MA05/367); 3♀♀ Madeira, south of São Jorge, ER 101, 200 m, 32°49'31.59"N, 16°53'56.82"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/368-KR-MA05/370); 2♀♀ Madeira, south of São Jorge, ER 101, 200 m, 32°49'31.59"N, 16°53'56.82"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/371, KR-MA05/372); 1♀ Madeira, Referta south of Porto da Cruz, 200 m, 32°45'18,77"N, 16°49'07,14"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/380); 1♀ Madeira, Referta south of Porto da Cruz, 200 m, 32°45'18,77"N, 16°49'07,14"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/381); 1♀ Madeira, Referta south of Porto da Cruz, 200 m, 32°45'18,77"N, 16°49'07,14"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/382); 1♀ Madeira, Pico do Facho, Machico, 320 m, 32°43'22.49"N, 16°45'30.60'W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/383); 5♀♀ Madeira, Rosario, 300 m, 32°46'36.57"N, 17°01'53.54"W, 03.04.1994, leg. Hohmann (ID-No UMBB49, UMBB52-UMBB54, UMBB65); 1♀ Madeira, Reis Magos, 20 m, 32°38'50.38"N, 16°49'27.93"W, 13.04.1994, leg. Hohmann (ID-No UMBB50); 10♀♀ Madeira, Jardim do Mar, 50 m, 32°44'18.64"N, 17°12'40.44"W, 02.04.1994, leg. Hohmann (ID-No UMBB56-UMBB60, UMBB69-UMBB72, UMBB100); 2♀♀ Madeira, Maloeira, 640 m, 32°45'55.93"N, 17°12'32.23"W, 02.04.1994, leg. Hohmann (ID-No UMBB61, UMBB62); 20♀♀ Madeira, Caniçal, 35 m, 32°44'20.68"N, 16°44'17.61"W, 31.03.1994, leg. Hohmann (ID-No UMBB66-UMBB68, UMBB73-UMBB89); 1♀ Madeira, Ribeira da Janela, 640 m, 32°50'16.58"N, 17°09'21.20"W, 03.04.1994, leg. Hohmann (ID-No UMBB93); 6♀♀ Madeira, Paul da Serra, 1400 m,

32°45'26.99"N, 17°05'49.83"W, 10.04.1994, leg. Hohmann (ID-No UMBB94-UMBB99); 1♂ Madeira, Pico do Facho, Machico, 320 m, 32°43'22.49"N, 16°45'30.60'W, 10.04.1995, leg. Kratochwil (ID-No KR-MA95/52); 7♂♂ Madeira, Ponta de São de Lorenzo, above Rochinha, 70 m, 32°44'42.29"N, 16°43'07.48"W, 26.03.2005, leg. Kratochwil (ID-No KR-MA05/42, KR-MA05/43, KR-MA05/48, KR-MA05/49, KR-MA05/51-KR-MA05/53); 3♂♂ Madeira, Cabo Girão, south of Quinta Grande, 610 m, 32°39'27.08"N, 17°00'23.91"W, 28.03.2005, leg. Kratochwil (ID-No KR-MA05/101, KR-MA05/102, KR-MA05/137); 2♂♂ Madeira, Cabo Girão, south of Quinta Grande, 610 m, 32°39'27.08"N, 17°00'23.91"W, 28.03.2005, leg. Kratochwil (ID-No KR-MA05/110, KR-MA05/112); 1♂ Madeira, Câmara do Bispo, south of Quinta Grande, 350 m, 32°39'17.50"N, 17°01'02.02"W, 28.03.2005, leg. Kratochwil (ID-No KR-MA05/130); 5♂♂ Madeira, west of Boca do Risco, 700 m, 32°45'23.76"N, 16°47'26.45"W, 29.03.2005, leg. Kratochwil (ID-No KR-MA05/143-KR-MA05/147); 5♂♂ Madeira, Referta, south of Porto da Cruz, 200 m, 32°45'18,77"N, 16°49'07,14"W, 29.03.2005, leg. Kratochwil (ID-No KR-MA05/162-KR-MA166); 1♂ Madeira, Cova do Negro, west of Rabaçal, 1130 m, 32°48'23.66"N, 17°11'50.04"W, 02.04.2005, leg. Kratochwil (ID-No KR-MA05/249); 1♂ Madeira, above Porto Monitz, 390 m, 32°51'35.12"N, 17°10'26.56"W, 03.04.2005, leg. Kratochwil (ID-No KR-MA05/286); 1♂ Madeira, S. Jorge, 250 m, 32°50'03.66"N, 16°54'21.61"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/373, KR-MA05/374); 1♂ Madeira, São Jorge, 250 m, 32°50'03.66"N, 16°54'21.61"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/375); 1♂ Madeira, São Jorge, 250 m, 32°50'03.66"N, 16°54'21.61"W, 06.04.2005, leg. Kratochwil (ID-No KR-MA05/376); 5♂♂ Madeira, Ribeira da Janela, 650 m, 35.50N, 17.11W, 12.-16.05.2007, leg. Hentscholek (ID-No OLML1-OLML5); 2♂♂ Madeira, north of João Frino, 13.04.1994, leg. Hohmann (ID-No UMBB101, UMBB102); 3♂♂ Madeira, Achada do Cedro Gordo, 04.04.1994, leg. Hohmann (ID-No UMBB103-UMBB105).

3. Keys of the females and males of the species of the *Andrena wollastoni* group

As expected, the most significant qualitative morphological similarity can be detected between the species *A. tiaretta* (mainland species) and *A. lineolata* (Canary Islands, Tenerife, area of Las Cañadas), which were characterised as species by WARNCKE (1968, 1974). In all other species or subspecies, which were formerly assigned by WARNCKE (1968) to *A. wollastoni*, these differences are variably pronounced but strong enough for a species or subspecies description. For some taxa, there is variation in some features; the proportions of the characteristics are given as percentages. In general, a dominant feature may be discernible. In comparison to the females, the males can be differentiated less clearly. This is especially the case between *A. gomerensis* and *A. acuta*. For better discrimination, the important features in the keys are underlined.

Females

1 clypeus deeper punctured; mesoscutum and scutellum fine-grained shagreened, deeper and denser punctured especially in the front; tergites rough hammertone-like shagreened; flagellum dorsally dark brown, ventrally light brown; colour of the mediotarsi yellowish-reddish; wings light brownish toned, colour of the veins yellowish or reddish-brown; T1-T4 black with reddish-brown depression zones; clypeus and parocular area with white hairs; mesoscutum with white-yellowish hairs; mesepisternum, propodeal corbicula, trochanteral, and femoral flocculus with white hairs; tibial scopa with white hairs; T2-T3 (T4) with fragmentary white hair bands; T5 with yellowish-reddish hairs in the centre 2

- clypeus shallow punctured; fine-grained shagreened, shallow, and very scattered punctured especially in the front; tergites hammertone-like shagreened but not rough, flagellum black or dark brown; colour of the mediotarsi reddish-brown (exception *Andrena catula*); wings brownish toned, colour veins reddish-brown; T1-4 black with black to dark reddish-brown depression zones; clypeus and parocular area with white-yellowish or yellowish-white hairs; mesoscutum with yellowish or yellowish-brownish hairs; mesepisternum, propodeal corbicula, trochanteral, and femoral flocculus with white-yellowish or yellowish-white hairs; tibial scopa with yellowish-white hairs, T2-T3 (T4) with fragmentary white-yellowish or

yellowish-white hair bands; T5: reddish-brownish hairs in the centre.....3

2 clypeus slightly convex with fragmented or without impunctate line; clypeus slightly shagreened (PD: [14-]28 µm; PDI: 14-42[58] µm); labrum process liguliform-trapezoidal; propodeum clearly rugose in two-third of the area and in the dorsolateral area, long basal lamina; colour of the tibia and the basitarsus reddish-brown; tibia mostly black or dark brown; basitarsus mostly reddish-brown; HL/HW index 0.8; LPW 0.12 mm .... *Andrena tiaretta* WARNCKE

- clypeus strong convex with impunctate line; clypeus slightly and denser shagreened in the front, clearly shagreened at the base (PD: 14-28 µm; PDI: 14-42[58] µm); labrum process triangular or triangular-trapezoidal; propodeum primarily in the basal centre and in the dorsolateral area rugose, with short basal lamina; mesosoma PD: 14-28 µm; tergites PD: 14-28 µm; colour of tibia and basitarsus brown; genal area and facial fovea with white hairs; tibial scopa with white hairs and dorsobasally slightly reddish hairs; HL/HW index 0.9; LPW 0.06 mm..... *Andrena lineolata* WARNCKE

3 Labrum process liguliform (70%) or liguliform-trapezoidal (26%); clypeus PD: 28 µm; PDI: 14-70[84] µm; mesosoma PD: 14 µm; tergites PD: 14 µm; colour of the tibia and the basitarsus brown; colour of the mediotarsi yellowish-reddish; wings light brownish toned; pterostigma yellowish, brown marginated; veins yellowish-reddish brown; clypeus with white-yellowish hairs; paraocular area with white-yellowish hairs exclusively (71%) or only with some brownish hairs between the subantennal socket and the facial fovea (29%); scapus with white-yellowish hairs, genal area with white hairs; T2-T3(T4) with lateral white-yellowish, fragmentary open hair bands (dense hair rows)..... *Andrena catula* WARNCKE

- labrum process liguliform, liguliform-trapezoidal, but also trapezpoid, triangular, triangular-trapezoidal or triangular-liguliform; propodeum slightly rugose or rugose, primarily in the basal centre and in the dorsolateral area, and with short basal lamina; colour tibia and basitarsus black or dark brown; colour mediotarsi reddish-brown; wings brownish toned; pterostigma dark-yellowish or reddish-brown; veins reddish brown; clypeus with white-yellowish or yellowish-white hairs; paraocular area with white-yellowish or yellowish-white hairs; scapus with dorsal longer brownish and ventral shorter yellowish hairs; genal area with white-yellowish hairs; T2-T3(T4) with lateral yellowish-white, fragmentary open hair bands (dense hair rows); T5 with brown or dark brown hairs.....4

4 labrum liguliform (61%), liguliform-trapezoidal (26%), trapezoidal (11%) or triangular (2%); clypeus PD: 28 µm; PDI: 14-42 µm; propodeum slightly rugose, primarily in the basal centre and in the dorsolateral area, and with short basal lamina; mesonotum PD: 14 µm; clypeus with white-yellowish hairs, no dark hairs intermingled; paraocular area with white-yellowish hairs, only some few brownish hairs between the subantennal socket and the facial fovea; genal area with white-yellowish hairs; facial fovea in the upper part with brownish hairs, in the lower part with white-yellowish hairs; head vertex with some longer white-yellowish hairs; mesoscutum with yellowish hairs, lateral front with some longer hairs; mesepisternum with white-yellowish hairs; T6 with brown hairs .... *Andrena dourada* KRATOCHWIL & SCHEUCHL

- labrum not liguliform (partly liguliform-trapezoidal in *A. g. gomerensis*); clypeus with yellowish-white hairs, no dark hairs intermingled; paraocular area with yellowish-white hairs, some or many brownish or black hairs between the subantennal socket and the facial fovea; genal area with white or yellowish-white hairs; facial fovea in ther upper part with brownish hairs, in the lower part with white-yellowish or yellowish hairs; head vertex with some longer yellowish-white and brownish hairs; mesoscutum with yellowish-brownish hairs, in some cases laterally some yellowish hairs; mesepisternum with yellowish-white hairs; T6 with dark brown hairs.....5

5 Clypeus with fragmented or without impunctate line; labrum liguliform-trapezoidal, trapezoidal or triangular; paraocular area with yellowish-white hairs, some brownish or black hairs between the subantennal socket and the facial fovea; genal area with white hairs; facial fovea in the upper part with brownish hairs, in the lower part with yellowish-white hairs.....6

- clypeus without impunctate line; labrum structure different (mostly triangular, trapezoidal or in combination); paraocular area with yellowish-white hairs, many brownish or black hairs between the subantennal socket and the facial fovea; genal area with yellowish-white hairs; facial fovea in the upper part with brownish hairs, in the lower part with yellowish hairs.....7

6 clypeus without impunctate line; clypeus PD: 28 µm; PDI: 14-56[70] µm; labrum liguliform-trapezoidal (56%) or trapezoidal (46%), top rounded, partly thickened, laterally on the top more or less parallel; colour of the tibia and the basitarsus black or dark brown; colour of the mediotarsi reddish-brown; colour of T1-T4 black, with black to dark reddish-brown depression zones; tibial scopa with yellowish-white hairs, dorsoventrally with dark brown hairs ..... *Andrena gomerensis gomerensis* WARNCKE

- clypeus with (71%) or without (29%) impunctate line; clypeus PD: 28 µm; PDI: 14-56 µm; labrum triangular (56%) or trapezoidal (46%), top slightly rounded, laterally more or less oblique; colour of the tibia and the basitarsus black or dark brown (90%) or brown (10%); colour of the mediotarsi reddish-brown (86%), partly reddish (14%); colour of T1-T4 black with dark brown depression zones (71%) or black with dark reddish-brown depression zones (29%); tibial scopa with yellowish-white hairs (dorsoventrally slightly brownish), dorsobasally with reddish-brown hairs ..... *Andrena gomerensis palmae* nov.ssp.

7 clypeus PD: 28 µm; PDI: 14-84[112] µm; labrum process trapezoidal (86%), slightly emarginated or emarginated with the ends left and right side thickened, trapezoidal-liguliform (7%), liguliform (3.5%), trapezoidal-triangular (3.5%); trapezoidal form with the top slightly rounded, laterally more or less oblique; mesosoma PD: 14 µm; propodeum slightly rugose; colour of the tibia and the basitarsus black or dark brown (96%), partly reddish-brown (4%); tibial scopa with yellowish-white hairs, dorsoventrally with dark brown hairs ..... *Andrena wollastoni* COCKERELL

- clypeus PD: 28 µm; PDI: 14-56 µm; labrum process triangular-trapezoidal or triangular-liguliform; mesosoma PD: 14-28 µm; propodeum rugose; colour of the tibia and the basitarsus black or dark brown; tibial scopa with yellowish-white hairs (dorsoventrally slightly brownish), dorsobasally reddish-brown hairs 8

8 clypeus triangular-trapezoidal (75%), triangular (17%), liguliform (8%), top slightly rounded, laterally more or less oblique; propodeal corbicula with some yellowish-white hairs (92%) or white hairs (8%) ..... *Andrena acuta acuta* WARNCKE

- clypeus triangular-liguliform (85%), trapezoidal (5%), triangular-trapezoidal (5%), triangular (5%); top slightly rounded, laterally more or less oblique; colour flagellum black or dark brown; propodeal corbicula with some yellowish-white hairs ..... *Andrena acuta tenoensis* nov.ssp

- clypeus triangular-trapezoidal, top rounded, laterally more or less oblique; colour flagellum dark brown, to the end light brown; propodeal corbicula with some yellowish-white hairs ..... *Andrena acuta wildpreti* nov.ssp.

Males

1 mesoscutum and scutellum deeper and denser punctured, especially in the front; tergites rough hammertone-like shagreened; flagellum brown; colour of the mediotarsi reddish; wings light toned, colour of the veins reddish-brown; T1-T5 black or dark reddish-brown, with black to reddish-brown or partly reddish-brown depression zones; clypeus with white hairs but not with dark hairs; parocular area with white hairs, with or without brownish hairs between the subantennal socket and the compound eye; genal area with long white or white-yellowish hairs; mesoscutum and mesepisternum with white or white-yellowish hairs; T2-T3 (T4) with fragmentary white hair bands; T5 and T6 with white or with yellowish, partly reddish hairs in the centre; ST8 with white-yellowish hairs at the end 2

- mesoscutum and scutellum shallow and very scattered punctured, especially in the front; tergites hammertone-like shagreened but not rough; colour of the mediotarsi reddish-brown (exception: *Andrena catula*); wings light brownish toned, colour of the veins reddish or reddish-brown; T1-4 black with black to dark reddish-brown depression zones; clypeus with white-yellowish or yellowish-white hairs; parocular area with white and with some brownish hairs near the subantennal socket; genal area with yellowish-white and brownish hairs; mesoscutum with white-yellowish or yellowish-brownish hairs; mesepisternum with white-yellowish or yellowish-white hairs; T2-T3 (T4) with fragmentary white-yellowish or yellowish-white hair bands; T5 and T6 with yellowish-white, yellowish or yellowish-reddish hairs; ST8 with white-yellowish or yellowish hairs at the end 3

2 clypeus slightly convex; clypeus slightly shagreened; labrum process trapezoidal,

emarginated; vertex width narrow, as wide as half of the ocellar diameter (60%) or as wide as a ocellar diameter (40%); propodeum clearly rugose in the whole area with short basal lamina; colour of the tibia and the basitarsus reddish-brown; tibia mostly black or dark brown; basitarsus mostly reddish-brown; paraocular area with white hairs, with some (67%) and without (33%) brown hairs; scapus and antennal socket with dorsal longer white-yellowish (71%) or white (29%) hairs, no difference between dorsal and ventral pubescence; genal area with long white-yellowish hairs; tergites scarcely hairy, T2-3 with lateral longer white hairs, no distinct hair bands (63%) but rows of hairs between tergite and tergite depression (hair rows T2 and T3 fragmentary) or with fragmentary white hair bands (37%); T5 and T6 with white hairs, slightly yellowish; ST8 with long white-yellowish hairs at the end ..... *Andrena tiaretta* WARNCKE

- clypeus strong convex; clypeus more or less shagreened in the front, clearly shagreened at the base; labrum process trapezoidal, emarginated (82%), slightly emarginated (18%); vertex width narrow, as wide as the half of the ocellar diameter; propodeum rugose, primarily in the basal centre and in the dorsolataeral area, with basal lamina; colour of the tibia and the basitarsus brown; colour of the pterostigma yellowish, brown marginated; paraocular area with white hairs, no brownish hairs near the subantennal socket; scapus and antennal socket with dorsal longer and ventral shorter white-yellowish hairs; genal area with long white hairs; mesoscutum and mesepisternum with white hairs; base of T1 with some white-yellowish hairs, scarcely hairy in the centre, T2-T4 depression with laterally white very fragmented open hair bands (dense rows of hairs); T5 with some yellowish hairs, T6 with yellowish partly reddish hairs in the centre, laterally with yellowish-white hairs; ST8 with long white or yellowish hairs at the end ..... *Andrena lineolata* WARNCKE

3 clypeus shallow and denser punctured; clearly shagreened, slightly dull, PD: 28 µm; PDI: 14-28 µm; colour flagellum black or dark brown; pterostigma brown; veins brown; clypeus with yellowish-white hairs but not with dark hairs; paraocular area with white-yellowish hairs and with some or many brownish hairs near the subantennal socket 4

- clypeus in the front deeper, in the centre and basally shallow, not densely punctured; PD: 28 µm; PDI: 14-28 µm; slightly shagreened in the front, therefore shiny, clearly shagreened at the base, slightly dull; colour of the flagellum brown or light brown; colour of the tibia and the basitarsus brown, black or dark brown; colour of the mediotarsi reddish or reddish-brown; pterostigma yellowish in the centre, reddish-brown marginated; veins reddish-brown; clypeus with white-yellowish or yellowish-white hairs, without or with dark hairs at the base; paraocular area with white-yellowish or yellowish-white hairs and with some or many brownish hairs near the subantennal socket; scapus with dorsal longer brownish and ventral shorter white-yellowish or yellowish hairs; genal area with brownish (dorsal) and yellowish-white hairs (ventral) 5

4 labrum process trapezoidal, emarginated (75%) or not emarginated (25%); colour of the flagellum black; colour of the tibia and the basitarsus black or dark brown; pterostigma brown; paraocular area with white-yellowish hairs and with some brownish hairs near the subantennal socket; genal area with brownish (dorsal) and white (ventral) hairs; mesoscutum and mesepisternum with white-yellowish hairs; base of T1 with some yellowish-white hairs, scarcely hairy in the centre, T2-T4 depression with lateral yellowish-white very fragmented open hair bands (dense rows of hairs); ST8 with long white-yellowish hairs at the end; WL < 5.8 mm ..... *Andrena dourada* KRATOCHWIL & SCHEUCHL

- labrum process trapezoidal and emarginated; colour of the flagellum black or dark brown; colour of the tibia and the basitarsus black (96%) or reddish-brown (4%); pterostigma brown (96%) or yellowish (4%); paraocular area with yellowish-white hairs and with many brownish hairs near the subantennal socket; genal area with brownish (dorsal) and yellowish-white (ventral) hairs; mesoscutum with yellowish-brownish and mesepisternum with yellowish-white (96%) or yellowish (4%) hairs; some short hairs; tergites with no distinct hair bands but rows of hairs between the tergite and the tergite depression, T2 and T3 with fragmentary hair bands (52%) or without hair bands (48%); ST8 with long yellowish hair; WL > 5.8 mm ..... *Andrena wollastoni* COCKERELL

According to the present knowledge, the males of *Andrena gomerensis* and *A. a. acuta* cannot be distinguished morphologically from each other.

4 Univariate analysis of morphometric data

Table 3 and Table 4 show the different morphometric values of the analysed taxa for females and males. From all these parameters, differentiating values can be documented in females and males. This is shown by boxplots for the relevant parameters and by significance values within taxa comparisons in females. Only parameters with statistically significant relationships are used. These parameters are BL, FVL/FVW index, HL/HW index, LPL, and WL.

	a. acuta (n = 15)	*a. tenoensis* (n = 21)	*a. wildpreti* (n = 13)	*catula* (n = 50)	*dourada* (n = 46)
in mm	**mean ± SD, max, min**	**mean ± SD, max, min**	**mean ± SD, max, min**	**mean ± SD, max, min**	**mean ± SD, max, min**
BL	7.26 ± 0.33, 7.83, 6.75	7.57 ± 0.42, 8.33, 6.57	7.73 ± 0.36, 8.17, 6.83	6.80 ± 0.31, 7.50, 6.00	6.85 ± 0.32, 7.58, 6.00
CL	0.57 ± 0.01, 0.60, 0.53	0.55 ± 0.02, 0.61, 0.51	0.57 ± 0.02, 0.61, 0.54	0.57 ± 0.03, 0.61, 0.50	0.56 ± 0.03, 0.64, 0.51
FL1	0.24 ± 0.01, 0.26, 0.23	0.23 ± 0.02, 0.30, 0.20	0.23 ± 0.01, 0.26, 0.21	0.23± 0.02, 0.26, 0.17	0.24± 0.02, 0.27, 0.19
FL2	0.12 ± 0.01, 0.14, 0.11	0.13 ± 0.01, 0.14, 0.11	0.13 ± 0.01, 0.14, 0.11	0.13± 0.01, 0.13, 0.10	0.12± 0.01, 0.14, 0.10
FL3	0.13 ± 0.01, 0.14, 0.11	0.13 ± 0.01, 0.14, 0.11	0.13 ± 0.01, 0.16, 0.11	0.13± 0.01, 0.17, 0.10	0.12± 0.01, 0.14, 0.09
FL1:FL2:FL3	2.0:1.0:1.0	1.8:1.0:1.0	1.8:1.0:1.0	1.9:1.0:1.1	2.0:1.0:1.0
FVL	1.02 ± 0.03, 1.06, 0.97	1.01 ± 0.03, 1.06, 0.93	1.01 ± 0.02, 1.04, 0.97	1.01 ± 0.01, 1.06, 0.99	0.99 ± 0.03, 1.03, 0.86
FVW	0.23 ± 0.02, 0.27, 0.20	0.23 ± 0.02, 0.26, 0.19	0.23 ± 0.02, 0.26, 0.20	0.22 ± 0.01, 0.24, 0.20	0.18 ± 0.01, 0.20, 0.17
FVL/FVW	4.48 ± 0.34, 5.00, 3.78	4.35 ± 0.48, 5.46, 3.89	4.45 ± 0.35, 5.00, 3.89	4.68 ± 0.24, 5.14, 4.12	5.38 ± 0.33, 5.83, 4.86
HL	1.75 ± 0.05, 1.83, 1.67	1.71 ± 0.06, 1.83, 1.60	1.74 ± 0.05, 1.83, 1.67	1.69 ± 0.07, 1.80, 1.50	1.69 ± 0.06, 1.80, 1.50
HW	2.15 ± 0.05, 2.23, 2.07	2.16 ± 0.06, 2.27, 2.07	2.23 ± 0.05, 2.30, 2.17	2.06 ± 0.09, 2.23, 1.83	2.08 ± 0.08, 2.20, 1.83
HL/HW	0.81 ± 0.03, 0.85, 0.75	0.79 ± 0.02, 0.83, 0.76	0.78 ± 0.02, 0.82, 0.75	0.82 ± 0.03, 0.88, 0.74	0.81 ± 0.03, 0.91, 0.76
HW:MSW:MTW	1.0:1.0:1.0	1.0:1.0:1.0	1.0:1.0:1.0	1.0:1.0:1.0	1.0:1.0:1.0
LPW	0.07 ± 0.01, 0.10, 0.06	0.08 ± 0.01, 0.09, 0.06	0.07 ± 0.01, 0.09, 0.06	0.10 ± 0.02, 0.13, 0.07	0.08 ± 0.01, 0.10, 0.04
MSW	2.11 ± 0.05, 2.17, 2.00	2.10 ± 0.07, 2.23, 2.00	2.16 ± 0.06, 2.27, 2.10	2.02 ± 0.10, 2.23, 1.70	2.06 ± 0.09, 2.23, 1.80
MTW	2.10 ± 0.06, 2.20, 2.00	2.10 ± 0.09, 2.27, 2.00	2.18 ± 0.08, 2.30, 2.00	2.02 ± 0.09, 2.27, 1.77	2.01 ± 0.10, 2.20, 1.73
OCD	0.10 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.07
OOD	0.42 ± 0.01, 0.44, 0.40	0.42 ± 0.02, 0.44, 0.40	0.41 ± 0.01, 0.42, 0.40	0.40 ± 0.02, 0.44, 0.36	0.40 ± 0.02, 0.42, 0.36
OOD:POD:OCD	4.4:3.6:1.0	4.5:3.5:1.0	4.5:3.6:1.0	4.3:3.6:1.0	4.6:3.8:1.0
PBAL	0.44 ± 0.01, 0.46, 0.41	0.45 ± 0.01, 0.47, 0.43	0.46 ± 0.02, 0.50, 0.43	0.47 ± 0.03, 0.54, 0.34	0.42 ± 0.04, 0.47, 0.36
POD	0.34 ± 0.02, 0.38, 0.31	0.32 ± 0.02, 0.36, 0.29	0.33 ± 0.02, 0.36, 0.31	0.33 ± 0.03, 0.40, 0.29	0.33 ± 0.03, 0.38, 0.27
PSL	0.88 ± 0.02, 0.93, 0.84	0.87 ± 0.04, 0.91, 0.80	0.89 ± 0.03, 0.96, 0.83	0.87 ± 0.04, 0.93, 0.76	0.86 ± 0.03, 0.90, 0.76
WL	5.35 ± 0.21, 5.75, 5.08	5.50 ± 0.22, 5.92, 5.17	5.66 ± 0.16, 6.00, 5.42	5.30 ± 0.20, 5.67, 4.67	5.43 ± 0.27, 6.17, 4.92

	g. gomerensis (n = 40)	*g. palmae* (n = 31)	*lineolata* (n = 13)	*tiaretta* (n = 8)	*wollastoni* (n = 49)
in mm	**mean ± SD, max, min**	**mean ± SD, max, min**	**mean ± SD, max, min**	**mean ± SD, max, min**	**mean ± SD, max, min**
BL	7.44 ± 0.36, 8.00, 6.67	7.32 ± 0.32, 8.00, 6.67	6.88 ± 0.36, 8.00, 6.50	6.84 ± 0.44, 7.33, 6.17	7.57 ± 0.33, 8.17, 6.83
CL	0.59 ± 0.03, 0.66, 0.54	0.58 ± 0.04, 0.64, 0.49	0.57 ± 0.02, 0.60, 0.54	0.56 ± 0.04, 0.60, 0.50	0.58 ± 0.05, 0.69, 0.49
FL1	0.25 ± 0.01, 0.29, 0.21	0.25 ± 0.02, 0.29, 0.21	0.25 ± 0.02, 0.27, 0.21	0.23 ± 0.02, 0.27, 0.20	0.25 ± 0.01, 0.29, 0.21
FL2	0.13 ± 0.01, 0.14, 0.10	0.13 ± 0.01, 0.14, 0.11	0.13 ± 0.01, 0.14, 0.11	0.10 ± 0.01, 0.11, 0.09	0.12 ± 0.01, 0.14, 0.09
FL3	0.14 ± 0.01, 0.16, 0.11	0.13 ± 0.01, 0.14, 0.10	0.12 ± 0.01, 0.14, 0.11	0.11 ± 0.01, 0.13, 0.10	0.13 ± 0.01, 0.16, 0.10
FL1:FL2:FL3	2.0:1.0:1.1	2.1:1.0:1.0	2.0:1.0:1.0	2.2:1.0:1.1	2.1:1.0:1.1
FVL	1.00 ± 0.01, 1.01, 0.97	1.00 ± 0.02, 1.03, 0.96	0.96± 0.02, 0.99, 0.91	0.89± 0.05, 0.97, 0.81	1.01± 0.02, 1.04, 0.94
FVW	0.22 ± 0.02, 0.26, 0.19	0.22 ± 0.01, 0.23, 0.19	0.19 ± 0.02, 0.23, 0.14	0.16± 0.02, 0.19, 0.14	0.21± 0.02, 0.26, 0.17
FVL/FVW	4.55 ± 0.43, 5.38, 3.89	4.68 ± 0.29, 5.38, 4.19	5.02 ± 0.68, 6.70, 4.19	5.49 ± 0.37, 6.00, 4.92	4.85 ± 0.55, 6.00, 3.89
HL	1.74 ± 0.05, 1.87, 1.63	1.76 ± 0.06, 1.87, 1.60	1.77 ± 0.07, 1.87, 1.63	1.71 ± 0.06, 1.80, 1.60	1.78 ± 0.06, 1.87, 1.63
HW	2.19 ± 0.06, 2.30, 2.07	2.18 ± 0.07, 2.30, 2.03	2.01 ± 0.05, 2.10, 1.93	2.10 ± 0.07, 2.20, 2.00	2.16 ± 0.07, 2.27, 2.03
HL/HW	0.79 ± 0.03, 0.86, 0.74	0.81 ± 0.02, 0.85, 0.75	0.90 ± 0.02, 0.83, 0.82	0.81 ± 0.01, 0.83, 0.79	0.82 ± 0.02, 0.89, 0.77
HW:MSW:MTW	1.1:1.0:1.0	1.0:1.0:1.0	1.0:1.0:1.0	1.1:1.0:1.0	1.0:1.0:1.0
LPW	0.07 ± 0.01, 0.10, 0.06	0.06 ± 0.01, 0.07, 0.03	0.06 ± 0.01, 0.09, 0.04	0.12 ± 0.02, 0.16, 0.10	0.09 ± 0.01, 0.11, 0.04
MSW	2.10 ± 0.07, 2.23, 1.97	2.18 ± 0.09, 2.33, 2.07	2.04 ± 0.16, 2.17, 1.67	2.02 ± 0.09, 2.13, 1.83	2.15 ± 0.09, 2.37, 1.93
MTW	2.08 ± 0.05, 2.17, 1.97	2.11 ± 0.07, 2.23, 1.90	2.09 ± 0.07, 2.20, 1.93	2.01 ± 0.13, 2.20, 1.80	2.08 ± 0.08, 2.23, 1.93
OCD	0.10 ± 0.01, 0.13, 0.09	0.11 ± 0.00, 0.11, 0.11	0.09 ± 0.01, 0.11, 0.09	0.10 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.07
OOD	0.42 ± 0.01, 0.44, 0.40	0.45 ± 0.02, 0.47, 0.40	0.38 ± 0.01, 0.40, 0.36	0.44 ± 0.02, 0.47, 0.42	0.42 ± 0.02, 0.44, 0.38
OOD:POD:OCD	4.2:3.2:1.0	4.1:3.2:1.0	4.1:3.9:1.0	4.3:3.4:1.0	4.7:4.1:1.0
PBAL	0.46 ± 0.02, 0.49, 0.43	0.46 ± 0.03, 0.51, 0.41	0.45 ± 0.03, 0.49, 0.41	0.41 ± 0.02, 0.43, 0.37	0.46 ± 0.04, 0.57, 0.39
POD	0.33 ± 0.02, 0.38, 0.31	0.36 ± 0.02, 0.38, 0.33	0.36 ± 0.01, 0.38, 0.36	0.35 ± 0.03, 0.38, 0.29	0.36 ± 0.02, 0.40, 0.31
PSL	0.89 ± 0.02, 0.96, 0.86	0.88 ± 0.04, 0.96, 0.81	0.81 ± 0.03, 0.86, 0.76	0.80 ± 0.06, 0.86, 0.71	0.93 ± 0.03, 1.00, 0.87
WL	5.57 ± 0.20, 5.92, 5.08	5.57 ± 0.18, 5.83, 5.25	5.28 ± 0.18, 5.50, 5.00	5.17 ± 0.24, 5.50, 4.83	6.11 ± 0.30, 6.67, 5.67

Table 3: Morphometric data of female individuals (n = 286). Abbreviations: BL: body length; WL: wing length; HL: head length, HW: head width; MSW: mesosomal width; MTW: metasomal width; OOD: ocellocular distance; POD: postocular distance; OCD: ocelloccipital distance; FVL: length of facial fovea; FVW: width of facial fovea; FL1-FL3: length of flagellomeres; LBW: labrum process width at the top; PSL: pterostigma length; PBAL: propodeum basal area length; ± = standard deviation.

Table 4: Morphometric data of male individuals (n = 150). Abbreviations see Table 3.

	a. acuta (n = 2)	*a. tenoensis* (n = 10)	*a. wildpreti* (n = 15)	*catula* (n = 21)	*dourada* (n = 4)
in mm	mean ± SD, max, min	mean ± SD, max, min	mean ± SD, max, min	mean ± SD, max, min	mean ± SD, max, min
BL	6.13 ± 0.06, 6.17, 6.08	6.06 ± 0.19, 6.33, 5.83	6.28 ± 0.36, 6.75, 5.75	5.77 ± 0.21, 6.25, 5.50	5.52 ± 0.04, 5.58, 5.50
CL	0.50 ± 0.02, 0.51, 0.49	0.50 ± 0.03, 0.56, 0.46	0.52 ± 0.03, 0.56, 0.46	0.52 ± 0.03, 0.56, 0.47	0.50 ± 0.04, 0.54, 0.46
FL1	0.21 ± 0.00, 0.21, 0.21	0.21 ± 0.01, 0.23, 0.19	0.21 ± 0.02, 0.23, 0.19	0.20 ± 0.01, 0.23, 0.19	0.21 ± 0.03, 0.23, 0.17
FL2	0.14 ± 0.01, 0.14, 0.13	0.14 ± 0.01, 0.16, 0.11	0.15 ± 0.01, 0.17, 0.13	0.15 ± 0.01, 0.17, 0.13	0.15 ± 0.01, 0.16, 0.14
FL3	0.15 ± 0.01, 0.16, 0.14	0.16 ± 0.02, 0.19, 0.13	0.17 ± 0.02, 0.19, 0.14	0.16 ± 0.01, 0.19, 0.13	0.16 ± 0.01, 0.17, 0.14
FL1:FL2:FL3	1.5:1.0:1.1	1.5:1.0:1.2	1.4:1.0:1.2	1.4:1.0:1.1	1.4:1.0:1.0
HL	1.57 ± 0.00, 1.57, 1.57	1.53 ± 0.08, 1.67, 1.43	1.57 ± 0.06, 1.67, 1.50	1.49 ± 0.05, 1.57, 1.37	1.48 ± 0.10, 1.57, 1.33
HW	1.93 ± 0.00, 1.93, 1.93	1.88 ± 0.08, 2.00, 1.77	1.95 ± 0.08, 2.10, 1.77	1.83 ± 0.07, 1.93, 1.67	1.78 ± 0.12, 1.93, 1.67
HL/HW	0.81 ± 0.00, 0.81, 0.81	0.82 ± 0.03, 0.87, 0.77	0.81 ± 0.02, 0.85, 0.78	0.81 ± 0.03, 0.90, 0.76	0.83 ± 0.04, 0.88, 0.78
HW:MSW:MTW	1.1:1.0:1.0	1.1:1.0:1.0	1.1:1.0:1.0	1.1:1.0:1.0	1.1:1.1:1.0
LPW	0.16 ± 0.01, 0.17, 0.16	0.13 ± 0.01, 0.16, 0.11	0.14 ± 0.01, 0.16, 0.11	0.14 ± 0.02, 0.17, 0.11	0.12 ± 0.01, 0.13, 0.11
MSW	1.88 ± 0.07, 1.93, 1.83	1.75 ± 0.08, 1.87, 1.57	1.85 ± 0.08, 2.03, 1.73	1.66 ± 0.09, 1.83, 1.50	1.72 ± 0.16, 1.90, 1.57
MTW	1.75 ± 0.02, 1.77, 1.73	1.72 ± 0.07, 1.83, 1.63	1.81 ± 0.09, 1.97, 1.63	1.64 ± 0.11, 1.87, 1.50	1.57 ± 0.17, 1.80, 1.40
OCD	0.11 ± 0.00, 0.11, 0.11	0.10 ± 0.01, 0.11, 0.09	0.11 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.09
OOD	0.42 ± 0.00, 0.42, 0.42	0.43 ± 0.03, 0.49, 0.38	0.43 ± 0.02, 0.44, 0.40	0.40 ± 0.02, 0.42, 0.38	0.39 ± 0.04, 0.42, 0.33
OOD:POD:OCD	4.1:3.2:1.0	4.1:3.2:1.0	4.0:3.1:1.0	4.3:3.5:1.0	4.2:3.4:1.0
PBAL	0.39 ± 0.02, 0.40, 0.37	0.40 ± 0.03, 0.43, 0.34	0.43 ± 0.03, 0.49, 0.39	0.42 ± 0.02, 0.44, 0.37	0.35 ± 0.02, 0.39, 0.33
POD	0.33 ± 0.00, 0.33, 0.33	0.33 ± 0.03, 0.40, 0.29	0.33 ± 0.01, 0.36, 0.31	0.32 ± 0.02, 0.36, 0.29	0.32 ± 0.02, 0.33, 0.29
PSL	0.78 ± 0.01, 0.79, 0.77	0.80 ± 0.05, 0.86, 0.73	0.81 ± 0.01, 0.83, 0.80	0.78 ± 0.04, 0.83, 0.64	0.75 ± 0.02, 0.79, 0.73
WL	4.71 ± 0.06, 4.75, 4.67	4.91 ± 0.25, 5.25, 4.42	5.03 ± 0.18, 5.25, 4.67	4.70 ± 0.18, 5.00, 4.33	5.11 ± 0.37, 5.42, 4.67

	g. gomerensis (n=4)	*g. palmae* (n = 18)	*lineolata* (n = 36)	*tiaretta* (n = 15)	*wollastoni* (n = 25)
in mm	mean ± SD, max, min	mean ± SD, max, min	mean ± SD, max, min	mean ± SD, max, min	mean ± SD, max, min
BL	6.13 ± 0.30, 6.67, 5.83	6.18 ± 0.32, 6.67, 5.83	6.15 ± 0.24, 6.67, 5.75	5.98 ± 0.35, 6.50, 5.17	6.38 ± 0.47, 7.50, 5.67
CL	0.52 ± 0.03, 0.59, 0.46	0.52 ± 0.03, 0.59, 0.46	0.53 ± 0.03, 0.59, 0.47	0.49 ± 0.04, 0.57, 0.43	0.56 ± 0.03, 0.61, 0.50
FL1	0.21 ± 0.02, 0.24, 0.17	0.21 ± 0.01, 0.24, 0.20	0.22 ± 0.01, 0.26, 0.20	0.20 ± 0.02, 0.23, 0.19	0.22 ± 0.02, 0.27, 0.14
FL2	0.14 ± 0.01, 0.16, 0.11	0.14 ± 0.01, 0.16, 0.11	0.15 ± 0.01, 0.17, 0.13	0.12 ± 0.01, 0.13, 0.09	0.15 ± 0.02, 0.17, 0.10
FL3	0.16 ± 0.01, 0.19, 0.13	0.16 ± 0.01, 0.17, 0.13	0.17 ± 0.01, 0.19, 0.16	0.13 ± 0.01, 0.14, 0.11	0.16 ± 0.02, 0.19, 0.11
FL1:FL2:FL3	1.5:1.0:1.2	1.5:1.0:1.1	1.5:1.0:1.1	1.8:1.0:1.2	1.5:1.0:1.1
HL	1.56 ± 0.09, 1.83, 1.40	1.55 ± 0.10, 1.83, 1.40	1.64 ± 0.08, 1.83, 1.47	1.53 ± 0.11, 1.80, 1.43	1.60 ± 0.10, 1.83, 1.40
HW	1.93 ± 0.10, 2.27, 1.73	1.94 ± 0.11, 2.27, 1.73	1.80 ± 0.06, 2.00, 1.67	1.90 ± 0.10, 2.20, 1.80	1.93 ± 0.14, 2.27, 1.60
HL/HW	0.81 ± 0.02, 0.84, 0.76	0.80 ± 0.02, 0.83, 0.76	0.91 ± 0.05, 1.02, 0.84	0.81 ± 0.05, 0.98, 0.77	0.83 ± 0.02, 0.88, 0.77
HW:MSW:MTW	1.1:1.1:1.0	1.1:1.1:1.0	1.1:1.1:1.0	1.1:1.0:1.0	1.1:1.0:1.0
LPW	0.11 ± 0.02, 0.14, 0.07	0.11 ± 0.01, 0.13, 0.07	0.09 ± 0.02, 0.13, 0.06	0.13 ± 0.01, 0.14, 0.11	0.15 ± 0.01, 0.17, 0.11
MSW	1.88 ± 0.14, 2.30, 1.53	1.85 ± 0.14, 2.30, 1.60	1.79 ± 0.08, 2.03, 1.63	1.72 ± 0.10, 2.00, 1.60	1.81 ± 0.17, 2.17, 1.47
MTW	1.74 ± 0.13, 2.17, 1.50	1.75 ± 0.12, 2.17, 1.60	1.70 ± 0.07, 1.93, 1.57	1.70 ± 0.10, 1.90, 1.53	1.75 ± 0.15, 2.10, 1.40
OCD	0.11 ± 0.00, 0.11, 0.09	0.11 ± 0.01, 0.11, 0.09	0.09 ± 0.01, 0.11, 0.07	0.11 ± 0.01, 0.11, 0.09	0.10 ± 0.01, 0.13, 0.09
OOD	0.42 ± 0.02, 0.44, 0.40	0.42 ± 0.02, 0.44, 0.40	0.37 ± 0.02, 0.42, 0.33	0.43 ± 0.02, 0.47, 0.38	0.43 ± 0.03, 0.51, 0.38
OOD:POD:OCD	3.8:3.1:1.0	3.8:3.1:1.0	4.2:3.9:1.0	4.1:3.2:1.0	4.3:3.5:1.0
PBAL	0.42 ± 0.02, 0.49, 0.39	0.43 ± 0.02, 0.49, 0.39	0.41 ± 0.02, 0.44, 0.37	0.35 ± 0.03, 0.43, 0.33	0.37 ± 0.02, 0.43, 0.33
POD	0.34 ± 0.02, 0.38, 0.31	0.34 ± 0.02, 0.36, 0.31	0.35 ± 0.02, 0.40, 0.31	0.34 ± 0.03, 0.42, 0.29	0.35 ± 0.03, 0.42, 0.31
PSL	0.80 ± 0.06, 0.91, 0.69	0.79 ± 0.06, 0.91, 0.69	0.75 ± 0.03, 0.80, 0.67	0.73 ± 0.04, 0.83, 0.67	0.85 ± 0.05, 0.96, 0.76
WL	4.87 ± 0.35, 5.58, 4.17	4.96 ± 0.32, 5.58, 4.17	4.91 ± 0.18, 5.33, 4.50	4.67 ± 0.17, 5.00, 4.33	5.43 ± 0.35, 6.08, 4.75

Body length (BL) in females

A total of 30 significant and 15 non-significant differences were found between the different taxa (Fig. 27). Group ‘a’ with a smaller body size includes *A. catula*, *A. dourada*, *A. lineolata*, and *A. tiaretta*; all others (*A. acuta, A. gomerensis*, and *A. wollastoni*) have a significantly larger body size. The subspecies of *A. gomerensis* do not differ in body size.

In *A. acuta*, however, *A. a. tenoensis* nov.ssp. and *A. a. wildpreti* nov.ssp. are significantly larger than *A. a. acuta*.

FVL/FVW index in females

A total of 30 significant and 15 non-significant differences were found between the different taxa (Fig. 28). Group 'a' with a high FVL/FVW index includes *A. dourada* and *A. tiaretta*; all other taxa (*A. acuta*, *A. catula, A. gomerensis*, and *A. wollastoni*) have a significantly lower index. The subspecies of *A. gomerensis* do not differ in the FVL/FVW index. In *A. acuta*, however, *A. a. tenoensis* and *A. a. wildpreti* are characterised by a lower index than *A. a. acuta*.

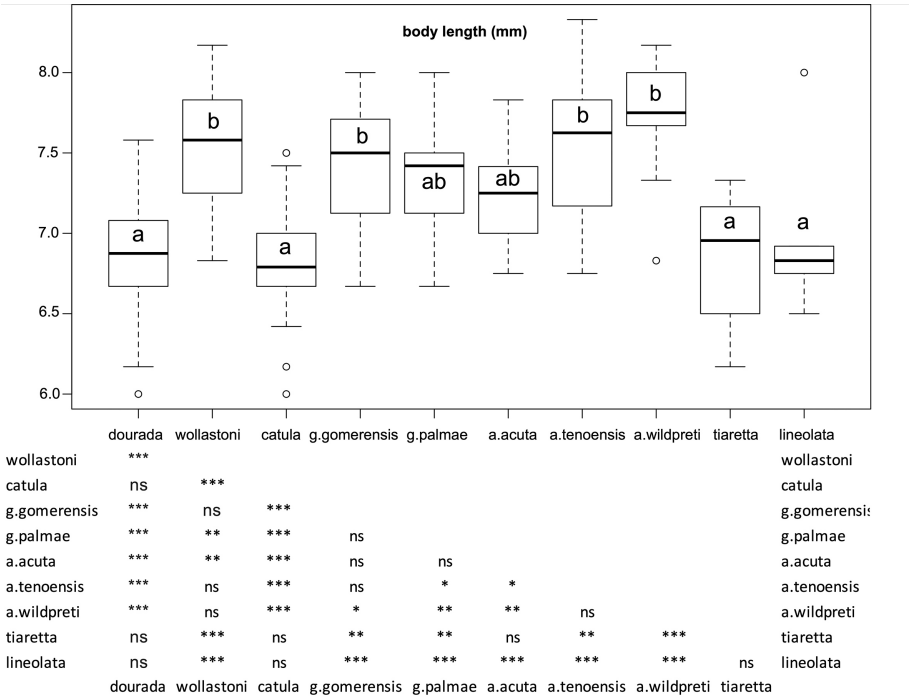


Fig. 27: Body length spectrum (boxplots) of the different taxa. Groups with the same letter are not significantly different. In the case of groups of two letters, significance exists only with one group identified by a single letter. Significance levels: * p <= 0,05; ** p <= 0,01; *** p <= 0,001; ns = not significant.

HL/HW index in females

A total of 30 significant and 15 non-significant differences were found between the different taxa (Fig. 29). *A. lineolata* ('a') present the highest HL/HW index; all other taxa (*A. wollastoni*, *A. catula, A. gomerensis*, and *A. acuta*) have a significantly lower index. *A. gomerensis palmae* and *A. dourada* (group 'b') are significantly different to *A. wollastoni* ('c'). *A. a. acuta*, *A. catula*, and *A. tiaretta* (group 'b, c') show significance against *A. gomerensis* (group 'd'). The subspecies of *A. gomerensis* differ significantly in the HL/HW index. In *A. acuta*, however, *A. a. tenoensis* and *A. a. wildpreti* are significantly different by a lower index than *A. a. acuta*.

Labrum process width (LPW) in females

A total of 38 significant and six non-significant differences were found between the different taxa (Fig. 30). This is the highest value of significances and also proves the great importance of the labrum process as a distinguishing feature, as can be seen from the morphological investigations. *A. tiaretta* ('a') present the highest LPW value. The subspecies of *A. gomerensis* differ significantly in the LPW value. *A. a. acuta* is well differentiated to *A. a. tenoensis* and *A. a. wildpreti*.

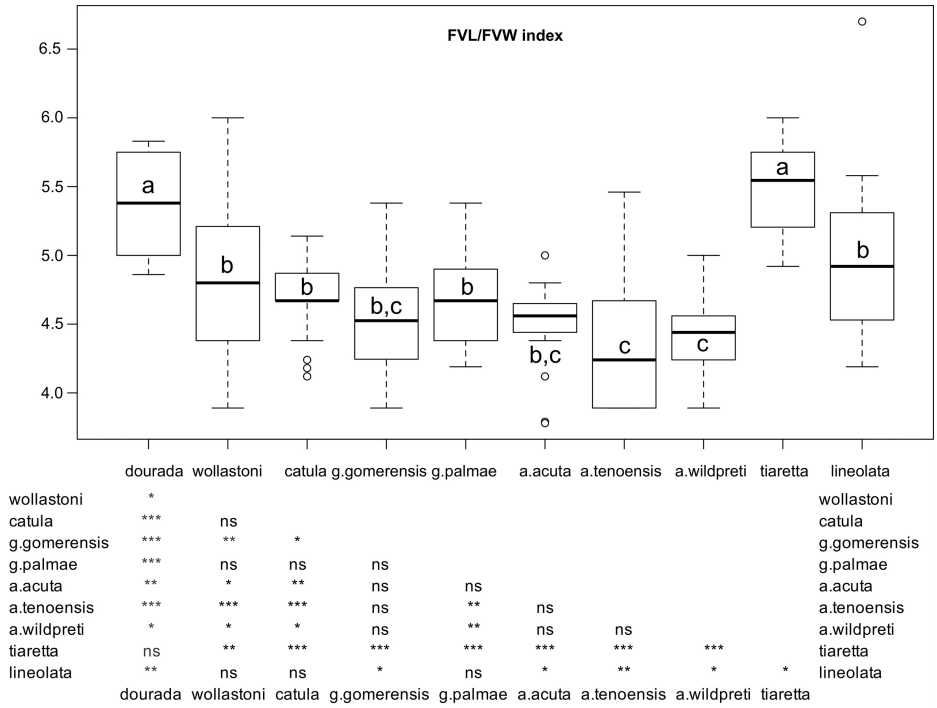


Fig. 28: Index spectrum (boxplots) of facial fovea FVL/FVB (length to width) of the different taxa. Groups with the same letter are not significantly different. In the case of groups of two letters, significance exists only with one group identified by a single letter. Significance levels: * p <= 0,05; ** p <= 0,01; *** p <= 0,001; ns = not significant.

Wing length (WL) in females

A total of 30 significant and 15 non-significant differences were found between the different taxa (Fig. 31). *A. wollastoni* ('b') present the highest WL value; *A. dourada*, *A. catula, A. a. acuta*, *A. tiaretta*, and *A. lineolata*) have significantly lower values. *A. gomerensis*, *A. a. tenoensis*, and *A. a. wildpreti* occupy a middle position. While the two subspecies of *A. gomerensis* do not differ significantly from each other, there are significant differences in wing length between the subspecies of *A. acuta*.

Synopsis of the morphometric differentiation

Table 5 summarises the results of the univariate analysis of the parameters BL, FVL/FVW index, HL/HW index, LPL, and WL. It shows that in all cases significant differences between the taxa can be observed.

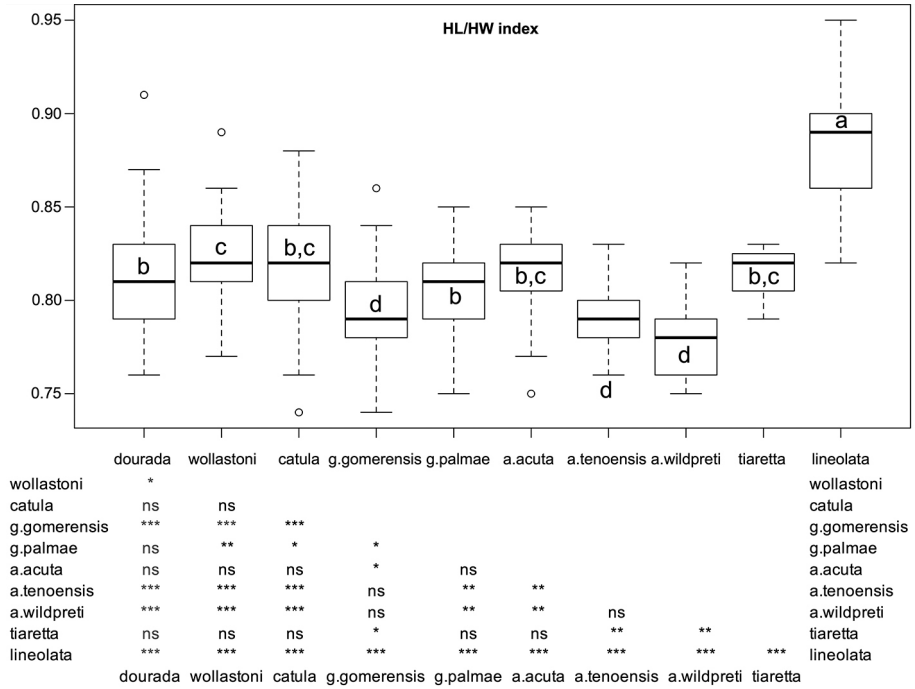


Fig. 29: Index spectrum (boxplots) of HL/HW index (head length to width) of the different taxa. Groups with the same letter are not significantly different. In the case of groups of two letters, significance exists only with one group identified by a single letter. Significance levels: * p <= 0,05; ** p <= 0,01; *** p <= 0,001; ns = not significant.

5 Multivariate analysis of morphometric data

The morphometric studies show that species that split into subspecies are more difficult to differentiate from other species due to their greater range of parameter variation. This applies to *A. acuta* and *A. gomerensis* (Table 6). For these two species, including their subspecies, a clear separation of morphometric data can be found only if comparisons are made with those species that are clearly different. A morphometric separation of *A. acuta* (including its subspecies) is found in contrast to *A. catula*, *A. dourada, A. lineolata, A. tiaretta*, and *A. wollastoni* (Table 6). The same is true for *A. gomerensis* in contrast to *A. lineolata*, *A. tiaretta*, and *A. wollastoni*, in which subspecies differentiation does not play a role (Table 6). A clear morphometric separation is found for *A. catula* in contrast to *A. dourada*, *A. lineolata*, *A. tiaretta*, and *A. wollastoni* and for *A. dourada* in contrast to *A. gomerensis*, *A. lineolata*, *A. tiaretta*, and *A. wollastoni* (Table 6). *A. lineolata* shows a clear morphometric separation against *A. tiaretta* and *A. wollastoni*, and *A. tiaretta* shows a clear

differentiation against *A. wollastoni* (Table 6). *A. acuta* and *A. gomerensis* can be separated morphometrically only on the subspecies level. The same is true for *A. catula* and *A. gomerensis* (Table 6). An exception is the comparison of *A. acuta* and *A. g. palmae*, for which partial differentiation can be shown (Table 6). Differentiation of the parameters is clearly pronounced, albeit only at the level of subspecies.

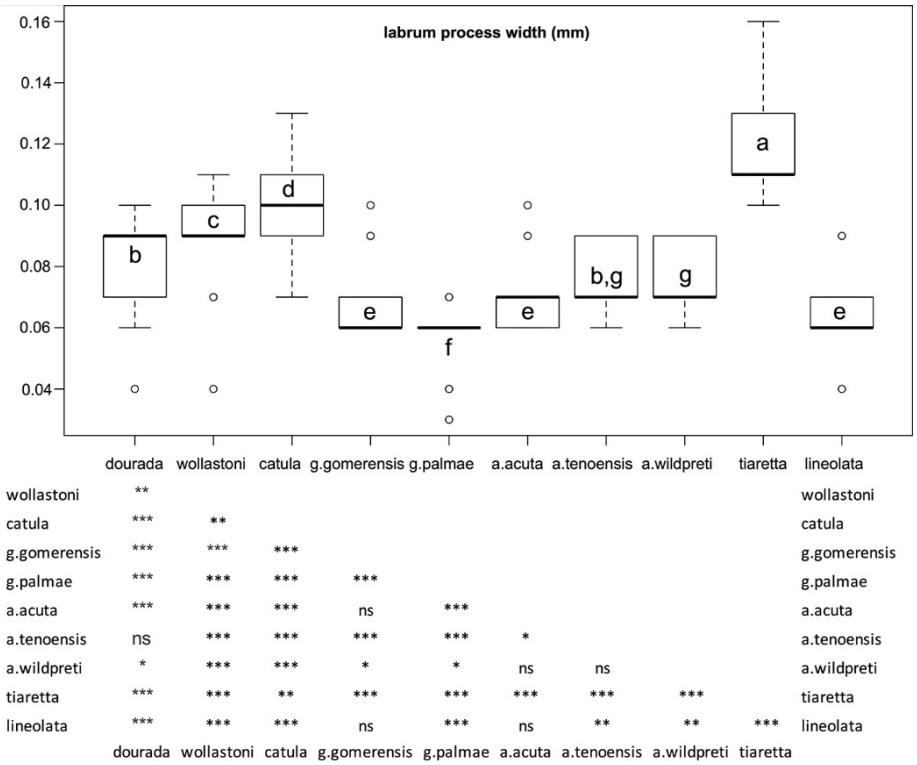
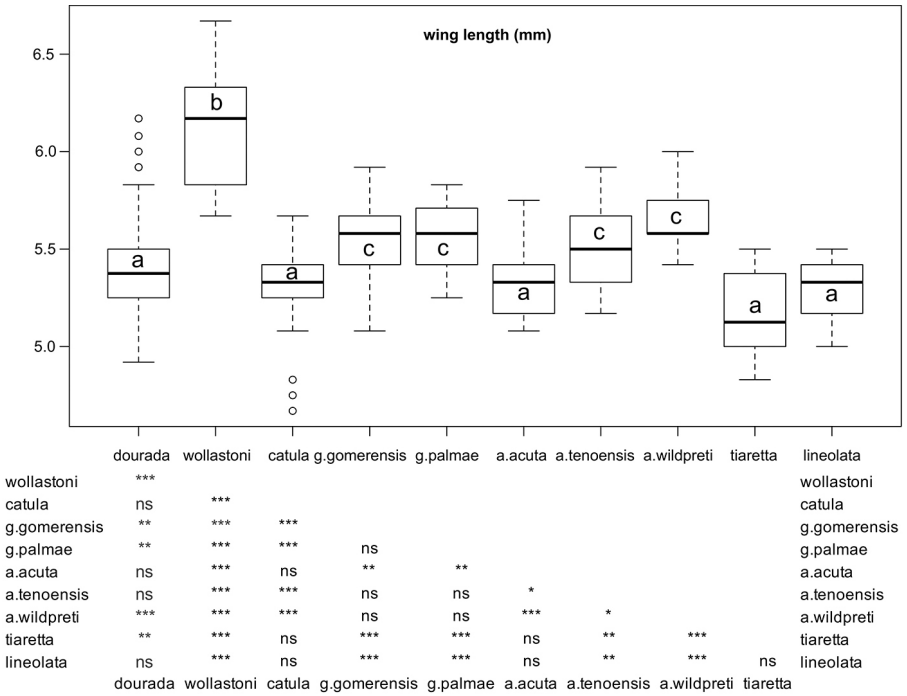


Fig. 30: Index spectrum (boxplots) of LPW values of the different taxa. Groups with the same letter are not significantly different. In the case of groups of two letters, significance exists only with one group identified by a single letter. Significance levels: * p <= 0,05; ** p <= 0,01; *** p <= 0,001; ns = not significant.



	dourada	wollastoni	catula	g.gomerensis	g.palmae	a.acuta	a.tenoensis	a.wildpreti	tiaretta	lineolata
wollastoni	***									wollastoni
catula	ns	***								catula
g.gomerensis	**	***	***							g.gomerensis
g.palmae	**	***	***	ns						g.palmae
a.acuta	ns	***	ns	**	**					a.acuta
a.tenoensis	ns	***	***	ns	ns	*				a.tenoensis
a.wildpreti	***	***	***	ns	ns	***	*			a.wildpreti
tiaretta	**	***	ns	***	***	ns	**	***		tiaretta
lineolata	ns	***	ns	***	***	ns	**	***	ns	lineolata
	dourada	wollastoni	catula	g.gomerensis	g.palmae	a.acuta	a.tenoensis	a.wildpreti	tiaretta	

Fig. 31: Index spectrum (boxplots) of WL values of the different taxa. Groups with the same letter are not significantly different. In the case of groups of two letters, significance exists only with one group identified by a single letter. Significance levels: * p <= 0,05; ** p <= 0,01; *** p <= 0,001; ns = not significant.

Table 5: Results of the univariate analysis of the parameters. Significance is shown by the following numbers 1 = BL, 2 = FVL/FVW index, 3 = HL/HW index, 4 = LPL, and 5 = WL.

wollastoni	1,2,3,4,5								
catula	2,4	1,4,5							
g.gomerensis	1,2,3,4,5	2,3,4,5	1,2,3,5						
g.palmae	1,2,4,5	1,3,4,5	1,3,5	3,4					
a.acuta	1,2,4	1,2,4,5	1,2	3,5	4,5				
a.tenoensis	1,2,3	2,3,4,5	1,2,3,5	4	1,2,3,4	1,3,4,5			
a.wildpreti	1,2,3,4,5	2,3,4,5	1,2,3,5	1,4	1,2,3,4	1,3,5	5		
tiaretta	4,5	1,2,4,5	2	1,2,3,4,5	1,2,4,5	2,4	1,2,3,4,5	1,2,3,4,5	
lineolata	2,3,4	1,3,4,5	3	1,2,3,4,5	1,3,4,5	1,2,3	1,2,3,4,5	1,2,3,4,5	2,3,4
	dourada	*wollastoni*	*catula*	*g.gomerensis*	*g.palmae*	*a.acuta*	*a.tenoensis*	*a.wildpreti*	*tiaretta*

Andrena acuta* differentiated from *A. catula*, *A. dourada*, *A. g. palmae*, *A. lineolata*, *A. tiaretta*, and *A. wollastoni

- *Andrena acuta – A. catula*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 12 morphometric parameters (BL, FL3, FVL, FVW, HL, HW, LPW, MSW, MTW, OOD, PSL, and WL) (Fig. 32a). The two best ratios plotted (the first and second ratios) are BL/FL3 and BL/LPW (the best ratios using 14 parameters: BL, FL2, FL3, FVL, FVW, HL, HW, LPW, MSW, MTW, OOD, PBAL, PSL, and WL). Both clusters are relatively close to each other.

Table 6: Results of the multivariate analysis of the parameters (NO: no cluster differentiation; X: cluster differentiation; PA: partial cluster differentiation; – : cluster differentiation at higher or lower taxonomic levels shown).

	acuta	*a. acuta*	*a. tenoensis*	*a. wildpreti*	*catula*	*dourada*	*gomerensis*	*g. gomerensis*	*g. palmae*	*lineolata*	*tiaretta*	*wollastoni*
a. tenoensis		X										
a. wildpreti		PA	PA									
catula	X	–	–	–								
dourada	X	–	–	–	X							
gomerensis	NO	–	–	–	X	X						
g. gomerensis	NO	X	X	X	–	–						
g. palmae	PA	X	X	X	–	–		PA				
lineolata	X	–	–	–	X	X	X	–	–			
tiaretta	X	–	–	–	X	X	X	–	–	X		
wollastoni	X	–	–	–	X	X	X	–	–	X	X	

- *Andrena acuta – A. dourada*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 12 morphometric parameters (BL, FL2, FVL, FVW, HL, HW, MSW, MTW, PBAL, POD, PSL, and WL) (Fig. 32b). The two best ratios plotted (the first and second ratios) are BL/PBAL and FVW/PSL (the best ratios using 11 parameters: BL, FVL, FVW, HL, HW, MSW, MTW, PBAL, POD, PSL, and WL). Both clusters are relatively close to each other.
- *Andrena acuta – A. g. palmae*: Both taxa are partially separated in the space spanned by shape PC1 and shape PC2 when using 16 morphometric parameters (BL, FL1, FL2, FL3, FVL, HL, HW, LPW, MSW, MTW, OCD, OOD, PBAL, POD, PSL, and WL) (Fig. 32c). The two best ratios plotted (the first and second ratios) are FVL/OCD and FVL/OOD (the best ratios using the same 16 parameters).

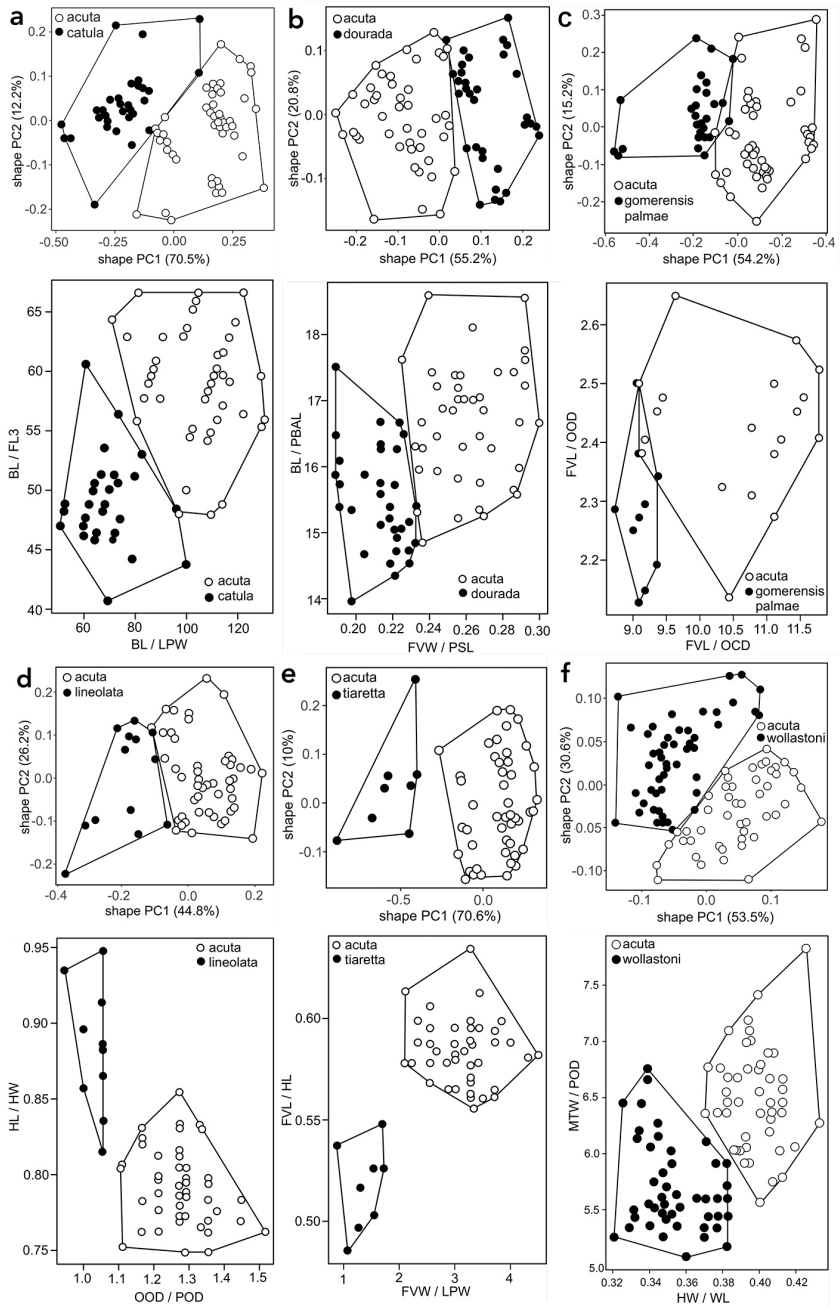


Fig. 32: Shape PC1 plotted against shape PC2 and the two best plotted ratios of morphometric features: (**a**) *Andrena acuta – A. catula*, (**b**) *A. acuta – A. dourada*, (**c**) *A. acuta – A. g. palmae*, (**d**) *A. acuta – A. lineolata*, (**e**) *A. acuta – A. tiaretta*, and (**f**) *A. acuta – A. wollastoni*.

- *Andrena acuta – A. lineolata*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 11 morphometric parameters (BL, FL3, FVL, FVW, HL, HW, MSW, MTW, OOD, POD, and PSL) (Fig. 32d). The two best ratios plotted are HL/HW and OOD/POD (using the same morphometric parameters). The cluster of PC1/PC2 are close in contrast to the clusters of the best ratios, which are well separated. The clusters of the best ratio of *A. acuta – A. lineolata* is much more separated than the clusters of *A. acuta – A. dourada*.
- *Andrena acuta – A. tiaretta*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 11 morphometric parameters (BL, CL, FL1, FL2, FL3, FVL, FVW, HL, HW, LPW, and MSW) (Fig. 32e). The two best ratios plotted are FVL/HL and FVW/LPW (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena acuta – A. wollastoni*: The species are separated in the space spanned by shape PC1 and shape PC2 when using six morphometric parameters (HL, HW, MSW, POD, PSL, and WL) (Fig. 32f). The two best ratios plotted are MTW/POD and HW/WL (using the morphometric parameters FL1, HL, HW, LPW, MSW, MTW, POD, PSL, and WL). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.

Andrena catula* differentiated from *A. dourada, A. gomerensis, A. lineolata, A. tiaretta,* and *A. wollastoni

- *Andrena catula – A. dourada*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 13 morphometric parameters (BL, FL1, FL3, FVL, FVW, HL, HW, MSW, MTW, OCD, OOD, PBAL, and WL) (Fig. 33a). The two best ratios plotted are PBAL/PSL and FVW/OOD (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena catula – A. gomerensis*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 15 morphometric parameters (BL, CL, FL1, FL2, FL3, HL, HW, LPW, MSW, MTW, OCD, OOD, POD, and PSL) (Fig. 33b). The two best ratios plotted are BL/MTW and BL/LPW (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena catula – A. lineolata*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, and WL) (Fig. 33c). The two best ratios plotted are FVW/HL and LPW/POD (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena catula – A. tiaretta*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 14 morphometric parameters (CLP, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, and WL) (Fig. 33d). The two best ratios plotted are FVL/HW and FVW/HW (using the same morphometric para-

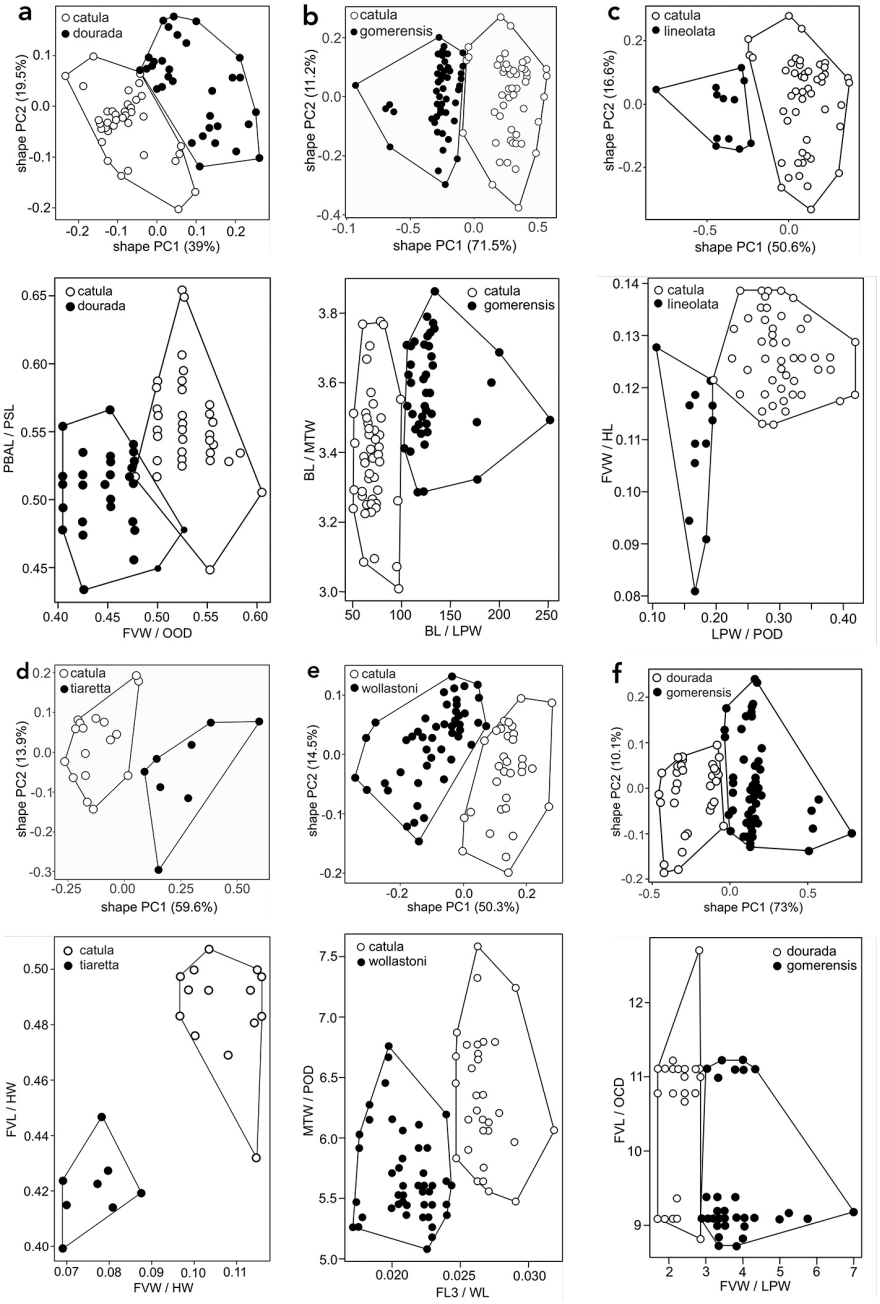


Fig. 33: Shape PC1 plotted against shape PC2 and the two best plotted ratios of morphometric features: (**a**) *A. catula – A. dourada*, (**b**) *A. catula – A. gomerensis*, (**c**) *A. catula – A. lineolata*, (**d**) *A. catula – A. tiaretta*, (**e**) *A. catula – A. wollastoni*, and (**f**) *A. dourada – A. gomerensis*.

meters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.

- *Andrena catula – A. wollastoni*: The species are separated in the space spanned by shape PC1 plotted against shape PC2 when using 13 morphometric parameters (BL, FL1, FL2, FL3, HL, HW, MSW, MTW, OOD, POD, PSL, and WL) (Fig. 33e). The two best ratios plotted are MTW/POD and FL3/WL (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.

Andrena dourada* differentiated from *A. gomerensis, A. lineolata, A. tiaretta*, and *A. wollastoni

- *Andrena dourada – A. gomerensis*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 13 morphometric parameters (BL, FVL, FVW, HL, HW, LPW, MSW, MTW, OCD, OOD, PBAL, PSL, and WL) (Fig. 33f). The two best ratios plotted are FVW/LPW and FVL/OCD (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena dourada – A. lineolata*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 15 morphometric parameters (BL, FL2, FL3, FVL, HL, HW, LPW, MSW, MTW, OCD, OOD, PBAL, POD, PSL, and WL) (Fig. 34a). The two best ratios plotted are LPW/POD and HW/MTW (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena dourada – A. tiaretta*: The species are separated in the space spanned by shape PC1 and shape PC2 when using seven morphometric parameters (FVL, HL, HW, MSW, MTW, OCD, and PSL) (Fig. 34b). The two best ratios plotted are FVL/HW and HL/PSL (using the same morphometric parameters). The cluster of PC1/PC2 and the clusters of the best ratios are clearly separated.
- *Andrena dourada – A. wollastoni*: The species are separated in the space spanned by shape PC1 and shape PC2 when using five morphometric parameters (BL, HL, HW, PSL, and WL) (Fig. 34c). The two best ratios plotted are FVL/HW and HL/PSL using 11 morphometric parameters (BL, FL1, FVL, FVW, HL, HW, MSW, MTW, POD, PSL, and WL). The cluster of PC1/PC2 and the clusters of the best ratios are separated.

Andrena gomerensis* differentiated from *A. lineolata, A. tiaretta*, and *A. wollastoni

- *Andrena gomerensis – A. lineolata*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 15 morphometric parameters (BL, FL2, FL3, FVL, FVW, HL, HW, MSW, MTW, OCD, OOD, PBAL, POD, PSL, and WL) (Fig. 34d). The two best ratios plotted are HW/MTW and HL/OOD using 15 morphometric parameters. The cluster of PC1/PC2 and the clusters of the best ratios are separated.
- *Andrena gomerensis – A. tiaretta*: The species are separated in the space spanned by shape PC1 plotted against shape PC2 when using 11 morphometric parameters (BL, FL2, FVL, FVW, HW, LPW, MSW, MTW, PBAL, PSL, and WL) (Fig. 34e). The two best ratios plotted are FVL/MTW and FL2/HW using eight morphometric parameters (FL2, FVL, HW, MSW. MTW, PBAL, PSL, and WL). The cluster of PC1/PC2 and the clusters of the best ratios are separated.

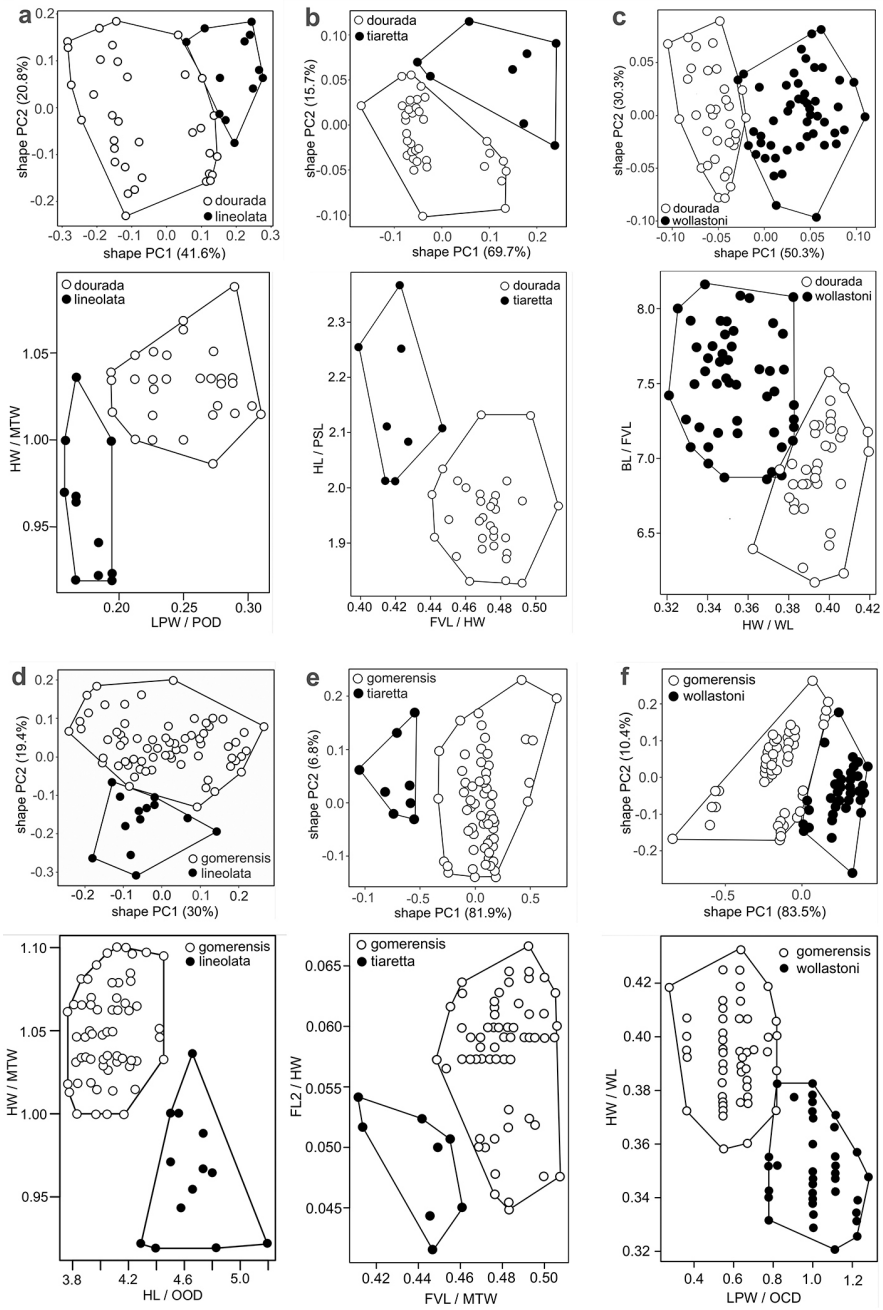


Fig. 34: Shape PC1 plotted against shape PC2 and the two best plotted ratios of morphometric features: (**a**) *A. dourada – A. lineolata*, (**b**) *A. dourada – A. tiaretta*, (**c**) *A. dourada – A. wollastoni*, (**d**) *A. gomerensis – A. lineolata*, (**e**) *A. gomerensis – A. tiaretta*, and (**f**) *A. gomerensis – A. wollastoni*.

- *Andrena gomerensis – A. wollastoni*: The species are separated in the space spanned by shape PC1 and shape PC2 when using nine morphometric parameters (BL, HL, HW, LPW, MSW, MTW, OCD, PSL, and WL) (Fig. 34f). The two best ratios plotted are LPW/OCD and HW/WL using nine morphometric parameters. The cluster of PC1/PC2 and the clusters of the best ratios are separated.

Andrena lineolata* differentiated from *A. tiaretta* and *A. wollastoni

- *Andrena lineolata – A. tiaretta*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, and WL) (Fig. 35a). The two best ratios plotted are FL2/LPW and FVL/HW using 18 morphometric parameters. The cluster of PC1/PC2 and the clusters of the best ratios are separated.
- *Andrena lineolata – A. wollastoni*: The species are separated in the space spanned by shape PC1 and shape PC2 when using nine morphometric parameters (BL, FVL, HL, HW, LPW, MSW, MTW, PSL, and WL) (Fig. 35b). The two best ratios plotted are LPW/MTW and HW/MTW using the same nine morphometric parameters. The cluster of PC1/PC2 and the clusters of the best ratios are separated.

Andrena tiaretta* differentiated from *A. wollastoni

- *Andrena tiaretta – A. wollastoni*: The species are separated in the space spanned by shape PC1 and shape PC2 when using 15 morphometric parameters (BL, FL1, FL2, FL3, FVL, FVW, HL, HW, LPW, MSW, MTW, OCD, OOD, PSL, and WL) (Fig. 35c). The two best ratios plotted are FVL/OOD and HL/WL using the same 15 morphometric parameters. The cluster of PC1/PC2 and the clusters of the best ratios are separated.

Andrena a. acuta* differentiated from *A. a. tenoensis, A. a. wildpreti, A. g. gomerensis*, and *A. g. palmae

- *Andrena a. acuta – A. a. tenoensis*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when using 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, and WL) (Fig. 35d). The two best ratios plotted are BL/FL1 and LPW/POD using the same 18 morphometric parameters. The cluster of PC1/PC2 and the clusters of the best ratios are separated.
- *Andrena a. acuta – A. a. wildpreti*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when using 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, and WL) (Fig. 35e). The two best ratios plotted are FVL/PBAL and FVL/MTW using nine morphometric parameters (BL, FL3, FVL, HW, MSW, MTW, PBAL, PSL, and WL). The cluster of PC1/PC2 is partly separated, the clusters of the best ratios are well separated.
- *Andrena a. acuta – A. g. gomerensis*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when using 11 morphometric parameters (BL, CL, FL2, FL3, FVL, HW, LPW, MSW, PBAL, POD, and WL) (Fig. 35f). The two best ratios plotted are FVL/WL and FL3/POD using the same 11 morphometric parameters. The clusters of PC1/PC2 and of the best ratios are well separated.
- *Andrena a. acuta – A. g. palmae*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when using 17 morphometric parameters (BL, CL, FL1, FL2, FL3, FVL, FVW, HL, HW, LPW, MSW, MTW, OCD, OOD, PBAL, PSL, and

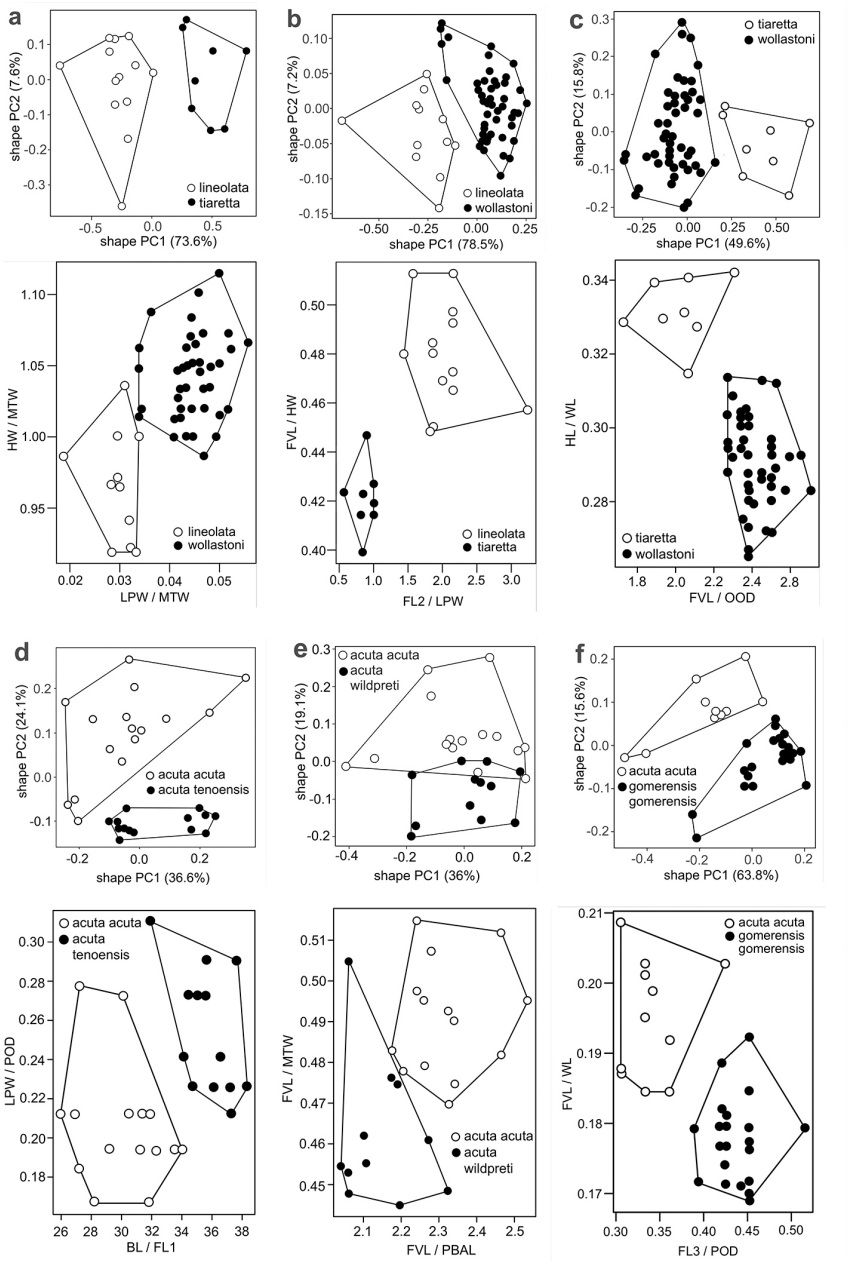


Fig. 35: Shape PC1 plotted against shape PC2 and the two best plotted ratios of morphometric features: (**a**) *A. lineolata – A. tiaretta*, (**b**) *A. lineolata – A. wollastoni*, (**c**) *A. tiaretta – A. wollastoni*, (**d**) *A. a. acuta – A. a.tenoensis*, (**e**) *A. a. acuta – A. wildpreti*, and (**f**) *A. a. acuta – A. g. gomerensis*.

WL) (Fig. 36a). The two best ratios plotted are FVL/OCD and FVL/OOD using the same 17 morphometric parameters. The clusters of PC1/PC2 and of the best ratios are well separated.

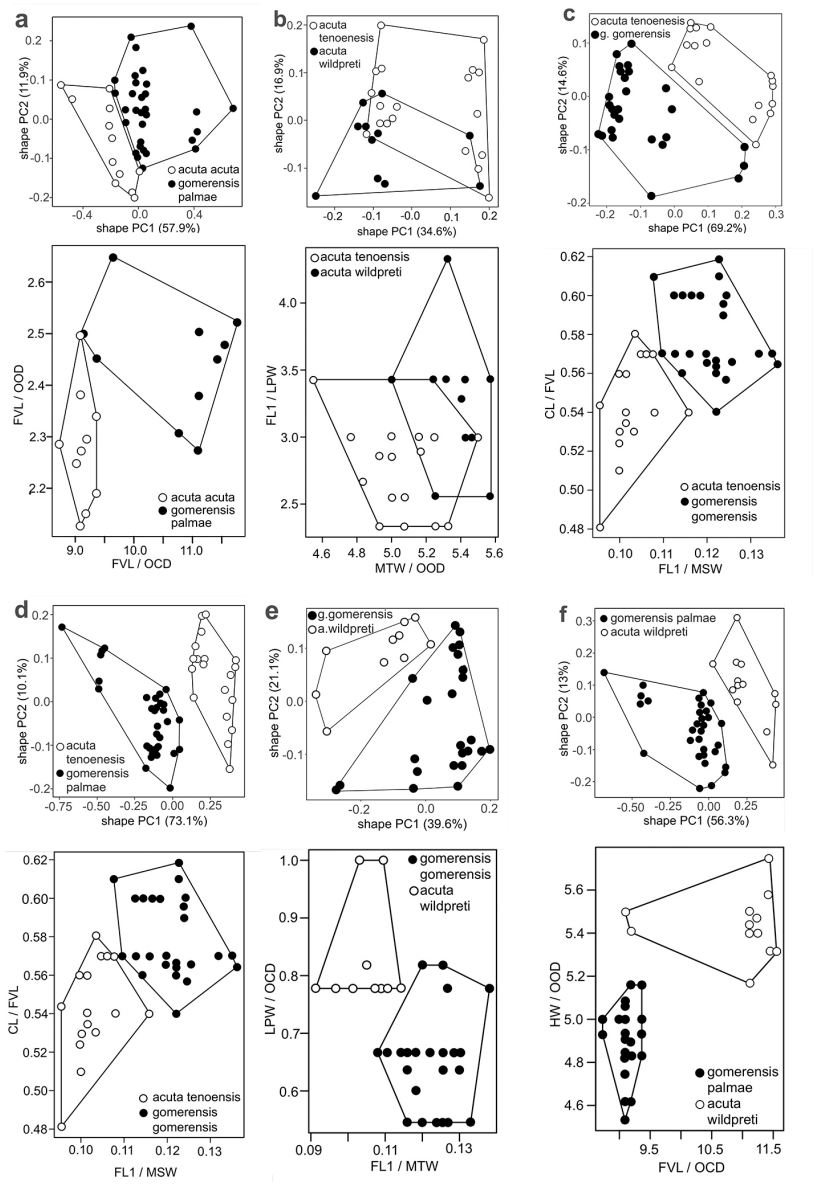


Fig. 36: Shape PC1 plotted against shape PC2 and the two best plotted ratios of morphometric features: (**a**) *Andrena a. acuta – A. g. palmae*, (**b**) *A. a. tenoensis – A. a. wildpreti*, (**c**) *A. a. tenoensis – A. g. gomerensis*, (**d**) *A. a. tenoensis – A. g. palmae*, (**e**) *A. g. gomerensis – A. a. wildpreti*, (**f**) *A. g. palmae – A. a. wildpreti*.

Andrena a. tenoensis* differentiated from *A. a. wildpreti, A. g. gomerensis*, and *A. g. palmae

- *Andrena a. tenoensis – A. a. wildpreti*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, and WL) (Fig. 36b). The two best ratios plotted are MTW/OOD and FL1/LPW using the same 18 morphometric parameters. The clusters of PC1/PC2 and of the best ratios show an overlapping zone.
- *Andrena a. tenoensis – A. g. gomerensis*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when 12 morphometric parameters (BL, CL, FL1, FL3, FVL, HL, HW, LPW, MSW, MTW, PSL, and WL) (Fig. 36c). The two best ratios plotted are FL1/MSW and CL/FVL using the same morphometric parameters. The clusters of PC1/PC2 and of the best ratios are well separated.
- *Andrena a. tenoensis – A. g. palmae*: The subspecies are separated in the space spanned by shape PC1 and shape PC2 when 14 morphometric parameters (BL, CL, FL1, FVL, FVW, HL, HW, LPW, MSW, MTW, OCD, OOD, POD, PSL, and WL) (Fig. 36d). The two best ratios plotted are FL1/MSW and CL/FVW using the same morphometric parameters. The clusters of PC1/PC2 and of the best ratios are well separated.

Andrena a. wildpreti* differentiated from *A. g. gomerensis and A. g. palmae*, and *A. g. gomerensis* differentiated from *A. g. palmae

- *Andrena a. wildpreti – A. g. gomerensis*: The subspecies are separated in shape PC1 plotted against shape PC2 when 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, WL) (Fig. 36e). The two best ratios plotted are FL1/MSW and CL/FVL using the same morphometric parameters. The clusters of PC1/PC2 and of the best ratios are well separated.
- *Andrena a. wildpreti – A. g. palmae*: The subspecies are separated in shape PC1 plotted against shape PC2 when 18 morphometric parameters (CL, FL1, FL2, FVL, FVW, HL, HW, LPW, MSW, MTW, POD, PBAL, PSL, WL) (Fig. 37f). The two best ratios plotted are HW/OOD and FVL/OCD using the same morphometric parameters. The clusters of PC1/PC2 and of the best ratios are well separated.
- *A. g. palmae* and *A. g. gomerensis*: The subspecies are separated in shape PC1 plotted against shape PC2 when 11 morphometric parameters (BL, FL3, FVL, HL, HW, MSW, MTW, OOD, POD, PBAL, PSL) (Fig. 37a). The two best ratios plotted are HW/OOD and BL/POD using the same morphometric parameters. The clusters of PC1/PC2 and of the best ratios are partly separated.

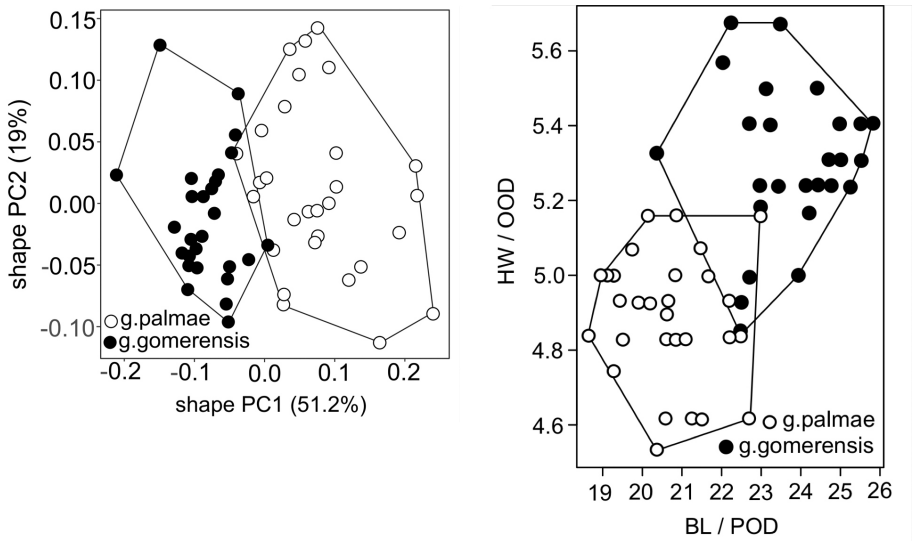


Fig. 37: Shape PC1 plotted against shape PC2 and the two best plotted ratios of morphometric features: *Andrena g. gomerensis – A. g. palmae.*

Discussion

This study refers to the morphological and morphometric analysis of the taxa of the *Andrena wollastoni* group, including the taxonomically related *A. lineolata* (*Micrandrena* species found in high elevations of Tenerife) and the mainland species *A. tiaretta*, the hypothetical ancestor. Colonisation processes cannot be considered comprehensively without a molecular genetic analysis of the taxa of the *A. wollastoni* group. Therefore, the taxonomical results will be compared with molecular genetic studies of *Andrena acuta, A. catula, A. dourada, A, gomerensis, A. lineolata* and *A. wollastoni* (in preparation).

Radiation processes of different taxa of invertebrates and vertebrates have been documented, such as the radiation of the flightless taxa of the weevil genus *Laparocerus* in the Madeira Archipelago (36 endemic taxa) and on the Canary Islands (196 endemic taxa) (e.g., MACHADO et al. 2017). Similar radiation patterns have been reported for the Canarian Tenebrionid beetles of the genus *Nesotes* (REES et al. 2001). For the Canary Islands, phenomena of colonisation processes that were followed by species radiation have also been detected for the beetle genera *Pimelia* (JUAN et al. 1996) and *Calathus* (EMERSON et al. 1999, 2000), for grasshoppers (HOCHKIRCH & HUSEMANN 2008, HUSEMANN et al. 2014, HOCHKIRCH & GÖRZIG 2009), for the mite genus *Steganecarus* (SALOMONE 2002), for the spider genus *Dysdera* (ARNEDO et al. 2001), for cockroaches such as *Loboptera* (OROMI et al. 1991), for molluscs (ABREU & TEIXEIRA 2008), and for vertebrates such as reptiles of the genus *Gallotia* (COX et al. 2010; THORPE et al. 1994) and skinks of the genus *Chalcides* (BROWN & PESTANO 1998).

In this study, it was shown, that the taxa of the *A. wollastoni* group differ significantly in morphology and morphometrics. Therefore, the need to be upgraded from former

subspecies to species rank, and further differentiation in new subspecies is necessary. In the following, I will discuss the analysed taxa of the two archipelagos separately.

Madeira Archipelago

A. wollastoni s. str. (Madeira Island) and *A. dourada* (Porto Santo) are species on their own and endemic for the Madeira Archipelago. In KRATOCHWIL & SCHEUCHL (2013), the speciation of *A. dourada* and *A. wollastoni* was discussed in the light of geological age, former landbridge situations (variation in sea levels in glacial times and geological processes of the creation and erosion of stepping-stone islands), changing distances to the continent, and other parameters. According to SCHMINCKE (1998), GALOPIM DE CARVALHO & BRANDAO (1991), and GELDMACHER et al. (2000), the age of the Madeiran Archipelago ranges from 5.2 to 14.3 Ma. Geologically, Porto Santo is the oldest island (14.3 Ma). Much younger are Madeira Island (5.2 Ma) and Desertas Islands (5.07 Ma). Concerning the geological age of the different islands of the Madeira Archipelago, we hypothesise, that the oldest one, Porto Santo, was colonised before the existence of Madeira (KRATOCHWIL & SCHEUCHL 2013).

A similar dispersal history of two other closely related *Andrena* species (subgenus *Suandrena*) could be shown: *Andrena portosanctana*, endemic to Porto Santo, is the ancestor of *A. maderensis* (Madeira Island). *A. portosanctana* (Porto Santo) descended with high probability from the mainland species *A. fratella* WARNCKE, 1968 (Morocco), or an ancestor of this species (KRATOCHWIL et al. 2014, KRATOCHWIL & SCHWABE 2018b).

Therefore, in both cases there is a high probability of a speciation leading to endemic taxa in Porto Santo followed by a later colonisation of the endemic species to Madeira Island and further development of an endemic species. Whether the colonisation of the Madeira Archipelago happened from the Canary Islands or from the mainland cannot be decided without molecular genetic studies.

Canary Islands

Due to the higher number of islands with different geological histories and geomorphology, the environmental conditions in the Canary Islands are highly diverse. Fuerteventura and Lanzarote are the oldest islands (20.2 Ma and 15.5 Ma; CARRACEDO 2011), but species of the *A. wollastoni* group are not present. Species of the *A. wollastoni* group occur in Gran Canaria (14.6 Ma), La Gomera (9.4 Ma) and La Palma (1.72 Ma; CARRACEDO 2011). The geological and geomorphological structure of Tenerife is highly complex. Features of the actual geological structure of Tenerife (age between 6 to 11.5 Ma) mainly based on three previously separated volcanic islands with different ages (Anaga area, 6 Ma; Teno area, 8 Ma; and Roque del Conde Adeje area, 11.5 Ma), growing together by various geological processes closely related to volcanism. Over long periods, volcanic activities have strongly affected Tenerife. It is therefore plausible that a diverse taxa differentiation in plant and animal species has taken place on this island. In the case of the studied taxa, two species (one separated into three subspecies) occur.

Concerning the Canary Islands, it is not possible to show the different colonisation events and directions over the time axis without a molecular genetic analysis. Although the age of the islands is an important indication, the duration of volcanism on each island also plays a decisive role.

After colonisation there was a development into new species on Gran Canaria (*A. catula*) and La Gomera (*A. gomerensis*), followed by an inter-island colonisation between La Gomera and the much younger island of La Palma by *A. gomerensis*. The populations of La Palma are morphologically and morphometrically significantly different from those of La Gomera (but with overlapping features), so that an own subspecies can be distinguished on La Palma (*A. g. palmae* nov.ssp.).

On Tenerife, a colonisation event led to the new endemic species *A. lineolata*. Currently, *A. lineolata* is limited to altitudes of about 2000 to 3300 m a.s.l. (Las Cañadas and areas on an elevational gradient to the Teide summit up to 3300 m a.s.l.; the latter are observation data of LARA-ROMERO et al. 2019). These are young geological and geomorphological structures dating from less than 200,000 years ago. In lower altitudes, there a second endemic species developed: *A. acuta*. This species split into three subspecies (*A. a. acuta*, *A. a. tenoensis* nov.ssp., and *A. a. wildpreti* nov.ssp.) characterised by morphological and morphometric differences but with partly overlapping features.

A. a. acuta is restricted to the Anaga area and *A. a. tenoensis* to the Teno area. Anaga and Teno were formerly separated palaeo-islands (proto-islands) that grew together. The volcanic events that led to the connection of Teno and Anaga began around 2 Ma and led to the formation of the volcanic structures Las Cañadas and later Pico Teide (ANCOCHEA et al. 1990). The area between Anaga and Las Cañadas was filled by coastal and lacustrine sediments since 0.9 Ma (the Dorsal Rift region = Cordillera Dorsal; ANCOCHEA et al. 1990).

This pattern of allopatric sister taxa of the Anaga and Teno region is found in diverse organism groups (e.g., lizards, skinks, beetles, mites, spiders, and cockroaches; JUAN et al. 2000). There are two hypotheses: (1) colonisation of the separated palaeo-islands and, after the eruptions of Pico Viejo and Teide, the formation of a connection between previously separated massifs of Anaga and Teno by large lava flows (proto-island hypothesis; e.g., JUAN et al. 2000) and (2) colonisation after the connection of the former palaeo-islands which were then 'inland islands' covered with vegetation and surrounded by lava flows ('kipuka scenario' MACHADO 1976, MACHADO et al. 2017); 'kipukas'are the remnants of the original habvitats in the area surrounded by lava flows (VANDERGAST & GILLESPIE 2004). Only a molecular clock can provide more detailed information.

A third subspecies lives in the Dorsal Rift region (*A. a. wildpreti* nov.ssp.) between Anaga and Las Cañadas at altitudes of 1000 and 2000 m a.s.l. (for the flower-visiting behaviour see see also KRATOCHWIL & SCHWABE 2020)

WARNCKE (1968) differentiated many *Andrena* species into island-specific subspecies. He grouped *A. maderensis* (*Suandrena*) in four subspecies: *Andrena m. maderensis* COCKERELL 1922 (Madeira), *A. m. portosanctana* COCKERELL 1922 (Porto Santo), *A. m. notata* WARNCKE 1968 (Canary Islands) and *A. m. fratella* WARNCKE 1968 (Morocco); see GUSENLEITNER & SCHWARZ (2002). This group needs to be revised.

Another example is the subspecies differentiation of *A. sinuata* (*A. sinuata sagittaria* WARNCKE 1968, Tenerife and La Gomera; *A. sinuata damara* WARNCKE 1968, Lanzarote and Fuerteventura). Both were classified to species or subspecies by GUSENLEITNER & SCHEUCHL (2000).

WARNCKE (1968) divided *A. vulcana* DOURS (*Zonandrena*) into three subspecies,

differering besides other morphological features primarily in body sizes: *A. vulcana ferina* WARNCKE 1968 (Gran Canaria; females 11-13 mm, males 9-11 mm), *A. vulcana nyroca* WARNCKE 1968 (Tenerife; females 13-14 mm, males 11-12 mm), and *A. vulcana zumboa* WARNCKE 1968 (La Palma; female 16 mm).

According to WARNCKE (1968, 1993) *A. chalcogastra* BRULLÉ 1938 (*Troandrena*) occurs in four subspecies on three Canary Islands: *A. ch. chalcogastra* WARNCKE 1968 (Tenerife), *A. ch. gomera* WARNCKE 1968 (Gomera), *A. ch. palmaensis* WARNCKE 1968 (La Palma), and *A. ch. extrema* WARNCKE 1993 (Gran Canaria). WARNCKE (1993) mentioned that in genital morphology, *A. ch. extrema* is different from the other subspecies; only due to the similarity in other morphological features, he assigned the rank of a subspecies.

The revision of all these species and subspecies groups is necessary to prove their taxonomical rank. These investigations are a precondition for elucidating the colonisation patterns and radiations of wild-bee species in island archipelagos.

Acknowledgements

I thank Fritz Gusenleitner (OLML) for his permission to use the Warncke collection for analysing specimens in Linz (Austria), for borrowing specimens and for the possibility to print OLML photos (Figs. 3-12, 14-25). I gratefully thank Hans Richard Schwenninger (Stuttgart, Germany) and Lars Krogmann (SMNS) for the loan of material and Volker Lohrmann and Herbert Hohmann for the possibility of analysing specimens from the museum collection of the UMBB. I am very grateful to David Notton (NHMUK) for the possibility to print NHMUK photos (Figs. 26) and to Wolfgang Schwarz (Biology Centre of the Upper Austrian Provincial Museum Linz) for producing the macro photographs (Fig. 13). I am much obliged to David Notton, James E. Hogan (OUMNH), Brian Harris (NMNH), Johannes Schuberth (ZMS), Stefan Schmidt (ZSM), and Mercedes París (MNCN) for checking the collections. I am indebted to Hannes Baur (Natural History Museum Berne, Switzerland), who informed me about new tools of morphometric analysis and provided me with literature and R scripts. Erwin Scheuchl (Germany), in particular, inspired me in many discussions that it is an important task to analyse *Micrandrena* species. Andreas Werner Ebmer (Puchenau, Austria) gave important impulses with his great taxonomical experience. I thank Antonio M. F. Aguiar (Núcleo de Entomologia, Laboratório Agrícola da Madeira, Camacha, Madeira, Portugal) and Jan Smit (European Invertebrate Survey Nederland, Nationaal Natuurhistorisch Museum Naturalis, Leiden, The Netherlands) for the many years of intensive and cordial collaboration on researching the bee fauna of the Madeira Archipelago. For the field trips in 2016, 2017, 2018, and 2019, collecting permits were issued to me by the governments of the Canary Islands. I am indebted to Prof. Dr. Wolfredo Wildpret de la Torre (Universidad La Laguna, Tenerife) for his supportive discussions.

Zusammenfassung

Die Taxa der *Andrena wollastoni*-Gruppe (Madeira Archipel, Kanarische Inseln) wurden taxonomisch bearbeitet und der Status von *A. wollastoni* WARNCKE, 1968 (Insel Madeira), *A. dourada* KRATOCHWIL & SCHEUCHL, 2013 (Porto Santo) und von den ehemaligen drei Unterarten von *A. wollastoni* COCKERELL, 1922 (Kanarische Inseln) neu bewertet. In die Analyse sind die folgenden beiden Arten, die der *A. wollastoni*-Gruppe taxonomisch nahestehen, einbezogen worden: *A. lineolata* WARNCKE, 1968 (Teneriffa) und der hypothetisch angenommene Ahn der *A. wollastoni*-Gruppe *A. tiaretta* WARNCKE, 1974 (südliches Spanien, Marokko, Algerien).

Für die morphologische Analyse dienten 40 Parameter, für die morphometrischen Untersuchungen

22 Parameter. Zur Anwendung kamen folgende Methoden: univariate Analyse, Berechnung der Produkt-Moment-Korrelation von Pearson, die multivariate Ratio-Analyse, Hauptkomponenten-Analyse, lineare Diskriminanzanalyse und Berechnung des Allometrie-Ratio-Spektrums). Dabei konnte gezeigt werden, dass sich die untersuchten Taxa in vielen morphologischen und morphometrischen Parametern signifikant unterscheiden.

A. wollastoni (endemisch für die Insel Madeira) und *A. dourada* (endemisch für Porto Santo) sind gut abgrenzbare Arten. Beide unterscheiden sich signifikant von den Taxa der *A. wollastoni*-Gruppe der Kanarischen Inseln und von *A. lineolata* (Kanarische Inseln) und *A. tiaretta* (Nordwest-Afrika, Iberische Halbinsel).

Die drei ehemaligen Unterarten der *A. wollastoni*-Gruppe erhalten Artrang: *A. catula* WARNCKE, 1968 (ehemals *A. wollastoni catula*; Gran Canaria), *A. gomerensis* WARNCKE, 1993 (ehemals *A. w. gomerensis,* La Gomera) und *A. acuta* WARNCKE, 1968 (ehemals *A. w. acuta*; Teneriffa, La Palma). Belege von La Palma (ehemals *A. w. acuta*; WARNCKE, 1968) wurden *A. gomerensis* zugeordnet. Aufgrund von morphologischen und morphometrischen Unterschieden, aber einer teilweisen Überappung von Merkmalen, werden Tiere von La Gomera und solche von La Palma eigenen Unterarten zugeordnet (*A. g. gomerensis* WARNCKE, 1993, *A. g. palmae* nov.ssp.).

Signifikante morphologische und morphometrische Unterschiede der Populationen dreier Regionen innerhalb des Verbreitungsgebietes von *A. acuta* rechtfertigen eine Untergliederung in drei Unterarten: *A. a. acuta* WARNCKE, 1968 (Anaga Region), *A. a. tenoensis* nov.ssp. (Teno Region) und *A. a. wildpreti* nov.ssp. (Dorsal Rift Region). *A. lineolata* zeigt eine große morphologische und morphometrische Ähnlichkeit mit *A. catula*, *A. dourada* und *A. tiaretta.*

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