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Taxonomic re-evaluation of *Andrena cyanomicans* PÉREZ, 1895, *A. fratella* WARNCKE, 1968, *A. maderensis* COCKERELL, 1922, *A. mirna* WARNCKE, 1969, *A. notata* WARNCKE, 1968, and *A. portosanctana* COCKERELL, 1922 (Hymenoptera, Anthophila)

Anselm KRATOCHWIL

A b s t r a c t : WARNCKE (1968) described *Andrena maderensis fratella* and *A. maderensis notata* as subspecies of *A. maderensis* COCKERELL, 1922. Later, this author changed the taxonomical status of *A. m. fratella* to *A. cyanomicans fratella* (WARNCKE 1974). DYLEWSKA (1983) grouped *A. m. notata* with *A. cyanomicans* and synonymised *A. m. notata* with *A. cyanomicans mirna* WARNCKE, 1969. KRATOCHWIL et al. (2014) confirmed *A. maderensis* COCKERELL, 1922 (Madeira Island) and *A. portosanctana* COCKERELL, 1922 (Porto Santo) as species of their own. This study revises the taxonomical status of *A. c. cyanomicans*, *A. c. mirna* WARNCKE, 1970, and *A. c. fratella*, as well as *A. maderensis* and *A. portosanctana*. Thirty-three morphological (non-meristic) characteristics (integument colour, pubescence, structural features) and 23 morphometric parameters of females and males were analysed. The morphometric differences were tested statistically. A morphometric analysis was carried out (calculation of correlation coefficient, principal component analysis). *Andrena maderensis* and *A. portosanctana* (KRATOCHWIL et al. 2014) were analysed for the first time using uni- and multivariate morphometric methods. The results show that *A. cyanomicans*, *A. fratella*, *A. maderensis*, *A. mirna*, *A. notata*, and *A. portosanctana* are well-defined species. Lectotypes and paralectotypes were described for the following species: *Andrena cyanomicans* (four females and three males as paralectoptypes), *A. maderensis* (one female as lectotype, three females and two males as paralectotypes), and *A. portosanctana* (one female as lectotype and one female as paralectotype).

K e y w o r d s : Andrenidae, Anthophila, Hymenoptera, lectotypes, nomenclature, morphometrics, non-meristic morphological analysis, Palaearctic distribution, paralectotypes, PCA, *Suandrena*

Introduction

The subgenus *Suandrena* WARNCKE, 1968 comprises a relatively small group of about 15 species with distribution from the Palaearctic to the Palaeotropical regions. This subgenus includes different colour types of mainly head and metasoma pubescence. The black type is realised in *A. sobrina* WARNCKE, 1975. Species with brown-reddish mesothorax pubescence are *A. aetherea* WARNCKE, 1974, *A. cyanomicans* PÉREZ, 1895, *A. hirticornis* PÉREZ, 1895, *A. maderensis* COCKERELL, 1922, *A. planiventris* DOURS, 1872, and *A. suerinensis* FRIESE, 1884. The white (off-white) colour type is found in *A. fratella* WARNCKE, 1974, *A. leucocyanea* PÉREZ, 1895, *A. mirna* WARNCKE, 1970, *A. notata* WARNCKE, 1968, and *A. portosanctana* COCKERELL, 1922. Two other species are characterised by their yellow-reddish abdomen integument: *Andrena aegypticola*

FRIESE, 1922 and *A. savignyi* SPINOLA, 1838. However, *A. savignyi* probably consists of three or four species, and therefore a revision of the *A. savignyi* group is currently being carried out (Kratochwil in prep.). In the case of *A. inaquosa* WOOD, 2021, the female has never been observed. The male genital structure (WOOD 2021) suggests close similarity to taxa of the *A. savignyi* group.

The status of many taxa of *Suandrena* is very confusing (GUSENLEITNER & SCHWARZ 2002). The main problem is that neither the males nor the females in the subgenus are well differentiated in terms of their morphological features. DYLEWSKA (1983) has revised the Palaearctic taxa of *Suandrena* and presented an identification key. However, DYLEWSKA's (1983) findings and interpretations are out of date.

COCKERELL (1922) described two *Suandrena* species for the Madeira Archipelago: *Andrena maderensis* and *A. portosanctana*. Not knowing about these type specimens WARNCKE (1968) defined *A. m. maderensis*, endemic to Madeira Island, as the nominate species, and *A. m. portosanctana* (Porto Santo) as the subspecies. DYLEWSKA (1983) noted erroneously (similarly to the *Andrena* specialist W. Grünwaldt, Munich, Germany) that type specimens of *A. maderensis* do not exist. DYLEWSKA (1983) suggested that the subspecies *A. m. maderensis* and *A. m. portosanctana* cannot be differentiated without analysing the type specimens. DYLEWSKA (1983) analysed two females and one male to describe *A. maderensis*. But these specimens were collected in Tunis (the females by Grünwaldt, the male by Schmiedeknecht), and – according to present knowledge – have to be classified as *A. m. fratella*. WARNCKE (1968) differentiated two subspecies of *A. maderensis*: *Andrena m. notata* (Canary Islands) and *A. m. fratella* (Morocco). Later, WARNCKE (1974) revised the classification of *A. m. fratella* into *A. cyanomicans fratella*, although earlier WARNCKE (1967) had already declared that *A. cyanomicans* was probably the second generation of *A. suerinensis*. DYLEWSKA (1983) grouped *A. m. notata* with *A. cyanomicans* and synonymised *A. m. notata* with *A. cyanomicans mirna*.

KRATOCHWIL et al. (2014) analysed in detail *A. maderensis* and *A. portosanctana*. The two taxa differ in many morphological features (e.g., length of body, wings, clypeus, stigma, propodeum, facial fovea index, colour of paraocular area, tibial scopa, tergites 5 and 6, labrum process structure). Both the analysis of type specimens, which could be detected in the NHMUK and CAS, and the morphological differential diagnosis supported the differentiation into two distinct species. KRATOCHWIL et al. (2014) hypothesised that '*fratella*' and '*notata*' were also species differentiated from *A. cyanomicans*. At that time, the status of *A. c. mirna* had not been clarified.

This study reconsiders the taxonomic status of all these taxa. This is realised on the one hand through a non-meristic morphological analysis (integument colour, pubescence, structural features) and on the other hand through a morphometric analysis (boxplot analyses, univariate statistical tests, correlation analyses, principal component analysis). The taxa *A. cyanomicans*, *A. fratella*, *A. maderensis*, *A. mirna*, *A. notata*, and *A. portosanctana* are analysed comparatively. Morphological features characteristic of the subgenus *Suandrena* in general are not listed here. The initial descriptions of the taxa or species descriptions made in the revision of the subgenus by DYLEWSKA (1983) are not discussed further. The aim of this study is to examine the taxonomical status of these six taxa. The diagnosis focuses only on differentiating morphological characteristics. An identification key will be presented, and new lectotypes and paralectotypes will be described.

Materials and methods

1. Materials examined

In this study, a total of 122 females and 80 males are analysed (see appendix: Specimens examined). The specimens are kept in the following collections (with acronyms for each depository) and individually characterised by an identity code (ID-No):

CS .....collection of Chris Saure, Berlin, Germany (n = 1)

CSE.....collection of Christian Schmid-Egger, Berlin, Germany (n = 1)

CAS .....California Academy of Science, San Francisco, USA (n = 1)

KR .....collection of the author (n = 65)

MNHN.....Muséum national d'histoire naturelle, Paris, France (n = 8)

NHMUK.....Natural History Museum London, United Kingdom (n = 6)

NMNH.....Smithsonian Institution, Washington DC, USA (n = 1)

OLML.....Upper Austrian State Museum Linz, Austria (n = 115)

UMBB .....Übersee-Museum Bremen, Germany (n = 3)

ZMS.....Zoologische Staatssammlung, München, Germany (n = 1).

1. Morphological, morphometric, and multivariate analysis

Different non-meristic morphological features (n = 33) were analysed, i.e., colour and structure of different body parts, including pubescence (head: clypeus, labrum, labrum process, labrum basal area, mandible, scapus, antennal socket, antenna, flagellomeres, frons, paraocular area, fovea facialis, vertex, genal area; mesosoma: mesoscutum, scutellum, propodeum, femur, tibia, basitarsus, mediotarsi, mesepisternum, propodeal corbiculae, trochanteral and femoral flocculus, tibial scopa, wings, pterostigma; metasoma: tergites, sternites, pygidium, genitals). Eighteen morphometric features were analysed and characterised in Table 1 (using terms according to MICHENER 2007, TADAUCHI & XU 1995, ARIANA et al. 2009, KRATOCHWIL & SCHEUCHL 2013).

Boxplots were constructed using the boxplot function in R statistics (R CORE TEAM 2016). The lower and upper parts of the boxes are the 25th and the 75th percentiles (lower quartile and upper quartile), and the central markers indicate the median (the 50th percentile). The ends of the vertical lines represent the minimum and maximum values. The outliers were plotted individually with an 'o'. Datasets were compared using the Welch two-sample t-test (R CORE TEAM 2016, RASCH et al. 2011). The principal component analysis (PCA) was carried out to show morphometric differences between the taxa. The parameters used were the ones that had p-values under 0.05% in the correlation test. The calculations were made with PAST 4.04 (HAMMER-MUNTZ et al. 2001). Analyses were carried out with a modular stereomicroscope Wild M3Z, Heerbrugg, Switzerland, with a 25x eyepiece (16.25x, 40x, 62.5x and 100x). The programs INKSCAPE (2020) and EAZYDRAW (2020) were used for the drawings.

Table 1: Abbreviations, character name, definition, and magnification of the 18 parameters used for the morphometric analyses; definition of parameters and method of measurements according to MICHENER (2007). Abbreviations: fv = frontal view, dv = dorsal view, lv = lateral view.

Abbreviation	Character name	Definition	Magnification
BL	Body length	Maximal length of the body from the antennal base to the tip of the pygidium (dv)	16,25x
CL	Clypeus length	Maximal length of the clypeus (fv)	62,5x
FL1-3	Length of flagellomeres	Measured on ventral surfaces of flagellomeres when antenna stretched forward (lv)	40x
FVL	Fovea length	Maximal length of facial fovea (dv)	100x
FVW	Fovea width	Maximal length of facial fovea (dv)	100x
HL	Head length	Maximal length of the head from top of the vertex to the edge of the clypeus (fv)	40x
HW	Head width	Maximal half width of the head from the outer ridge of the eye to the centre (fv)	40x
IOD	Interocellar distance	Distance between the upper ocelli (fv)	100x
LPW	Labrum process width	Width of the top of the labrum	100x
MSW	Mesosoma width	Maximal width of the mesosoma (dv)	40x
MTW	Metasoma width	Maximal width of the mesosoma (dv)	40x
OCD	Ocelloccipital distance	Distance between a posterior ocellus and the preoccipital ridge.	100x
OOD	Ocellular distance	Distance between the nearest ocellus and the eye (fv)	100x
PBAL	Propodeum basal area length	Maximum length of the horizontal part of the propodeum(fv)	100x
PSL	Pterostigma length	Maximum length of the pterostigma; distance between the proximal base of the pterostigma and the position where the vein R1 has its typical width (MICHENER 2007)	100x
WL	Wing length	Maximal length of the forewing from the wing base to the wing tip	25x

3. Comments regarding the labrum structure

For *Andrena*, the terminology for parts of the labrum is confusing; this was also pointed out by MICHENER (2007): 'The term "process" is misleading because this plate does not project, as one expects of a process. In other bees, e.g., the Panurginae (see RUZ 1986), the same structure is called the basal area of the labrum. Use of the word "process" in the sense of basal area is further confusing because in some bees, especially the Halictidae, there is an entirely different process on the apex of the labrum, here called the apical process of the labrum.' MICHENER's (2007) opinion cannot be completely confirmed for taxa considered here, because there are cases where the basal area has a process, although it is not always very pronounced.

We distinguish the following areas and structures on the female labrum (Fig. 1): (a) basal area (basal plate); (b) lateral margin of the basal area; (c) apical (distal) process-like structure of the basal area; (d) apical margin of the basal area; (e) vertical area of the labrum with long hairs (see also KRATOCHWIL et al. 2014).

If the lateral margin of the basal area is angularly indented (extended line), a process-like structure may characterise the apex of the labrum. If the lateral margin is straight (broken line) this process-like structure is absent. In species under consideration of the subgenus *Suandrena* the basal area (Fig. 1a) may or may not have such an apical (distal) process-like structure of the apical basal area (Fig. 1c). If this structure is absent (e.g., in *A. portosanctana*), the margin of the basal area may be broadly formed as a semicircular margin (broken line in Fig. 1b), which is apically blunted (Fig. 1d). In some cases, the lateral margin of the basal area has an undulated structure. The basal area may be more or less distinctly trapezoidal or liguliform in shape, symmetrical or asymmetrical, with a straight or an indented apical margin, and with or without thickened ends on the left or

right side of basal area apex. These different features may occur to varying degrees both in one species and between species. In *A. cyanomicans*, the process is trapezoidal in 90% of cases, liguliform in 10%, symmetrical in 57%, slightly or more pronounced in 43%, and with a thickened end on the left and right side in 40%. In all cases, whether with or without process-like structure, the width of the apical straight line of the basal plate can be measured (apical labrum process or labrum basal area width = LPW). The vertical area of the labrum is hairy.

Although some variation in labrum structures exists even within a species, the evaluations nevertheless reveal differences that could help with differentiation. But there are also species with uniform, non-varying labrum structure.

4. Abbreviations

PD = puncture diameter; PDI = puncture distance; T1, T2, etc. = first, second, etc., metasomal terga; S1, S2, etc. = first, second, etc., metasomal sterna.

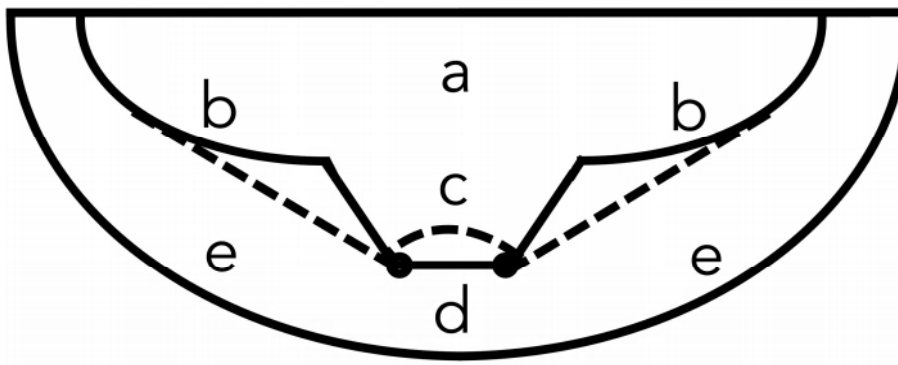

Fig. 1: Areas and structures on the female labrum. **a**) basal area, **b**) margin of the basal area, **c**) apical (distal) process of the basal area, **d**) apical margin of the process, **e**) vertical area of the labrum.

Species status and typus deposition

1. *Andrena* (*Suandrena*) *cyanomicans* PÉREZ, 1895

S t a t u s : *Andrena cyanomicans* was described by PÉREZ (1895) (Espec. nouv. Mellif. Barbarie: 35). The type specimen (lectotype, one male, 'Barcelone') is in the collection of Pérez (MNHN) (WARNCKE 1967, DYLEWSKA 1983). R. Le Divelec (MNHN) detected the type series (pers. comm.). The type series has been split into several boxes. Four females and four males exist in perfect condition. As usual, Warncke labelled only one specimen (in this case a male) as the lectotype. **All other specimens should be treated as paralectotypes.**

The lectotype (Fig. 2) has the following labels: MNHN Paris, barcode label, lectotype label designated by K. Warncke, round reddish-rose label (darkened by time), label of the Pérez collection in Paris, determination label of K. Warncke. The round coloured

labels, about 3 mm wide, found under the specimens collected by Pérez indicate during which month the specimens had been collected. The colours have the following meaning: white = December, January; salmon pink = February; light blue = March; violet = April; blue = May; green = June; yellow = July; orange = August; red = September; reddish-rose ('amaranth', similarly to magenta, but redder) = October; pink = November. A golden label was given to specimens that were of special personal interest to Pérez (pers. comm. A. Touret-Alby, MNHN).

In the 'Hymenoptera-Catalogue manuscrit de la collection d'hyménoptères de J. Pérez et notes éthologiques' (MUSÉUM NATIONAL D'HISTOIRE NATURELLE 2021), *A. cyanomicans* is listed under the number 1547 (Fig. 3). The lectotype of *A. cyanomicans* was collected in October (Barcelona, Antigua) on *Inula viscosa* [L.] AITON in parallel with *Colletes frigidus* (valid name *Colletes collaris* DOURS, 1872).

The Pérez collection includes several types and specimens with the locality of Barcelona. The printed label reading 'Museum Paris Coll. J. Pérez 1915' is the museum's collection label with the year when the collection was acquired.

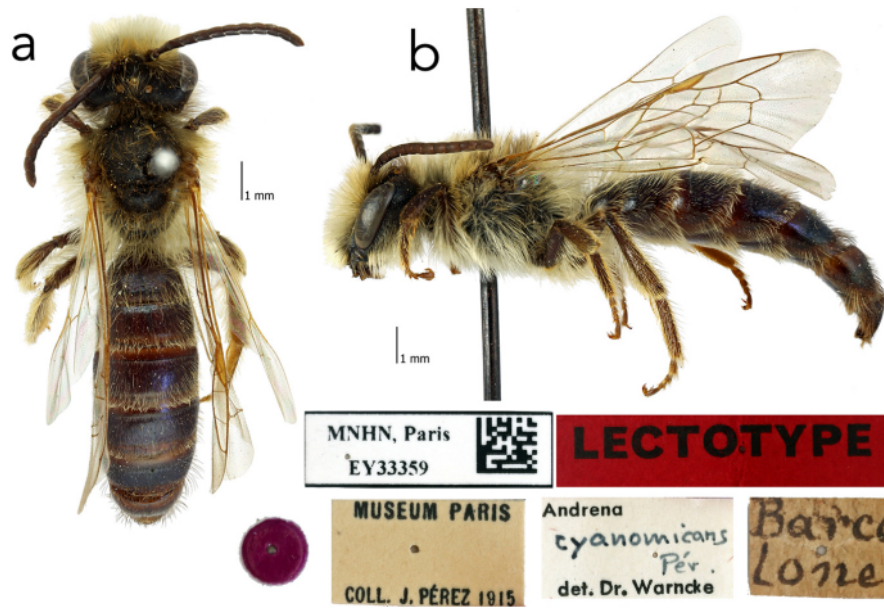

Fig. 2a-b: Dorsal and lateral view of the lectotype type specimen of *Andrena cyanomicans* with labels. Photos: B. F. Santos & A. Touret-Alby © MNHN 2021.

Two paralectotypes (one male, one female) are in OLML (Fig. 4). These two specimens were labelled by Warncke as paratypes. It would have been more correct to label them as lectoparatypes. Both types are also labelled with 'Barcelone'. The label for the Pérez collection in Paris is missing. The two specimens belong to the same type series and were taken from the series of the MNHN and deposited by Warncke in his collection. Thus, the whole type series of *A. cyanomicans* consists of five females and five males.

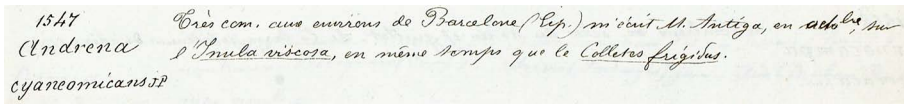

Fig. 3: 'Hymenoptera-Catalogue manuscrit de la collection d'hyménoptères de J. Pérez et notes éthologiques' (MUSÉUM NATIONAL D'HISTOIRE NATURELLE 2021). *Andrena cyanomicans* is mentioned under number 1547.

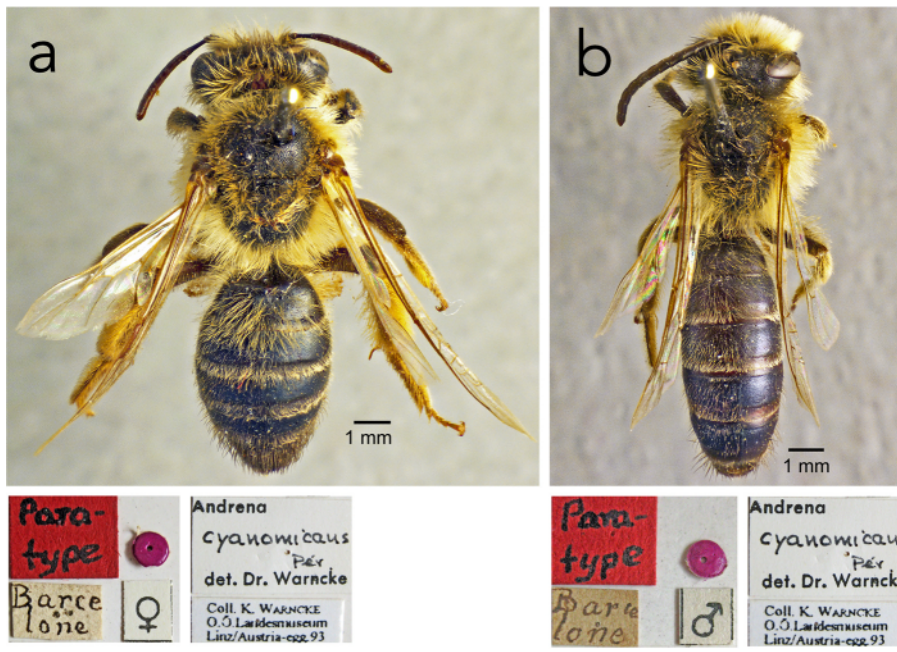

Fig. 4a-b: Dorsal view of the type specimen of *Andrena cyanomicans* with labels. (**a**) female (OLML Nr. 6952279); (**b**) male; labels (OLML Nr. 6952278). Photos: ZOBODAT, 2021/25/03.

2. *Andrena* (*Suandrena*) *fratella* WARNCKE, 1968

Andrena maderensis fratella WARNCKE, 1968
Andrena cyanomicans fratella WARNCKE, 1968

S t a t u s : WARNCKE (1968) designated *A. fratella* as a subspecies of *A. m. maderensis* (GUSENLEITNER & SCHWARZ 2002). The holotype and three paratypes of *A. fratella* (two females and two males; 12 further specimens) are deposited in the OLML (Fig. 5). WARNCKE (1968) described *A. m. fratella* on the basis of four specimens from Marrakesch, Morocco (Notul. ent., Helsingfors 48: 71–72). The holotype is a female; the three paratypes are a female and two males. This corresponds to the catalogue of BLANK & KRAUS (1994). WARNCKE (1968) published a drawing characterising the genitals of *A. m. fratella*. Later, WARNCKE (1974) revised the classification of *A. m. fratella*, including it into *A. cyanomicans fratella*. However, this new taxonomic classification is not explained in the publication. Only the holotype and the paratypes are labelled as *A. m. fratella.* All other specimens in the Warncke collection (OLML) were characterised as '*A. cyanomicans fratella*, det. Dr. Warncke'.

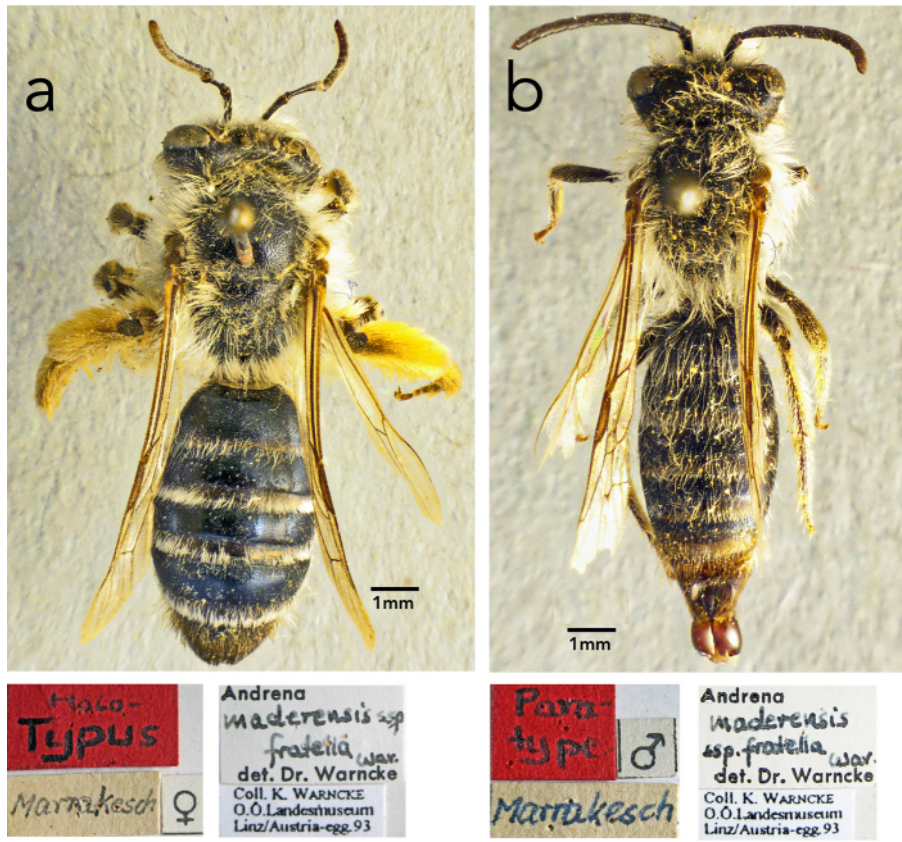

Fig. 5a-b: Dorsal view of the type specimen of *Andrena fratella* with labels. (**a**) female (OLML Nr. 6952474); (**b**) male (OLML Nr. 6952473). Photos: ZOBODAT, 2021/25/03.

3. *Andrena* (*Suandrena*) *maderensis* COCKERELL, 1922

Andrena bimaculata KIRBY?, var.
Andrena maderensis maderensis COCKERELL, 1922

S t a t u s : *Andrena maderensis* was described by COCKERELL (1922) on the basis of four females and two males from Madeira Island, kept in the T. V. Wollaston collection (NHMUK). He referred to SAUNDERS (1903), who described these specimens as '*A. bimaculata* var.?'. SAUNDERS (1903) also wrote, 'males and females. Madeira. In too bad condition to determine for certain'. According to FELLENDORF et al. (1999), the types of *A. maderensis* (four females and two males) are deposited in the University Museum, Hope Entomological Collections, Oxford, but J. E. Hogan, Oxford, confirmed that the types are not in Oxford. They are deposited in the NHMUK (GUSENLEITNER & SCHWARZ 2002; also pers. comm. J. Monks, NHMUK). All specimens are pinned and in good condition. Five of the specimens have a syntype label on them. There is one female without a syntype label; presumably this specimen has lost its label. All six specimens

have a small printed label reading ‘Madeira 58-21’ and a second handwritten label reading ‘*Andrena maderensis*, Ckll’. The exceptions are a female labelled by Cockerell as the type and a male, labelled as the cotype. WARNCKE (1968) defined the nominate species *A. m. maderensis* (Madeira), based on one female and one male (type and cotype of *A. maderensis*, NHMUK), as well as one male collected on 13.06.1957 by Lindberg (Valparaíso west of Camacha, Madeira), which was deposited in the collection of Grünwaldt. Today, this last specimen is no longer part of the collection of Grünwaldt (ZMS), but the accompanying female is still there.

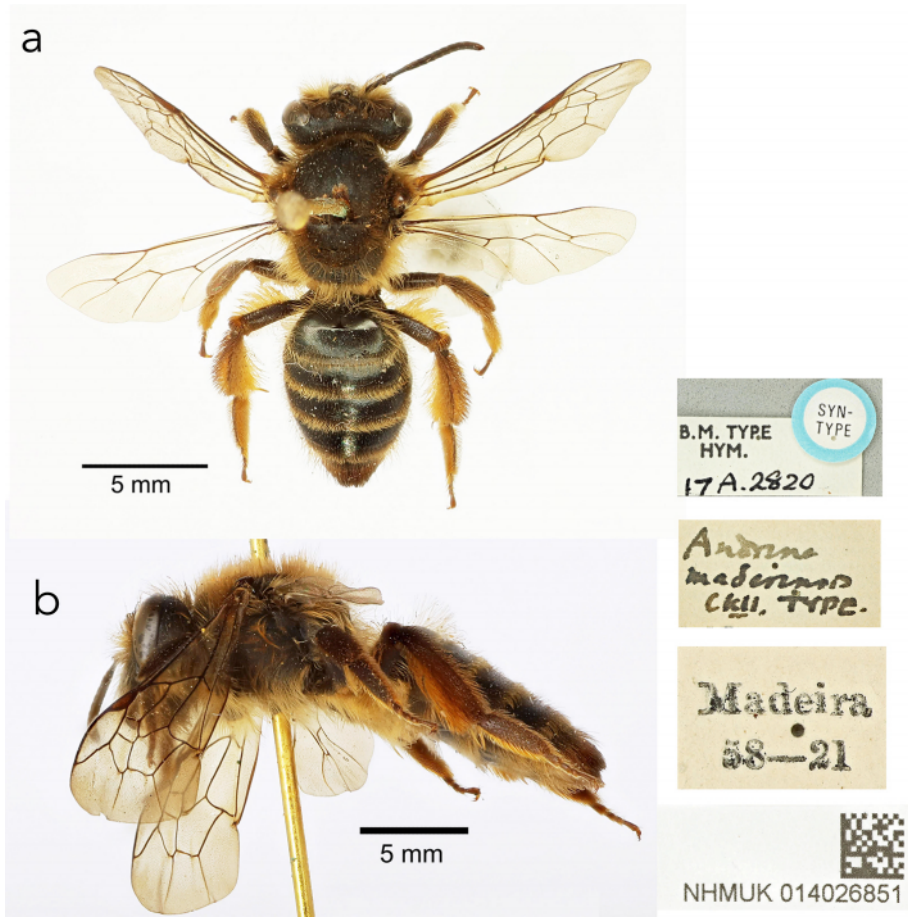

Fig. 6a-b: Lectotype of the female of *Andrena maderensis* COCKERELL, 1922 (NHMUK). (**a**) dorsal view, (**b**) lateral view, labels. Photos: J. Monks, copyright NHMUK.

Type (Fig. 6): The female NHMUK 014026851 (NATURAL HISTORY MUSEUM 2014) is kept separately in the bee type collection (syntype: primary type number 17a.2820). The labels are attached in the following order: printed register label reading ‘Madeira 58-21’; handwritten type label in ink by Cockerell reading ‘*Andrena maderensis* Ckll type’; round printed label with a blue margin reading ‘Syntype’; printed label reading ‘B.M.

TYPE HYM.'; and handwritten reading '17a2820' (the registration number of Hymenoptera types at the NHMUK). The labelling is similar to the NHMUK's lectotype and paralectotypes of *A. wollastoni*, which were analysed by KRATOCHWIL (2018). MICHENER (cited in ZUPARKO 2008) has pointed out that Cockerell, for a species newly described by him, marked one specimen with 'type' (in the sense of holotype) for every new species he described.

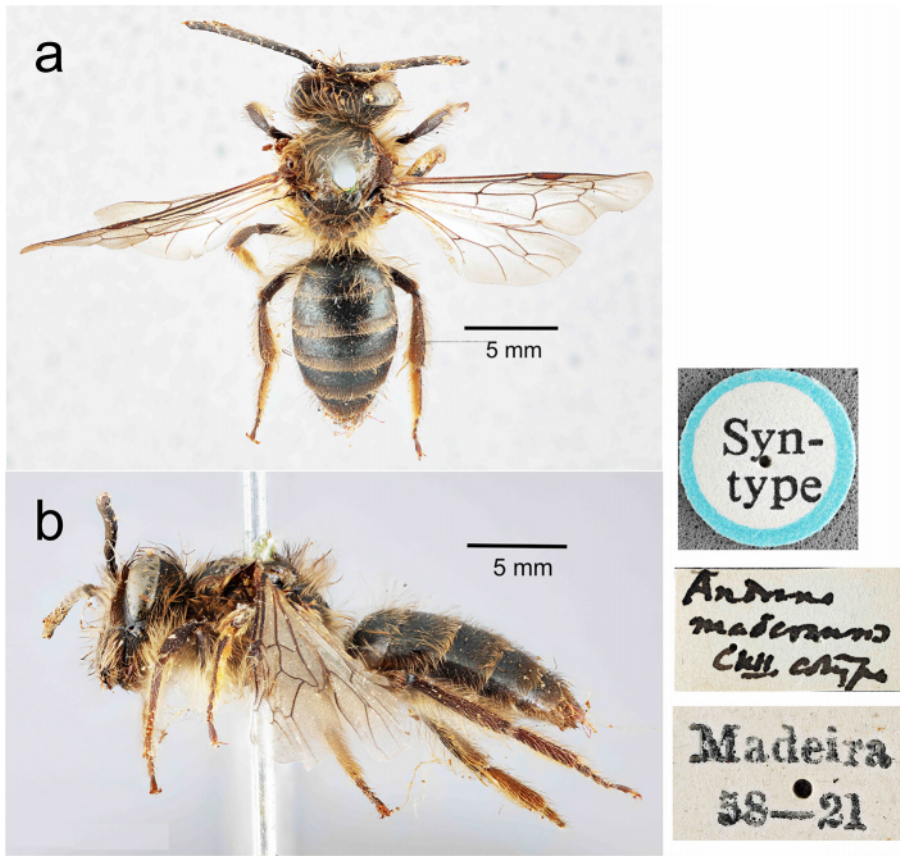

Fig. 7a-b: Paralectotype of the male of *Andrena maderensis* COCKERELL, 1922 (NHMUK). (**a**) dorsal view, (**b**) lateral view, labels. Photos: J. Monks, copyright NHMUK.

The female of *A. maderensis* with the barcode label reading 'NHMUK 014026851' will be designated as the lectotype. The label of the type specimen reading 'Madeira 58-21' is an administrative entry label for the museum's acquisition register. The number 58 refers to the year 1858 (the entry in the museum's collections). As in the case of the lectotype of *A. wollastoni*, the origin of this female *A. maderensis* specimen is still an open question (KRATOCHWIL 2014). The exact time of transfer to the NHMUK is not clear, but the reference to the specimen in COCKERELL's (1922) published description is evident. A comparison with typical Cockerell labels confirms the authenticity of these labels (KRATOCHWIL 2014). The syntypes were deposited sometime between the years

1858 and 1922. The number 21 in the label reading 'Madeira 58-21' refers to the twenty-first register of specimens, a specific group of specimens. MACHADO (2006) described the chronology of the distribution of the Wollaston collections. At the NHMUK, there is no record for 'Madeira 58-21' (MACHADO 2006). Some collections from other museums were sold or just transferred to the NHMUK and had own registration labels (further information in KRATOCHWIL 2014). This may be one of them.

Cotype (Fig. 7): The labels are in the following order: printed register label reading 'Madeira 58-21'; handwritten type label in ink by Cockerell reading '*Andrena maderensis* Ckll cotype'; round printed label with blue margin reading 'Syntype'. **This male, along with all other types of the series, will be designated as a paralectotype.**

4. *Andrena* (*Suandrena*) *mirna* WARNCKE, 1969

Andrena cyanomicans ssp. *mirna* WARNCKE, 1969

Fig. 8: Dorsal view of the holotype specimen (female) of *Andrena mirna* with labels; female (OLML Nr. 6952277). Photos: ZOBODAT, 2021/25/03.

S t a t u s : WARNCKE (1969) described the subspecies *mirna* of *A. cyanomicans*. The holotype is a female from Beersheba (Israel), which was collected on 14.03.1946 by Bytinski-Salz (Fig. 8). The paratypes designated by WARNCKE (1969) are one female, Jericho, 25.01.1946; one male, Maghtas, 25.02.1946; one female, Beersheba 14.03.1946; one female, Yeroham, 13.03.1946; all probably collected by Bytinski-Salz. The holotype

and one paratype (female) are deposited at the OLML. According to BLANK & KRAUS (1994), the male paratype should also be stored at the OLML; however, this male could not be found. It is unclear whether BLANK & KRAUS (1994) were correct or whether the specimen was deposited in another collection. WARNCKE (1969) gave the distribution range 'from the Canarian Islands to Spain, Israel', which certainly refers not to this subspecies, but to the entire complex of the species group, which Warncke included in *A. cyanomicans*.

5. *Andrena* (*Suandrena*) *notata* WARNCKE, 1968

Andrena maderensis ssp. *notata* WARNCKE, 1968

S t a t u s : WARNCKE (1968) described the subspecies *A. maderensis notata*. The holotype is a female from Catalina Garcia (Fuerteventura, Spain), and was collected on 15.04.1934 by an unknown collector (Fig. 9). The paratypes designated by WARNCKE (1969) are: one male, Rio Palma, 06.03.1934; one female, Las Penitas, 11.03.1935; one male, La Costilla, 12.03.1935; one female, Valle de las Granadillos, 24.03.1934. The holotype and the paratypes are deposited in the OLML (BLANK & KRAUS 1994).

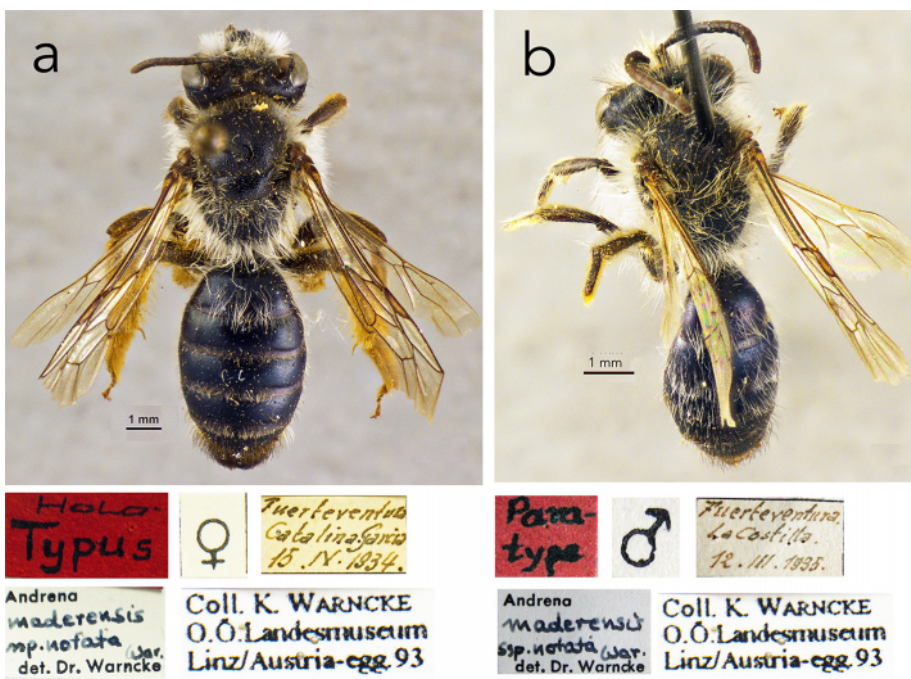

Fig. 9a-b: Dorsal view of the holotype **(a)** and paratype **(b)** specimens of *Andrena notata* with labels; female (OLML Nr. 6953082); male (OLML Nr. 6953081). Photos: ZOBODAT, 2021/25/03.

6. *Andrena* (*Suandrena*) *portosanctana* COCKERELL, 1922

Andrena maderensis ssp. *portosanctana* COCKERELL, 1922

S t a t u s : COCKERELL (1922) described *Andrena portosanctana*. Due to the lack of known syntypes and in the absence of further specimens of this species, the *Andrena* specialist Robert Wilhelm Grünwaldt, from Munich, Germany (1909–2003) doubted the validity of *A. portosanctana* as a distinct species (WARNCKE 1967). According to GUSENLEITNER & SCHWARZ (2002), *A. portosanctana* is a synonym for *A. maderensis*. This is also argued in the Fauna Europaea (DE JONG 2013). In contrast, WARNCKE (1967) gave *A. portosanctana* the status of a subspecies of *A. maderensis*. The first syntype is deposited in the CAS (CAS TYPE 15373: syntype, female, adult; Fig. 10); the second (Fig. 11), in the NMNH (USNM 24656, barcode number 00533697). *Andrena portosanctana* is an independent species (KRATOCHWIL et al. 2014).

The syntype of *A. portosanctana* (female) deposited in the CAS (CAS TYPE15373) will be designated as the lectotype; the syntype of *A. portosanctana* (female) deposited in the NMNH (USNM 24656, barcode number 00533697) will be designated as a paralectotype.

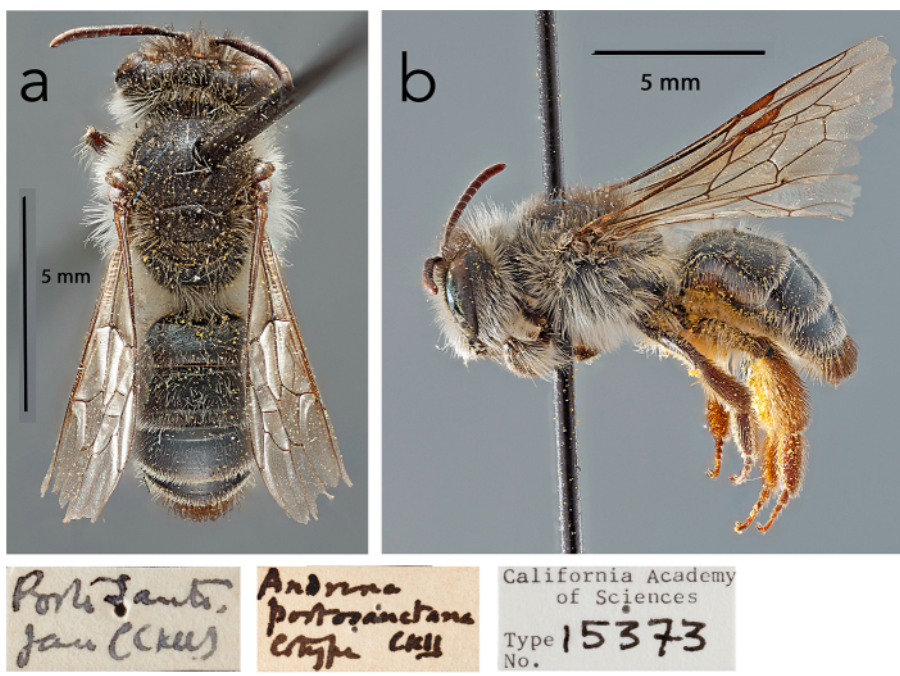

Fig. 10a-b: Lectotype of *Andrena portosanctana* (female) deposited in the CAS (CAS TYPE15373); **(a)** dorsal view; **(b)** lateral view; labels (written by Cockerell, first label with pencil, second label with ink). Photos: V. Smith, CAS.

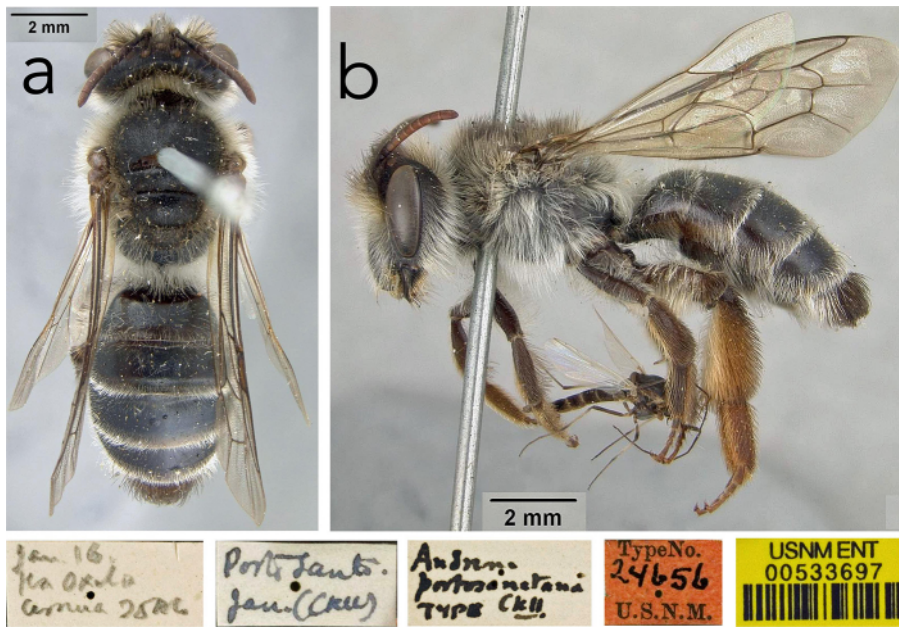

Fig. 11a-b: Paralectotype of *Andrena portosanctana* (female) deposited in the NMNH (USNM 24656, barcode number 00533697); **(a)** dorsal view; **(b)** lateral view. First label written by Wilmatte Porter Cockerell with pencil; the two other labels written by Cockerell with ink. Photos: Department of Entomology, NMNH, Smithsonian Institution.

Comparative morphological (non-meristic) analysis

In the following, the six taxa are analysed comparatively. Morphological features characteristic for of the subgenus *Suandrena* will not be mentioned. The taxonomic differentiation will be carried out on a tagma-specific basis including 31 morphological (non-meristic) parameters. The specimens examined are listed in the appendix. The habitus of the females of the six species is shown in Fig. 4 (*A. cyanomicans*, paralectotype), Fig. 5 (*A. fratella*, holotype), Fig. 6 (*A. maderensis*, paralectotype), Fig. 8 (*A. mirna*, holotype), Fig. 9 (*A. notata*, holotype), Fig. 10 and Fig. 11 (lectotype and paralectotype, *A. portosanctana*). The habitus of the males is shown in Fig. 2 (*A. cyanomicans*, lectotype), Fig. 4 (*A. cyanomicans* paralectotype), Fig. 5 (*A. fratella*, paratype), Fig. 7 (*A. maderensis*, lectotype), Fig. 9 (*A. notata*, paratype). In the case of three males (*A. maderensis*, *A. mirna*, *A. portosanctana*) the paratypes could not be detected. The habitus of males is shown in Fig. 12.

1. Head (female)

A comparison of the six species in terms of their head morphology (Fig. 13) reveals some similarities in some features. In all species, the vertex width corresponds to an ocellular diameter; the inner eye margin does not converge; and the face area above the antennal fossae is characterised by elongated rugulae (Fig. 14a). The clypeus is convex, shiny, and smooth, with few or no punctures in front; it is clearly punctured in the centre and shagreened at the base (Fig. 13, Fig. 14).

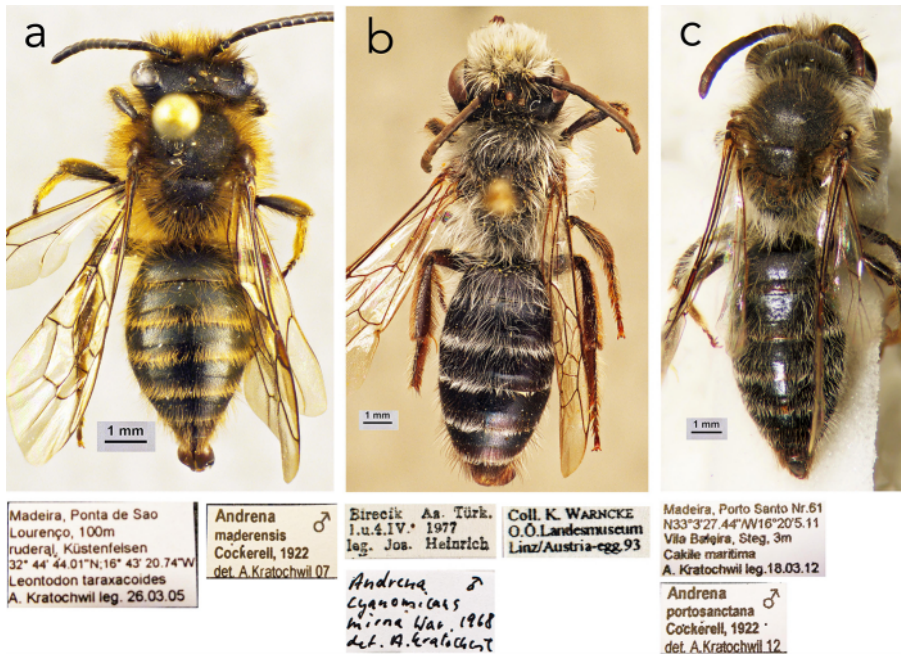

Fig. 12a-b: Habitus of the males: (**a**) *Andrena maderensis* (Photo: A. Kratochwil); (**b**) *A. mirna* (Photo: M. Schwarz, OLML); (c) *A. portosanctana* (Photo: A. Kratochwil).

The species differ in terms of the following characteristics:

S t r u c t u r e : The clypeus of 87% of *A. maderensis* specimens and 88% of *A. mirna* is characterised by a fragmented frontal median line, which either lacks punctation or has strongly reduced punctation (Fig.13c, Fig. 13d, Fig. 14c). A fragmented median line is absent in *A. notata* (100%) and *A. portosanctana* (89%). In *A. cyanomicans* and *A. fratella*, specimens occur both with and without a fragmented median line (*A. cyanomicans*, 33% with, 67% without; *A. fratella* 59% with, 41% without). Differences also occur in the puncturing of the lateral area of the clypeus (PD, PDI). For all species, smaller and larger puncture diameters occur in the lateral clypeus area on one and the same individual, and the distances between the punctures also vary. In all species, the puncture diameters range between 14 and 56 µm, with the exception of *A. portosanctana* ([14]28–42 µm; Fig. 13f). The distances between punctures are 14–32 µm (e.g., Fig. 14b, Fig. 14d), except in *A. maderensis* (14–70 µm; Fig. 14c) and *A. portosanctana* (14–56[70] µm; Fig. 13f).

All species have a labrum process, with the exception of *A. fratella* (all specimens studied without or with a very short apical labrum process; Fig. 13b) and *A. portosanctana* (without process in 53%; with a very short process in 47%; Fig. 13f). The species differ in terms of labrum process shape, symmetry and other labrum structures (overview and terminology in Fig. 1 and KRATOCHWIL 2020). In *A. cyanomicans*, the shape of the labrum process is trapezoidal in 95% (liguliform in 5%) (Fig. 13a). In all specimens examined of *A. mirna*, it is trapezoidal (Fig. 13d). A short trapezoidal labrum process was observed in 90% of *A. maderensis* (Fig. 14c) and 100% of *A. notata* (Fig. 14d).

With regard to labrum symmetry, the labrum process is predominantly symmetrical in the following species: *A. portosanctana* (all specimens examined), *A. mirna* (88% of the specimens), *A. cyanomicans* (83%), and *A. notata* (79%). In *A. fratella*, 67% of the specimens have a symmetrical labrum process, and in *A. maderensis*, 57% (though the other 43% are only slightly asymmetrical).

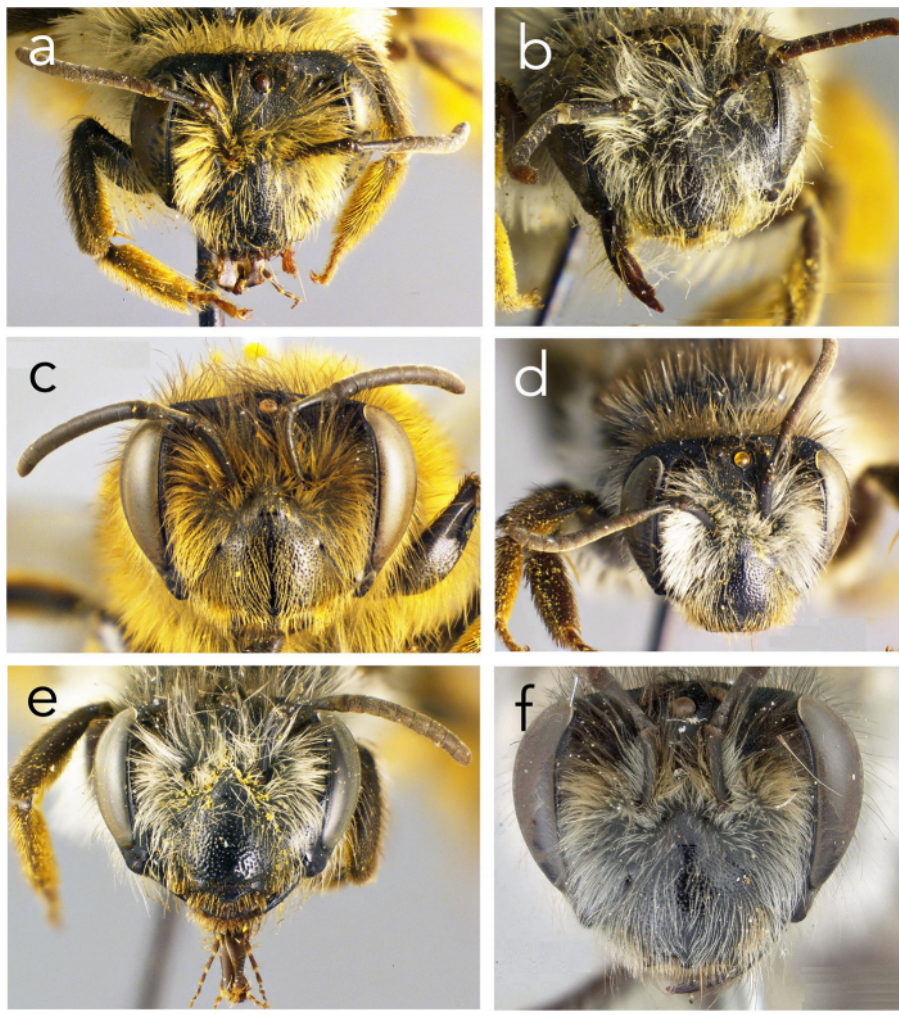

Fig. 13a-f: Head of the females: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: ZOBODAT, 2021/25/03); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

In some of the species studied, the labrum process is partially emarginated and laterally thickened. In *A. maderensis*, this is the case in 77% of the specimens examined. In *A. fratella*, an emarginated labrum process occurs in 70% of specimens. A slight or very

slight emargination occurs in *A. notata* (100%) and in *A. mirna* (88%). In *A. notata*, the labrum process is laterally thickened; in *A. mirna*, it is not thickened. In *A. cyanomicans*, 56% of the specimens do not show any process emargination; in the remaining 44%, the labrum process is only slightly emarginated. In *A. portosanctana*, 99% of the specimens have a straight labrum process.

The process apex is narrowest in *A. portosanctana* (0.12 ± 0.02 µm) and in *A. maderensis* (0.15 ± 0.02 µm), and widest in *A. mirna* (0.24 ± 0.02 µm). The process apex width of the other three species is between these values (0.19 ± 0.02 µm); see also the chapter 'Comparative morphometric analysis'.

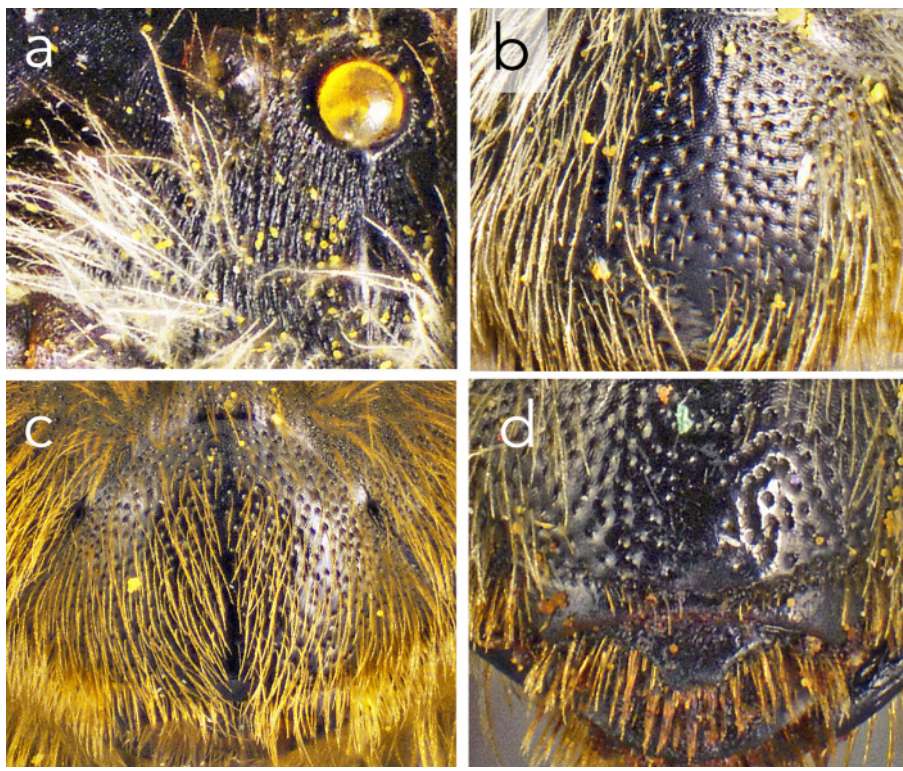

Fig. 14a-d: Details in head morphology of the females: (**a**) rugulae of *Andrena mirna* (Photo: ZOBODAT, 2021/25/03); (**b**) clypeus of *A. mirna* (Photo: ZOBODAT, 2021/25/03), (**c**) clypeus of *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) clypeus and labrum of *A. notata* (Photo: ZOBODAT, 2021/25/03).

P u b e s c e n c e : With regard to the hair colouration on the head, three different types can be distinguished. *Andrena cyanomicans* is characterised by a dominant yellowish pubescence (Fig. 13a), and *A. maderensis*, by a yellowish-reddish/yellowish-brownish pubescence (Fig. 13c). All other species have a predominantly white/off-white pubescence (Fig. 13b, Fig. 13d, Fig. 13e, Fig. 13f).

Andrena cyanomicans has yellowish hairs at the front of the head (Fig. 13a). In the paraocular area, yellowish hairs predominate. Beside and between the antennal sockets,

including on the scapus, there are long yellowish (slightly reddish) hairs in 89% of the specimens (11% have only yellowish hairs). The upper part of the paraocular area has some black-brownish hairs. The facial fovea has off-white hairs in the lower part and brownish hairs in the upper part. The colouration of the facial fovea is similar to all other species with the exception of *A. maderensis* (lower part yellowish, upper part brownish). The vertex shows yellowish hairs supplemented by some dark brownish hairs. The area of the genae has yellowish hairs similar to *A. maderensis*. On the sides of the clypeus there are dense yellowish hairs.

Andrena maderensis has yellowish and yellowish-reddish (yellowish-golden) hairs at the front (Fig. 13c). In the paraocular area, there are dense yellowish hairs, longer than the clypeal hairs. Between the antennal sockets (including on the scapus), long yellowish-brownish hairs are found in 83% of specimens, and yellowish hairs, in 17%. The upper part of the paraocular area has some brownish hairs. The facial fovea has yellowish hairs in the lower part and brownish hairs in the upper part. The vertex shows yellowish and yellowish-reddish (yellowish-golden) hairs with some brownish and dark brownish hairs intermingled. The area of the genae is characterised by dense long yellowish hairs, brighter than paraocular hairs. The hairs of the clypeus are orientated on the top, in most of all cases with a hairless line in the centre and with long yellowish-reddish hairs on the sides (Fig. 14c).

Andrena fratella, *A. mirna*, *A. notata*, and *A. portosanctana* (Fig. 13b, Fig. 13d, Fig. 13e, Fig. 13f) are characterised predominantly by white and off-white hairs in front (mostly dense yellowish-white hairs only on the sides of the clypeus area). The paraocular area has white hairs in the lower part (in *A. fratella*, off-white hairs; Fig. 14b), with some brownish hairs in the upper part. The facial fovea has off-white hairs in the lower part, with brownish hairs in the upper part. These species have different hair colour in the area of the scapus and the antennal sockets. In *A. mirna*, the hairs are white (in *A. fratella*, 90% white, 10% yellowish). In *A. notata*, the hairs are off-white, and in *A. portosanctana* whitish-yellowish with some brownish hairs. The genae have dense white hairs in *A. fratella* and *A. notata*, white hairs with brownish hairs in the upper part in *A. mirna*, and dense off-white hairs brighter than in the paraocular area in *A. portosanctana*. The vertex is characterised by white or off-white hairs with some brownish hairs in *A. fratella* and *A. mirna*, or dark brownish (black) hairs in *A. notata*. It is more strongly developed in *A. portosanctana*. The lower part of the facial fovea has off-white hairs; the upper part has brownish hairs. There are long reddish-yellowish hairs in the basal area in all species except *A. portosanctana*, which has long reddish-yellowish hairs (Fig. 14d).

C o l o u r : The integument colour is black with slightly greenish parts. The flagellomeres are yellow on the lower side and brownish on the upper side, except *A. maderensis*, in which flagellomeres 3–10 are black-brown. The mandibles of *A. fratella*, *A. mirna*, and *A. notata* are black with a red tip; in *A. maderensis*, 83% of the specimens have a red tip, but 27% have totally black mandibles; in *A. portosanctana*, 68% have a red tip and 32% have totally black; and in *A. cyanomicans*, 34% have a red tip and 66% have totally black.

2. Mesosoma (female)

S t r u c t u r e : The mesoscutum and scutellum are chagreened and punctured in all species (Fig. 15). In *A. fratella*, the mesoscutum and scutellum are shagreened in 94% of the specimens (only the base) and fairly shiny and smooth (Fig. 15b). In *A. mirna*, the

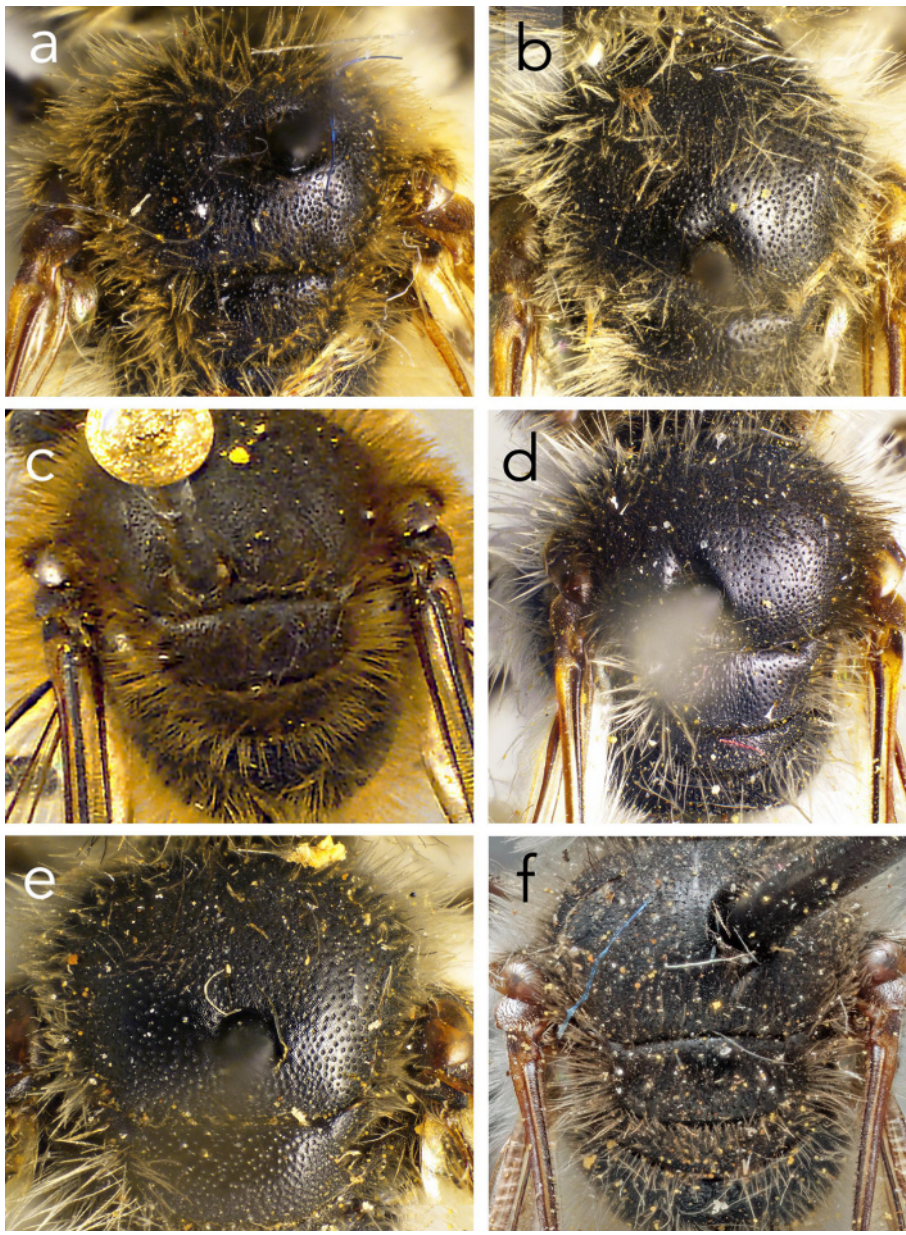

Fig. 15a-f: Mesoscutum of the females: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: ZOBODAT, 2021/25/03); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

scutellum is fairly shiny. In *A. cyanomicans*, the mesoscutum is visible more deeply and densely punctured (Fig. 16a). In *A. fratella*, *A. mirna*, and *A. notata*, the mesoscutum is visible more deeply and densely punctured. The distance of the punctures is usually 2 or 3 PD (Fig. 16b, Fig. 16d, Fig. 16e). The PD of all these species is 14–32 µm. In *A. maderensis* and *A. portosanctana*, the punctation is very shallow, the PD is smaller than in the other species (14–28 µm), and the PDI is usually larger (Fig. 16c, Fig. 16f).

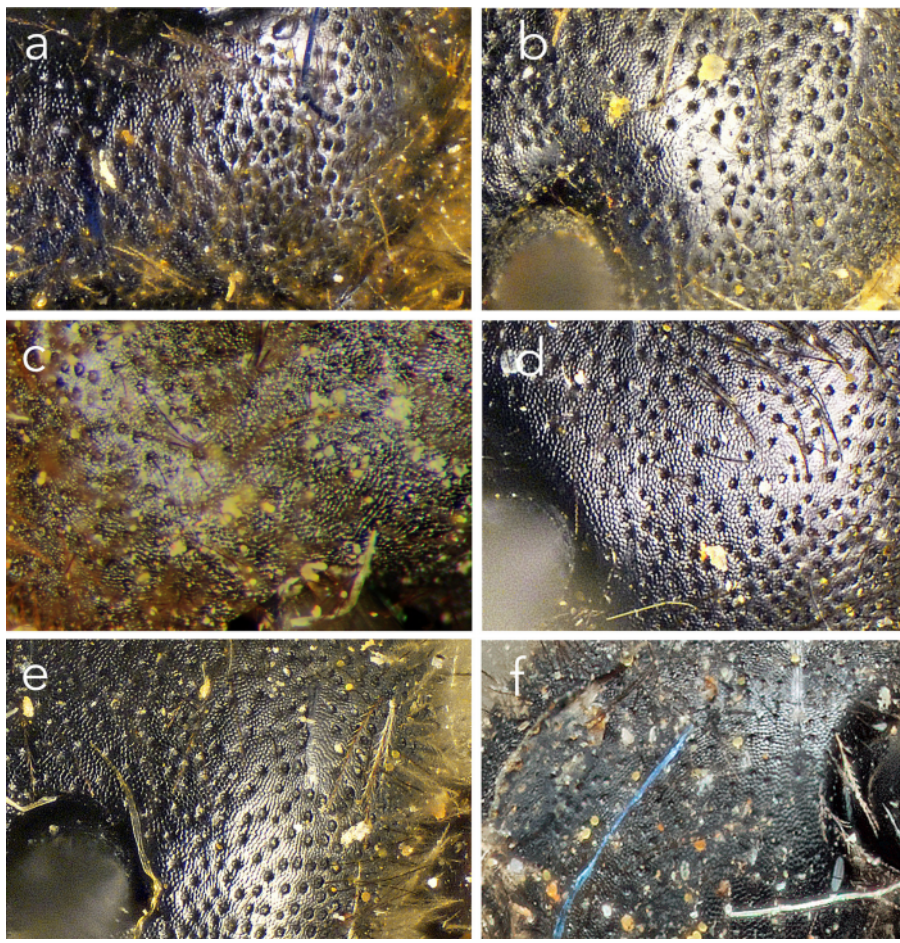

Fig. 16a-f: Puncturing of the mesoscutum of the females: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: ZOBODAT, 2021/25/03); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

The propodeum structure is somewhat variable, but there are recognisable patterns that are similar in females and males. *Andrena notata* (Fig. 17a, Fig. 17b) and *A. mirna* (Fig. 17c) are both characterised by a roughly rugose structure without longitudinal laminae. In *A. fratella* (Fig. 17d), the propodeum is roughly rugose without longitudinal lamina in 56% of the specimens, and has some fragmented longitudinal laminae in 44% (Fig. 17e).

In *A. cyanomicans*, the propodeum is roughly rugose without longitudinal laminae in 78% of specimens. The central longitudinal laminae (22%) are partly fan-shaped backwards (Fig. 17e). In *A. portosanctana*, the structure is slightly rugose in the centre, with or without dorsoventral laminae. The propodeum of *A. maderensis* is rugose in the centre (Fig. 17f) with some longitudinal laminae on the sides or without laminae. The propodeum is demarcated with a central and lateral boundary line.

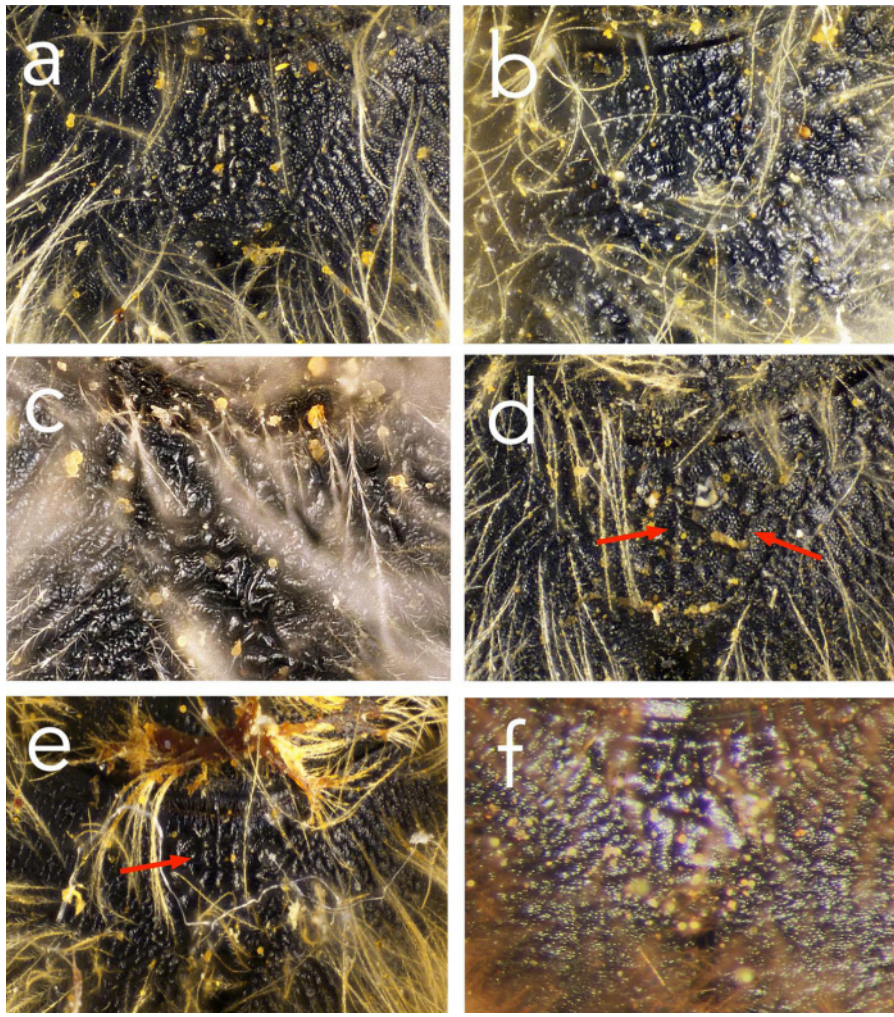

Fig. 17a-f: Structure of the propodeum: (**a**) *Andrena notata*, female: roughly rugose without dorsoventral laminae (Photo: ZOBODAT, 2021/25/03); (**b**) *A. notata*, male: pattern similar to female (Photo: ZOBODAT, 2021/25/03); (**c**) *A. mirna*, male: roughly rugose without dorsoventral laminae (Photo: ZOBODAT, 2021/25/03); (**d**) *A. fratella* female: roughly rugose with dorsoventral laminae, red arrows (Photo: ZOBODAT, 2021/25/03); (**e**) *A. cyanomicans* female: roughly rugose with dorsoventral laminae, red arrow (Photo: ZOBODAT, 2021/25/03); (**f**) *A. maderensis* male: rugose only in the centre (Photo: A. Kratochwil).

P u b e s c e n c e : With regard to the hair colouration of the mesoscutum and scutellum, three different types are recognisable. They are similar to the hair colouration of the head. *Andrena cyanomicans* is characterised by yellowish lateral pubescence and with some brownish hairs in the centre. This is the case in 78% of the specimens studied (Fig. 15a). In 22% of the specimens, yellowish-reddish lateral hairs occur with some brownish central hairs. The scutellum shows lateral yellowish hairs, with brownish hairs in the centre in 93% of the specimens; there are lateral yellowish-reddish hairs and central brownish hairs in 7% of the specimens. The mesepisternum is characterised by long yellowish hairs. In *A. maderensis*, lateral yellowish-reddish (golden) hairs predominate in 90%, with central brownish hairs in 37% (Fig. 15c). Only 10% of the specimens are characterised by yellow hairs. The scutellum shows yellowish-reddish hairs in 97% of specimens, and yellowish hairs in 3%. The mesepisternum is characterised by yellowish-reddish in 97%, and by yellowish hairs in 10%.

In *Andrena fratella*, *A. mirna*, *A. notata* and *A. portosanctana* (Fig. 15b, Fig. 15d, Fig. 15e, Fig. 15f), most hairs are white, off-white or yellowish-white. The mesoscutum of *A. fratella* is characterised by white hairs on the sides and in front in 65% of the specimens studied; in 24%, there are also brownish hairs in the centre (in 21%, yellowish-white hairs are on the sides and in front, and brownish hairs in the centre); Fig. 15b. The scutellum has white hairs on the sides and in the centre, and the mesepisternum is characterised by long white hairs. In *A. mirna*, the mesoscutum has off-white hairs on the sides and in front, and brownish hairs in the centre. The scutellum shows off-white hairs on the sides, and the mesepisternum has long off-white hairs. The mesoscutum of *A. notata* and *A. portosanctana* has yellowish-white hairs on the sides. In the centre, *A. notata* has dense black-brownish hairs, and *A. portosanctana*, only sparse brownish hairs (Fig. 15e, Fig. 15f). *Andrena notata* and *A. portosanctana* also differ in terms of the hair colour of the scutellum and mesepisternum. The scutellum hairs of *A. notata* are white on the sides and dark brownish in the centre. The mesepisternum of *A. notata* is characterised by long white hairs, in contrast to *A. portosanctana*, which has yellowish-white scutellum hairs on the sides and dark brownish (black) hairs in the centre, and long yellowish-white hairs on the mesepisternum. The scutellum hairs of *A. mirna* are off-white on the sides and in front, and brownish in the centre. The scutellum has off-white hairs on the sides, and the mesepisternum has long off-white hairs.

The hairs of the propodeal corbicula, the trochanteral flocculus and the femoral flocculus of *A. cyanomicans* are yellowish. On the other hand, *A. maderensis* has a propodeal corbicula with yellowish-reddish hairs in 83% of specimens and with some shorter hairs in the centre, and with yellowish hairs in 17%. The trochanteral flocculus of *A. maderensis* has yellowish hairs in 97% of specimens and brownish hairs in 3%; the pubescence of the femoral flocculus is yellowish. The hairs of the propodeal corbicula, the trochanteral flocculus, and the femoral flocculus of *A. fratella*, *A. notata*, and *A. portosanctana* are similar. The propodeal corbicula has dense white hairs and some hairs in the centre. Only *A. portosanctana* has no hairs in the centre. The trochanteral flocculus is characterised by long white hairs; *A. portosanctana* has shorter white hairs. The femoral flocculus of *A. fratella* has long white hairs in 87% and white-yellowish hairs in 13%. In *A. notata*, it has long white hairs, and in *A. portosanctana* white hairs. The hairs of the propodeal corbicula, the trochanteral flocculus, and the femoral flocculus of *A. mirna* are long and off-white.

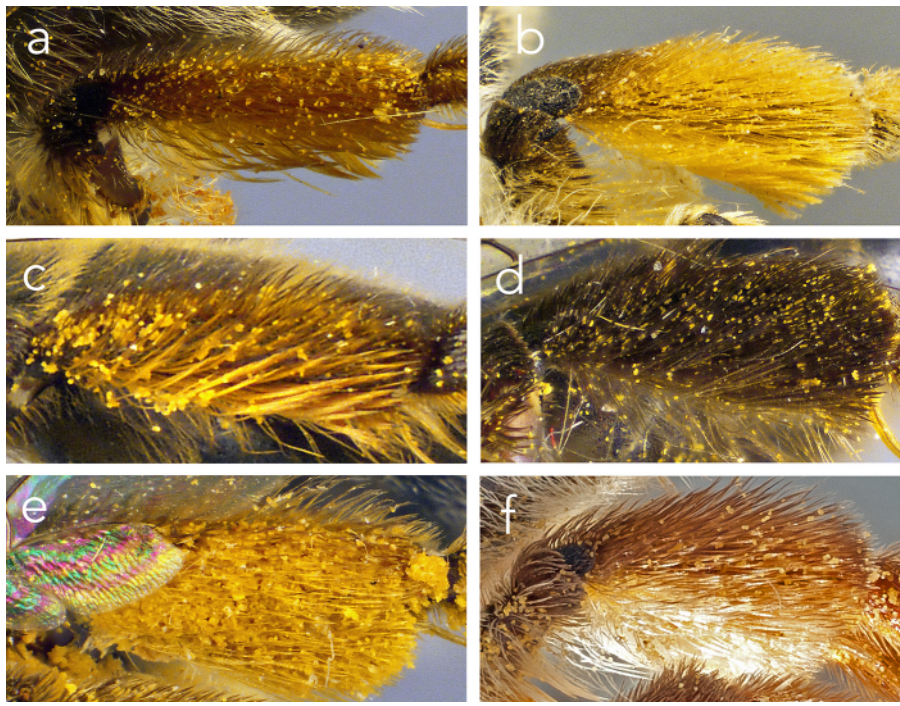

Fig. 18a-f: Scopa: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: A. Kratochwil); (**d**) *A. mirna* (Photo: ZOBODAT, 2021/25/03); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: A. Kratochwil).

The dorsal region of the tibial scopa of *A. cyanomicans* has reddish hairs with brownish tips; the dorsobasal region has brownish hairs; the ventral part has yellowish-reddish hairs (Fig. 18a). In *A. fratella*, the dorsal region has reddish-brown hairs, some with brownish tips; the dorsobasal region has brownish hairs (similar to *A. cyanomicans*); and the ventral region is characterised by white-yellowish hairs in 65% of the specimens and yellowish in 35% (Fig. 18b). The scopal hairs of *A. maderensis* are yellowish-reddish with brownish tips in the dorsal region; brown at the base; and in the ventral region, yellowish-reddish in 77% and yellowish in 23% (Fig. 18c). The pubescence of the scopa of *A. mirna* is dark brown in the dorsal region, with brownish hairs in the dorsobasal region and yellowish-reddish hairs in the ventral region. The hairs of the tibial scopa have no brownish tips (Fig. 18d). *Andrena notata* and *A. portosanctana* are characterised by reddish-brown hairs with brownish tips in the dorsal region and by brownish hairs in the dorsobasal region (Fig. 18e, Fig. 18f). *Andrena notata* has reddish hairs in the ventral region, while *A. portosanctana* has yellowish hairs.

C o l o u r : Tibia 1 and tibia 2 of *A. cyanomicans* are black-brownish in 83% of specimens, and brownish in 17%. Tibia 1 of *A. fratella* is brownish in 85% of the specimens, brownish and partly reddish-brown in 6%, and black in 9%. Tibia 2 of *A. fratella* is brownish and partly reddish-brown in 56% and brownish in 44%. Tibia 1 and tibia 2 are black in *A. maderensis*, black-brownish in *A. mirna*, brownish in *A. notata*, and black in

A. portosanctana. Tibia 3 is brownish and partly reddish-brown in *A. cyanomicans*, *A. fratella*, and *A. notata*; black and partly reddish-brown in *A. maderensis* and *A. portosanctana*; and black-brownish in *A. mirna*. The basitarsus, mediotarsi, and distitarsus are all brownish and partly reddish-brown in *A. cyanomicans*, *A. fratella*, and *A. notata*, and black and partly reddish-brown in A. maderensis. The basitarsus of A. mirna is also black-brownish and partly reddish-brown; in *A. portosanctan* basitarsus 1 and basitarsus 2 are brown, while basitarsus 3 is reddish-brown. The mediotarsi and the distitarsus of *A. mirna* and *A. portosanctana* are brownish und partly reddish brown. The wings are hyalin except in *A. maderensis* (subhyalin). The veins are yellowish in *A. cyanomicans*; reddish-brown in *A. fratella*, *A. mirna*, and *A. notata*; and brown and partly reddish-brown in *A. maderensis* and *A. portosanctana*. There are also differences in the colour of the pterostigma. In *A. cyanomicans* and *A. notata*, the pterostigma is yellow and has a reddish-brown margin. In *A. fratella*, the pterostigma is yellow in 94% of the specimens, and reddish with a reddish-brown margin in 6%. In *A. maderensis*, *A. mirna*, and *A. portosanctana*, the petrostigma is yellow-orange with a reddish-brown margin.

3. Metasoma (female)

S t r u c t u r e : The tergites are smooth and shiny (Fig. 19). In *A. cyanomicans*, the metasoma is visibly deeply and densely punctured; in *A. fratella*, *A. mirna*, and *A. notata*, it is visibly deeply punctured, but with greater distance between punctures. The PD of all these species is 14–32 µm. In *A. maderensis* and *A. portosanctana*, the punctation is very shallow; the PD is smaller than in the other species (14–28 µm), and the PDI is also usually larger. The tergites are characterised by a posterior depression zone (T1–T5).

C o l o u r : T1–4 are black with slight blue-greenish shine in *A. cyanomicans* (Fig. 19a), *A. notata* (Fig. 19e), and *A. portosanctana* (Fig. 19f). In *A. fratella*, they are black and slightly greenish (Fig. 19b); in *A. maderensis*, black and slightly greenish or bronze-like (Fig. 19c), and in *A. mirna*, black and slightly blue-greenish or slightly brown (Fig. 19d). The depression zones are reddish-brown in *A. cyanomicans* (Fig. 19a) and *A. mirna* (Fig. 19d), and black to dark reddish-brown in all other species (Fig. 19b, Fig. 19c, Fig. 19e, Fig. 19f). The pygidium is black in all species.

P u b e s c e n c e : *Andrena cyanomicans* (Fig. 19a) is characterised by long yellowish hairs in the centre of T1 and T2, and by a yellowish hair row in T1. T3 and T4 have a few short yellowish hairs in the centre. The tergite ends of T2–T4 show yellowish-brownish hair bands. In the centre of T5, there are long dark brownish hairs, with long white hairs on the sides. T6 is characterised by dense dark brownish hairs reaching to the pygidium. In *A. fratella* (Fig. 19b), *A. mirna* (Fig. 19d), and *A. portosanctana* (Fig. 19d), the centres of T1 and T2 have long off-white hairs, and there are off-white hair rows in T1. In T1 of *A. fratella*, there is an off-white hair row in 87% of specimens, and an open hair band in 17%. In *A. portosanctana*, there is a white partly closed hair band. In *A. fratella* (Fig. 19b), *A. mirna* (Fig. 19d), and *A. portosanctana* (Fig. 19d), the centres of T3 and T4 has few short off-white hairs. The tergites ends (T2–T4) show white closed hair bands in *A. fratella*, off-white closed hair bands in *A. mirna*, and white partly closed hair bands in *A. portosanctana*. In *A. fratella* (Fig. 19b), *A. mirna* (Fig. 19d), and *A. portosanctana* (Fig. 19d), the centre of T5 is characterised by dark brownish hairs, also found in T6 reaching the pygidium. Differences exist in the colour of the lateral pubescence of T5:

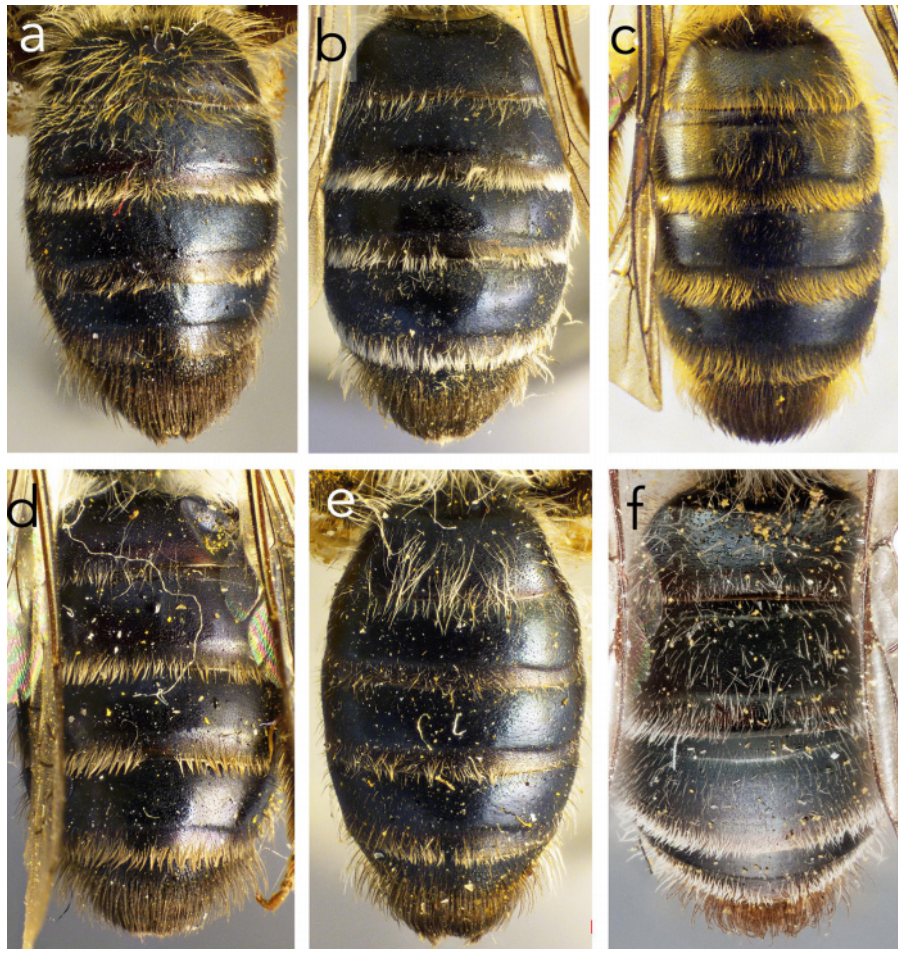

Fig. 19a-f: Metasoma of the females: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: ZOBODAT, 2021/25/03); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

Andrena fratella and *A. portosanctana* have long white hairs, while *A. mirna* has dark brownish hairs.

In *A. maderensis* (Fig. 19c), the centres of T1 and T2 have long brownish hairs (90% of specimens) or long whitish-yellowish hairs (10%). T1 shows a yellowish (golden) hair row, or either a fragmented lateral yellowish (golden) hair band (90%) or a whitish-yellowish hair band (10%). T3 and T4 have short brownish (90%) or whitish-yellowish hairs in the centre. The tergite ends of T2–T4 have yellowish hair bands (open in the centre in 60%; reduced T4 in 23%; white-yellowish colour in 17%). In the centre of T5, there are long dense brownish hairs, with yellowish hairs on the sides. T6 is characterised by dense brownish hairs reaching to the pygidium. In *A. notata* (Fig. 19e), the

centres of T1 and T2 are characterised by long whitish-yellowish hairs. In T1, a whitish-yellowish hair band is formed. T3 and T4 have short whitish-yellowish hairs in the centre. T2–T4 are characterised by whitish-yellowish hair bands. T5 long dark brownish hairs in the centre and white hairs on the sides. T6 is covered in dense dark brownish hairs reaching the pygidium.

4. Head (male)

S t r u c t u r e : As in the females, the vertex width corresponds to an ocellular diameter, the inner eye margin does not converge, and the face area above the antennal fossae is characterised by elongated rugulae. As in the females, the clypeus is convex, shiny in front, with or without any punctures; the other clypeus area is punctured, and the clypeus base is shagreened. The degree of frontal puncturing varies both within and between species. In *A. cyanomicans*, the clypeus front and the other clypeus area are punctured in 86%, and not punctured in 14%; in *A. mirna*, the front is punctured in 67%, and not punctured in 33%. In *A. maderensis* and *A. portosanctana*, the front is very shiny, with some punctures in 70% and without punctures in 30%. The remaining area of the clypeus is punctured. In *A. fratella* the clypeus has no punctures in front, but punctures elsewhere in 36%; punctures in front, but punctures elsewhere in 32%; and punctures all over the clypeus in 32%. In *A. notata*, the front of all specimens is unpunctured.

In the centre, the clypeus is shiny, smooth, and punctured, and on the base, shagreened (Fig. 20f, Fig. 21a). *Andrena notata* (Fig. 21a) has an unpunctured median line; *A. mirna* has a fragmented unpunctured median line in 67% (no line in 33%); and *A. fratella* a fragmented unpunctured median line in 44% (no line in 56%). An unpunctured median line is absent in *A. portosanctana*, in 86% of *A. cyanomicans*, and in 70% of *A. maderensis*.

The PD ranges between 28 and 42 µm in all species except *A. fratella* (28–70 µm) and *A. maderensis* (28–56 µm). The PDI varies between the species (*A. cyanomicans* and *A. fratella*: 28–42 µm; *A. maderensis*: 14–56 µm; *A. mirna*: 28–42 µm; *A. notata*: 28–42 µm, *A. portosanctana*: 14–42 µm).

P u b e s c e n c e : As in the females, three different types of head hair colouration occur. *Andrena cyanomicans* is characterised by a dominant yellowish pubescence (Fig. 20a), and *A. maderensis*, by a yellowish-reddish/yellowish-brownish pubescence (Fig. 20c). All other species have a predominantly white pubescence (Fig. 20b, Fig. 20d, Fig. 20e, Fig. 20f). Different head areas may have different colourings, which is important for further differentiation. The labrum of the species examined here has a cavity in the centre, which is hairy, and there are hairs on the sides of the labrum (Fig. 21b, Fig. 21c, Fig. 21d).

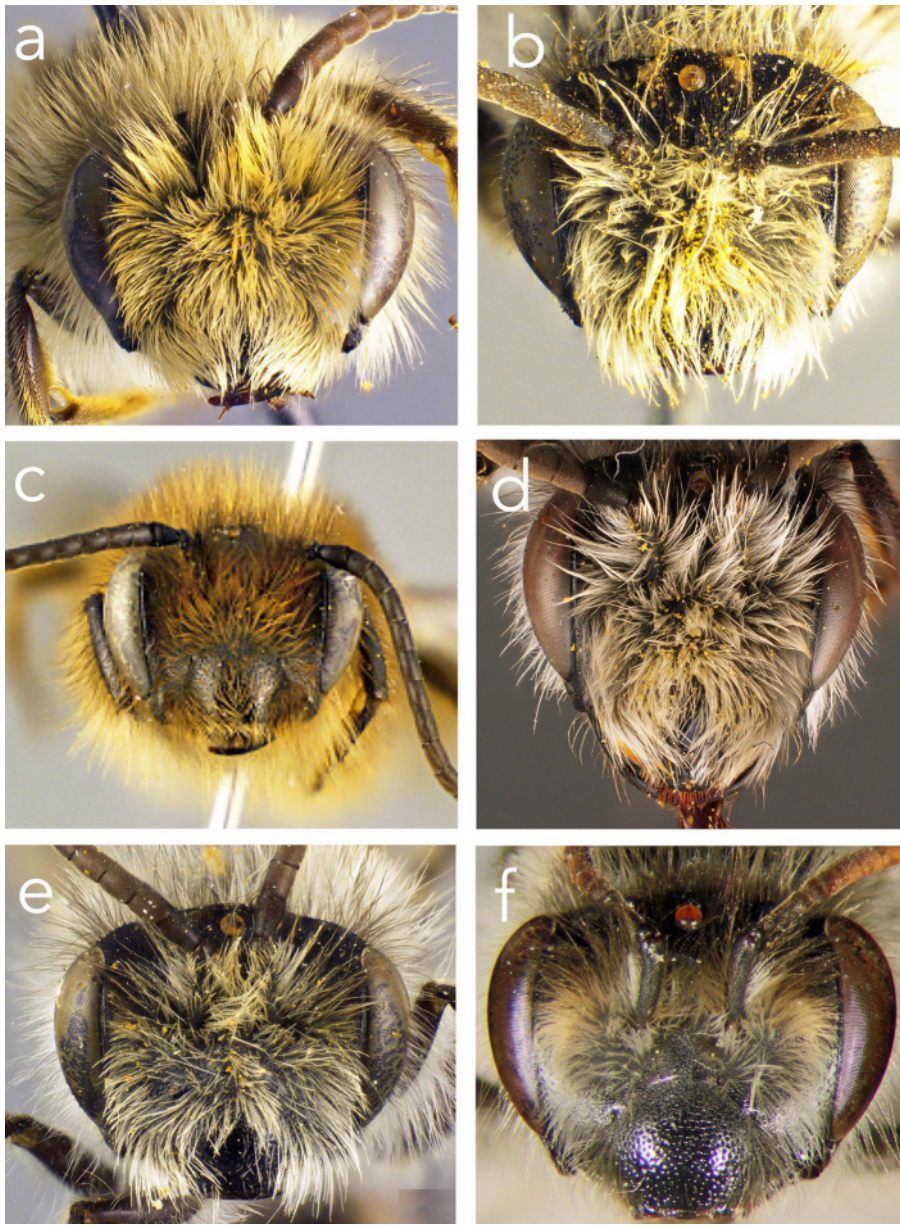

Fig. 20a-f: Head of the males: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: M. Schwarz, OLML); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

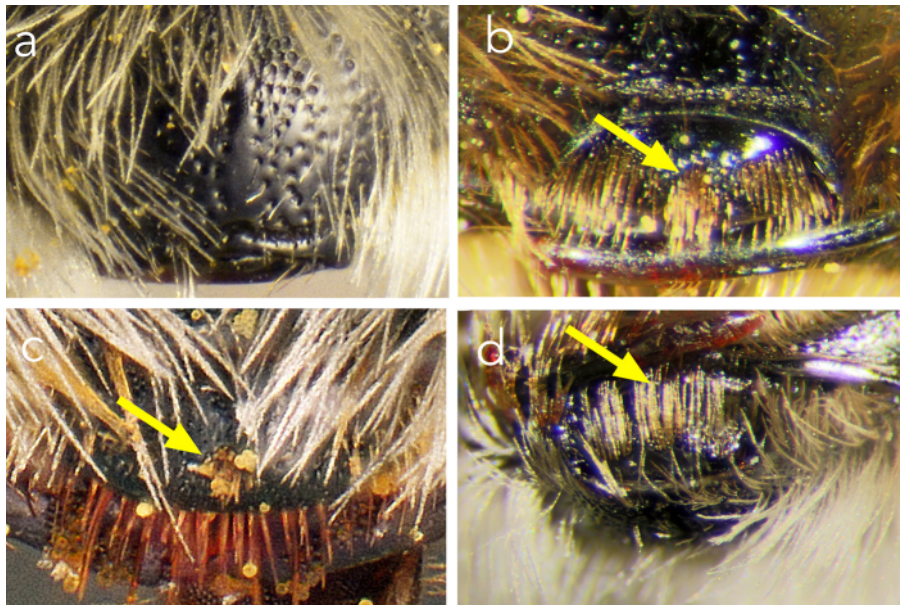

Fig. 21a-d: Details of the head of the males: (**a**) clypeus of *Andrena notata* with unpunctured medium line (Photo: ZOBODAT, 2021/25/03**)**; (**b**) labrum of *A. maderensis* (Photo: A. Kratochwil); (**c**) labrum of *A. mirna* (Photo: M. Schwarz, OLML); (**d**) labrum of *A. portosanctana* (Photo: A. Kratochwil). Yellow arrow: central hollow of the labrum with hairs.

Andrena cyanomicans has yellowish hairs in the front of the head (Fig. 20a). Beside and between the antennal sockets, including on the scapus, there are yellowish hairs in 79% of specimens, yellowish with a reddish tinge in 14%, and off-white in 7%. The paraocular area has yellowish hairs in the lower part in 71%, slightly reddish in 21%, and off-white in 8%; in all specimens, there are brownish hairs in the upper part. The vertex shows yellowish hairs, supplemented by some brownish hairs. The genae are characterised by dense yellowish hairs in 93% and dense off-white hairs in 7%; there are brownish hairs in the upper part. The clypeus shows dense yellowish hairs in 93% and off-white hairs in 7%. Thus, the colour of the head pubescence in the males corresponds to that of the females. In the centre of the labrum, the hairs are yellowish-reddish in 79%, whitish-yellowish in 7%, and absent in 14%. On the sides, the hairs, which are long, are yellowish-reddish in 79%, white-yellowish in 14%, and yellowish colour in 7%.

Andrena maderensis has yellowish-reddish (golden) hairs in the front (Fig. 20c). In the paraocular area there are also dense yellowish-reddish hairs, longer than the clypeal hairs. Between the antennal sockets, including on the scapus, there are long yellowish-reddish hairs. The upper part of the paraocular area has brownish hairs. The vertex shows yellowish-reddish hairs, with some longer and dark brownish hairs on the sides. The area of the genae is characterised by dense long yellowish hairs, brighter than the paraocular hairs. The hairs on the clypeus are yellowish, and there is a hairless line in the centre. The labrum hairs are yellowish-reddish in the centre; there are long yellowish hairs on the sides. The colour of the head pubescence in the males corresponds to that of the females.

Andrena fratella, *A. mirna*, *A. notata*, and *A. portosanctana* (Fig. 20b, Fig. 20d, Fig. 20e, Fig. 20f) are characterised predominantly by white or off-white hairs in front. The hair colour in the paraocular area and between the antennal sockets, including on the scapus, varies slightly amoung these species. In *A. mirna* and *A. notata*, the hairs are white. This is also the case in *A. fratella* in 85% of specimens, but there are also white-yellowish hairs in 15%. *Andrena portosanctana* is characterised by dense off-white hairs and brownish hairs behind the antennal sockets. In all these species, the upper part shows some brownish hairs. The vertex shows white hairs in *A. fratella*, *A. mirna*, and *A. notata*, with some brownish hairs in *A. fratella*, brownish hairs in 67%, but reddish-brown hairs in 33% of *A. mirna*, and dark brownish (black) hairs in *A. portosanctana*. The pubescence of the genal area is dense and white, with some brownish hairs in the upper part in *A. fratella*, *A. mirna*, and *A. notata*. In *A. portosanctana*, it has dense off-white hairs, brighter than the paraocular hairs, and with brownish hairs in the upper part. The clypeus shows dense off-white hairs in *A. fratella*, *A. mirna*, and *A. notata*, and off-white hairs on the sides and a hair-free line in *A. portosanctana*.

C o l o u r : The integument colour is black and slightly greenish, as in the females. In contrast to the females, the flagellomeres 3–10 are dark brownish on the upper side and brownish on the lower side. An exception is *A. portosanctana* (upper side black or dark brownish, lower side brownish). *Andrena fratella*, *A. mirna*, and *A. notata* have mandibles with a red tip; *Andrena portosanctana* a black tip except in a few cases.

5. Mesosoma (male)

S t r u c t u r e : The mesoscutum and scutellum are shagreened and punctured in all the species considered (Fig. 22). The PD of *A. cyanomicans*, *A. fratella*, *A. mirna*, and *A. notata* is 14–32 µm, that of *A. maderensis* and *A. portosanctana* is 14–28 µm. In *A. cyanomicans*, *A. fratella*, *A. mirna*, and *A. notata*, the punctures are visibly more deeply formed (Fig. 22a, Fig. 22b, Fig. 22d, Fig. 22e) than in *A. maderensis* and *A. portosanctana* which have very shallow punctures (Fig. 22c, Fig. 22f). The punctures of *A. cyanomicans* (Fig. 22a) are positioned more densely than those of *A. fratella*, *A. mirna*, and *A. notata*. The punctures of *A. maderensis* and *A. portosanctana* are shallow and very scattered (Fig. 22c, Fig. 22f). The structure of the propodeum is similar to that of the females (Fig. 17), but the structure of the laminae differs slightly. *Andrena cyanomic*ans and *A. mirna* do not have longitudinal laminae, and *A. portosanctana* lack longitudinal laminae in 75% of specimens. *Andrena fratella* and *A. notata* show fragmented longitudinal laminae in 94%; *Andrena maderensis* has longitudinal laminae in 90%. There are also differences in terms of propodeum boundary line. *Andrena mirna* has no central line, and *A. portosanctana* has no lateral boundary line. *Andrena cyanomicans* has no central boundary line in 86%, and both a central and a lateral boundary line in 14%. *Andrena fratella* and *A. notata* have a fragmented boundary line in 94% and both a central and a lateral boundary line in 6%.

P u b e s c e n c e : The hair colouration of the mesoscutum and scutellum is similar to that of the females, but there are some differences (Fig. 22). In 79% of *A. cyanomicans*, in the mesoscutum and scutellum area, there are yellowish hairs on the sides, with some additional dark brownish hairs in the centre. In 7%, the pubescence is off-white on the sides; in 7%, yellowish-reddish; and in 7%, reddish-yellowish; in all cases, there are some additional dark hairs in the centre (Fig. 22a). The mesepisternum is characterised by long yellowish hairs in 93%, or off-white hairs in 7%. The pubescence colour of *A. fratella* and *A. notata* is similar (Fig. 22b, Fig. 22e), but in *A. fratella*, greater variation was observed.

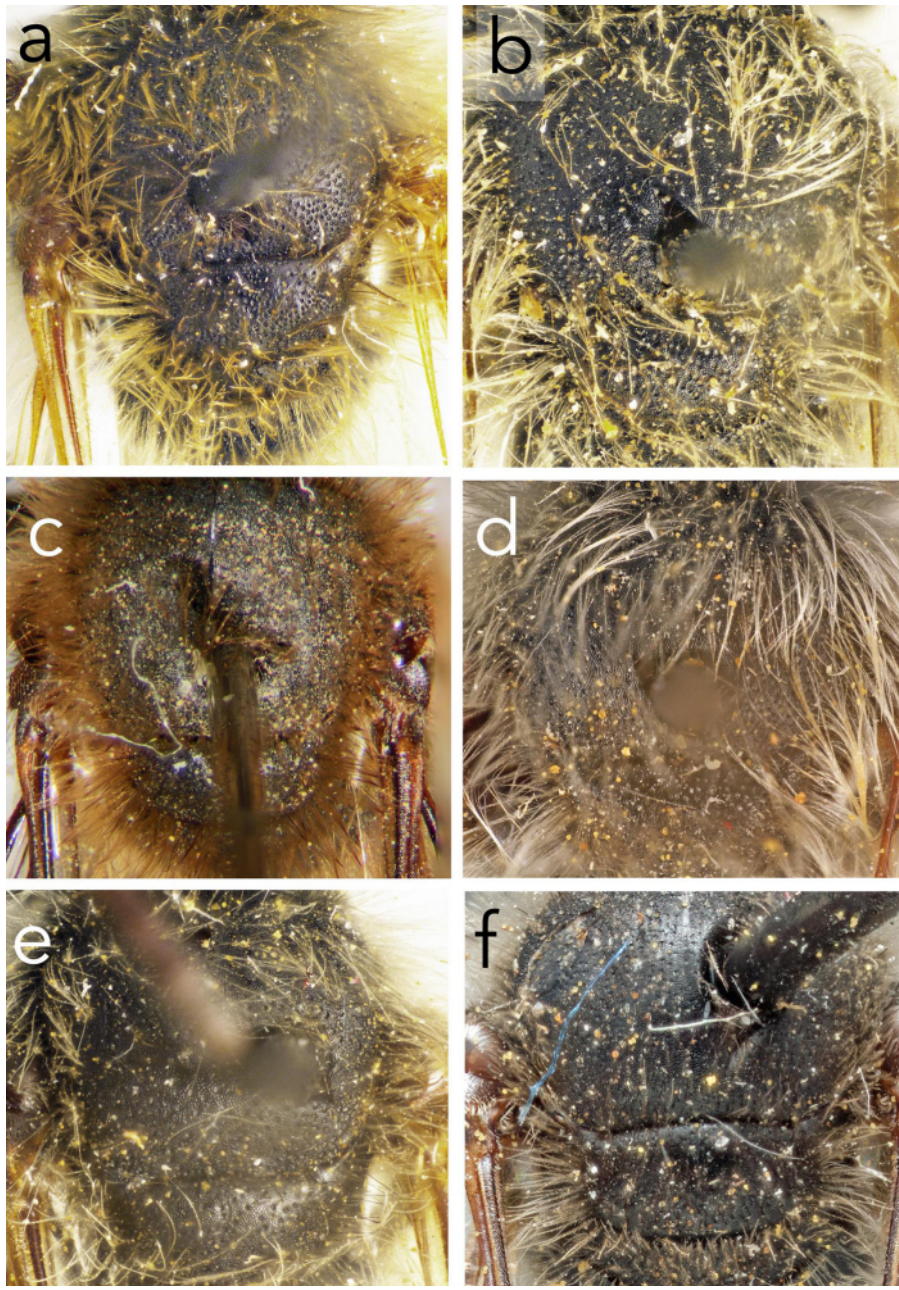

Fig. 22a-f: Mesoscutum of the males: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: M. Schwarz, OLML); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

The mesoscutum and scutellum of *A. fratella* are characterised by yellowish hairs on the sides, with a few yellowish hairs in the centre, supplemented with some brownish hairs in 15%. The mesoscutum and scutellum of *A. notata* show long yellowish hairs on the sides and in the centre (Fig. 22e). In both species, the mesepisternum has long white hairs.

In contrast, the mesoscutum pubescence of *A. maderensis* is yellowish-reddish in 50%, yellowish in 40%, and reddish-brownish in 10%. The scutellum shows reddish-brown hairs on the sides in 50% and yellowish-reddish hairs in 50% (Fig. 22c). In half of all specimens, there are brownish hairs in the centre of the scutellum. The mesepisternum is characterised by long yellowish-whitish hairs (70%), long yellowish hairs (20%), or reddish-brown hairs (10%). The mesoscutum and the scutellum of *A. mirna* are characterised by white hairs, supplemented in 33% by reddish-brownish hairs in the centre (Fig. 22d). The mesepisternum has long white hairs. *Andrena portosanctana* is characterised by off-white hairs on the sides of the mesocutum and scutellum area (Fig. 22f), supplemented by some brownish hairs.

C o l o u r : The colouration of the mesosoma is similar to that of the females. In *A. mirna*, all specimens have a black mesoscutum, in contrast with the females (brownish in 85%). The species-typical colouration of the tibiae, metatarsi, and tarsi vary slightly. The following differences were observed. Tibia 2 of *A. fratella* is black (in females, black-brownish). Tibia 3 is in *A. cyanomicans* black-brownish in 72% and reddish-brown in 28% (in females brownish, partly reddish-brown); in *A. fratella*, black (in females, brownish, partly reddish-brown); in *A. maderensis*, black (in females, black, partly reddish-brown); in *A. mirna*, as in the females, brownish black; in *A. notata*, brownish (in females, brownish and partly reddish-brown); and in *A. portosanctana*, black (in females, black and partly reddish-brown). The basitarsus, mediotarsi, and distitarsus have a similar colouration in *A. cyanomicans*, *A. fratella*, *A. maderensis*, *A. notata*, and *A. portosanctana* – black-brownish and partly reddish-brown colour. The basitarsus of *A. mirna* is also brownish and partly reddish-brown. As in the females, the wings are hyalin, except in *A. maderensis* (subhyalin). The veins are yellowish-reddish in *A. cyanomicans*; reddish in *A. fratella*; brown (reddish-black) in *A. maderensis* and *A. portosanctana*; brown-reddish (66%) or reddish (44%) in *A. mirna*; and reddish in *A. notata*. In *A. cyanomicans*, *A. fratella*, and *A. notata*, the pterostigma is yellow or yellowish and has a reddish margin. In *A. maderensis*, *A. mirna*, and *A. portosanctana*, the petrostigma is orange-yellow, partly dark reddish, with a brown margin.

6. Metasoma (male)

S t r u c t u r e : The tergites are smooth and shiny; in *A. portosanctana*, they are smooth, shiny, and slightly shagreened (Fig. 23). As in the females, the metasoma is visibly deeply and densely punctured in *A. cyanomicans*; in *A. fratella*, *A. mirna*, and *A. notata*, it is visibly deeply punctured (PD: 14–28 µm), but with more distance between punctures. In *A. maderensis* and *A. portosanctana*, the punctation is very shallow; the PD is smaller than in the other species (14–28 µm), and the PDI is also usually larger. The tergites are characterised by a posterior depression zone (T1–T5). S8 is broad in *A. cyanomicans*, *A. fratella*, *A. mirna*, and *A. notata*, and narrow in *A. maderensis* and *A. portosanctana*.

Fig. 23a-f: Metasoma of the males: (**a**) *Andrena cyanomicans* (Photo: ZOBODAT, 2021/25/03); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: M. Schwarz, OLML); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: V. Smith, CAS).

The genitals of the six species show remarkable differences, confirming the species status (Fig. 24). The differences are in the length of gonocoxite spur; the shape of spur apex (blunt or pointed, broad or narrow); the shape of the valve (narrower and straight, broader and slightly curved, or broader and very curved); the transition between the gonocoxite and gonostylus (angular, slightly canted, or more rounded); and the colour of the pubescence on the gonostylus.

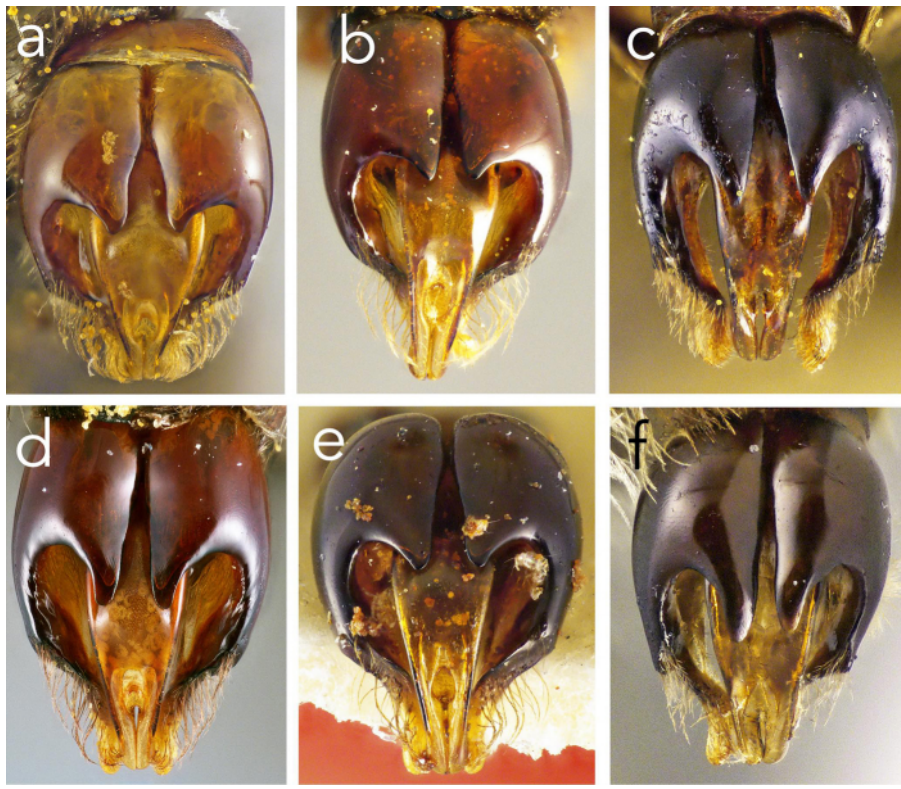

Fig. 24a-f: Genitals of the males: (**a**) *Andrena cyanomicans* (Photo: L. Haitzinger, OLML); (**b**) *A. fratella* (Photo: ZOBODAT, 2021/25/03); (**c**) *A. maderensis* (Photo: L. Haitzinger, OLML); (**d**) *A. mirna* (Photo: ZOBODAT, 2021/25/03); (**e**) *A. notata* (Photo: ZOBODAT, 2021/25/03); (**f**) *A. portosanctana* (Photo: L. Haitzinger, OLML).

- *A. cyanomicans*: the spur on the gonocoxite is short, as wide as it is long, slightly pointed, and curved; the valve is broad and curved at the outer edge; the transition zone between the gonocoxite and gonostylus is slightly angular; the gonostylus pubescence is yellowish.
- *A. fratella*: the spur of the gonocoxite is short, pointed, and slightly curved; the valve is narrow and straight at the outer edge; the transition zone between the gonocoxite and gonostylus is rounded; the gonostylus pubescence is off-white.
- *A. maderensis*: the spur of the gonocoxite is very long and pointed; the valve is narrow and slightly curved at the outer edge; the transition zone between the gonocoxite and gonostylus is angular; the gonostylus pubescence is yellowish-reddish.
- *A. mirna*: the spur of the gonocoxite is long, blunt, and slightly curved; the valve is narrow and more or less straight at the outer edge; the transition zone between the gonocoxite and gonostylus is angular; the gonostylus pubescence is off-white.

- *A. notata*: the spur of the gonocoxite is short, pointed and slightly curved; the valve is narrow and straight at the outer edge; the transition zone between the gonocoxite and gonostylus is angular; the gonostylus pubescence is yellowish-whitish.
- *A. portosanctana*: the spur of the gonocoxite is very long and blunt; the valve is narrow and slightly curved at the outer edge; the transition zone between the gonocoxite and gonostylus is angular; the gonostylus pubescence is white.

C o l o u r : In *A. cyanomicans*, T1–4 are black with a slight blue-greenish shine (Fig. 23a). In *A. fratella* (Fig. 23b), *A. mirna* (Fig. 23d), *A. notata* (Fig. 23e), and *A. portosanctana* (Fig. 23f) they have a black, slightly greenish colour; in *A. maderensis*, a black, slightly greenish or bronze-like colour (Fig. 23c). The depression zones are black to dark reddish-brown in *A. fratella*, *A. maderensis* (Fig. 23c), *A. notata* (Fig. 23e), and *A. portosanctana* (Fig. 23f). In *A. cyanomicans*, the depression zones are black to dark reddish-brown in 93%, and reddish-brown in 7% (Fig. 23a); in *A. mirna*, they are totally reddish-brown (Fig. 23d). The colour of the pygidium is black-reddish in *A. cyanomicans*, *A. mirna*, and *A. portosanctana*; in *A. maderensis*, black reddish in 90% and black in 10%; in *A. notata*, black or black-reddish. *Andrena fratella* shows greater variability in the pygidium colour (black-reddish in 65%, reddish in 21%, black-brown-reddish in 12%, and reddish in 3%).

P u b e s c e n c e : T1 and T2 of *A. cyanomicans* (Fig. 23a) are characterised by long yellowish hairs in the centre, as in the females. T3 and T4 have short yellowish hairs. T2–T4 have yellowish, fairly sparse hair bands in 75%, yellowish-reddish hair bands in 17%, and yellowish-brownish hair bands in 7%. In T5, there are reddish hairs in the centre and yellow hairs on the sides; in T6, there are dense reddish hairs, reaching to the pygidium. ST8 is characterised by yellowish-reddish hairs in 93% and yellowish hairs in 7%.

T1 and T2 of *A. fratella* (Fig. 23b), *A. notata* (Fig. 23e), and *A. portosanctana* (Fig. 23f) are characterised by long off-white hairs in the centre. *Andrena mirna* (Fig. 23d) has long white hairs in the centre. In these three species, T3 and T4 have short off-white hairs in the centre. The margin has an off-white hair row in *A. fratella*, *A. mirna*, *A. notata*, and *A. portosanctana*. T2–T4 of *A. fratella*, *A. mirna*, *A. notata*, and *A. portosanctana* are characterised by white or off-white hair bands. In the centres of T5 and T6, there are long reddish hairs in *A. fratella* (Fig. 23b) and in *A. portosanctana* (Fig. 23f); reddish-brown hairs in *A. notata* (Fig. 23e); and dark brown hairs in *A. mirna* (Fig. 23d). In all these species, T5 has off-white hairs on the sides. ST8 has yellowish hairs in 91% and white hairs in 9% in *A. fratella*; dark brown hairs with some yellowish hairs in *A. mirna*; white-yellowish hairs in *A. notata*; and white hairs in *A. portosanctana*.The metasoma pubescence of *A. maderensis* shows greater colour variability than in the other species (Fig. 23c). T1 is characterised by long yellowish-whitish hairs in the centre in 70%, by long yellowish hairs in 20%; or by long reddish-brown hairs in 10%. The margin of T1 has a yellowish-whitish hair row in 80% or a yellowish hair row in 20%. The centre of T2 has long whitish-yellowish hairs in 80%, long yellowish hairs in 10%, and long off-white hairs in 10%. The centre of T3 shows short off-white hairs in 70% and short reddish hairs in 30%. T4 has shorter reddish hairs in the centre. T2–T4 are characterised by yellowish-whitish hair bands in 90% or off-white hairs bands in 10%, both open in the centre. T5 has yellowish hairs in the centre in 80% and reddish hairs in 20%; on the sides the hairs are off-white in 80% and yellowish in 20%. T6 has reddish hairs reaching to the pygidium. ST8 shows reddish hairs.

Comparative morphometric analysis

The six species were compared in terms of 23 morphometric parameters. An overview of the morphometric data (the average values and standard deviations of the taxa studied) is given in the appendix (Table 1A for females, in Table 2A for males). The results of the comparative univariate morphometric analysis are presented in boxplot diagrams including a statistical comparison of the species-specific values. Groups with the same letter are not significantly different. Significance levels are as follows: * $p \leq 0,05$; ** $p \leq 0,01$; *** $p \leq 0,001$; n.s. = not significant. It should be noted that only a small number of *A. notata* specimens could be measured.

1. Females

- Body length (BL) (Fig. 25): *Andrena cyanomicans*, *A. maderensis*, and *A. mirna* have the greatest body length out of the six species, while *A. notata* and *A. portosanctana* have the smallest body length. *Andrena fratella* shows an intermediate value. No significant differences are evident between *A. cyanomicans* and *A. mirna*; between *A. maderensis* and *A. mirna*; and between *A. notata* and *A. portosanctana*. This feature shows significant differences between species in eleven cases, including seven cases with highly significant differences.

- Clypeus length (CL) (Fig. 25): *Andrena maderensis* has by far the longest clypeus of all species. The other species hardly differ from each other in terms of clypeus length. A weakly significant difference is detectable only between *A. fratella* and *A. mirna*. In terms of the clypeus length, six cases of significant differences are detectable. Four of them are highly significant.

- Length of flagellomere 1 (FL1) (Fig. 25): In twelve cases there are significant differences in FL1 length between the species. Four of these are weakly significant; the rest are either significant or highly significant. *Andrena maderensis* has the longest FL1, followed by *A. mirna*. In the remaining species, FL1 is significantly shorter.

- Length of flagellomere 2 (FL2) (Fig. 25): As with FL1, *A. maderensis* shows by far the greatest FL2 length, followed by *A. portosanctana*. The other species with shorter flagellomere lengths have either no or only weakly significant differences between them. In total, there are four cases of highly significant and significant differences.

- Length of flagellomere 3 (FL3) (Fig. 25): For FL3, there are eight cases with highly significant differences. FL3 is longest in *A. maderensis*; *A. cyanomicans* occupies a middle position. All other species have shorter flagellomere 3.

- Index of flagellomeres 1 and 2 (FL1/FL2) (Fig. 25): All species are similar except of *A. portosanctana*, which has by far the lowest index value. There are significant differences in only four cases.

- Index of flagellomeres 1 and 3 (FL1/FL3) (Fig. 26): The FL1/FL3 index shows seven cases of significant differences, but five are weak. The significant differences are between *A. cyanomicans* and *A. fratella* and between *A. cyanomicans* and *A. mirna*.

- Index of flagellomeres 2 and 3 (FL2/FL3) (Fig. 26): This index is not very suitable

for morphometric differentiation. Significant differences between the species can be found only in five cases. *Andrena portosanctana* is noticeably different from the other species.

- Fovea length (FVL) (Fig. 26): *Andrena maderensis* has the greatest FVL, whereas *A. notata* and *A. portosanctana* have the smallest. The remaining species have intermediate lengths; *Andrena cyanomicans* and *A. mirn*a have the same length. However, both have a significantly greater FVL than *A. fratella*. In thirteen cases, there are significant differences. Only three of them are weakly significant.

- Fovea width (FVW) (Fig. 26): With regard to the fovea facialis width, all species except *A. notata* differ highly significantly from *A. portosanctana* (which has the lowest value). *Andrena cyanomicans*, *A. maderensis*, and *A. mirna* have the widest fovea facialis. Significant differences between the species can be found in only seven cases.

- Index of fovea length and fovea width (FVL/FVW) (Fig. 26): *Andrena maderensis* has the largest value by a wide margin. The other species do not differ from each other, except of *A. portosanctana*, which has a significant mean value. Significant differences between the species can be found in only seven cases.

- Head length (HL) (Fig. 26): *Andrena maderensis* and *A. mirna* have the highest HL values. *Andrena fratella*, *A. notata* and *A. portosanctana* have the lowest values. *Andrena cyanomic*ans occupies a middle position. In eight cases there are significant differences between the species. With one exception (weak significance between *A. cyanomicans* and *A. mirna*), all differences are highly significant.

- Head width (HW) (Fig. 27): *Andrena maderensis* has by far the widest head of the species studied here, followed by *A. cyanomicans* and *A. mirna*, both with the same HW. A smaller HW is found in *A. fratella* and *A. portosanctana* (not significantly different from each other). By far the smallest HW is found in *A. notata*. Significant differences are found in thirteen cases, with eight being highly significant.

- Index of head length and head width (HL/HW) (Fig. 27): A high HL/HW index value is found in *A. cyanomicans* and *A.* mirna; the other species have lower values. *Andrena notata* is not significantly different from either group. In total, there are only three significant and three weakly significant cases. The index differentiates species only to a small extent.

- Interocellar distance (IOD) (Fig. 27): *Andrena cyanomicans*, *A. fratella*, and *A. mirna* show a large interocellar distance (no significant differences between these species). *Andrena maderensis* and *A. portosanctana* have a smaller value (no significant difference between these two species), and *A. notata* has the smallest. There are eleven cases of significant differences, eight of which are highly significant.

- Labrum process width (LPW) (Fig. 27): The highest LPW is found in *A. mirna*, followed by *A. cyanomicans*, *A. fratella* and *A. notata*, which are not significantly different from each other. *Andrena maderensis* has a low LPW. The lowest LPW is found in *A. portosanctana*. In total, twelve cases of highly significant differences occur.

- Mesosoma width (MSW) (Fig. 27): *Andrena maderensis* has the widest mesosoma, followed by *A. cyanomicans* and *A. mirna* (no significant difference between these two

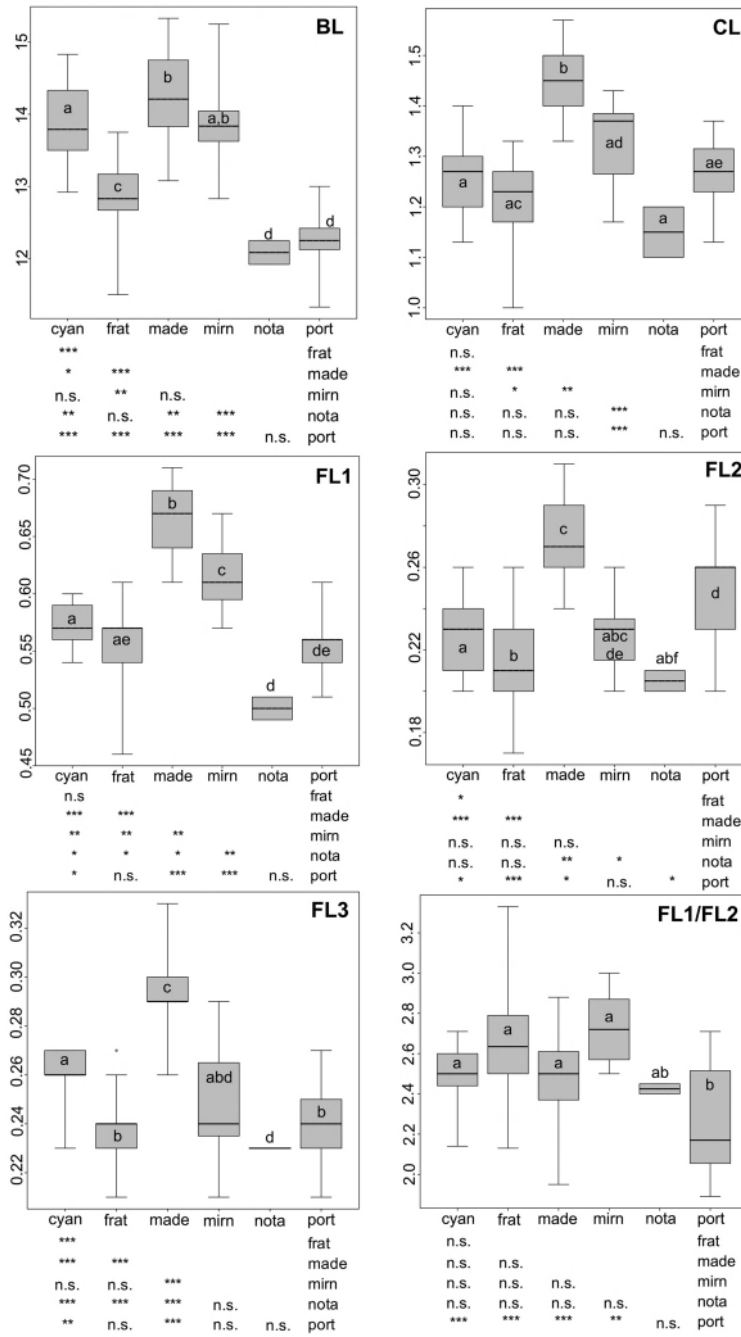

Fig. 25: Morphometric analyses (females) of body length (BL), clypeus length (CL), length of flagellomeres 1–3 (FL1–Fl3), and Fl1/Fl2 index.

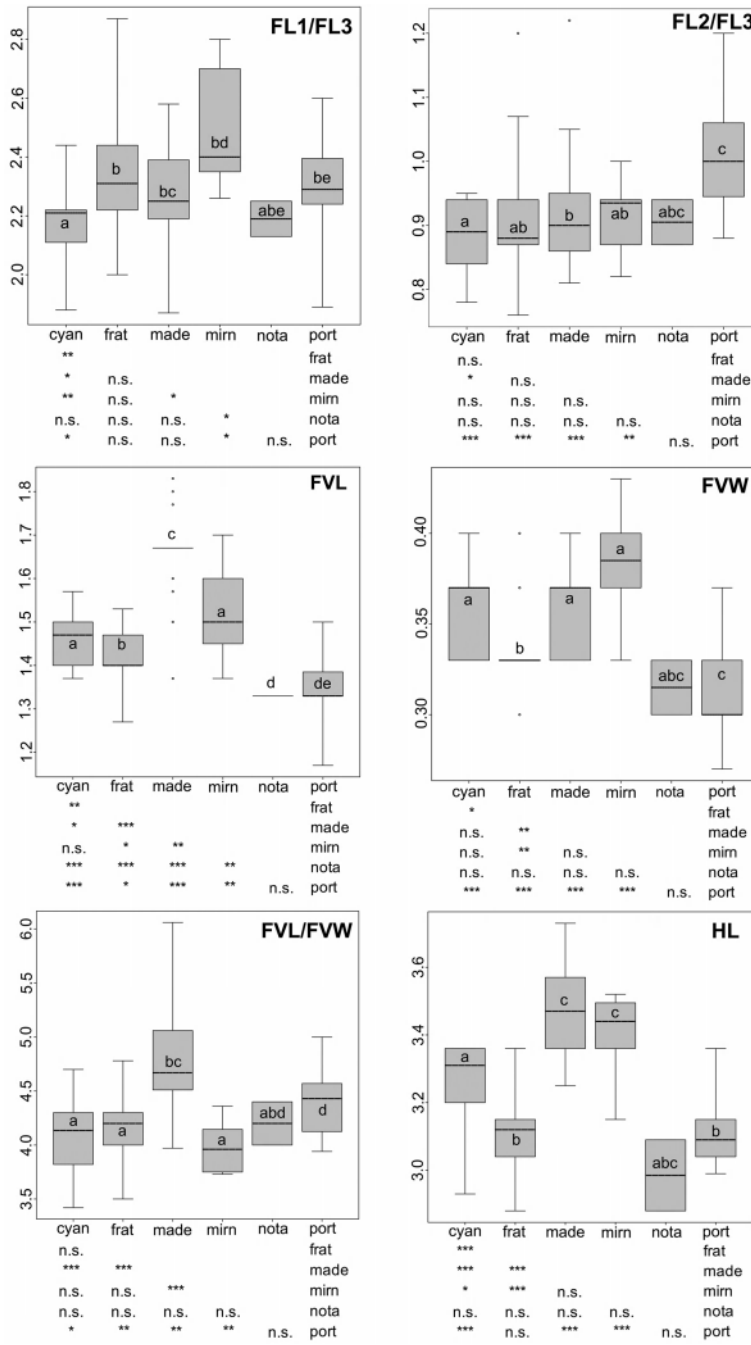

Fig. 26: Morphometric analyses (females) of FL1/FL3 and FL3/Fl3 index, fovea length (FVL), fovea width (FVW), FVL/FVW index, head length (HL).

species). A small MSW is found in *A. fratella* and *A. portosanctana* (no significant difference between the two species). *Andrena notata* has an intermediate value between the two groups. Significant differences are found in eight cases, of which four are highly significant.

- Metasoma width (MTW) (Fig. 27): *Andrena maderensis* has the highest value, followed by *A. cyanomicans*, *A. fratella*, and *A. mirna*, which, however, are not significantly different from each other. *Andrena maderensis* and *A. mirna* are also not significantly different. *Andrena notata* and *A. portosanctana* have the lowest MTW with an equal value. In eleven cases, there are significant differences between the species, six of which are highly significant.

- Ocelloccipital distance (OCD) (Fig. 28): *Andrena cyanomicans*, *A. fratella*, *A. maderensis*, and *A. mirna* have high values. The differences are not significant except for the one between *A. cyanomicans* and *A. maderensis*. The lowest value was observed in *A. portosanctana*. *Andrena notata* is intermediate. In ten cases, there are significant differences between the species, six of which are highly significant.

- Ocellular distance (OOD) (Fig. 28): *Andrena maderensis* and *A. mirna* have by far the highest OOD value. The two species do not differ from each other. The lowest values are found in *A. fratella*, *A. notata*, and *A. portosanctana*. *Andrena cyanomicans* lies between the two groups. Significant differences are present in twelve cases, ten of which are highly significant.

- Propodeum basal area length (PBAL) (Fig. 28): Except for *A. notata*, the species can be separated quite well via this parameter. *Andrena mirna* has the highest PBAL value, significantly different from A. maderensis, which has a lower value. *Andrena cyanomicans* and *A. fratella* follow with an even lower value, but similar to each other. *Andrena portosanctana* has by far the lowest value. In nine cases there are significant differences between the species.

- Pterostigma length (PSL) (Fig. 28): Five of the six species can also be well separated using PSL. Only in the case of *A. mirna* are significant differences to *A. cyanomicans* and *A. fratella* detectable. Significant differences occur in 13 cases in total. In eight cases these differences are highly significant.

- Wing length (WL) (Fig. 28): *Andrena maderensis* has by far the longest wings, *A. portosanctana* has the shortest. *Andrena cyanomicans* and *A. mirna* have wings of similar length. The difference with the shorter wing length of *A. fratella* is significant. Significant differences between the species occur in nine cases. They are highly significant in seven seven cases.

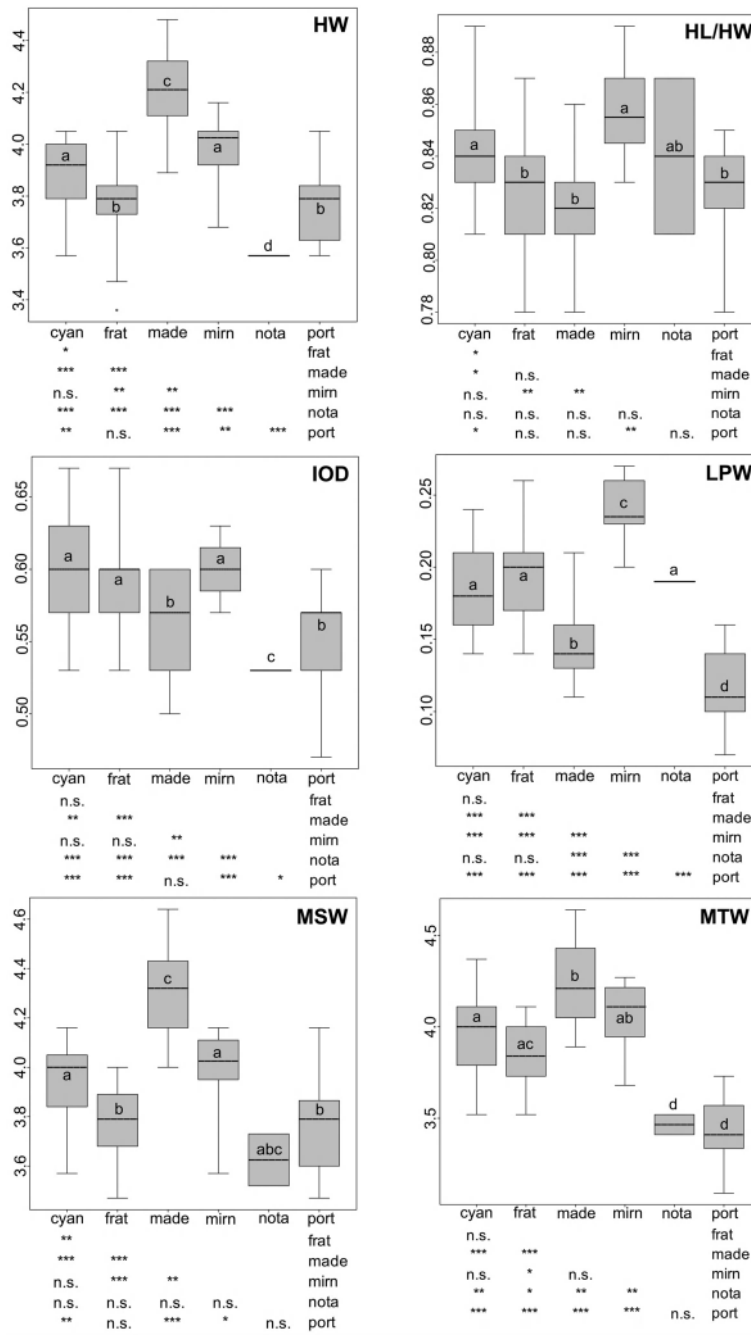

Fig. 27: Morphometric analyses (females) of head width (HW), HL/HW index, interocellar distance (IOD), labrum process width (LPW), mesosoma width (MSW), metasoma width (MTW).

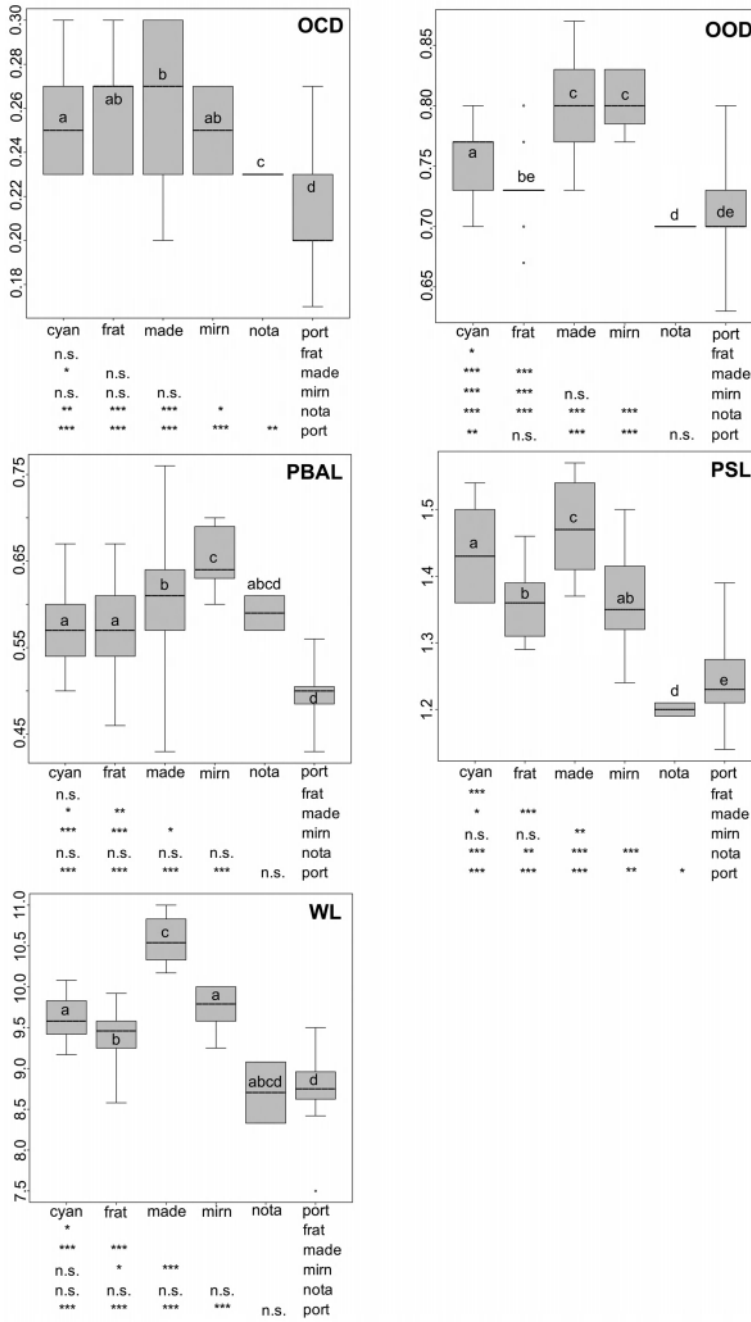

Fig. 28: Morphometric analyses (females) of ocelloccipital distance (OCD), ocellular distance (OOD), propodeum basal area length (PBAL), pterostigma length (PSL), wing length (WL).

Synopsis of the morphometric differentiation in females

Table 2 summarises the results of the univariate analysis of the 23 parameters (BL, CL, FL1–FL3, FL1/FL2 index, FL1/FL3 index, FL2/FL3 index, FVL, FVW, FVL/FVW index, HL, HW, HL/HW index, IOD, LPW, MSW, MTW, OCD, OOD, PBAL, PSL, and WL). It shows significant differences between the taxa in all cases. On average, there are 14 parameters in the species-species comparison (SD = 5). The lowest number (n = 6) differentiates *A. cyanomicans* from *A. mirna* as well as *A. notata* from *A. portosanctana*. In all other cases, at least ten parameters are significant for differentiating two species.

The number of citations of the various parameters, in descending order, shown in parentheses, demonstrates their significance in differentiating the species: FVL (13), HW (13), OOD (13), PSL (13), FL1 (12), LPW (12), BL (11), IOD (11), MTW (11), OCD (10), FL2 (9), PBAL (9), WL (9), HL (8), MSW (8), FL3 (7), FL1/FL3 (7), FVW (7), FVL/FVW (7), CL (6), HL/HW (6), FL2/FL3 (5), FL1/FL2 (4). However, their specific informative value depends on the comparison of two distinct species (Table 2).

A particularly high number of significantly different parameters (n = 21) is found between *A. cyanomicans* and *A. portosanctana*, between *A. cyanomicans* and *A. maderensis*, and between *A. mirna* and *A. portosanctana*. In most cases, there are between 10 and 20 parameters, except with *A. cyanomicans* and *A. mirna* (n = 6) and *A. portosanctana* and *A. notata* (n = 6).

2. Males

- Body length (BL) (Fig. 29): The males of the six species do not differ from each other, except for *A. portosanctana*, which have much smaller BL than *A. cyanomicans*, *A. fratella*, or *A. mirna*. The females of *A. notata* and *A. portosanctana* also have smaller BL than the other species. In males, significant differences occur only in three cases, with no significance in twelve cases.

- Clypeus length (CL) (Fig. 29): As in the females, *A. maderensis* has by far the longest clypeus and differs highly significantly from all other species except *A. notata* (weakly significant). This is due to the small number of measured specimens of *A. notata*. In three cases (*A. cyanomicans* vs. *A. fratella*, *A. cyanmicans* vs. *A. portosanctana*, *A. fratella* vs. *A. mirna*), there is only a weak significance. Significant differences occur in eight cases. In seven cases the differences are not significant.

- Length of flagellomere 1 (FL1) (Fig. 29): As in females, *A. maderensis* has a much greater FL1 than *A. cyanomicans* and *A. portosanctana* (highly significant difference). In the other thirteen cases, no significant differences are detectable.

- Length of flagellomere 2 (FL2) (Fig. 29): In contrast to the females, where *A. maderensis* and *A. portosanctana* have the longest flagellomere 2, the males of *A. portosanctana* have the shortest flagellomere 2. However, this result is only weakly significant. In all other eleven cases, no significant difference is detectable.

- Length of flagellomere 3 (FL3) (Fig. 29): *Andrena cyanomicans*, *A. maderensis*, and *A. mirna* have the longest flagellomere 3; *Andrena portosanctana* has the shortest (highly significant difference between *A. cyanomicans* and *A. portosanctana*; significant difference between *A. fratella* and *A. maderensis*; weakly significant difference between *A. portosanctana* and *A. mirna*). *Andrena fratella* and *A. notata* show intermediate flagellomere lengths. Significant differences occur in six cases (three weakly significant

and three highly significant or significant). No significance can be detected in the other comparisons.

- Index of flagellomeres 1 and 2 (FL1/FL2) (Fig. 29): Other than *A. maderensis* and *A. portosanctana* (higher index values), all other species have a similar values. Significant differences occur in four cases.

Table 2: Results of the univariate analysis of the parameters (females). Significance is shown by the following numbers: 1 = BL, 2 = CL, 3 = FL1, 4 = FL2, 5 = FL3, 6 = FL1/FL2 index, 7 = FL1/FL3 index, 8 = FL2/FL3 index, 9 = FVL, 10 = FVW, 11 = FVL/FVW index, 12 = HL, 13 = HW, 14 = HL/HW index, 15 = IOD, 16 = LPW, 17 = MSW, 18 = MTW, 19 = OCD, 20 = OOD, 21 = PBAL, 22 = PSL, 23 = WL. The number of significant parameters is given in parentheses.

	cyanomicans	fratella	maderensis	mirna	notata
fratella	1,4,5,7,9,10, 12,13,14,17, 20,22,23 (n=13)				
maderensis	1,2,3,4,5,7,8, 9,11,12,13, 14,15,16,17, 18,19,20,21, 22,23 (n=21)	1,2,3,4,9,10, 11,12,13,15, 16,17,18,20, 21,22,23 (n=17)			
mirna	3,7,12,16,20, 21 (n=6)	1,2,3,9,10,12, 13,14,16,17, 18,20,21,23 (n=14)	2,3,5,7,9,11, 13,14,15,16, 17,21,22,23 (n=14)		
notata	1,3,5,9,13,15, 18,19,20,22 (n=10)	3,5,8,9,13,15, 18,19,20,22 (n=10)	1,3,4,5,9,13, 15,16,18,19, 20,22 (n=12)	1,2,3,4,7,9, 13,15,16,18, 19,20,22 (n=13)	
portosanctana	1,3,4,6,7,8,9, 10,11,12,13, 14,15,16,17, 18,19,20,21, 22,23 (n=21)	1,4,6,9,10,11, 15,16,18,19, 20,21,22,23 (n=14)	1,3,4,5,6,8,9, 10,11,12,13, 16,17,18,19, 20,21,22,23 (n=19)	1,2,3,6,7,8,9, 10,11,12,13, 14,15,16,17, 18,19,20,21, 22,23 (n=21)	4,13,15,16, 19,22 (n=6)

- Index of flagellomeres 1 and 3 (FL1/FL3) (Fig. 30): *Andrena portosanctana* has the highest FL1/FL3 index. However, the differences are only weakly significant. *Andrena maderensis* shows a significant difference from the lower values of *A. cyanomicans* and *A. fratella*. Significant differences occur in seven cases (five are only weakly significant). In eight cases, no significant differences can be detected.

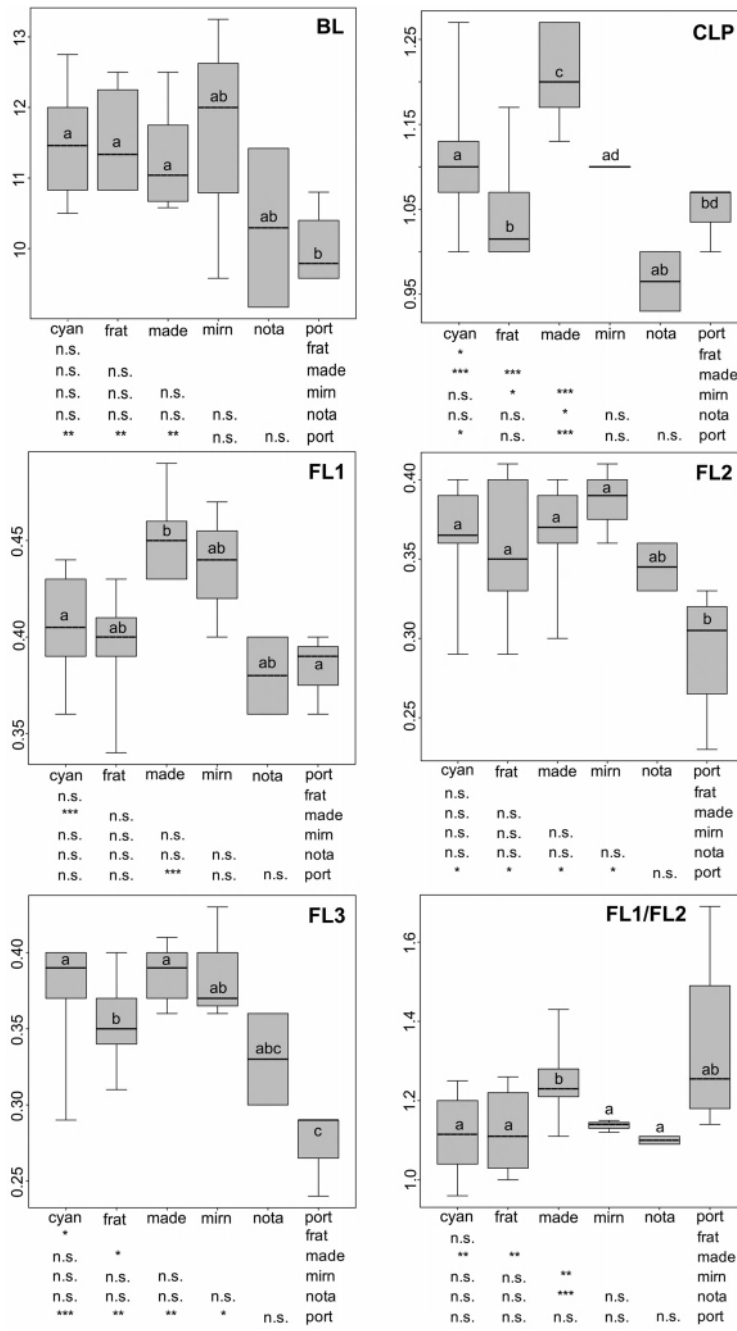

Fig. 29: Morphometric analyses (males) of body length (BL), clypeus length (CL), length of flagellomeres 1–3 (FL1–Fl3), and Fl1/Fl2 index.

- Index of flagellomeres 2 and 3 (FL2/FL3) (Fig. 30): As with females, this index is not suitable for morphometric differentiation of the species studied. In no case significant differences were found.

- Head length (HL) (Fig. 30): As in females, *A. maderensis* has the longest head; *Andrena portosanctana* and *A. notata* have the shortest. *Andrena cyanomicans*, *A. fratella*, and *A. mirna* have intermediate head lengths. The difference between *A. cyanomicans* and *A. maderensis* on one hand and *A. portosanctana* on the other is highly significant, and that between *A. cyanomicans* and *A. fratella* versus *A. maderensis* is significant. Significant differences occur in six cases (two highly significant, two significant, two weakly significant). In nine cases, significant differences are not detectable.

- Head width (HW) (Fig. 30): As in females, *A. maderensis* has by far the widest head (also wider than in *A. mirna*). No significant differences can be detected between the other species with smaller head width (twelve cases). Only in three cases do significant differences occur (two significant, one highly significant).

- Index of head length and head width (HL/HW) (Fig. 30): In contrast to the females, where three significant differences and three weakly significant differences between the species are detectable, the males show no differences at all. As already noted for the females, this index is not suitable for morphometric differentiation in this species comparison.

- Interocellar distance (IOD) (Fig. 30): This parameter also shows no differentiation except for a weakly significant difference between *A. cyanomicans* and *A. maderensis*. In females, on the other hand, eleven cases with significant differences and eight with highly significant differences could be detected.

- Labrum process width (LPW) (Fig. 31): High LPW values were found in *A. cyanomicans*, *A. fratella*, *A. maderensis* and *A. mirna*; lower values, in *A. notata* and *A. portosanctana*. The lowest LPW value, beside that of *A. notata*, is in *A. portosanctana*, as with the females (highly significant difference in the case of *A. cyanomicans* and *A. mirna*; significant in the case of *A. fratella* and *A. maderensis*). *Andrena cyanomicans*, *A. fratella*, *A. maderensis*, and *A. mirna* do not differ. In nine cases, the differences between species are insignificant.

- Mesosoma width (MSW) (Fig. 31): As in the females, *A. maderensis* has the widest mesosoma, which is significantly different only from *A. cyanomicans* and highly significantly different from *A. maderensis*. The remaining thirteen cases are not significant.

- Metasoma width (MTW) (Fig. 31): *Andrena maderensis* dominates as in the females, but in this case it is not significantly different from *A. mirna*. Small MTW was observed in *A. fratella* and *A. portosanctana*. Highly significant differences were found between *A. fratella* and *A. maderensis* and between *A. maderensis* and *A. portosanctana*. In seven cases, significant differences occur (three weakly significant, two significant, two highly significant). In eight cases, no significant differences can be detected between the species.

- **Ocelloccipital distance (OCD)** (Fig. 31): In contrast to females, significant differences in OCD occur only between *A. portosanctana* on one hand and *A. cyanomicans*, *A. fratella*, and *A. maderensis* on the other (significant to highly significant). In twelve cases, no differences are detectable between the species.

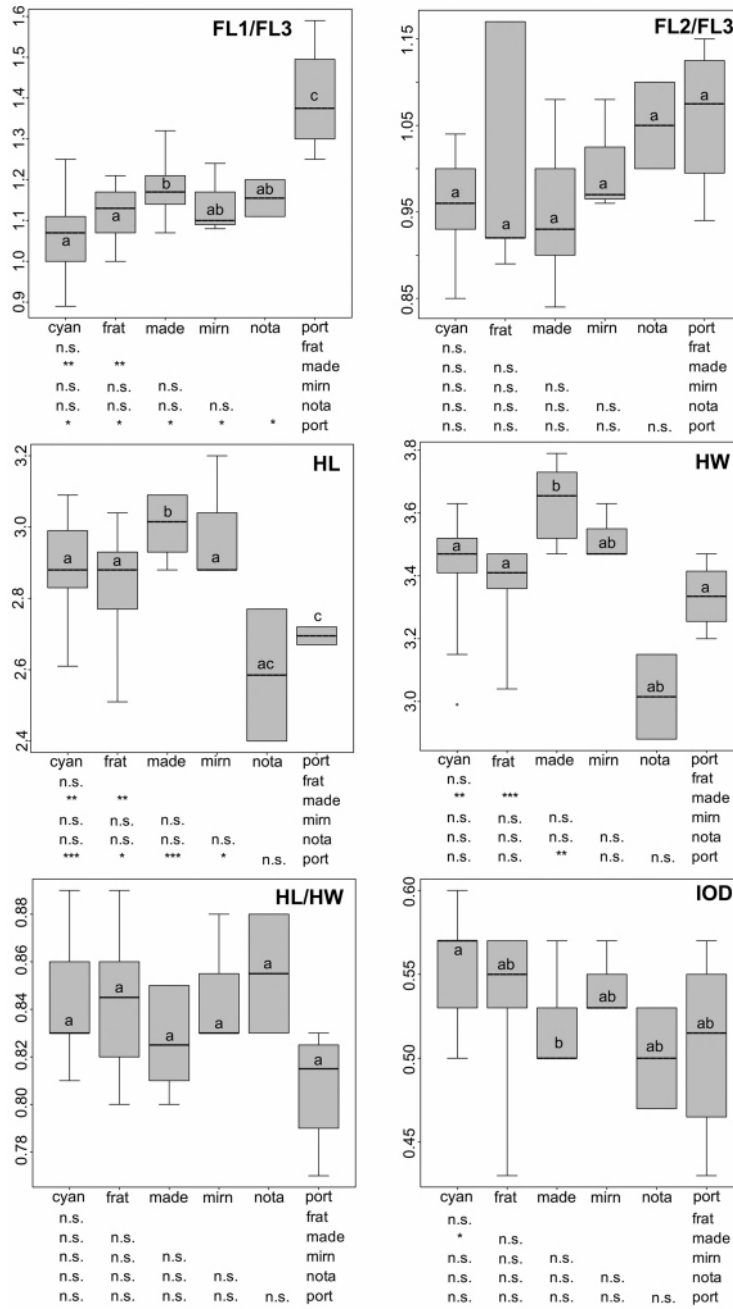

Fig. 30: Morphometric analyses (males) of FL1/FL3 and FL3/Fl3 index, fovea length (FVL), fovea width (FVW), FVL/FVW index, head length (HL), head width (HW), HL/HW index, interocellar distance (IOD).

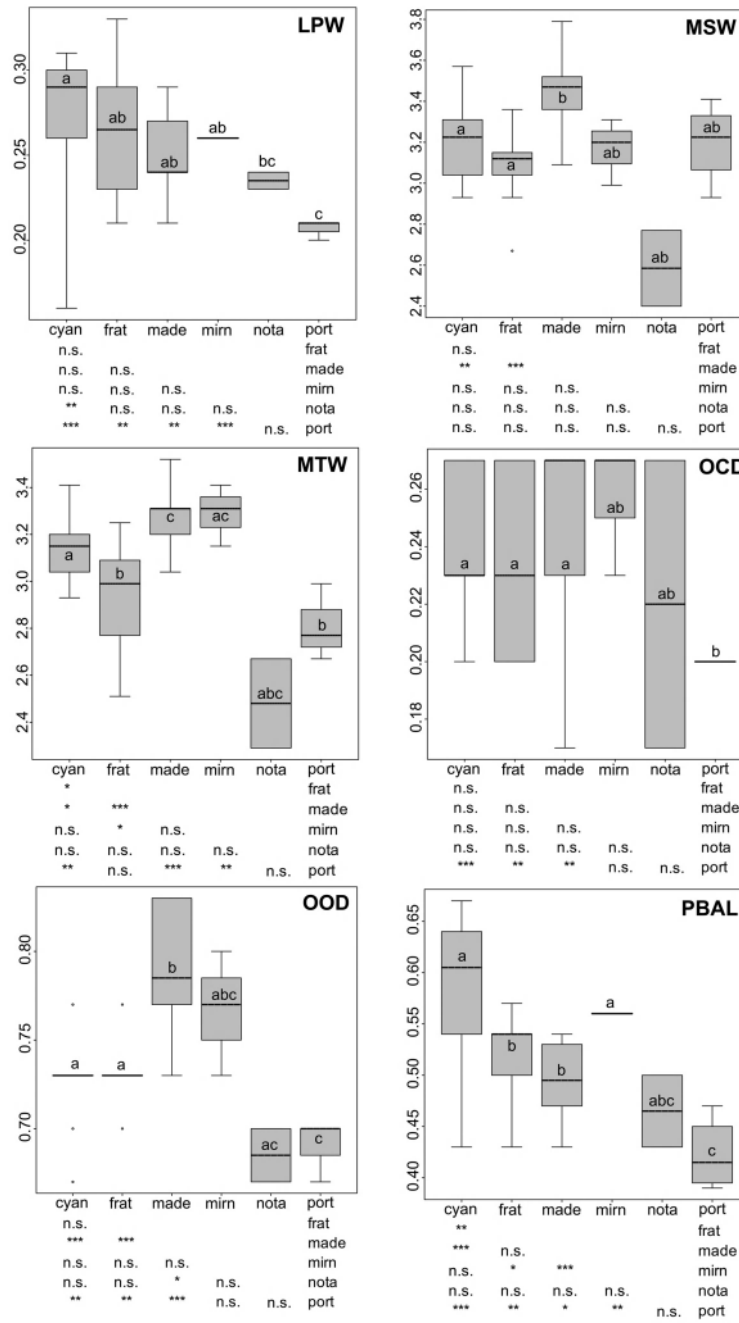

Fig. 31: Morphometric analyses (males) of labrum process width (LPW), mesosoma width (MSW), metasoma width (MTW), ocelloccipital distance (OCD), ocellular distance (OOD), propodeum basal area length (PBAL).

- Ocellular distance (OOD) (Fig. 31): As in females, *A. maderensis* (and to a lesser extent *A. mirna*) has by far the highest OOD value (highly significant difference from *A. cyanomicans*, *A. fratella*, and *A. portosanctana*). The lowest values were observed in *A. notata* and *A. portosanctana*, as in females. Significant differences are present in six cases, with highly significant differences in three cases.

- Propodeum basal area length (PBAL) (Fig. 31): The results are similar to those from the females. *Andrena cyanomicans* and *A. mirna* have the highest PBAL value; *Andrena portosanctana* the lowest value. *Andrena cyanomicans* and *A. mirna* differ significantly from *A. fratella* and *A. maderensis*, and the latter differ significantly from *A. portosanctana*. In eight cases significant differences can be detected (three highly significant, three significant, two weakly significant). In seven cases no significant differences exist.

- Pterostigma length (PSL) (Fig. 32): *Andrena cyanomicans*, *A. maderensis*, and *A. mirna* have by far the longest pterostigma; *Andrena portosanctana* has the shortest. *Andrena fratella* occupies a middle position. In seven cases, significant differences are present (three highly significant, four significant). In eight cases, significant differences are not detectable.

- Wing length (WL) (Fig. 32): In contrast to the females, *A. mirna* has by far the longest wings. This species is followed by *A. maderensis*, which again differs significantly in wing length from *A. cyanomicans* and *A. fratella*. As in the females, *A. portosanctana* has the shortest wings. Significant differences occur in nine cases (five highly significant, three significant, one weakly significant). In six cases, no significance is detectable.

Synopsis of the morphometric differentiation in males

Table 3 summarises the results of the univariate analysis of the 20 parameters (BL, CL, FL1–FL3, FL1/FL2 index, FL1/FL3 index, FL2/FL3 index, HL, HW, HL/HW index, IOD, LPW, MSW, MTW, OCD, OOD, PBAL, PSL, and WL).

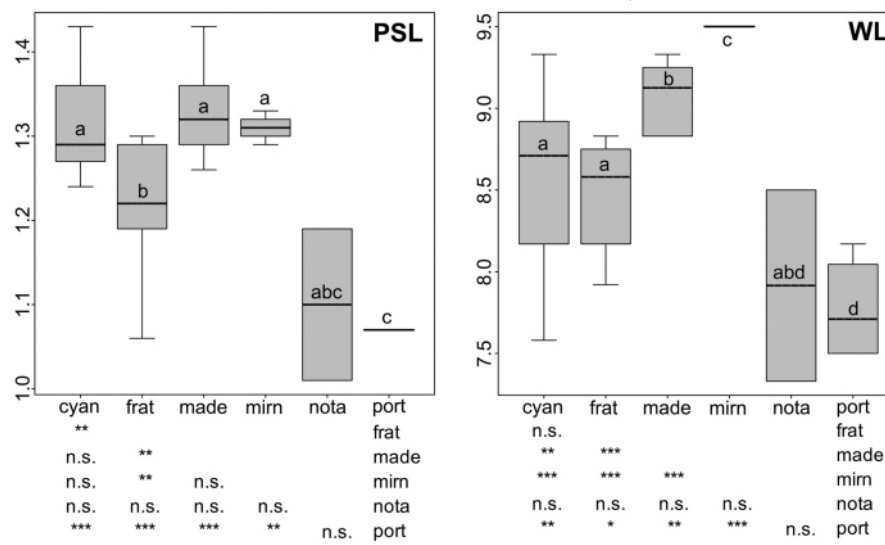

Fig. 32: Morphometric analyses (males) of pterostigma length (PSL) and wing length (WL).

Table 3: Results of the univariate analysis of the parameters (males). Significance is shown by the following numbers: 1 = BL, 2 = CL, 3 = FL1, 4 = FL2, 5 = FL3, 6 = FL1/FL2 index, 7 = FL1/FL3 index, 8 = FL2/FL3 index, 9 = HL, 10 = HW, 11 = HL/HW index, 12 = IOD, 13 = LPW, 14 = MSW, 15 = MTW, 16 = OCD, 17 = OOD, 18 = PBAL, 19 = PSL, 20 = WL. The number of significant parameters is given in parentheses.

	cyanomicans	fratella	maderensis	mirna	notata
fratella	2,5,15,18,19 (n=5)				
maderensis	2,3,6,7,9,10, 12,14,15,17, 18,20 (n=12)	2,5,6,7,9,10, 14,15,17,19, 20 (n=11)			
mirna	20 (n=1)	2,15,18,19, 20 (n=5)	2,6,18,20 (n=4)		
notata	13 (n=1)		2,6,17 (n=3)		
portosanctana	1,2,4,5,7,9, 13,15,16,17, 18,19,20 (n=13)	1,4,5,7,9,13, 16,17,18,19, 20 (n=11)	1,2,3,4,5,7,9, 10,13,15,16, 17,18,19,20 (n=15)	4,5,7,9,13,15, 18,19,20 (n=9)	7 (n=1)

The number of significant differences is much lower for males than for females. This may be partly due to the small number of individuals of *A. notata* (n = 2), where no significant morphometric differences could be found from *A. fratella*, and only one difference was found from *A. cyanomicans*. The dataset for *A. mirna* (n = 3) is also small. On average, there are seven parameters in the species-species comparison (SD = 5). With more than ten parameters, *A. cyanomicans* can be separated from *A. maderensis* and *A. portosanctana*; *Andrena fratella* from *A. maderensis* and *A. portosanctana*; and *A. maderensis* from *A. portosanctana*. The number of citations of the various parameters, in descending order (in parentheses), demonstrates their significance in differentiating the species: WL (9), CL (8), PBAL (8), FL1/FL3 (7), MTW (7), PSL (7), FL3 (6), HL (6), OOD (6), LPW (5), FL2 (4), FL1/FL2 (4), BL (3), HW (3), OCD (3), FL1 (2), MSW (2), IOD (1), FL2/FL3 (0), HL/HW (0). The specific informative value depends on the comparison of two distinct species (Table 3).

Multivariate analysis

1. *Andrena maderensis*, *A. portosanctana*, *A. notata* (Fig. 33)

For females, 16 of the 18 parameters could be used for the PCA. LPW and POD were eliminated because of insufficient correlation values ($p > 0.05\%$). *Andrena portosanctana* and *A. maderensis* show a clearly separated clustering on the first axis, similarly influenced by most of all the parameters. The value of explained variance is very high (74%). The two females of *A. notata* are marginally separated from *A. portosanctana*. OCD and PBAL influence the separation on the second axis. In males, 14 parameters could be used.

For males, too, the three species are clearly separated from each other. The value of the explained variance of the first axis is very high (70.1%). The influence of the parameters corresponds to that of the females.

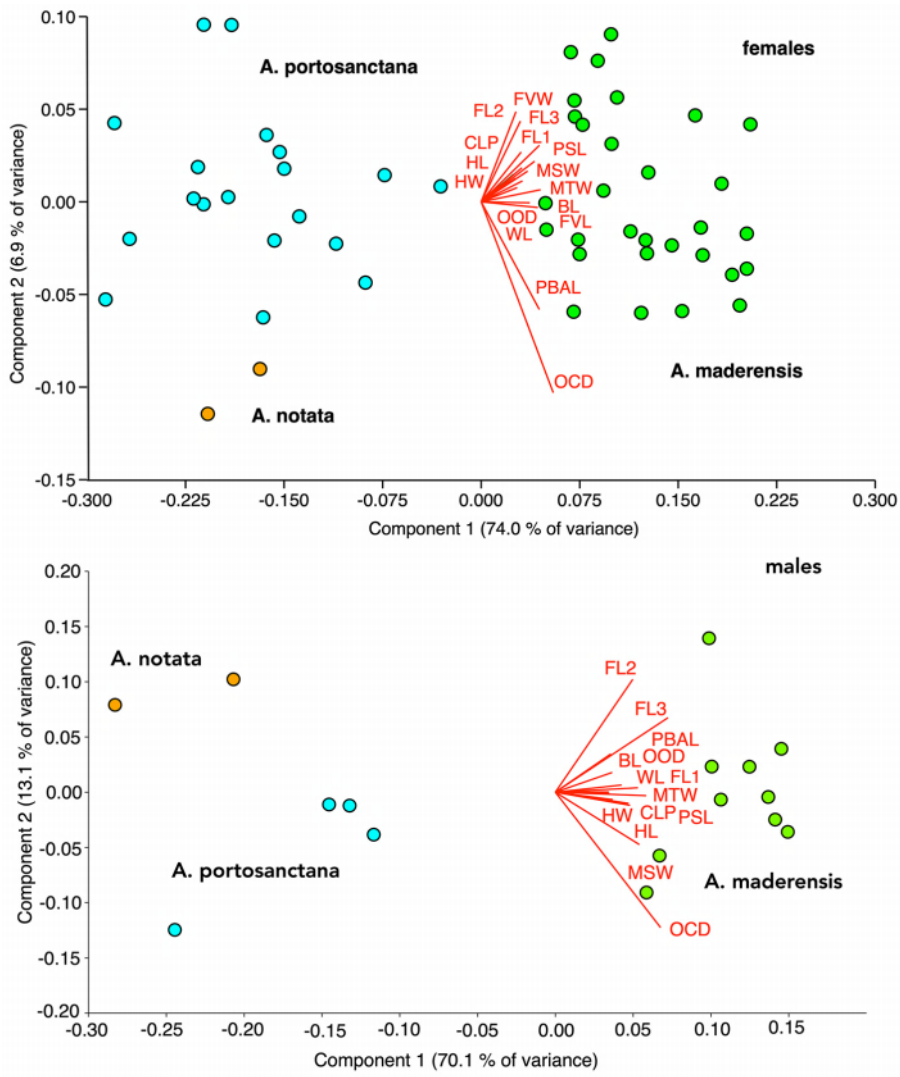

Fig. 33: PCA of 16 morphometric parameters (females) and 14 parameters (males). Cyan dot = *A. portosanctana*; green dot: *A. maderensis*, orange dot: *A. notata*. Abbreviations of biplot parameters see Table 1.

2. *Andrena fratella*, *A. cyanomicans* (Fig. 34)

For females, only seven of the 18 parameters could be used for the PCA. All other morphometric parameters were excluded because of insufficient correlation values. *Andrena fratella* and *A. cyanomicans* show a significant clustering separated on the first axis, influenced by all parameters. The value of explained variance is high (64.2%). In the males, eight parameters could be used for PCA. The clusters of *A. fratella* and *A. cyanomicans* are close to each other, with slight overlap. Again, the values of the explained variance are high on the first axis (54.7 %). The values for the males of *A. fratella* vary more than those of *A. cyanomicans*.

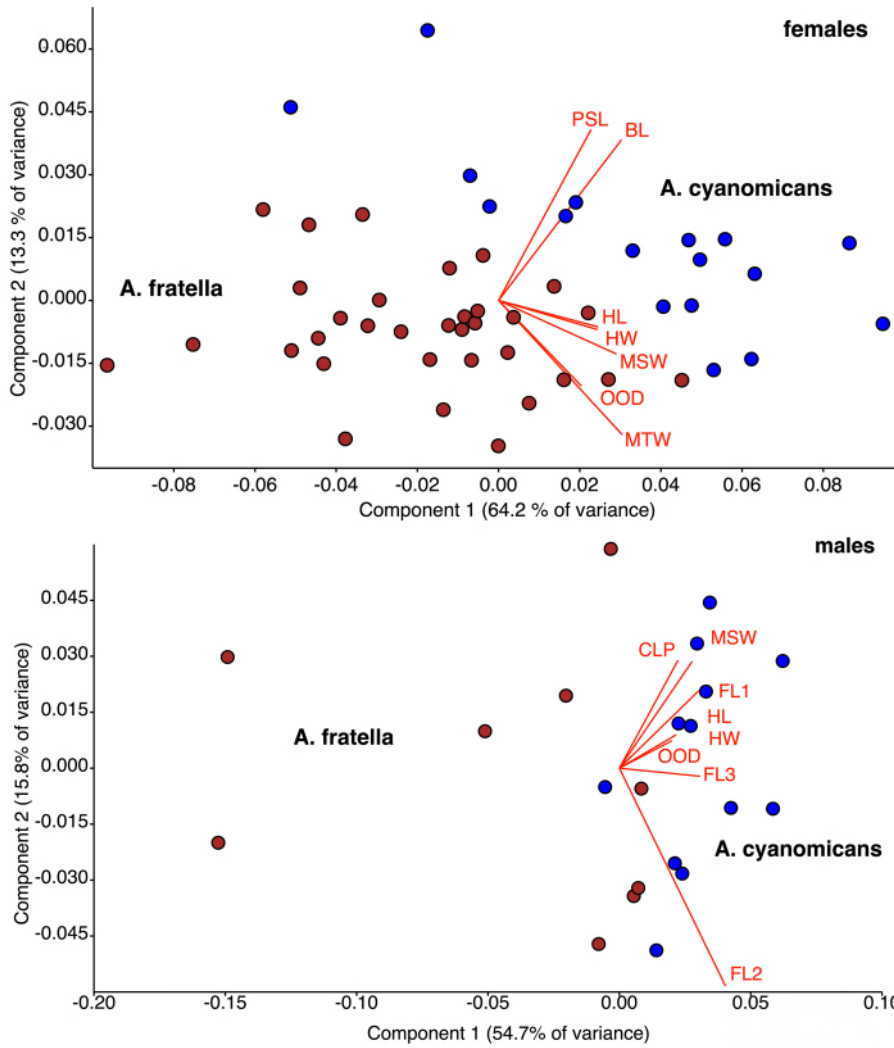

Fig. 34: PCA of seven morphometric parameters (females) and 8 parameters (males). Brown dot = *A. fratella*; blue dot: *A cyanomicans*. Abbreviations of biplot parameters see Table 1.

3. *Andrena cyanomicans*, *A. mirna* (Fig. 35)

For females, only eight of the 18 parameters could be used for the PCA. These parameters are CLP, FL1, FL2, HL, HW, MSW, MTW, and OOD. All other parameters were eliminated because of insufficient correlation values ($p > 0.05\%$). *Andrena cyanomicans* and *A. mirna* show a clearly separated clustering. The value of the explained variance of the first axis is high (69.4%). In males, only six parameters could be used (FL1, FL2, FL3, HL, HW, OOD). The three species are not clearly separated from each other in males (two males in marginal positions). The value of the explained variance of the first axis is high (68.8%). The influence of the parameters corresponds to that of the females.

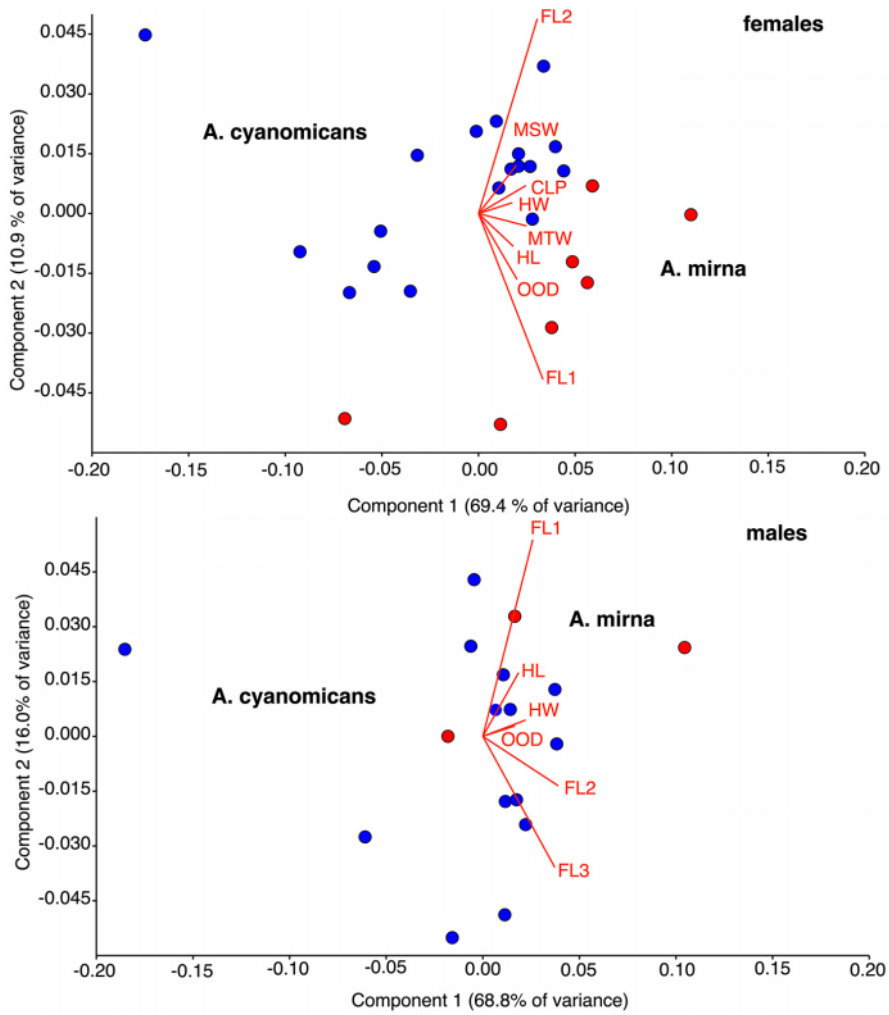

Fig. 35: PCA of seven morphometric parameters (females) and 8 parameters (males). Red dot = *A. mirna*; blue dot: *A cyanomicans*. Abbreviations of biplot parameters see Table 1.

4. *Andrena fratella*, *A. mirna* (Fig. 36)

For females, only 14 of the 18 parameters could be used for the PCA. FL3, OCD, POD, and PSL were eliminated because of insufficient correlation values ($p > 0.05\%$). *Andrena fratella* and *A. mirna* show a clearly separated clustering. The value of explained variance is high (46.6%/19.7%). In males, only six parameters could be used (CLP, HL, HW, MSW, MTW, WL). The three species are clearly separated from each other for males. The value of the explained variance of the first axis is high (64.1%).

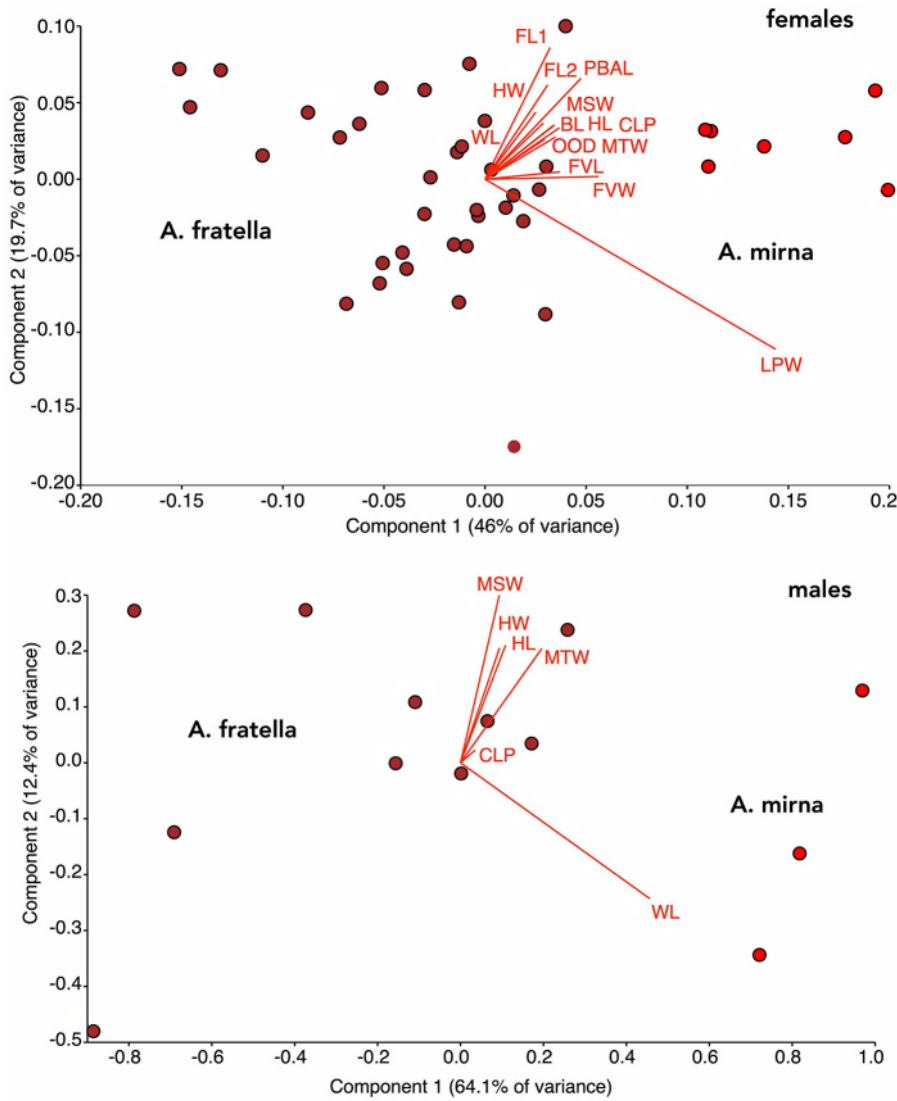

Fig. 36: PCA of 14 morphometric parameters (females) and six parameters (males). Brown dot = *A. fratella*; red dot: *A mirna*. Abbreviations of biplot parameters see Table 1.

Keys of the females and males of the species

For a better differentiation, the important features in the keys are underlined.

Females

1 **Head:** predominating pubescence off-white; paraocular area with white or off-white hairs, with some brownish hairs in the upper part; scapus und area with white or off-white hairs beside and between the antennal socket (*A. portosanctana* with whitish-yellowish and some brownish hairs); genal area with dense white or off-white hairs; clypeus with white or off-white hairs in the centre and/or on the sides (*A. notata* and *A. portosanctana* with white-yellowish hairs on the sides). **Mesosoma**: predominating pubescence white, off-white or yellowish-white; mesoscutum with white or yellowish-white hairs on the sides (in some cases also in front), some (black) brownish hairs in the centre; scutellum with white or yellowish-white hairs in the centre and on the sides (sometimes dark brownish hairs in the centre); mesepisternum with long white or yellowish-white hairs; propodeal corbicula with dense white or off-white hairs, some white or off-white hairs in the centre; trochanteral and femoral flocculus with long white or off-white hairs (*A. portosanctan*a with yellowish-white hairs); propodeal scopa, trochanteral flocculus, and femoral flocculus with white hairs (*A. portosanctan*a with off-white hairs); tibial scopa with reddish-brown hairs in the dorsal region (*A. portosanctana* with dark brown hairs). **Metasoma**: T1 and T2 with long off-white hairs in the centre (*A. notata* with whitish-yellowish hairs); T3 and T4 with off-white hairs in the centre (*A. notata* with short whitish-yellowish hairs); T2–T4 with white or off-white hair bands (*A. notata* with short whitish-yellowish hair bands).....2

\- **Head**: predominating pubescence yellowish or yellowish-reddish (golden); paraocular area with yellowish or yellowish-reddish hairs and with some brownish hairs in the upper part; scapus und area with long yellowish, partly reddish or reddish-brownish hairs beside and between the antennal socket; genal area with yellowish hairs; clypeus with yellowish hairs (*A. maderensis* with hairs in the centre; hairs top-orientated). **Mesosoma**: predominating pubescence with yellowish, yellowish-reddish or reddish-brownish hairs on the sides; mesoscutum with brownish hairs in the centre, with yellowish or yellowish-reddish (reddish-brownish) hairs on the sides; scutellum similar to mesoscutum; mesepisternum with long yellowish or yellowish-reddish hairs; propodeal corbicula with long yellowish or yellowish-reddish hairs; trochanteral and femoral flocculus with long yellowish hairs; tibial scopa with reddish or yellowish-reddish hairs in the dorsal region. **Metasoma**: T1 and T2 with long yellowish or brownish hairs; margin of T1 with yellowish hair rows; T3 and T4 with short yellowish or brownish hairs in the centre; T2–T4 with yellowish or yellowish-brownish hair bands 4

2 **Head**: scapus and area with whitish-yellowish hairs beside and between the antennal socket, supplemented by some brownish hairs; PD of the clypeus: 28–42 µm; PDI of the clypeus: 14–56(70) µm; labrum process slightly emarginated or emarginated; apical pubescence of the labrum yellowish-reddish. **Mesosoma**: mesoscutum and scutellum with yellowish-white hairs on the sides, supplemented by some brownish hairs in the centre; mesepisternum with long yellowish-white hairs; mesoscutum and scutellum very scattered and shallow punctured (PD: 14–28 µm); propodeum slightly rugose in the centre; tibia 1 and tibia 2 black; tibia 3 black and partly reddish-brown; basitarsus 1 and basitarsus 2 brown, basitarsus 3 reddish-brown; wing veins brown (reddish-black) ....*Andrena portosanctana* COCKERELL

\- **Head**: scapus and area with white or off-white hairs beside and between the antennal socket; vertex only with some brownish hairs; PD of the clypeus: 14–56 µm; PDI of the clypeus (14)28–42 µm; labrum process not emarginated; apical pubescence of the labrum reddish. **Mesosoma**: white or off-white hairs in front and on the sides, white or off-white hairs in the centre (*A. notata* supplemented by dark brownish hairs); mesepisternum with long white or off-white hairs; mesoscutum and scutellum visibly deeply and densely punctured (PDI: 1–3 PD); propodeum roughly rugose; tibia 1 and tibia 2 brownish or black-brownish; tibia 3 and basitarsus brownish or black-brownish, partly reddish-brown; wing veins reddish-brown 3

3 **Head**: genal area with white hairs, in the upper part, supplemented by brown hairs. **Mesosoma**: predominating pubescence off-white; mesepisternum with long off-white hairs; propodeal corbiculae, trochanteral flocculus and femoral flocculus with long off-white hairs; tibial scopa with dark brown hairs in the dorsal region, with yellowish-reddish hairs in the ventral region; integument of the mesosoma black or brown; tibia 1 and tibia 2 black-brownish; tibia 3 black-brownish or partly reddish-brown; basitarsus black-brownish and partly reddish-brown; pterostigma yellow-orange with reddish-brown margin. **Metasoma**: reddish-brown depression zone; T5 laterally with dark brownish hairs ..... *Andrena mirna* WARNCKE

- **Head**: genal area with dense white hairs. **Mesosoma**: predominating pubescence white; mesepisternum with long white hairs; propodeal corbiculae, trochanteral flocculus, and femoral flocculus with long white hairs; tibial scopa with reddish-brown hairs in the dorsal region, with white-yellowish or reddish hairs in the ventral region; integument of the mesosoma black; tibia 1, tibia 2, tibia 3, and basitarsus brownish and partly reddish-brown; pterostigma yellow with reddish-brown margin. **Metasoma**: black to dark reddish-brown depression zone; T5 laterally with long white hairs 5

4 **Head**: predominant hair colour yellowish; paraocular area with yellowish hairs, upper part slightly reddish; facial fovea whitish in the lower part, brownish in the upper part; clypeus with dense yellowish hairs on the sides; clypeus punctured; labrum process trapezoidal, emarginated or not emarginated; clypeus without an unpunctured median line in two third of all cases; flagellomeres 3–10 yellow on the lower side, brownish on the upper side. **Mesosoma**: yellowish hairs on the sides, with some brownish hairs in the centre; scutellum with brownish hairs in the centre, with yellowish-reddish hairs on the sides; mesepisternum with long yellowish hairs; propodeal corbicula with long yellowish hairs; propodeal corbicula with long yellowish hairs; tibial scopa with reddish hairs in the dorsal region; mesoscutum and scutellum shagreened and visibly deeply and densely punctured; propodeum roughly rugose, with or without longitudinal laminae (partly fan-shaped); tibia 1 and tibia 2 black-brownish; tibia 3 brownish and partly reddish-brown; metatarsus and tarsi brownish and partly reddish-brown; wings hyalin; veins yellowish; pterostigma yellow, with a reddish-brown margin. **Metasoma**: T1 and T2 with long yellowish hairs in the centre; T3 and T4 with short yellowish hairs in the centre; T2–T4 with yellowish-brownish hair bands; T5 with long dark brownish hairs in the centre, with long white hairs on the sides; T6 with dense dark brownish hairs reaching to the pygidium; visibly deeply and densely punctured (PD: 14–32 µm); T1–4 black, slightly blue-greenish, with reddish-brown depression zone..... .....*Andrena cyanomicans* PÉREZ

- **Head**: predominant hair colour yellowish-reddish (golden); paraocular area with dense yellowish-reddish hairs (longer than clypeal hairs), supplemented by brownish hairs in the upper part; scapus and antennal socket with yellowish-brownish hairs, with brownish hairs in the upper part; facial fovea yellowish in the lower part, brownish in the upper part; clypeus punctured; labrum process short trapezoidal, emarginated in most of all cases; clypeus with yellowish hairs top-orientated, hairless line in the centre and with long yellowish-reddish hairs on the sides; clypeus with a fragmented unpunctured median line; flagellomeres 3–10 black-brownish. **Mesosoma**: yellowish-reddish on the sides, with brownish hairs in the centre; scutellum with yellowish-reddish hairs; mesepisternum with long yellowish-reddish hairs; propodeal corbicula with long yellowish hairs; propodeal corbicula with yellowish-reddish hairs, some shorter hairs in the centre; tibial scopa with yellowish-reddish hairs in the dorsal region; mesoscutum and scutellum shagreened, shallow and very scattered punctured; propodeum rugose only in the centre, with some longitudinal lamina on the sides or missing; tibia 1 and tibia 2 black; tibia 3, metatarsus, and tarsi, black and partly reddish-brown; wings subhyalin; veins brown or reddish-black; pterostigma yellow-orange with a reddish-brown margin. **Metasoma**: T1 and T2 with long brownish hairs in the centre; T3 and T4 with short brownish hairs in the centre; T2–T4 with yellowish hair bands, in most of all cases open in the centre; T5 long brownish hairs in the centre, with yellowish hairs on the sides; T6 with dense brownish hairs reaching to the pygidium; shallow punctured (PD: 14–28 µm); T1–4 black, slightly greenish (bronze-like), with black to dark reddish-brown depression zone.....*Andrena maderensis* COCKERELL

5 **Head**: paraocular area with off-white hairs; scapus and antennal socket with white hairs; vertex supplemented by some brownish hairs; clypeus with or without an unpunctured median line (*A. mirna* with a fragmented median line); the labrum process is emarginated in most of all cases (*A. notata* and *A. mirna* very slightly emarginated) with or without a very short labrum process (*A. mirna* with a trapezoidal labrum process). **Mesosoma**: mesoscutum with white hairs on the sides, in front, and in the centre (sometimes with brownish hairs in the centre); tibial scopa with white-yellowish hairs in the ventral region and without brownish hair tips. **Metasoma**: T1 and T2 with long off-white hairs in the centre; T3–T4 with short off-white hairs in the centre; T1 with an off-white hair row; T2–T4 with white closed hair bands..... .....*Andrena fratella* WARNCKE

- **Head**: paraocular area with white hairs; scapus and antennal socket with off-white hairs; vertex supplemented by some dark brownish or black hairs; clypeus without an unpunctured median line; with a short trapezoidal labrum process. **Mesosoma**: mesoscutum with yellowish-white hairs on the sides; with dense black-brownish hairs in the centre; tibial scopa with reddish hairs on the sides and with brownish hair tips. **Metasoma**: T1 and T2 with long whitish-yellowish hairs in the centre; T3–T4 with short yellowish-whitish hairs in the centre; T1–T4 with whitish-yellowish hair bands..... .....*Andrena notata* WARNCKE

Males

1 **Head:** predominating pubescence white; paraocular area white or off-white; scapus und area with white or off-white hairs beside and between the antennal socket (*A. portosanctana* with off-white hair and brownish hairs behind the antennal socket); genal area with dense white or off-white hairs; clypeus with dense white hairs (*A. portosanctana* with off-white hairs on the sides and with a hairless line in the centre). **Metasoma**: T1 with a white or off-white hair row; T3 with short off-white hairs in the centre; T2–T4 with white or off-white hair bands, partly open in the centre; T5 with off-white hairs on the sides; pubescence of ST8 white, white-yellowish, yellowish, or dark brown 2

- **Head**: predominating pubescence yellowish or yellowish-reddish (golden); paraocular area with yellowish or yellowish-reddish hairs; scapus und antennal socket with long yellowish, slightly reddish or yellowish-reddish-brownish hairs; genal area with dense yellowish hairs, in the upper area with brownish hairs; clypeus with dense yellowish hairs (*A. maderensis* hairs with a hairless line in the centre). **Metasoma**: T1 with a yellowish or yellowish-white hair row; T2 with long yellowish or brownish hairs; T1 margin with yellowish hair rows; T3 with short yellowish or long off-white hairs in the centre (in some cases with shorter reddish hairs); T2–T4 with yellowish (partly yellowish-reddish) or yellowish-whitish (slightly off-white) hair bands, partly open in the centre; T5 with yellowish or off-white hairs on the sides; pubescence of ST8 reddish or yellowish-reddish. 4

2 **Head**: paraocular area, scapus, and antennal socket with dense off-white hairs with some brownish hairs behind; genal area with dense off-white hairs, with some brownish hairs in the upper part; clypeus with off-white hairs on the sides, and a hairless line in the centre; clypeus very shiny in front with some punctures, and without an unpunctured median line; labrum with a central hollow with whitish-yellowish hairs; labrum with long yellowish hairs on the sides; vertex with dark-brownish or black hairs; LPW: 0.21 µm; flagellum 3–10 black-dark brownish on the upper side. **Mesosoma**: mesoscutum and scutellum with whitish hairs on the sides, with some brownish hairs in the centre; mesepisternum with long whitish hairs; mesoscutum and scutellum very scattered and shallow punctured (PD: 14-28 µm); propodeum centrally slightly rugose, without longitudinal lamina and without lateral bounder line. **Metasoma**: T2-T4 with whitish hair bands, pubescence of ST8 white; tergites smooth and shiny, slightly shagreened, shallow and scattered punctured (PD: 14–28 µm); ST8 narrow; genital see Fig. 24f.....*Andrena portosanctana* COCKERELL

- **Head**: paraocular area, scapus and antennal socket with white hairs with some brownish hairs behind; genal area with dense white hairs, upper area with some brownish hairs; clypeus with dense white hairs; clypeus front with or without punctures, with an fragmented or with an unpunctured median line; the labrum has a

central hollow with yellowish-reddish hairs; labrum with long reddish or yellowish-reddish on the sides; vertex with some brownish or reddish-brown hairs; LPW: 0.24–0.26 µm; flagellum 3–10 with dark brownish upper side. **Mesosoma**: mesoscutum and scutellum with white or yellowish hairs on the sides, with some yellowish or white hairs in the centre; mesepisternum with long white hairs; mesoscutum and scutellum visibly deeply punctured (PD: 14–32 µm; PDI: 1–3 PD); propodeum roughly rugose in the centre, without or with some fragmented longitudinal laminae, without or with a fragmented boundary line. **Metasoma**: T2–T4 with white closed or open hair bands; pubescence of ST8 white-yellowish, yellowish or dark brown; tergites smooth and shiny, visibly and scattered punctured (PD: 14–32 µm); ST8 broad 3

3 **Head**: predominant hair colour white with some brown-reddish hairs on the vertex region; front of the clypeus and the other area visibly punctured; only in some cases shiny in front and without punctures; labrum pubescence with long yellowish-reddish on the sides. **Mesosoma**: mesoscutum and scutellum with white hairs, in a third of all cases with some reddish-brown hairs in the centre; propodeum without longitudinal laminae and without a central boundary line; tibia 1, tibia 2, and tibia 3 black-brownish; veins brown-reddish or reddish; pterostigma yellow-orange with brown-reddish margin, or yellow or reddish margin. **Metasoma**: reddish-brown depression zone; T5 with dark brownish hairs in the centre, T6 with dense dark brownish hairs reaching the pygidium; ST 8 with dark brown hairs (some yellowish hairs intermingled); genital see Fig 24d ..... *Andrena mirna* WARNCKE

- **Head**: predominant hair colour white with some brownish hairs in the vertex region; front of the clypeus shiny and in most of all cases without punctures; labrum pubescence laterally long and reddish. **Mesosoma**: mesoscutum and scutellum with long yellowish hairs, in some cases few brownish hairs in the centre; propodeum with some fragmented longitudinal laminae; tibia 1, tibia 2, and tibia 3 black or brownish; veins reddish; pterostigma yellow or yellow-reddish with reddish margin. **Metasoma**: black to dark reddish-brown depression zone; T5 reddish or reddish-brown hairs in the centre; T6 with reddish or reddish-brown hairs reaching the pygidium; ST 8 with yellowish or white-yellowish hairs.....5

4 **Head**: predominant hair colour yellowish; paraocular area with yellowish hairs; scapus and antennal socket with yellowish, slightly reddish hairs; vertex area with some brownish hairs; clypeus in front and in the other area punctured; labrum with long yellowish-reddish hairs on the sides. **Mesosoma**: mesoscutum and scutellum with long yellowish hairs on the sides, with some dark brownish hairs in the centre; mesoscutum and scutellum visibly and dense punctured (PD: 14–32 µm); propodeum roughly rugose, without longitudinal laminae and central boundary line; tibia 1, tibia, and tibia 3 black-brownish; wings hyalin; veins yellowish-reddish; pterostigma yellow, with a yellowish-reddish margin. **Metasoma**: T1 and T2 with long yellowish hairs in the centre; T3 and T4 with short yellowish hairs in the centre; T2–T4 with yellowish not dense hair bands; T5 and T6 with reddish hairs, in T5 with yellowish hairs on the sides; ST8 with yellowish-reddish hairs; visibly punctured (PD: 14–32 µm); T1-4 black slightly blue-greenish; genital see Fig. 24a ..... *Andrena cyanomicans* PÉREZ

- **Head**: predominant hair colour yellowish-reddish (golden); paraocular area with yellowish-reddish hairs; scapus and antennal socket with yellowish-reddish-brownish hairs; vertex area with longer dark hairs on the sides; clypeus in front very shiny with some punctures, in the other area punctured; labrum with long yellowish hairs on the sides. **Mesosoma**: mesoscutum and scutellum with yellowish-reddish or yellowish hairs; mesoscutum and scutellum shallow and very scattered punctured (PD: 14–28 µm); propodeum rugose in the centre with longitudinal laminae and with a small central and lateral boundary line; tibia 1, tibia 2, and tibia 3 black; wings subhyalin; veins black-brown; pterostigma yellow (orange) with a brown (reddish-black) margin. **Metasoma**: T1–T3 with long off-white hairs in the centre; T3 (partly) and T4 with shorter reddish hairs in the centre; T2–T4 with yellowish-whitish hair bands; T5 and T6 with yellowish hairs, in T5 with off-white hairs on the sides; ST8 with reddish hairs; shallow and scattered punctured (PD: 14–28 µm); T1–4 black slightly greenish (bronze-like); genital see Fig. 24c ..... *Andrena maderensis* COCKERELL

5 **Head**: paraocular area, scapus, and antennal socket with white or yellowish-white hairs; clypeus with or without an unpunctured median line (*A. mirna* with an unpunctured median line). **Mesosoma**: tibia 1, tibia 2, and tibia 3 black, basitarsus and mediotarsi black and partly reddish-brown. **Metasoma**: T2–T4 with partly open hairs bands; T5 and T6 with reddish hairs; ST8 with yellowish hairs; genital see Fig. 24b..... .....*Andrena fratella* WARNCKE

- **Head**: paraocular area, scapus, and antennal socket with white hairs; clypeus with an unpunctured median line. **Mesosoma**: tibia 1, tibia 2, and tibia 3 brownish, basitarsus and mediotarsi brownish and partly reddish-brown. **Metasoma**: T2–T4 with only few white hairs band fragments on the sides; T5 and T6 with reddish-brown hairs; ST8 with white-yellowish hairs; genital see Fig. 24e.....*Andrena notata* WARNCKE

Discussion and synopsis

The revision confirms the species status of *Andrena cyanomicans*, *A. fratella*, *A. maderensis*, *A. mirna*, and *A. portosanctana*. As in the revisions of other species groups (e.g., the *A. tiaretta* group, KRATOCHWIL 2015; the *A. wollastoni* group, KRATOCHWIL 2020), it is evident that a combination of morphological, morphometric, univariate, and multivariate analyses enables a particularly clear differentiation. Even though molecular genetic studies are still pending, this analysis creates a foundation on which further studies can be based.

In the literature cited for the different species, the former subspecies classification of WARNCKE (1968, 1974), DYLEWSKA (1983), and GUSENLEITNER & SCHWARZ (2002) was used in many cases, which facilitated the taxonomical assignments within the frame of this study. RASMONT et al. (2013) did not consider a subspecies classification in this context. In ORTIZ-SÁNCHEZ (2011), for the Canary Islands, only *A. cyanomicans* is named.

The species studied here also show a clear geographical differentiation in their distribution areas:

- *Andrena cyanomicans* is distributed in the northern part of the Iberian Peninsula of Portugal and Spain (PÉREZ 1895, WARNCKE 1976, GUSENLEITNER & SCHWARZ 2002, BALDOCK et al. 2018, WOOD et al. 2020a, Scheuchl pers. comm.).

- *Andrena mirna* occupies the easternmost range of this species group and has been observed in Egypt, Israel, south-eastern Turkey, Iran, and Lebanon (WARNCKE 1969, GUSENLEITNER & SCHWARZ 2002, BOUSTANI et al. 2021, WOOD et al. 2020b, Scheuchl pers. comm.).

- *Andrena fratella* occurs in Morocco, Algeria, Tunisia, and western Libya (WARNCKE 1968, 1974, 1980, BENARFA et al. 2013, LHOMME et al. 2020, DERMANE et al. 2021, Scheuchl pers. comm.).

The three remaining species are island endemics: *Andrena notata* on the Canary Islands Fuerteventura and Lanzarotte (WARNCKE 1968, HOHMANN et al. 1993, KRATOCHWIL & SCHWABE 2018); *A. portosanctana* on Porto Santo Island in the Madeira Archipelago (COCKERELL 1922, KRATOCHWIL et al. 2008, KRATOCHWIL 2014, KRATOCHWIL et al. 2014, 2018, KRATOCHWIL & SCHWABE 2018); and *A. maderensis* on Madeira Island (COCKERELL 1922, KRATOCHWIL et al. 2008, KRATOCHWIL 2014, KRATOCHWIL et al. 2014, 2018, KRATOCHWIL & SCHWABE 2018).

In the absence of molecular investigations, there is no information about the distributional history and evolution of this group. Nevertheless, as suggested by other examples,

the three island endemics are of very recent origin (KRATOCHWIL et al. 2021). In many cases, an east-west dispersal is assumed; e.g., the dispersal of the *A. tiaretta* group from east (Iranian-Turanian centre) to west (KRATOCHWIL 2015). The hypothesis is that *A. mirna* or its ancestor is phylogenetically the oldest taxon of this species group, and that *A. fratella* or its ancestor arose from a North African westward migration. An isolated position in the north of the Iberian Peninsula is held by *A. cyanomicans*, the only taxon within this species group with a bivoltine evolutionary cycle. The multivariate analyses have shown that the separation of the clusters between *A. cyanomicans* and *A. mirna* is smaller than that between *A. cyanomicans* and *A. fratella*. From this result, the hypothesis can be formulated that *A. cyanomicans* emerged from a migration north of the Mediterranean. The occurrence of *A. mirna* in Turkey seems to support this. It would be interesting to see the results of molecular genetic studies.

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Zusammenfassung

WARNCKE (1968) beschrieb *Andrena maderensis fratella* und *A. maderensis notata* als Unterarten von *A. maderensis* COCKERELL, 1922, und revidierte die Klassifizierung von *A. m. fratella* später in *A. cyanomicans fratella* (WARNCKE 1974). DYLEWSKA (1983) stellte die Unterart von *A. m. notata* zu *A. cyanomicans* und synonymisierte *A. m. notata* mit *A. cyanomicans mirna* WARNCKE, 1969. Nach KRATOCHWIL et al. (2014) sind *A. maderensis* COCKERELL, 1922 (Insel Madeira) und *A. portosanctana* COCKEREL, 1922 (Porto Santo) zwei verschiedene Arten. Im Rahmen dieser

Untersuchung wird der taxonomische Status von *A. c. cyanomicans* und *A. c. mirna* WARNCKE, 1970 geprüft. Dabei werden 31 morphologische (nichtmeristische) Merkmale (Integumentfarbe, Behaarung, Strukturmerkmale) und 34 morphometrische Parameter von Weibchen und Männchen analysiert. Die morphometrischen Unterschiede wurden statistisch überprüft. Die morphometrische Analyse (Berechnung des Korrelationskoeffizienten, Hauptkomponentenanalyse) konnte für 18 Parameter durchgeführt werden. Die in KRATOCHWIL et al. (2014) bereits untersuchten Arten *A. maderensis* COCKERELL, 1922 und *A. portosanctana* COCKERELL, 1922 wurden erstmals einer umfassenden morphometrischen Analyse unterzogen. Die Ergebnisse zeigen, dass *A. cyanomicans*, *A. fratella*, *A. maderenesis*, *A. mirna*, *A. notata* und *A. portosanctana* gut abgegrenzte Arten sind. Für die folgenden Arten wurden Lectotypen und/oder Paralectotypen beschrieben: *A. cyanomicans* vier Weibchen und drei Männchen als Paralectotypen, *A. maderensis* ein Weibchen als Lectotyp, drei Weibchen und zwei Männchen als Paralectotypen, *A. portosanctana* ein Weibchen als Lectotyp und ein Weibchen als Paralectotyp.

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Appendix

Specimens examined (122 females and 80 males)

***Andrena cyanomicans* (females n = 22; males n = 18)**

Females: MNHN5–MNHN8: specimens of the type series of the male MNHN1; OLML66, OLML67, OLML166, OLML168–OLML171, OLML173, OLML174: label 1: Alicante-Hisp., 02.XI.1964, leg. Kl. Warncke (printed), label 2: *Andrena* (printed) *cyanomican*s Pér. (handwritten), det. Dr. Warncke (printed); OLML68: label 1: illegible 10.X.19 (?), Canet (handwritten in ink), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML 69: label 1: Alicante-Hisp., 2.XI.1964, leg. Kl. Warncke (printed), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML70: label 1: Vaciamadrid, Dusmet, label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML 71: label 1: Alicante-Hisp., 2.XI.1964, leg. Kl. Warncke (printed), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML72: label 1: Montarco, Dusmet, label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML105: label 1: Paratype (handwritten, red), label 2: Barcelone, label 3: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML167: label 1: Torrente (Valencia), M. Escaleva (handwritten in ink), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML172: label 1: Zaragoza, 26-IV-3, label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML 175: label 1: Alicante-Hisp., 24.X.1964, leg. Kl. Warncke (printed), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed).

Males: MNHN1: label 1: Barcelone (handwritten with ink), label 2: round, violet 3 mm, label 3 in red: LECTOTYPE (printed), label 4: MUSEUM PARIS Coll. J. PÉREZ 1915 (printed), label 5: *Andrena* (printed) *cyanomicans* Pér. (handwritten) det Dr. Warncke (printed), label 6 MNHN, Paris EY33359 (printed) with barcode; MNHN2–MNHN4: specimens of the type series of the male MNHN1; OLML73: label 1: Alicante-Hisp., 2.XI.1964, leg. Kl. Warncke (printed), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML74: label 1: illegible Cadlete, 29-IV-2 (handwritten in ink), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML75: label 1: PUIG, Valencia, (Hispania), ?uilis (illegible) (printed), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML76: label 1: Pozuela de C^A (?), La Fuente (illegible) (printed), label 2: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML77: label 1: Pozuela de C^A, La Fuente (printed), label 2: *Andrena cyanomicans* Pér. (handwritten), 1904 Alfken det. (printed); OLML106: label 1: Paratype (handwritten, red), label 2: Barcelone, label 3: *Andrena* (printed) *cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML108, OLML186, OLML188–OLML191: label 1: Alicante-Hisp., 2.XI.1964, leg. Kl. Warncke (printed), label 2: *Andrena cyanomicans* Pér. (printed), det. Dr. Warncke (printed); OLML185: label 1: PUIG, Valencia, (HISPANIA) Quilis (printed), label 2: *Andrena cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed); OLML187: Villaverde, 10.-IV-90(?), J. Arias (handwritten in ink), label 2: *Andrena cyanomicans* Pér. (handwritten), det. Dr. Warncke (printed).

***Andrena fratella* (females n = 34, males n = 34)**

Females: OLML54, OLML55, OLML140, OLML142–OLML143, OLML152, OLML156, OLML162: label 1: Tunesien, 10 km N Foum Tatahouine, 21-2-92 Warncke (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML56–57: label 1: Marruecos, Maraquesh, III-1907 Escalera (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML58: label 1: Mogador, Maroc, 17.-22.III.32, Dr. R. Meyer (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML99: label 1: Holotypus (handwritten, red), label 2: Marrakesch (handwritten), label 3: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML100: label 1: Paratype (handwritten, red), label 2: Marrakesch (handwritten), label 3: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML101, OLML153: label 1: Tunesien, 30 km N Foum Tatahouine, 12-2-92 Warncke (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML141, OLML144, OLML148, OLML151, OLML154–OLML155,

OLML157, OLML158, OLML160, OLML163–OLML165: label 1: Tunesien, 10 km N Foum Tatahouine, 25-2-92 Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (printed); OLML 145, OLML146, OLML149, OLML159, OLML161: label 1: Tunesien, 55 km S Foum Tatahouine, 29-2-92 Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (printed); OLML147: label 1: Tunesien, 30 km S Foum Tatahouine, 15-2-92 Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (printed); OLML150: label 1: Tunesien, 30 km N Foum Tatahouine, 12-2-92 Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (printed).

Males: OLML59, OLML61, OLML192, OLML194, OLML203, OLML204, OLML209–OLML212, OLML216: label 1: Tunesien, 30 km N Foum Tatahouine, 12-2-92 Warncke (all printed), label 2: Andrena (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML60: label 1: Tunisia: Kasserine, 13.II.88, Nr. 2029, leg. G. E. Nilsson (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML62: label 1: TN, 16-2-1992; 30 km S Zarzis, leg. Warncke (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handschriftlich), det. Dr. Warncke (printed); OLML63, OLML64: label 1: Marruecos, Maraquesh, III-1907 Escalera (all printed), label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML102–OLML103: label 1: Paratype (handwritten, red), label 2: Marrakesch (handwritten): label 3: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML104: label 1: Maroc, mer occ; Sous-Delta, 27.2-5.3.83, H. Waiffenbach, label 2: *Andrena* (printed), *cyanomicans fratella* War (handwritten), det. Dr. Warncke (printed); OLML193, OLML195–OLML201, OLML205–OLML208, OLML213: label 1: Tunesien, 30 km N Foum Tatahouine, 15-2-92 Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (all printed); OLML202: label 1: TN 26-2-1992, 20 km S Zarzis, leg. Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (all printed); OLML214–OLML215: label 1: Tunesien, 55 km S Foum Tatahouine, 25-2-92 Warncke (all printed), label 2: *Andrena cyanomicans* ssp. *fratella* War., det. Dr. Warncke (all printed);

***Andrena maderensis* (females n = 34, males n = 16)**

Females: NHMUK1: Madeira 58-21, label 2: *Andrena maderensis* Ckll. Type (handwritten), label 3 round label with blue margin, Syntype (printed), label 4 B.M. TYPE HYM. (printed 17A.2820 (handwritten), label 5: NHMUK 014026851 (printed) with barcode; NHMUK2, NHMUK3: specimens of the type series of the female NHMUK1, KR-MA05/29, KR-MA05/40: Madeira, Ponta de São Lourenço, coastal rock, partly ruderalised, 80 m, 32°44'40.19"N, 16°43'22.21"W, 26.03.2005, leg. et det. A. Kratochwil; KR-MA05/140; KR-MA05/153, KR-MA05/155: Madeira, Larano east of Porto da Cruz, vegetable garden, 280 m, 32°45'45.14"N 16°48'29.69"W, 29.03.2005, leg. et det. A. Kratochwil; KR-MA05/179: Madeira, west of Ponta do Garajau, south of Caniço, coastal rock, partly ruderalised, 80 m, 32°38'23.20"N, 16°51'13.01"W, 30.03.2005, leg. et det. A. Kratochwil; KR-MA05/232, KR-MA05/234, KR-MA05/238, KR-MA05/242: Madeira, west of Ribeira Brava, Ribeira da Caldeira, E 216, coastal rock, 5 m, 32°40'25.21"N, 17°04'09.99"W, 02.04.2005, leg. et det. A. Kratochwil; KR-MA05/244; KR-MA05/245: Madeira, west of Ribeira Brava, between Ribeiro da Corujeira and Ribeira da Caldeira, E 213, coastal rock, 20 m, 32°40'34.34"N, 17°04'27.05"W, 02.04.2005, leg. et det. A. Kratochwil; KR-MA05/291, KR-MA05/294–KR-MA05/296: Madeira, above Paul do Mar, ER 213, ruderal site, 30 m, 32°45'28.83"N, 17°13'41.69"W, 03.04.2005, leg. et det. A. Kratochwil; KR-MA05/321, KR-MA05/322–KR-MA05/324, KR-MA05/329, KR-MA05/336–KR-MA05/340, KR-MA05/344–KR-MA05/346: Madeira, Ponta de São Lourenço, coastal rock, partly ruderalised, 80 m, 32°44'40.19"N, 16°43'22.21"W, 04.04.2005, leg. et det. A. Kratochwil; KR-MA05/378: Madeira, Referta south of Porto da Cruz, rock, 200 m, 32°45'18.77"N, 16°49'0'7.14"W, 06.04.2005, leg. et det. A. Kratochwil; ZMS1: label 1: Mad Valparaiso, label 2: *Andrena maderensis* Ckll., female sign, W. Grünwaldt det.

Males: NHMUK4: Madeira 58-21, label 2: *Andrena maderensis* Ckll. Cotype (handwritten), label 3 round label with blue margin, Syntype (printed); NHMUK5, NHMUK6: specimens of the type series of the female NHMUK1; KR-MA95/34, KR-MA95/36: Madeira, Ponta de São Lourenço, coastal rock, partly ruderalised, 80 m, 32°44'35.16"N, 16°42'01.06"E, 10.04.1995, leg. et det. A. Kratochwil; KR-MA05/30, KR-MA05/38, KR-MA05/41: Madeira, Ponta de São Lourenço, coastal rock, partly ruderalised, 80 m, 32°44'40.19"N, 16°43'22.21"W, 26.03.2005, leg. et det. A.

Kratochwil; KR-MA05/208: Madeira, Ponta da Oliveira, Caniço de Baixo, coastal rock, partly ruderalised, 35 m, 32°38'28.16"N, 16°49'53.02"W, 02.04.2005, leg. et det. A. Kratochwil; KR-MA05/285: Madeira, above Porto Moniz, roadside, planted, 390 m, 32°51'35.12"N, 17°10'26.56"W, 03.04.2005, leg. et det. A. Kratochwil; KR-MA05/314: Madeira, Ponta de São Lourenço, coastal rock, partly ruderalised, 80 m, 32°44'40.19"N, 16°43'22.21"W, 04.04.2005, leg. et det. A. Kratochwil; KR-MA05/379: Madeira, Referta south of Porto da Cruz, rock, 200 m, 32°45'18.77"N, 16°49'0'7.14"W, 06.04.2005, leg. et det. A. Kratochwil; UMBB 170, UMBB 171: Madeira, 2 km east south east of Seixal, 25 km northwest of Funchal, 11.04.1994. leg. H. Hohmann; UMBB 173: Madeira, Caniçal, 20 km east of Funchal, 31.03.1994. leg. H. Hohmann.

***Andrena mirna* (females n = 8, males n = 4)**

Females: OLML 107, OLML 178, OLML 181: label 1: Birecik, As. Türk.; 1 u. 4.IV.1977; leg. Jos Heinrich (printed), label 2: Coll. K. WarnckeOÖ Landesmuseum Linz/Austria egg93; OLML 176: label 1: ISRAEL, Sede Boqer, 23.3.90, Wolf, label 2: *Andrena* (printed) *cyanomicans mirna* War (printed), det. Dr. Warncke (printed); OLML 177: label 1: ISRAEL (printed), Avdat, 31.III.85 (handwritten), I. Susmann, label 2: *Andrena* (printed) *cyanomicans mirna* War (handwritten), det. Dr. Warncke (printed); OLML 179: label 1: TÜRKEI-Harran-, Urfa 26-IV-76, leg. Kl. Warncke (printed); OLML 180: label 1: TÜRKEI-Birecik-, Urfa 16-IV-76, leg. Kl. Warncke (printed); OLML 182: label 1: Date: 11.III.2010, Loc. Iran. Fars, Nurabad, Ghandiel, Coll: R. Khodaparast, Code: 293, label 2: det. E. Scheuchl, female sign, *Andrena mirna* Warncke.

Males: OLML 109: label 1: Brecik, As. Türk., 1 u. 4.IV.1977, leg. Jos Heinrich (printed), label 2: Coll. K. WarnckeOÖ Landesmuseum Linz/Austria egg93; OLML 183: label 1: Date: 11.III.2010, Loc. Iran. Fars, Nurabad, Ghandiel, Coll: R. Khodaparast, Code: 52, label 2: det. E. Scheuchl, male sign, *Andrena mirna* Warncke; OLML 184: label 1: PALESTINE (printed), Bir Rechme, 13.III. (handwritten), leg. Bytinsky-Salz (printed); label 2: *Andrena* (printed) *cyanomicans mirna* War (handwritten), det. Dr. Warncke (printed).

***Andrena notata* (females n = 2, males n = 2)**

Females: OLML 65: label 1: Paratype (handwritten, in red), label 2: Fuerteventura, Las Peritas, 11.III.1935 (handwritten), label 3: *Andrena* (printed) *maderensis* ssp. *notata* War. (handwritten), det. Dr. Warncke (printed); OLML 97: label 1: Holotypus (handwritten, in red), label 2: Fuerteventura, Catalina Garcia (?), 15.IV.1934 (handwritten), label 3: *Andrena* (printed) *maderensis* ssp. *notata* War. (handwritten), det. Dr. Warncke (printed).

Males: OLML 98: label 1: Paratype (handwritten, in red), label 2: Fuerteventura, La Costilla, 12.III.1935 (handwritten), label 3: *Andrena* (printed) *maderensis* ssp. *notata* War. (handwritten), det. Dr. Warncke (printed); SE21-kr219, Fuerteventura, 2km N Betancuria Mirador, 28.438N, 14.050W, Schmid-Egger leg., 28.03.19, det. A. Kratochwil.

***Andrena portosanctana* (females n = 22, males n = 6)**

Females: CAS1: label 1: Porto Santo, Jan (Ckll.) (handwritten with ink), label 2: *Andrena portosanctana* Cptype Ckll (handwritten with ink), label 3 California Academy of Science TypeNo. (printed) 15373 (handwritten), CS1: surrounding Hotel Luamar, dune area, 5 m, 33°02'12.80"N, 16°21'36.86"W, 18.03.1994, leg. G. Jaeschke, det A. Kratochwil; KR-PS12/29–KR-PS12/34: Porto Santo, east of Campo de Baixo, south of restaurant 'Mare Sol', dune area, 5 m, 33°02'53.33"N, 16°20'50.46"W, 17.03.2012, leg. et det. A. Kratochwil; KR-PS12/53, KR-PS12/60, KR-PS12/65, KR-PS12/69, KR-PS12/70, KR-PS12/72, KR-PS12/73: Porto Santo, Campo de Baixo, Estrada dos Carreiros, dune area, 5 m, 33° 02'45.58"N, 16°21'0.22"W, 18.03.2012, leg. et det. A. Kratochwil; KR-PS12/82: Porto Santo, Vereda do Pico Branco, fallow land, 310 m, 33°05'31.84"N, 16°18'17.16"W, 19.03.2012, leg. et det. A. Kratochwil; KR-PS12/142: Porto Santo, Vila Baleira, near sports field, ruderal site, 25 m, 33°02'35.16"N, 16°21'38.48"W, 20.03.2012, leg. et det. A. Kratochwil; KR-PS12/150, KR-PS12/151, KR-PS12/153: Porto Santo, Campo de Baixo, near tennis court, ruderal, fallow land, 20 m, 33°02'50.07"N, 16°21'23.35"W, 20.03.2012, leg. et det. A. Kratochwil; KR-PS12/154: Porto Santo, Capela de S. Pedro, ruderal site, 50 m, 33°02'44.85"N, 16°21'43.82"W, 20.03.2012, leg. et det. A. Kratochwil, NMNH1: label 1: Jan 16 flw? (illegible) *Oxalis cernua* W.P.C. (handwritten with pencil), label 2: Porto Santo (Ckll) (handwritten with ink), label 3: *Andrena portosanctana* Type Ckll. (handwritten with ink), label 4 (in red): TypeNo. (printed) 24656 (handwritten), label 5 (in yellow): USNM ENT 00533697 (printed) with barcode.

Males: KR-PS12/35: Porto Santo, east of Campo de Baixo, south of restaurant ‘Mare Sol’, dune area, 5 m, 33°02'53.33"N, 16°20'50.46"W, 17.03.2012, leg. et det. A. Kratochwil; KR-PS12/41: near Pico da Cabrita, fallow land, 230 m, 33°05'42.18"N, 16°19'04.49"W, 18.03.2012, leg. et det. A. Kratochwil; KR-PS12/66–KR-PS12/68, KR-PS12/74: Campo de Baixo, Estrada dos Carreiros, dune area, 5 m, 33°02'45.58"N, 16°21'0.22"W, 18.03.2012, leg. et det. A. Kratochwil.

Table 1A: Morphometric data of the females (± = standard deviation). Abbreviations: BL: body length; CL: clypeus length; FL1, FL2, FL3: length of flagellomeres 1, 2, and 3; FL1/FL2, FL2/FL3, FL2/FL3: index of two flagellomeres; FVL: length of facial fovea; FVW: width of facial fovea; FVL/FVW: index of FVL and FVW; HL: head length, HW: head width; HL/HW: index of HL and HW; IOD: interocellar distance; LBW: labrum process width at the top; MSW: mesosomal width; MTW: metasomal width; OCD: ocelloccipital distance; OOD: ocellocular distance; PBAL: propodeum basal area length; PSL: pterostigma length; WL: wing length.

in mm	*cyanomicans* (n = 18) mean ± SD, max, min	*fratella* (n = 34) mean ± SD, max, min	*maderensis* (n = 30) mean ± SD, max, min
BL	13.88 ± 0.52, 14.83, 12.92	12.79 ± 0.48, 13.75, 11.50	14.24 ± 0.55, 15.33, 13.08
CL	1.26 ± 0.08, 1.40, 1.13	1.22 ± 0.07, 1.33, 1.00	1.44 ± 0.06, 1.57, 1.33
FL1	0.57 ± 0.04, 0.60, 0.43	0.57 ± 0.05, 0.80, 0.46	0.66 ± 0.03, 0.71, 0.61
FL2	0.23 ± 0.02, 0.26, 0.20	0.21 ± 0.02, 0.26, 0.17	0.27 ± 0.02, 0.31, 0.24
FL3	0.26 ± 0.01, 0.27, 0.23	0.24 ± 0.01, 0.27, 0.21	0.29 ± 0.01, 0.33, 0.26
FL1/FL2	2.50 ± 0.14, 2.71, 2.14	2.66 ± 0.28, 3.33, 2.13	2.48 ± 0.21, 2.88, 1.95
FL2/FL3	0.88 ± 0.06, 0.95, 0.78	0.90 ± 0.08, 1.20, 0.76	0.92 ± 0.08, 1.22, 0.81
FL1/FL3	2.19 ± 0.12, 2.44, 1.88	2.38 ± 0.29, 3.73, 2.00	2.28 ± 0.15, 2.58, 1.87
FVL	1.46 ± 0.05, 1.57, 1.37	1.41 ± 0.06, 1.53, 1.27	1.67 ± 0.08, 1.83, 1.47
FVW	0.36 ± 0.03, 0.40, 0.33	0.34 ± 0.02, 0.40, 0.30	0.36 ± 0.03, 0.40, 0.33
FVL/FVW	4.11 ± 0.34, 4.70, 3.42	4.15 ± 0.26, 4.78, 3.50	4.76 ± 0.53, 6.06, 3.97
HL	3.26 ± 0.12, 3.36, 2.93	3.12 ± 0.10, 3.36, 2.88	3.46 ± 0.12, 3.73, 3.25
HW	3.88 ± 0.14, 4.05, 3.57	3.77 ± 0.14, 4.05, 3.36	4.21 ± 0.15, 4.48, 3.89
HL/HW	0.84 ± 0.02, 0.89, 0.81	0.83 ± 0.02, 0.87, 0.78	0.82 ± 0.02, 0.86, 0.78
IOD	0.61 ± 0.04, 0.67, 0.53	0.59 ± 0.02, 0.67, 0.53	0.57 ± 0.03, 0.60, 0.50
LPW	0.19 ± 0.03, 0.24, 0.14	0.19 ± 0.03, 0.26, 0.14	0.15 ± 0.02, 0.21, 0.11
MSW	3.94 ± 0.16, 4.16, 3.57	3.79 ± 0.14, 4.00, 3.47	4.31 ± 0.19, 4.64, 4.00
MTW	3.95 ± 0.23, 4.37, 3.52	3.83 ± 0.16, 4.11, 3.52	4.24 ± 0.23, 4.64, 3.89
OCD	0.25 ± 0.02, 0.30, 0.23	0.26 ± 0.02, 0.30, 0.23	0.27 ± 0.03, 0.30, 0.20
OOD	0.75 ± 0.03, 0.80, 0.70	0.73 ± 0.02, 0.80, 0.67	0.80 ± 0.03, 0.87, 0.73
PBAL	0.58 ± 0.05, 0.67, 0.50	0.58 ± 0.05, 0.67, 0.46	0.62 ± 0.06, 0.76, 0.43
PSL	1.43 ± 0.07, 1.54, 1.36	1.35 ± 0.05, 1.46, 1.29	1.48 ± 0.07, 1.57, 1.37
WL	9.61 ± 0.26, 10.08, 9.17	9.43 ± 0.29, 9.92, 8.58	10.55 ± 0.25, 11.00, 10.17

in mm	*mirna* (n = 8) mean ± SD, max, min	*notata* (n = 2) mean ± SD, max, min	*portosanctana* (n = 19) mean ± SD, max, min
BL	13.89 ± 0.68, 15.25, 12.83	12.09 ± 0.23, 12.25, 11.92	12.27 ± 0.42, 13.00, 11.33
CL	1.33 ± 0.09, 1.43, 1.17	1.15 ± 0.07, 1.20, 1.10	1.26 ± 0.07, 1.37, 1.13
FL1	0.62 ± 0.03, 0.67, 0.57	0.50 ± 0.02, 0.51, 0.57	0.55 ± 0.02, 0.61, 0.51
FL2	0.23 ± 0.02, 0.26, 0.20	0.21 ± 0.01, 0.21, 0.20	0.25 ± 0.02, 0.29, 0.20
FL3	0.25 ± 0.02, 0.29, 0.21	0.23 ± 0.00, 0.23, 0.23	0.24 ± 0.02, 0.27, 0.21
FL1/FL2	2.73 ± 0.18, 3.00, 2.50	2.43 ± 0.04, 2.45, 2.40	2.27 ± 0.25, 2.71, 1.89
FL2/FL3	0.92 ± 0.06, 1.00, 0.82	0.90 ± 0.05, 0.94, 0.87	1.02 ± 0.08, 1.20, 0.88
FL1/FL3	2.50 ± 0.21, 2.80, 2.26	1.19 ± 0.08, 2.25, 2.13	2.30 ± 0.17, 2.60, 1.89
FVL	1.52 ± 0.11, 1.70, 1.37	1.30 ± 0.00, 1.33, 1.33	1.36 ± 0.08, 1.50, 1.17
FVW	0.38 ± 0.03, 0.43, 0.33	0.32 ± 0.02, 0.33, 0.30	0.31 ± 0.03, 0.37, 0.27
FVL/FVW	3.98 ± 0.23, 4.36, 3.73	4.20 ± 0.28, 4.40, 4.00	4.39 ± 0.30, 5.00, 3.94
HL	3.41 ± 0.12, 3.52, 3.15	2.99 ± 0.15, 3.09, 2.88	3.10 ± 0.09, 3.36, 2.99
HW	3.98 ± 0.15, 4.16, 3.68	3.57 ± 0.00, 3.57, 3.57	3.76 ± 0.13, 4.05, 3.57
HL/HW	0.86 ± 0.02, 0.89, 0.83	0.84 ± 0.04, 0.87, 0.81	0.83 ± 0.02, 0.85, 0.78
IOD	0.60 ± 0.03, 0.63, 0.57	0.53 ± 0.00, 0.53, 0.53	0.55 ± 0.04, 0.60, 0.47
LPW	0.24 ± 0.02, 0.27, 0.20	0.19 ± 0.00, 0.19, 0.19	0.12 ± 0.02, 0.16, 0.07
MSW	3.99 ± 0.18, 4.16, 3.57	3.63 ± 0.15, 3.73, 3.52	3.76 ± 0.18, 4.16, 3.47
MTW	4.06 ± 0.20, 4.27, 3.68	3.47 ± 0.08, 3.52, 3.41	3.44 ± 0.18, 3.73, 3.09
OCD	0.25 ± 0.02, 0.27, 0.23	0.23 ± 0.00, 0.23, 0.23	0.21 ± 0.03, 0.27, 0.17
OOD	0.80 ± 0.03, 0.83, 0.77	0.70 ± 0.00, 0.70, 0.70	0.71 ± 0.04, 0.80, 0.63
PBAL	0.65 ± 0.03, 0.70, 0.60	0.59 ± 0.03, 0.61, 0.57	0.50 ± 0.03, 0.56, 0.43
PSL	1.36 ± 0.08, 1.50, 1.24	1.20 ± 0.01, 1.21, 1.19	1.25 ± 0.06, 1.39, 1.14
WL	9.75 ± 0.27, 10.00, 9.25	8.71 ± 0.53, 9.08, 8.33	8.78 ± 0.42, 9.50, 7.50

Table 2A: Morphometric data of the males. Abbreviations see Table 1A.

in mm	*cyanomicans* (n = 14) mean ± SD, max, min	*fratella* (n = 10) mean ± SD, max, min	*maderensis* (n = 10) mean ± SD, max, min
BL	11.52 ± 0.69, 12.75, 10.50	11.50 ± 0.68, 12.50, 10.83	11.28 ± 0.66, 12.50, 10.58
CL	1.11 ± 0.06, 1.27, 1.00	1.04 ± 0.06, 1.17, 1.00	1.21 ± 0.05, 1.27, 1.13
FL1	0.41 ± 0.03, 0.44, 0.36	0.40 ± 0.03, 0.43, 0.34	0.45 ± 0.02, 0.49, 0.43
FL2	0.36 ± 0.03, 0.40, 0.29	0.36 ± 0.04, 0.41, 0.29	0.36 ± 0.03, 0.40, 0.30
FL3	0.38 ± 0.03, 0.40, 0.29	0.36 ± 0.03, 0.40, 0.31	0.38 ± 0.02, 0.41, 0.36
FL1/FL2	1.12 ± 0.10, 1.25, 0.96	1.12 ± 0.10, 1.26, 1.00	1.25 ± 0.09, 1.43, 1.11
FL2/FL3	0.96 ± 0.05, 1.04, 0.85	1.00 ± 0.12, 1.17, 0.89	0.94 ± 0.07, 1.08, 0.84
FL1/FL3	1.07 ± 0.10, 1.25, 0.89	1.11 ± 0.07, 1.21, 1.00	1.17 ± 0.07, 1.32, 1.07
HL	2.88 ± 0.13, 3.09, 2.61	2.84 ± 0.15, 3.04, 2.51	3.01 ± 0.08, 3.09, 2.88
HW	3.42 ± 0.17, 3.63, 2.99	3.37 ± 0.15, 3.47, 3.04	3.64 ± 0.12, 3.79, 3.47
HL/HW	0.84 ± 0.02, 0.89, 0.81	0.84 ± 0.03, 0.89, 0.80	0.83 ± 0.02, 0.85, 0.80
IOD	0.55 ± 0.03, 0.60, 0.50	0.54 ± 0.04, 0.33, 0.21	0.52 ± 0.03, 0.57, 0.50
LPW	0.27 ± 0.04, 0.31, 0.16	0.26 ± 0.04, 0.33, 0.21	0.25 ± 0.03, 0.29, 0.21
MSW	3.22 ± 0.19, 3.57, 2.93	3.08 ± 0.18, 3.36, 2.67	3.45 ± 0.18, 3.79, 3.09
MTW	3.15 ± 0.12, 3.41, 2.93	2.95 ± 0.22, 3.25, 2.51	3.29 ± 0.16, 3.52, 3.04
OCD	0.24 ± 0.02, 0.27, 0.20	0.23 ± 0.03, 0.27, 0.20	0.25 ± 0.03, 0.27, 0.17
OOD	0.73 ± 0.03, 0.77, 0.67	0.73 ± 0.02, 0.77, 0.70	0.79 ± 0.04, 0.83, 0.73
PBAL	0.59 ± 0.07, 0.67, 0.43	0.52 ± 0.05, 0.57, 0.43	0.49 ± 0.04, 0.54, 0.43
PSL	1.31 ± 0.06, 1.43, 1.24	1.22 ± 0.07, 1.30, 1.06	1.33 ± 0.05, 1.43, 1.26
WL	8.55 ± 0.49, 9.33, 7.58	8.48 ± 0.33, 8.83, 7.92	9.07 ± 0.21, 9.33, 8.83

in mm	*mirna* (n = 3) mean ± SD, max, min	*notata* (n = 2) mean ± SD, max, min	*portosanctana* (n = 4) mean ± SD, max, min
BL	11.61 ± 1.86, 13.25, 9.58	10.30 ± 1.59, 11.42, 9.17	9.99 ± 0.58, 10.80, 9.58
CL	1.10 ± 0.00, 1.10, 1.10	0.97 ± 0.05, 1.00, 0.93	1.05 ± 0.04, 1.07, 1.00
FL1	0.44 ± 0.04, 0.47, 0.40	0.38 ± 0.03, 0.40, 0.36	0.38 ± 0.02, 0.40, 0.36
FL2	0.39 ± 0.03, 0.41, 0.36	0.35 ± 0.02, 0.36, 0.33	0.29 ± 0.04, 0.33, 0.23
FL3	0.39 ± 0.04, 0.43, 0.36	0.33 ± 0.04, 0.36, 0.30	0.28 ± 0.02, 0.29, 0.24
FL1/FL2	1.14 ± 0.01, 1.15, 1.12	1.10 ± 0.01, 1.11, 1.09	1.33 ± 0.24, 1.69, 1.14
FL2/FL3	1.00 ± 0.07, 1.08, 0.96	1.05 ± 0.07, 1.10, 1.00	1.06 ± 0.09, 1.15, 0.94
FL1/FL3	1.14 ± 0.09, 1.24, 1.08	1.16 ± 0.06, 1.20, 1.11	1.49 ± 0.14, 1.59, 1.25
HL	2.99 ± 0.18, 3.20, 2.88	2.59 ± 0.26, 2.77, 2.40	2.69 ± 0.03, 2.72, 2.67
HW	3.52 ± 0.09, 3.63, 3.47	3.02 ± 0.19, 3.15, 2.88	3.33 ± 0.11, 3.47, 3.20
HL/HW	0.85 ± 0.03, 0.88, 0.83	0.86 ± 0.03, 0.88, 0.83	0.81 ± 0.03, 0.83, 0.77
IOD	0.54 ± 0.02, 0.57, 0.53	0.50 ± 0.04, 0.53, 0.47	0.51 ± 0.06, 0.57, 0.43
LPW	0.26 ± 0.00, 0.26, 0.26	0.24 ± 0.01, 0.24, 0.23	0.21 ± 0.01, 0.21, 0.20
MSW	3.16 ± 0.16, 3.31, 2.99	2.59 ± 0.26, 2.77, 2.40	3.20 ± 0.20, 3.41, 2.93
MTW	3.29 ± 0.13, 3.41, 3.15	2.48 ± 0.27, 2.67, 2.29	2.80 ± 0.13, 2.99, 2.67
OCD	0.26 ± 0.02, 0.27, 0.23	0.22 ± 0.07, 0.27, 0.17	0.20 ± 0.00, 0.20, 0.20
OOD	0.77 ± 0.03, 0.80, 0.73	0.69 ± 0.02, 0.70, 0.67	0.69 ± 0.02, 0.70, 0.67
PBAL	0.56 ± 0.00, 0.56, 0.56	0.47 ± 0.05, 0.50, 0.43	0.42 ± 0.04, 0.47, 0.39
PSL	1.31± 0.02, 1.33, 1.29	1.10 ± 0.12, 1.19, 1.01	1.07 ± 0.00, 1.07, 1.07
WL	9.50 ± 0.00, 9.50, 9.50	7.92 ± 0.83, 8.50, 7.33	7.77 ± 0.33, 8.17, 7.50