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Revision of the taxonomic status of *Rhodanthidium sticticum ordonezi* (Dusmet, 1915), an anthidiine bee endemic to Morocco (Apoidea: Anthidiini)

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Abstract: *Rhodanthidium ordonezi* (Dusmet, 1815) is recognized here as a valid species endemic to central and southern Morocco. It has previously been regarded as a subspecies of *R. sticticum* (Fabricius). The two taxa are in allopatry throughout most of their respective ranges, but probably cooccur in the Middle Atlas Mountains. They are clearly distinguished by their coloration and some aspects of their color patterns. Structural differences are minor, but a multivariate discriminant function analysis of 11 morphometric traits has showed that these are sufficient to assign 82.7% of all specimens correctly. While *R. ordonezi* has a restricted range in central and southern Morocco (extending over approximately 500 km), *R. sticticum* is widely distributed in the Mediterranean basin with a range extending over approximately 2500 km from east to west. The distribution areas of these two species are contiguous in the same ecozone of the Middle Atlas mountain range, but sympatric occurrence or a transition zone where intermediate specimens occur is not known.

Key words: *Anthidium*, taxonomy, distribution, allopatry, discriminant analysis, multivariate statistics, morphometry

1. Introduction

In 1915, José María Dusmet y Alonso described the bee *Anthidium ordonezi* from the town of Mogador, today's Essaouira, on the Atlantic coast of Morocco (Dusmet, 1915). Pasteels (1969) classified this taxon as a subspecies of *Rhodanthidium sticticum* (Fabricius, 1787) ("*sticticum* F. (*ordonezi* Dusmet)"). In his overview of the bees of the tribe Anthidiini of the Western Palearctic, Warncke (1980) accepted this assignment, but did not recognize Pasteel's generic classification. Subsequently, *ordonezi* was accepted as a subspecies of *sticticum*, either as *Anthidium sticticum ordonezi* or as *Rhodanthidium sticticum ordonezi* (e.g., Ornosa et al., 2008; Kuhlmann, 2016; http://westpalbees.myspecies.info), including in online databases such as Encyclopedia of Life (http://eol.org), BioLib.cz (www.biolib.cz), DiscoverLife (www.discoverlife.org), and the Integrated Taxonomic Information System (www.catalogueoflife.org/col) by Ruggiero et al. (2018). In the course of a review and revision of the tribe Anthidiini (Kasparek, 2015; 2017; in press), we examined material of these two taxa and can hereby revise their taxonomic status.

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2. Materials and methods

2.1. Material

Materials deposited in the Senckenberg Museum, Frankfurt am Main (Germany) (SMF), the Biologiezentrum – Oberösterreichisches Landesmuseum, Linz (Austria) (OLL), and the private collection of Maximilian Schwarz (Ansfelden, Austria) (cMS) were examined. The search for faunistic literature records was concentrated on Morocco and Algeria. The faunistic references for *R. sticticum* for other areas of the Mediterranean are not necessarily complete. Data from the Snow Entomological Collection (University of Kansas, Lawrence, KS, USA) (SEMC) were downloaded from the SEMC database at https://biodiversity.ku.edu/node/1095. Data from the Global Biodiversity Information Facility (GBIF) database (www.gbif.org) were also checked but did not provide additional information, particularly as human observations were not used here due to possible confusion with *R. siculum*.

2.1.1. *Rhodanthidium ordonezi*

Material examined and measurements taken (13♀, 11♂). **MOROCCO**. 3♀ Morocco, 1934, ex coll. Schuster (SMF). – 1♀ Mohammedia, 33°41′N, 07°23′W, 06.v.2003, M. Halada leg. (OLL). – 1♀, 1♂ Cascades d'Ouzoud, 32°00′N, 06°43′W, 12.v.1997, K. Deneš leg. (OLL). – 4♂ 50 km SW

of Beni-Mellal, 31°58′N, 06°34′W, 13.v.1997, J. Halada leg. (OLL). – 1♀ 1♂ Touama E of Marrakech, 31°33′N, 07°30′W, 09.04.1996, M. Schwarz leg. (cMS). – 1♀ Tizi n'Test (= Tizi n'Tichka), 31°17′N, 07°22′W, 30.iii.1987, J. Gusenleitner leg. (OLL). – 1♂ Imouzzer (NNE of Agadir), 30°40′N, 09°28′W, 31.iii.1987, J. Gusenleitner leg. (OLL). – 1♂ ibid., 11.iv.1988, J. Gusenleitner leg. (OLL). – 1♀ Bigoudine (NE of Agadir), 30°39′N, 09°16′W, H.-J. Flügel leg. (cMS). – 1♀ 1♂ Iourioua Ounneiene (80 km E of Taroudant), 30°33′N, 08°02′W, 09.iv.1996, O. & M. Niehuis leg. (cMS). – 1♀ Tadouarte 10 km NW of Tiznit, 30°23′N, 09°24′W, 12.iv.1988, J. Gusenleitner leg. (OLL). – 1♀ 50 km SE Taroudant, road to Igherm, 30°10′N, 08°28′W, 28.iii.1987, J. Gusenleitner leg. (OLL). – 1♀ Ait Baha, 30°04′N, 09°09′W, 1.iv.1987, J. Gusenleitner leg. (OLL). – 1♀ 2♂ 10 km SE Ait Baha (60 km SE Agadir), 30°02′N, 09°05′W, 18.iv.1996, J. Gusenleitner & M. Schwarz leg. (cMS, OLL).

Further material examined (all NHMUK) (8♀, 13♂). **MOROCCO**: 3♀, 4♂ High Atlas, 1–5 km S Tizi-n-Test (500 m), 31°14′N, 07°24′W, 01.iv. and 09.iv.1983, G. R. Else leg. – 7♀, 8♂ High Atlas, 15–17 km S Tizi-n-Test Taroudant rd. (1000 m), 31°08′N, 07°25′W, 08.–09.iv.1983, G. R. Else leg. – 1♀ 25 km N of Taroudant (30°42′N, 08°53′W), 07.iv.1983, G. R. Else leg. – 1♀, 3♂ 6 km S of Sidi Ifni, 29°19′N, 10°08′W (150 m), 29.iii.–01.iv.1974, K. M. Guichard & G. R. Else leg.

Literature and other records. MOROCCO. Moulay Driss Zerhoun ("Muley, Idris"), 34°03′N, 05°31′W, 12.v.1928 (Alfken 1930). – Fes-Zalagh, 34°03′N, 05°00′W, 27.v.1930 (Maidl, 1933). – Salé, 34°01′N, 06°46′W, 12.iv.1932 (Rungs, 1936). – Rabat 33°58′N, 06°50′W, 08.iv.1932 (Rungs, 1936). – 1♂ Oued Cherrat, 33 km SW of Rabat (33.82°N, 07.09°W), 10.04.1968, J. G. Rozen & E. Suissa leg. (American Museum of Natural History, see www.discoverlife.org). – Azrou, 33°27′N, 05°13′W, 29.–30.v.1930 (Maidl, 1933). – Essaouira ("Mogador"), 31°30′N, 09°45′W (Dusmet, 1915). – Amizmiz, 31°13′N, 08°14′W (Dusmet, 1915). – Tiout, 29°56′N, 09°21′W (www.flickr.com/photos/nico_bees_wasps/8613170283). – Sus [?] near Tiznit, 29°41′N, 09°43′E (Dusmet, 1915).

2.1.2. ***Rhodanthidium sticticum***

Material examined and measurements taken. GREECE: 1♀ Olympia, 37°38′N, 21°37′E, 1912, O. Schmiedknecht leg., ex coll. A. Weis (SMF). – **ITALY:** 1♂ Sicily: Madonia Collesano env., 37°55′N, 13°56′E, 600 m, 3.–5.vi.2002, J. Halada leg. (OLL). – 1♂ Sicily: Mt. Ziretto nr. Taormina, 37°52′N, 15°17′E, 27.iii.1957, K. Kusdas leg. (OLL). – 1♀ Sicily: Taormina, 37°51′N, 15°17′E, 15.iv.1958, E. Priesner leg., ex coll. Warncke (OLL). – 1♂ Sicily: Taormina, 37°51′N, 15°17′E, 24.v.1955, K. Kusdas leg. (OLL). – 2♀ Sicily: Taormina env., Sirina valley, 37°51′N, 15°16′E, 26.iii.1957, K. Kusdas leg. (OLL). – 1♀, 1♂ Sicily: Catania, 37°30′N, 15°04′E, 19.iv.1958, E. Priesner leg., ex coll. Warncke (OLL). – 2♀, 3♂ Sicily: 35 km N Gela: NE of Piazza Armerine, 37°24′N, 14°23′E, 27.–29.v.2002, J. Halada leg. (cMS). – **LIBYA**: 1♂ E of Tripoli: Tagiura, Beledije Enzara, 32°52′N, 13°20′E, 12.–13.iii.1981, W. Eckweiler & A. Hofmann, ex coll. Hofmann (SMF). – **MOROCCO:** 1♀, 3♂ N of Aknoul, 34°40′N, 03°52′W, 04.v.2003, M. Snižek leg. (OLL). – 1♂ ibid., 1997, K. Deneš jun. leg. (OLL). – 1♂ SW of Sefrou, 33°48′N, 04°51′W, 16.v.2003, M. Halada leg. (OLL). – 4♂ 12 km E Ifrane, 33°32′N, 04°58′W, 9.–10.v.1997, J. Halada leg. (cMS, OLL). – 4♀, 3♂ Ifrane env., 33°31′N, 05°06′W, 17.v.2003, M. Halada leg. (OLL). – 1♀ ibid., 09.v.1997, K. Denes leg. (OLL). – 3♀, 3♂ NE of Ifrane Dayf-Ifrah, 33°31′N, 05°04′W, 1750 m, 17.v.2003, M. Halada & M. Snižek leg. (OLL). – **PORTUGAL:** 1♂ Odemira env., 37°35′N, 08°38′W, 30.iv.2002, J. Kadlec leg. (cMS). – 1♀ Algarve: Castra Marim, 37°13′N, 07°26′W, 17.iv.1985, J. A. W. Lucas leg. (OLL). – **SPAIN**: 1♀ 1♂ Port Bou, 42°25′N, 03°09′E, April 1990, M. Halada leg. (OLL). – 1♂ Figueres, 42°15′N, 02°57′E, 02.v.2003, M. Halada leg. (OLL). – 1♂ Catalanien Palafrugell, 41°55′N, 03°09′E, April/May 1957, Dr. Rebmann leg. (SMF). – 1♀ 80 km SW Valencia: Reserva de Muela de Cortes, 39°11′N, 00°55′W, 14.v.2003, J. Halada leg. (OLL). – 1♀ De Jumilla, 38°28′N, 01°19′W, 800 m, 19.v.2003, M. Snizek leg. (OLL). – 1♂ Sierra de Nevada, env. Lanjarón, 36°55′N, 03°28′W, 04.v.2002, J. Halada leg. (OLL). – **TUNISIA:** 1♂ Tunis, 36°49′N, 10°08′E, 16.iv.1971, J. Gusenleitner leg. (OLL). – 1♀ ibid., E. Graeffe leg. (SEMC). – 1♂ 5 km NW Teboursouk, 36°28′N, 09°10′E, 14.v.1992, J. Gusenleitner leg. (OLL). – 1♀ Djebel Zaghouan, 36°22′N, 10°08′E, 20.v.1995 (OLL). – 1♂ Friguia, 30 km SW Hammanet, 36°11′N, 10°25′E, 2006, P. Kressl leg. (cMS). – 1♀ 1♂ 15 km SW Makthar [Mactaris], 35°51′N, 09°12′E, 21.iv.1994, M. Schwarz leg. (cMS). – 1♀ 5 km S Tadjerounie, 35°49′N, 08°32′E, 20.v.1982, H. Malicky leg. (OLL). – 1♀ Oum Djeddour, 35°38′N, 08°56′E, 29.–30.05.1982, H. Malicky leg. (OLL). – 1♀ 15 km NW Sbeitla, 35°21′N, 09°05′E, 19.iv.1994, M. Schwarz leg. (cMS). – 1♀ Sbeitla, 35°13′N, 09°07′E, 18.iv.1994, M. Schwarz leg. (cMS). – 1♂ 15 km NW Feriana, 35°03′N, 08°38′E, 08.v.1973, Jos. Schmidt leg. (SMF). – 1♀, 1♂ 30 km SW Sfax, 34°31′N, 10°30′E, 10.iv.1994, M. Schwarz leg. (cMS).

Further material examined (all from NHMUK). **FRANCE:** 1♀ S France, E. Saunders coll. – 1♂, 1 ex., Marseille (43°17′N, 05°22′E), F. J. Manning coll. – 1♀, Lyons (45°45′N, 04°50′E). – 1♂, Remoulins, Pont-du-Gard (43°56′N, 04°32′E), 08.04.1938, O. W. Richards leg.; 1♂, same data 02.04.1938. – 1♀, Cassis, Port Miou (43°12′N, 05°31′E), 15.04.1967. – 1 ex., Toulon: Saint-Cyr-sur-Mer (Le Castellet) (43°12′N, 05°46′E), 18.04.1968. – 2♀ ibid., F. J. Manning coll. – Corsica: Porto Veccio (41°35′N, 09°16′E), April 1976. – **GIBRALTAR (United**

Kingdom): 06.05.1959, O. W. Richards coll. – **LIBYA:** 6 ex., Cyrene (Shahat) (32°47′N, 21°51′E), 1800 ft., 29.03.1954, K. M. Guichard leg. – **MONACO**: Monte Carlo (43°44′N, 07°25′E), v.1955, E. Elkan & L. Mathieu leg. – **PORTUGAL:** 4 ex., Estremadura: Porthino (38°28′N, 08°59′W), 08.–20.04.1970, J. F. Perkins leg. – **SPAIN:** 11 ex., Palamós, 41°51′N, 03°07′E, 11.04.1963, F. J. Manning coll. – c. 18 ex., Malaga: Mare (36°44′N, 04°05′W), 14.04.1955, I. H. H. Yarrow leg. – c. 3 ex., Huelva: Gibraleon (37°22′N, 06°58′W), 19.04.1955, I. H. H. Yarrow leg. – 1 ex., Tarragona: Hospitalet (41°07′N, 01°15′E), 06.04.1955, I. H. H. Yarrow leg. – 1 ex., Arguis (42°15′N, 0°25′W), 22.05.1953, I. H. H. Yarrow leg. – 1 ex., Valencia: La Dehesa (39°23′N, 0°22′W), 29.v.–29.vi.1971, I. H. H. Yarrow leg.

Other localities from Algeria and Morocco and selected records from other countries. ALGERIA: "Barbaria" (which usually stands for that part of the North African coast that is today Algeria) (Fabricius, 1804). – Tlemcen, 34°53′N, 01°19′W, 4.v.1928 (Alfken, 1930; Morice, 1916). – "Djebel Mourdjadjo" west of Oran, 35°41′N, 00°48′W, 1.v.1928, 06.v.1930 (Alfken, 1930; Maidl, 1933; Schmiedeknecht, 1896). – Oran inclusive of Batterie espagnole near Oran and Santa Cruz, 35°41′N, 00°37′W, 11.iv.1928 (Lucas, 1844; Morice, 1916; Alfken, 1916, 1930; Werner, 1929). – Muaskar ("Mascara"), 35°23′N, 00°08′E (Alfken, 1916). – Tipasa 36°37′N, 02°23′E (Tkalců, 1975). – Hamman Righa ("Rirha", "Rhira"), 36°22′N, 02°24′E, 1911 (Morice, 1916; Illinois Natural History Survey Insect Collection [GBIF]). – Zéralda ("Zeralde") 36°43′N, 02°49′E (Tkalců, 1975). – Sidi Fredj ("Sidi Ferouch") west of Algiers, 36°45′N, 02°50′E (Alfken, 1916; Tkalců, 1975). – El Biar (neighborhood of Algiers), 36°46′N, 03°01′E (Alfken, 1916). – Bab el Oued (neighborhood of Algiers), 36°47′N, 03°02′E (Alfken, 1916). – Algiers, 36°46′N, 03°03′E (Friese, 1898; Saunders, 1908; Schulthess, 1924). – Djurjura, 36°27′N, 04°13′E (Tkalců, 1975). – Mila Province: Bouhatème (36°18′N, 06°02′E), Darahi Bouslah [Derradji Bouslah] (36°20′N, 05°57′E) and Tiberguent (36°25′N, 06°02′E) (Boumala and Kadri, 2014). – 1♀ Lambaesa SE Batna, 35°29′N, 06°15′E, A. Handlirsch leg. (SEMC). – Constantine including University Campus, 36°20′N, 06°37′E (Saunders, 1908; Aguib et al., 2010; Redjem and Barka, 2016). – 1♀ el Kantour, 36°34′N, 06°43′E, Handlirsch leg. (SEMC). – Oum El Bouaghi, 35°47′N, 07°10′E (Aguib et al., 2010). – Annaba ("Bonnê"), 36°54′N, 07°45′E (Saunders, 1908). – **CROATIA**: Dalmatia, Mann leg. (Mus. Wien; Friese, 1898). – **FRANCE**: 2♀ 1♂ Provence-Alpes-Cote d'Azur: Le Beausset, 43.20′N, 05.80′E (SEMC). – **ITALY**: Further unspecified records referring to Sicily available (e.g., material in SEMC; Friese, 1898). – Santa Margherita Belice and Montevago (Agrigento Province) (Verde and La Mantia, 2011). – **LIBYA**: Marj [= El Merg or Merg or Barke], 32°29′N, 20°49′E (Museum Zurich according to Warncke, 1980; see also Schulthess, 1924). – **MOROCCO**: Restinga near Melilla, 35°16′N, 02°57′W (Dusmet, 1915). – Oujda [Oudjda-Bergnend], 34°41′N, 01°55′W, 11.v.1930 (Maidl, 1933). – **PORTUGAL**: 2 spec., Lisboa (Estoril), 38.71′N, 09.39′W, N. de Andrade leg. (SEMC). – Kap Espichel, 38°25′N, 09°12′W (Warncke, 1980). – **SPAIN**: 1♀ Asturias: Tuilla (SEMC) [no information on collector or date is available]. – 23 spec., Girona: Tamariu, Puig Grui, 41.91°N, 03.02°E, 10.vi.1962 (SEMC). – 1 spec., Girona: Lestartit, 42.05′N, 03.20′E, 09.vi.1963 (SEMC). – Reserve 'Punta de la Glea', southern part of Alicante Province (37°54′N, 00°44′W) (Agulló et al., 2015). – 1♂ Andalusia: Playa de la Barrosa, Chiclana de la Frontera, 36°20′N, 06°09′W, 1987, F. Pinero leg. (SEMC). – 1♀ Andalusia: Granada, 37.23°N, 03.56°W, J. Ortitz leg. (SEMC). – Mallorca (several localities) (Baldock, 2014). – **TUNISIA**: Tunis, 36°49′N, 10°08′E (Friese, 1898). – Sfax (34°43′N, 10°46′E), Sbéitla (35°14′N, 09°07′E) and Hammam Lif (36°43′N, 10°20′E) (Schulthess, 1924). – **GENERAL**: See also records available via www.discoverlife.org. Records from Spain also by Ortiz and Sanchez (1990).

2.2. Methods

In order to discover morphological differences between the two taxa, 11 morphological traits were measured (Table; see also Kasparek, 2018). Body parts were photographed for this purpose under a stereozoom microscope (constant 2× magnification) and subsequently measured with TSView7 (v.7.3.1.7) software. To obtain exact measurements, it is critical that the points of reference be equidistant from the lens of the microscope. This is challenging because of the three-dimensional shape of the specimens and requires some experience on the part of the observer. All measurements were taken by the same person and with the same instruments.

The morphometric data were analyzed with discriminant function analysis (DFA) (=canonical variate analysis, CVA) to determine whether a set of body measurements was effective in predicting category membership. The significance of differences between body measurements was tested with a t-test. The statistical tests were performed with XLSTAT v.19.7, which is a statistical software package for Microsoft Excel.

2.3. Abbreviations

cMS Private collection of Maximilian Schwarz (Ansfelden, Austria)
NHMUK Natural History Museum (London, UK)
OLL Biologiezentrum – Oberösterreichisches Landesmuseum, Linz (Austria)
SEMC Snow Entomological Collection, University of Kansas (Lawrence, KS, USA)
SMF Senckenberg Museum (Frankfurt a.M., Germany)
T1, T2, T3, … Tergum 1, tergum 2, tergum 3, …

Table. List of measurements taken from the body of *Rhodanthidium* sp. for morphometric analysis.

Parameter	Explanation
Clypeus length	Clypeus length along middle line, excluding the dark crenulated apical margin
Clypeus width	Clypeus width at widest point
Clypeus surface	Surface area of clypeus as calculated by the computer program, usually based on 7 different points taken at the margin
Clypeus circumference	Circumference of clypeus as calculated by the computer program, usually based on 7 different points taken at the margin
Eye distance I	Inner distance between eyes at the position where the clypeus reaches its maximum width
Eye distance II	Inner distance between eyes at the position of the center of the lateral ocelli
Ocellus I	Distance between outer margin of lateral and frontal ocellus
Ocellus II	Distance between outer margins of lateral ocelli
Ocellus III	Distance between outer margin of lateral ocellus and preoccipital ridge
Marginal cell	Length of marginal cell from inner proximal edge to inner distal edge
T2	Distance of lateral bands on T2

3. Results and discussion

A description of the female and male of both taxa is given by Kasparek (in press). The description is therefore confined here to the distinguishing character features.

3.1. Comparison of the coloration

Both taxa can easily by distinguished by their overall coloration (Figures 1 and 2): it is red in *R. sticticum* and yellow in *R. ordonezi*. Coloration is bright red in live specimens and often becomes brownish-red in preserved specimens. In *R. sticticum*, red coloration is present on the lateral bands, the metasomal terga, and the lateral macula on the vertex. The clypeus and the paraocular area are also red in females but are yellow in males (similar to *R. ordonezi*). Legs (except the base of the femora) are ochreous in both species, with a tinge of red in *R. sticticum*, and slightly more yellowish in *R. ordonezi*. Coloration of the pubescence on the head and dorsal side of the mesosoma is similar (ochreous) in both species, with on average a slightly more rufous tone in *R. sticticum*.

In *R. sticticum*, 10 out of 25 females (40%) have some brown darkening in the middle of the clypeus, mostly at the base; in one case, a female has a blurred brown middle line. In *R. ordonezi*, 4 out of 13 females show similar darkening (31%). Such darkening is much rarer in males; it was found in only 2 out of 33 males of *R. sticticum* (6.0%), and in none of 11 males of *R. ordonezi* (0%).

The metasomal terga have broad lateral bands on the disc, not reaching the middle; they are red in *R. sticticum* and yellow in *R. ordonezi*. The distance between the bands decreases from proximal to distal. The distance between the lateral bands (measured on T2) is on average 1.27 mm in *R. ordonezi* (N = 24) and 1.19 mm in *R. sticticum* (N = 57) and is statistically not significantly different between the 2 species (t-test, $P > 0.05$). In *R. ordonezi*, the marginal zone is dark opaque black and with dense punctation. The distance between punctures is about half their diameter. In *R. sticticum*, the marginal zone and margin are rufous and slightly transparent.

The band on T1 is sometimes reduced to an irregularly formed maculation not extending over the entire disc. This was found in 9 out of 58 females and males of *R. sticticum*, including 1 male in which red maculation on T1 was entirely absent. In addition, a male from Corsica in NHMUK had an entirely black T1, but a narrow continuous red band in the marginal zone of T1. No such variation in the color pattern of T1 was observed in *R. ordonezi* (N = 24 examined).

In both females and males of *R. sticticum*, T6 is in typical cases entirely red, but may have some darkening in the middle anteriorly and rarely some lateral darkening. By contrast, *R. ordonezi* has a broad black middle line and black lateral ends. Male T7 is uniformly red (*R. sticticum*) or yellow (*R. ordonezi*), at most with some darkening of the apex.

3.2. Morphometric comparison

DFA carried out on 11 characters of the clypeus size, eye distance, ocelli distance, length of marginal cell, and distance between lateral bands on T2 showed that *R. sticticum* and *R. ordonezi* can be separated on the basis of these characters. While data from these 2 species form distinct clusters, there is broad overlap among both males and females (Figure 3). The confusion matrix, which summarizes the reclassification of the observations and enables us to quickly see the percentage of well-classified

Figure 1. Female of *Rhodanthidium sticticum* from Tunisia in cMS (left) and *R. ordonezi* from Morocco in OLL (right).

Figure 2. Apical terga. Upper row: females (left: *Rhodanthidium sticticum*, right: *R. ordonezi*). Lower row: males (left: *Rhodanthidium sticticum*, right: *R. ordonezi*). – All material from Morocco in SMF, OLL, and cMS.

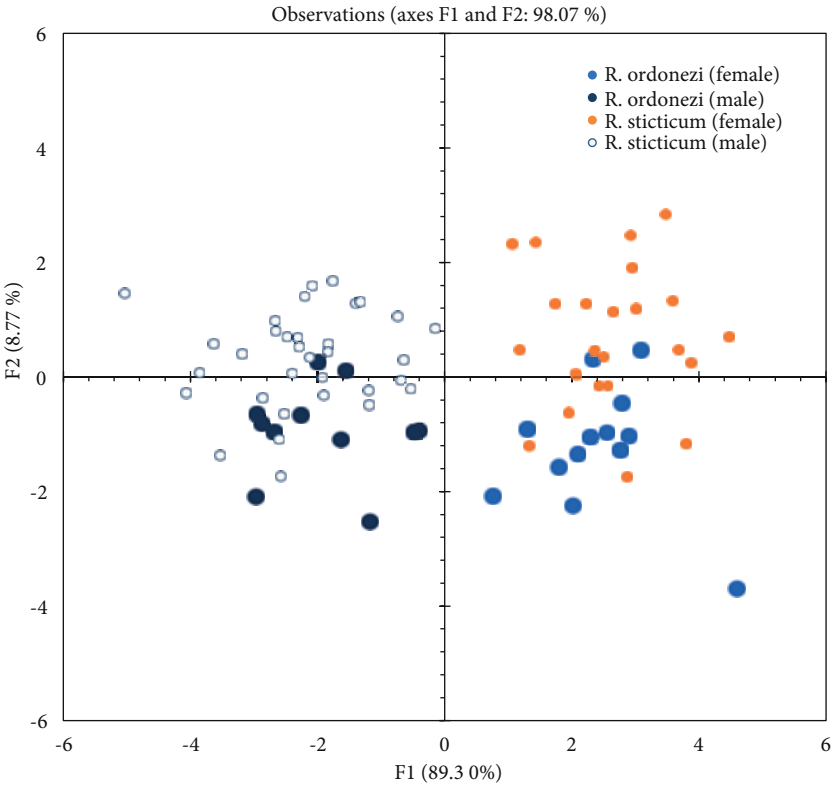

Figure 3. Discriminant analysis (DA) based on 11 morphometric characters of females and males of *Rhodanthidium ordonezi* and *R. sticticum*. Assignment to one of these two groups was based on overall coloration (yellow versus red).

observations, shows that 82.7% of all specimens were correctly classified.

The distance between the lateral bands of T2—the only nonstructural character included in this analysis—had no influence on the result. When this character was omitted, the same 82.7% of all specimens were still correctly classified.

3.3. Conclusions and synonymy

The differences between *R. sticticum* and *R. ordonezi* are both in structure and coloration; the most relevant differences can be summarized as follows: maculation of head and metasoma is red in *R. sticticum* and yellow in *R. ordonezi*. The marginal zone of the metasomal terga is reddish to brownish translucent in *R. sticticum* and opaque black in *R. ordonezi*. *Rhodanthidium ordonezi* has a black longitudinal middle line on T6 reaching the apex, while *R. sticticum* has at most some blurred darkening at the base of the tergum and rarely a dark middle line not reaching the apex. These striking character features well characterize *R. ordonezi* as a distinct species and not as a subspecies of *R. sticticum*, and may raise the question of what guided Warncke (1980) to classify *R. ordonezi* as a subspecies of *R. sticticum*.

The morphometric differences between *R. ordonezi* and *R. sticticum* support the heterospecificity of both taxa, but are not robust enough to clearly distinguish all individuals.

The distribution areas of both species are well separated: *R. ordonezi* is distributed in central and southern Morocco, where it is endemic. By contrast, *R. sticticum* has a much wider distribution, which extends on one side from northern Morocco to the coastal regions of Algeria, Tunisia, and Libya, and on the other side from southern Portugal to the coastal regions of southern Spain and southern France up to Monaco and includes the Mediterranean islands of Mallorca, Sardinia, and Sicily (Figure 4; see also Kasparek, in press). Records from northern Spain, the foothills of the Pyrenees, Croatia, and the Peloponnese in Greece (see Section 2.1 and Friese, 1898) need confirmation as they may refer to drifted individuals, for example. While the distribution of *R. sticticum* extends over more than 2500 km from east to west, the distribution of *R. ordonezi* extends only over 500 km.

Rhodanthidium ordonezi has been found from sea level (Mohammedia/Casablanca) to 1200 m altitude (Tizi n'Test, High Atlas Mountains). The collection localities of *R. sticticum* are situated in Morocco at roughly between 800 and 1750 m. However, the latter species has been

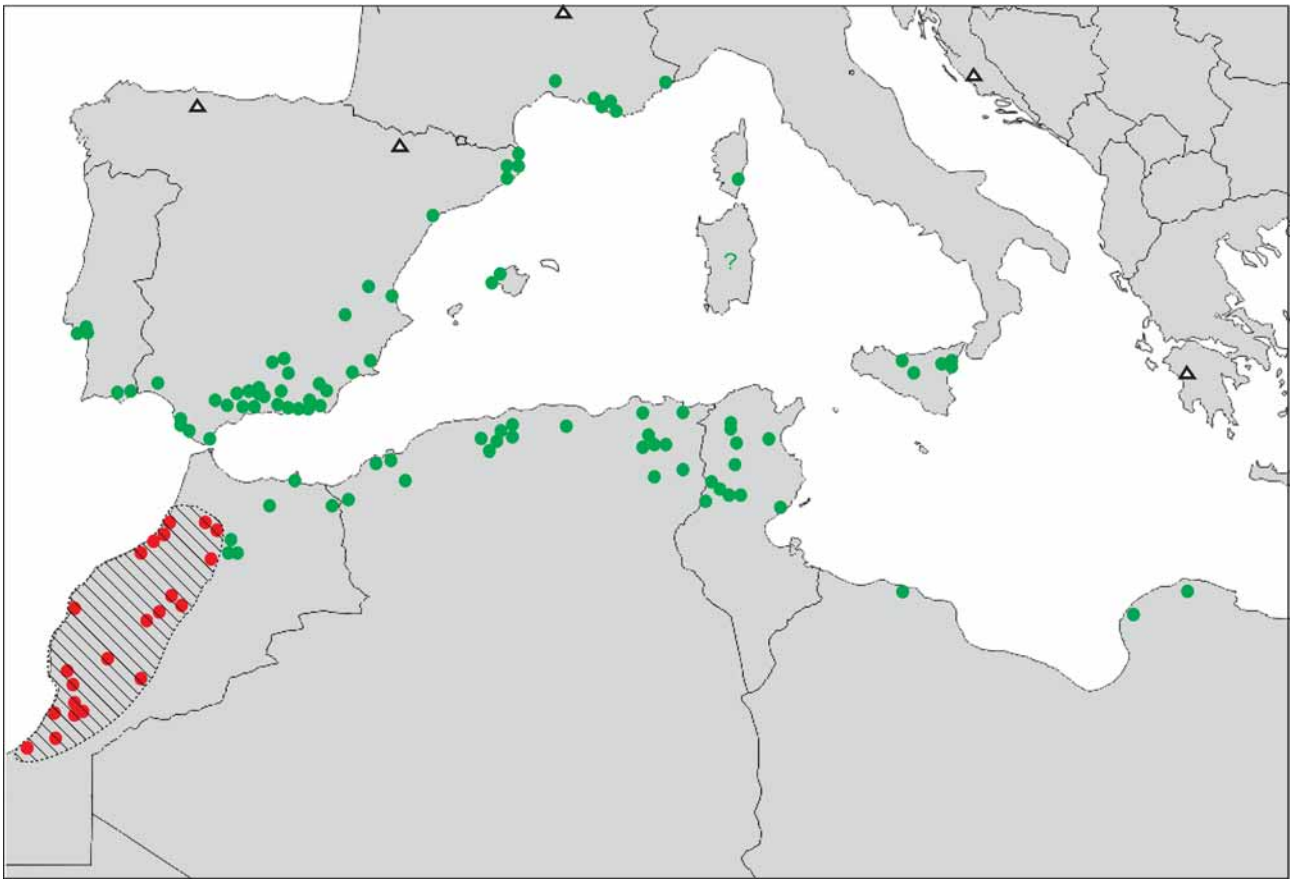

Figure 4. Distribution of *Rhodanthidium ordonezi* (red dots) and *R. sticticum* (green dots) in the Mediterranean basin and the north-eastern Atlantic. Records of *R. sticticum* beyond the regular distribution area that need confirmation are indicated by black triangles.

found in Spain, Portugal, Algeria, and other areas close to sea level. Both species therefore do not exhibit different altitude preferences.

The only area where the distributions of both species come very close together is the Middle Atlas Mountains. This is not very surprising, as the Atlas Mountains are known to constitute an extended transition gradient where Mediterranean and Saharan bee species often cooccur (Patiny and Michez, 2007). More research on their habitat requirements, nesting behaviors, and floral preferences are needed to explain this geographic separation.

The following synonymy can be established:

***Rhodanthidium ordonezi* (Dusmet, 1915) stat. nov.**

Anthidium ordoñezi Dusmet, 1915 (Morocco).

Anthidium sticticum F., var. *Amismiziana* nov. Dusmet, 1915 (Morocco).

Rhodanthidium sticticum ordonezi (Dusmet, 1915). – Assigned to *Rhodanthidium* by Pasteels (1969).

Anthidium sticticum ssp. *ordonezi* Dusmet, 1915. – Subspecies status accepted by Warncke (1980), but not generic classification.

***Rhodanthidium sticticum* (Fabricius, 1787)**

Apis stictica Fabricius, 1787. Mant. Insect. 1 p. 302 (Algeria).

Anthidium sticticum (Fabricius, 1787). – Synonymy established by Fabricus (1804).

Trachusa stictica (Fabricius, 1787). – Transferred to *Trachusa* by Jurrine (1807).

Dianthidium sticticum (Fabricius, 1787). – Cockerell (1904) ("I find that it belongs to *Dianthidium*").

Rhodanthidium sticticum (Fabricius, 1787). – "probably should be included in *Rhodanthidium*" Isensee (1927).

Rhodanthidium sticticum (Fabricius, 1787). – Assigned to *Rhodanthidium* by Pasteels (1969).

Anthidium sticticum (Fabricius, 1787). – Warncke (1980).

Rhodanthidium (Rhodanthidium) sticticum (Fabricius, 1787). – Subgeneric classification established by Michener and Griswold (1994). See also Michener (2007).

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