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The bees (Hymenoptera, Apoidea) of Egadi's Archipelago (Sicily, Italy)

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Keywords: biodiversity conservation, Egadi Islands, Italy, Mediterranean pollinators, wild bees.

SUMMARY

In the present study, we analysed the bee fauna reported in the Egadi Archipelago (circumsicilian islands). Field and bibliographical research carried out have allowed us to identify 40 taxa, between species and subspecies, belonging to five families: Colletidae (3 species), Andrenidae (9 spp.), Halictidae (4 spp.), Megachilidae (15 spp.), and Apidae (9 spp.). Twenty-seven species are reported here for the first time for the Egadi Archipelago, together with 13 species previously known from this archipelago, of which five are confirmed. For each species, details on collection data, distribution, and plants visited are given. Amongst the species recorded, *Hylaeus duckei* (Alfken, 1904) (Colletidae) and *Osmia alfkenii* Ducke, 1899 (Megachilidae) are new for Sicily. We include the first 'Checklist of bees of Egadi's Archipelago' (40 species reported). Furthermore, the Apidae *Nomada sicula* Schwarz, 1974 is reported for the first time as a parasite of *Panurgus siculus* Morawitz, 1871 (Andrenidae) and *Lasioglossum parvulum* (Schenck, 1853) (Halictidae) species.

INTRODUCTION

The Mediterranean Basin contains about 5000 islands and an equally high number of smaller islands (Blondel et al. 2010). Opposite the Trapani and Marsala coast, in western Sicily, is the Egadi Archipelago, consisting of three main islands, Favignana, Levanzo, and Marettimo, and several islets and stacks. The island of Favignana, the largest of the three, has an area of

about 19.5 km² and is about 8 km from the Sicilian coast; in front of it (less than 4 km from each other) is Levanzo, with a surface area of 5.6 km² and distant from the Sicilian coast by about 13 km. The farthest from Sicily (at a distance of about 35 km), Marettimo, has an area of 12.3 km² and reaches a higher elevation (686 m a.s.l.) than do Favignana (302 m a.s.l.) and Levanzo (278 m a.s.l.).

These islands show an interesting botanical diversity (Francini and Messeri 1956; Romano et al. 2006; Pasta et al. 2014) that reaches its greatest richness on the island of Marettimo, with about 500 infra-generic taxa (including species, subspecies, and varieties), and different endemic taxa (Francini and Messeri 1956; Gianguzzi et al. 2006; Scuderi 2008). However, due to different factors, including the arrival of allochthonous plants (Gianguzzi et al. 2006) and animals, the botanical heritage of this island is threatened.

Egadi islands are also known for possessing a significant number of endemics amongst animal species, invertebrates in particular, and since the last century, numerous expeditions have been made to these islands aimed at studying their fauna. A complete list of zoological publications for Egadi's Archipelago is reported in Muscarella and Baragona (2017). To date, the apidological fauna of these islands, has never been specifically treated, and only a few records are reported in Nobile (1990, 1991), Smit (2018), and Comba (2019).

In this paper, we add 27 new species to the list of bees of the Egadi Islands, after recent surveys conducted in 2021 in Favignana and Marettimo, and compile the first 'Checklist of Bees of Egadi's Archipelago'.

Further observations were made on an aggregation nest of *Panurgus siculus* Morawitz, 1871 and *Lasioglossum parvulum* (Schenk, 1853), located at Bue Marino in Favignana island, where the presence of *Nomada sicula* Schwarz, 1974 is reported for the first time as a parasite of these two species.

MATERIALS AND METHODS

Surveys in Favignana and Marettimo (Fig. 1) were conducted between the end of April and the beginning of May 2021 by R. Catania and S. Bella. Specimens were collected with net, intercepting bees from flowers, or looking for

nests. The distribution, locality, date of capture, number of specimens observed, and the plants visited are reported for each species. Most of the material of the present study was identified by V. Nobile based mainly on the works of Ebmer (1969, 1970), Schmid-Egger & Scheuchl (1997), and Scheuchl (2000, 2006). Specimens of *Nomada* Scopoli and *Eucera* Scopoli genera were identified by R. Catania. Reference was made to the online checklist of Western Palearctic Bees by Kuhlmann et al. (2018), Atlas Hymenoptera by Rasmont & Haubruge (2015), and Hymenoptera: Apoidea: Anthophila of Italy by Comba (2019). The classification used in this paper follows Michener (2007) for supra-specific taxa and their nomenclature is according to Polaszek (2013). The specimens have been preserved in the collection of the authors.

VISITED SITES

Favignana

- Bue Marino, 37.9170424, 12.3696627, 9 m a.s.l.
- Cala Grande, 37.9223898, 12.2954755, 40 m a.s.l.
- Cala Rossa, 37.9225028, 12.3661443, 15 m a.s.l.
- Calamoni Beach, 37.9202861, 12.3257915, 0-5 m a.s.l.
- Calazza, 37.9467878, 12.3012771, 7 m a.s.l. (Fig. 2C)
- Castello di Santa Caterina, 37.9280786, 12.3164661, 105 m a.s.l.

Marettimo

- Case Romane, 37.9703953, 12.0633393, 265 m a.s.l. (Fig. 2A)
- Contrada Pelosa, 37.9663714, 12.0679705, 175 m a.s.l.
- Contrada Pelosa, near the town, 37.9669125, 12.0717611, 63 m a.s.l.
- Praia di Pigna, 37.9733503, 12.0671420, 57 m a.s.l.
- Spiaggia de Rotolo, 37.9609201, 12.0774018, 24 m a.s.l.

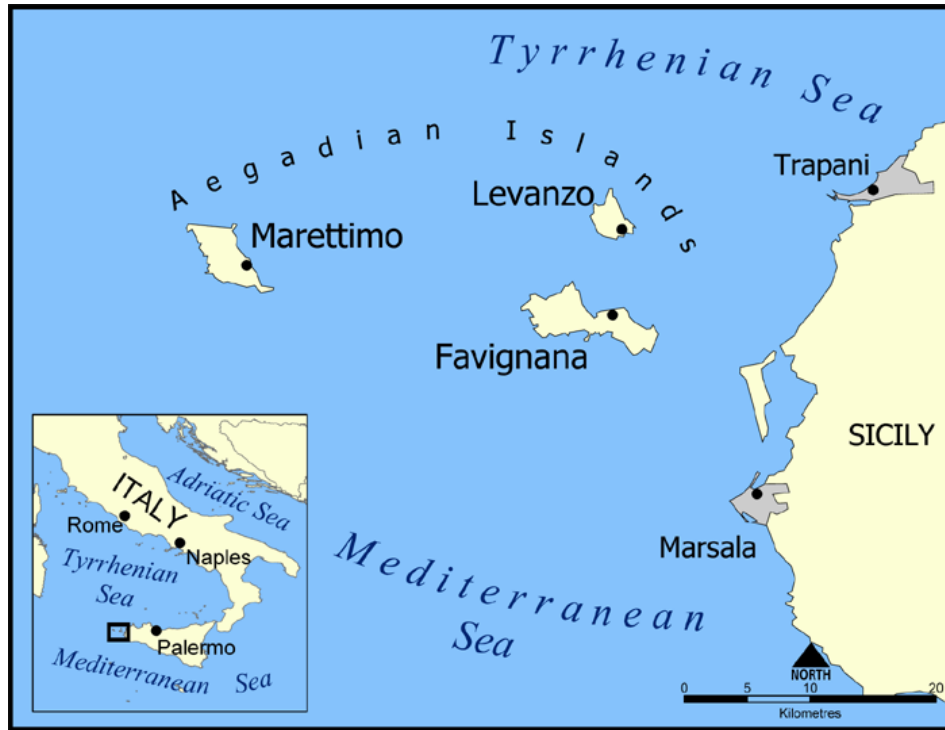


Figure 1. Position of Egadi's Archipelago in western Sicily (Trapani province).

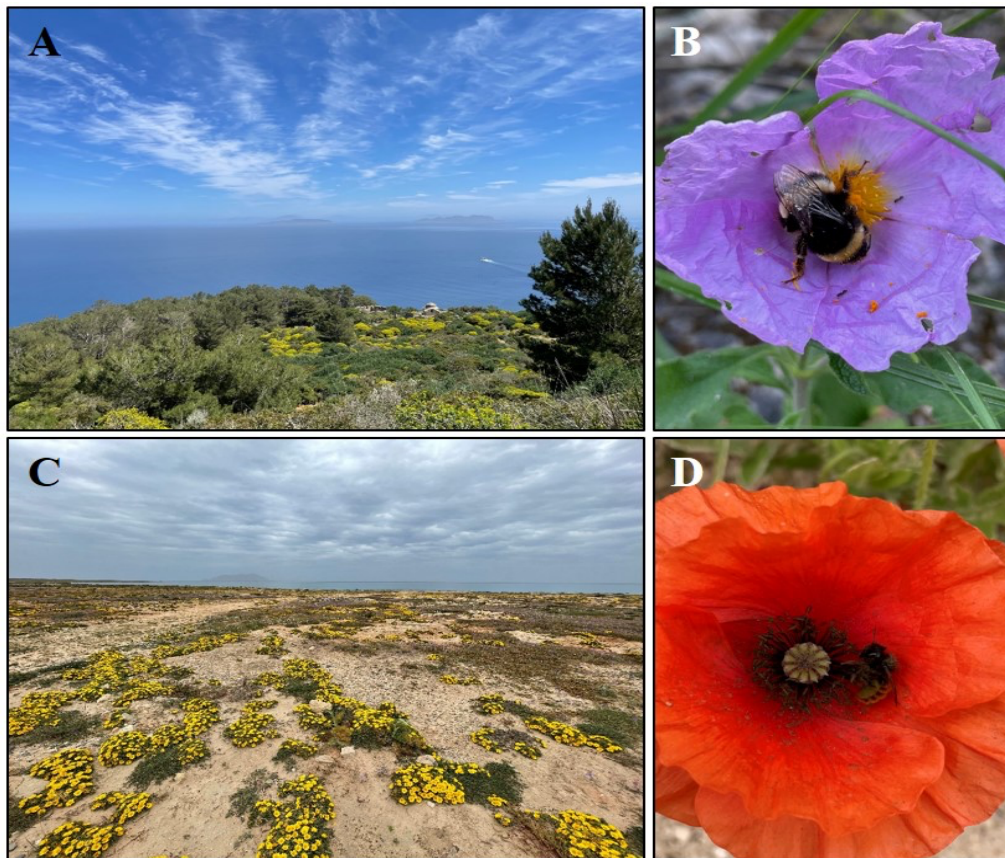


Figure 2. Sampling sites in Egadi's Archipelago (A-D), A: Marettimo, Case Romane; B: *Bombus terrestris* on *Cistus creticus* (Cistaceae); C: Favignana, Calazza; D: *Osmia aurulenta* on *Papaver rhoeas* (Papaveraceae).

RESULTS

A total of 40 species belonging to five families (Colletidae 3 species, Andrenidae 9 spp., Halictidae 4 spp., Megachilidae 15 spp., and Apidae 9 spp.) are reported for Egadi's Archipelago. In the different islands, the number of species is as follows: Favignana 35 species, Levanzo 2 spp., and Marettimo 9 spp. (Table 1). Amongst these species, 27 are new records for this Archipelago. Furthermore, *Hylaeus* (*Prosopis*) *duckei* (Alfken, 1904) (Colletidae)

and *Osmia* (*Helicosmia*) *alfkenii* Ducke, 1899 (Megachilidae) are also new record for Sicily, and a total of 9 species are not known for continental Italy (Table 2).

Table 3 shows the comparison of bee species between Sicilian and other Mediterranean archipelagos, in relation with the total area (km²) and the distance from the mainland (km) (for the Egadi and Eolie, this refers to the distance from Sicily).

Table 1. Bees from Egadi's Archipelago. Legend: ○ = previous bibliographic record; ● = record confirmed in the present study; + = new record.

Taxa	Favignana	Levanzo	Marettimo
COLLETIDAE			
<i>Hylaeus clypearis</i> (Schenck, 1853)	+		
<i>Hylaeus duckei</i> (Alfken, 1904)	+		
<i>Hylaeus punctatus</i> (Brullé, 1832)	+		
ANDRENIDAE			
<i>Andrena agilissima italica</i> Warncke, 1967	+		
<i>Andrena alfkenella</i> Perkins, 1914	+		
<i>Andrena nigroaenea nigrosericea</i> Dours, 1872	+		+
<i>Andrena nitida</i> (Müller, 1766)	+		
<i>Andrena rhypara</i> Pérez, 1903	+		
<i>Andrena rugothorace</i> Warncke, 1965	+		
<i>Andrena stabiana</i> Morice, 1889	+		
<i>Andrena tenuistriata</i> Pérez, 1895	+		
<i>Panurgus siculus</i> Morawitz, 1871	+		
HALICTIDAE			
<i>Halictus fulvipes</i> (Klug, 1817)	○		
<i>Lasioglossum malachurum</i> (Kirby, 1802)	+		
<i>Lasioglossum nitidulum aeneidorsum</i> (Alfken, 1921)	●		
<i>Lasioglossum parvulum</i> (Schenck, 1853)	+		+
MEGACHILIDAE			
<i>Osmia alfkenii</i> Ducke, 1899	+		
<i>Osmia aurulenta</i> (Panzer, 1799)	+		
<i>Osmia kohli</i> Ducke, 1900	+		+
<i>Osmia latreillei iberoafricana</i> Peters, 1975			+
<i>Osmia notata</i> (Fabricius, 1804)	+		
<i>Protosmia exenterata</i> (Pérez, 1895)	+		
<i>Rhodanthidium acuminatum</i> (Mocsáry, 1884)		○	
<i>Rhodanthidium septemdentatum</i> (Latreille, 1809)			+
<i>Rhodanthidium siculum</i> (Spinola, 1838)	●		
<i>Rhodanthidium sticticum</i> (Fabricius, 1787)	○		
<i>Coelioxys acanthura</i> (Illiger, 1806)	○		
<i>Coelioxys argentea</i> Lepeletier, 1841	○		
<i>Coelioxys echinata</i> Foerster, 1853	○		
<i>Megachile pilidens</i> Alfken, 1923	○		

Taxa	Favignana	Levanzo	Marettimo
<i>Megachile sicula sicula</i> (Rossi, 1792)	+		
APIDAE			
<i>Xylocopa violacea</i> (Linnaeus, 1758)			+
<i>Nomada sicula</i> Schwarz, 1974	●		
<i>Eucera oraniensis</i> Lepeletier, 1841	+		
<i>Eucera rufa</i> Lepeletier, 1841	+		
<i>Amegilla quadrifasciata</i> (de Villers, 1789)	○		
<i>Anthophora crinipes</i> Smith, 1854	+		
<i>Anthophora pruinosa</i> Smith, 1854	○		●
<i>Bombus terrestris</i> (Linnaeus, 1758)			+
<i>Apis mellifera</i> (Linnaeus, 1758)	●	○	●
Total species	35	2	9

Table 2. Distribution data of bee species known from Egadi's Archipelago and their presence in Sicily, Sardinia, the Italian peninsula, and northern Africa.

Taxa	Sicily	Sardinia	Italian peninsula	North Africa
<i>Hylaeus clypearis</i> (Schenck, 1853)	x	x	x	x
<i>Hylaeus duckei</i> (Alfken, 1904)			x	
<i>Hylaeus punctatus</i> (Brullé, 1832)	x	x	x	
<i>Andrena agilissima italica</i> Warncke, 1967	x		x	
<i>Andrena alfkenella</i> Perkins, 1914	x	x	x	x
<i>Andrena nigroaenea nigrosericea</i> Dours, 1872	x			x
<i>Andrena nitida</i> (Müller, 1766)	x	x	x	x
<i>Andrena rhypara</i> Pérez, 1903	x			x
<i>Andrena rugothorace</i> Warncke, 1965	x			
<i>Andrena stabiana</i> Morice, 1889	x		x	
<i>Andrena tenuistriata</i> Pérez, 1895	x		x	x
<i>Panurgus siculus</i> Morawitz, 1871	x	x	x	
<i>Halictus fulvipes</i> (Klug, 1817)	x	x	x	x
<i>Lasioglossum malachurum</i> (Kirby, 1802)	x	x	x	x
<i>Lasioglossum nitidulum aeneidorsum</i> (Alfken, 1921)	x		x	
<i>Lasioglossum parvulum</i> (Schenck, 1853)	x	x	x	
<i>Osmia alfkenii</i> Duce, 1899		x		x
<i>Osmia aurulenta</i> (Panzer, 1799)	x	x	x	
<i>Osmia kohli</i> Duce, 1900	x		x	x
<i>Osmia latreillei iberoafricana</i> Peters, 1975	x			x
<i>Osmia notata</i> (Fabricius, 1804)	x	x	x	x
<i>Protosmia exenterata</i> (Pérez, 1895)	x			x
<i>Rhodanthidium acuminatum</i> (Mocsáry, 1884)	x			x
<i>Rhodanthidium septemdentatum</i> (Latreille, 1809)	x	x	x	
<i>Rhodanthidium siculum</i> (Spinola, 1838)	x			x
<i>Rhodanthidium sticticum</i> (Fabricius, 1787)	x	x		x
<i>Coelioxys acanthura</i> (Illiger, 1806)	x	x	x	x
<i>Coelioxys argentea</i> Lepeletier, 1841	x		x	x
<i>Coelioxys echinata</i> Foerster, 1853	x	x	x	x
<i>Megachile pilidens</i> Alfken, 1923	x	x	x	x
<i>Megachile sicula sicula</i> (Rossi, 1792)	x	x	x	
<i>Xylocopa violacea</i> (Linnaeus, 1758)	x	x	x	x

Taxa	Sicily	Sardinia	Italian peninsula	North Africa
<i>Nomada sicula</i> Schwarz, 1974	x			
<i>Eucera oraniensis</i> Lepeletier, 1841	x	x	x	x
<i>Eucera rufa</i> Lepeletier, 1841	x		x	x
<i>Amegilla quadrifasciata</i> (de Villers, 1789)	x	x	x	x
<i>Anthophora crinipes</i> Smith, 1854	x	x	x	x
<i>Anthophora pruinosa</i> Smith, 1854	x			
<i>Bombus terrestris</i> (Linnaeus, 1758)	x	x	x	x
<i>Apis mellifera</i> (Linnaeus, 1758)	x	x	x	x

Detected taxa

Bue Marino, 02.V.2021, 1 ♂, on *Bituminaria bituminosa* (L.) C.H. Stirt. (Fabaceae).

COLLETIDAE

Gen. *Hylaeus* Fabricius, 1793

Hylaeus (Paraprosopis) clypearis (Schenck, 1853)

Examined material: Favignana. Cala Grande, 30.IV.2021, 1 ♂.

Distribution: widespread in Europe, northern Africa (Morocco, Algeria, Tunisia, and Egypt), and western Asia (Turkey, and Cyprus).

Remark: new record for Favignana, and Egadi's Archipelago.

Hylaeus (Prosopis) duckei (Alfken, 1904)

Examined material: Favignana. Castello di Santa Caterina, 01.V.2021, 3 ♂♂, on *Rapistrum rugosum* (L.) All. (Brassicaceae); Bue Marino, 02.V.2021, 1 ♂, on *Convolvulus lineatus* L. (Convolvulaceae).

Distribution: widespread in Europe, and western Asia (Turkey, Georgia, Armenia, and Azerbaijan).

Remark: new record for Egadi's Archipelago, and Sicily.

Hylaeus (Spatulariella) punctatus (Brullé, 1832)

Examined material: Favignana. Cala Grande, 30.IV.2021, 1 ♀, on *Crepis* sp. (Asteraceae);

Distribution: widespread in Europe, and western Asia (Turkey).

Remark: new record for Favignana, and Egadi's Archipelago.

ANDRENIDAE

Gen. *Andrena* Fabricius, 1775

Andrena (Agandrena) agilissima italica Warncke, 1967

Examined material: Favignana. Castello di Santa Caterina, 01.V.2021, 1 ♀ and 1 ♂, on *Rapistrum rugosum* (Brassicaceae).

Distribution: Italy.

Remark: new record for Favignana, and Egadi's Archipelago.

Andrena (Chlorandrena) stabiana Morice, 1889

Examined material: Favignana. Cala Grande, 01.V.2021, 2 ♀♀, on *Glebionis coronaria* (L.) Spach (Asteraceae), 1 ♂, on *Papaver rhoeas* L. (Papaveraceae).

Distribution: central and southern Europe (France, Switzerland, and Italy).

Remark: new record for Favignana, and Egadi's Archipelago.

Andrena (Melandrena) nigroaenea nigrosericea Dours, 1872

Examined material: Marettimo. Case Romane, 28.IV.2021, 1 ♀; Favignana. Cala Grande, 01.V.2021, 1 ♂, on *Hypochaeris achyrophorus* L. (Asteraceae); Bue Marino, 02.V.2021, 1 ♀, on *Teucrium fruticans* L. (Lamiaceae).

Distribution: southern Europe (Portugal, Spain, and Italy), northern Africa (Morocco, Algeria, and Tunisia).

Remark: new record for Favignana, Marettimo, and Egadi's Archipelago.

Andrena (Melandrena) nitida (Müller, 1766)

Examined material: Favignana. Calazza, 01.V.2021, 1 ♀, on *Visnaga daucooides* Gaertn. (Apiaceae).

Distribution: widespread in Europe, northern Africa (Morocco, and Algeria), western Asia (Georgia, Armenia, and Azerbaijan).

Remark: new record for Favignana, and Egadi's Archipelago.

Andrena (Micrandrena) alfenella Perkins, 1914

Examined material: Favignana. Cala Grande, 01.V.2021, 1 ♂, on *Hypochaeris achyrophorus* (Asteraceae); Calamoni Beach, 01.V.2021, 1 ♀, on *Rapistrum rugosum* (Brassicaceae); Bue Marino, 02.V.2021, 2 ♀♀, on *Bituminaria bituminosa* (Fabaceae).

Distribution: widespread in Europe, northern Africa (Morocco), and western Asia (Turkey).

Remark: new record for Favignana, and Egadi's Archipelago.

Andrena (Micrandrena) rugothorace Warncke, 1965

Examined material: Favignana. Calazza, 01.V.2021, 2 ♀♀, on *Visnaga daucooides*; Castello di Santa Caterina, 01.V.2021, 1 ♂, on *Rapistrum rugosum*.

Distribution: southern Europe (Italy, and Greece), and western Asia (Turkey).

Remark: new record for Favignana, and Egadi's Archipelago.

Andrena (Micrandrena) tenuistriata Pérez, 1895

Examined material: Favignana. Calamoni Beach, 01.V.2021, 1 ♀, on *Rapistrum rugosum*. Castello di Santa Caterina, 01.V.2021, 1 ♀, on *Rapistrum rugosum*; Bue Marino, 02.V.2021, 1 ♀ and 1 ♂.

Distribution: southern Europe (Portugal, Spain, France, and Italy), and northern Africa (Morocco, Algeria, Tunisia, and Libya).

Remark: new record for Favignana, and Egadi's Archipelago.

Andrena (Simandrena) rhypara Pérez, 1903

Examined material: Castello di Santa Caterina, 01.V.2021, 1 ♀.

Distribution: southern Europe (Spain, and Italy), and northern Africa (Morocco, Algeria, and Tunisia).

Remark: new record for Favignana, and Egadi's Archipelago.

Gen. *Panurgus* Panzer, 1806

Panurgus (Panurgus) siculus Morawitz, 1871

Examined material: Favignana. Calazza, 30.IV.2021, 7 ♂♂, on *Pallenis maritima* (L.) Greuter (Asteraceae); Cala Grande, 01.V.2021, 1 ♂, on *Hypochaeris achyrophorus* (Asteraceae); Castello di Santa Caterina, 01.V.2021, 1 ♀, on *Urospermum dalechampii* (L.) F.W. Schmidt (Asteraceae); Calamoni Beach, 01.V.2021, 1 ♀ and 1 ♂, on *Hypochaeris achyrophorus*; Bue Marino, 02.V.2021, 2 ♀♀, from the nest, and 1 ♂ on *Helichrysum panormitanum* Tineo subsp. *panormitanus* (Asteraceae).

Distribution: southern Europe (Corsica, and Italy).

Remark: new record for Favignana, and Egadi's Archipelago.

Bio-ecological aspects: males sleeping aggregations were observed at Calazza (Favignana), at 6.00 p.m., on the flowers of

Pallenis maritima (Fig. 3); in some cases up to two males slept on the same flower.



Figure 3. Males sleeping aggregations of *Panurgus siculus* on *Pallenis maritima* flowers, Calazza (Favignana), 30.IV.2021.

Table 3. Comparison of the diversity of bee species in Sicilian and other western Mediterranean archipelagos; (*): distance from Sicily; (**): distance from Africa.

Archipelagos	Total species	Total area (km ²)	Distance from the mainland (km)	Maximum altitude (m a.s.l.)	References
Egadi (Sicily)	40	37.45	8*	686	This work
Favignana	35	19.5	8	302	
Levanzo	2	5.6	13	278	
Marettimo	9	12.3	35	686	
Pelagie (Sicily)	41	25.48	113**	195	Pagliano and Scaramozzino 1995
Lampedusa	41	20.2	113	133	
Linosa	2	5.43	160	195	
Pantelleria (Sicily)	11	84.53	65**	836	Pagliano and Scaramozzino 1995
Eolie (Sicily)	70	114.7	20*	962	Turrisi et al. 2020
Alicudi	3	5.10	53	675	

Archipelagos	Total species	Total area (km ²)	Distance from the mainland (km)	Maximum altitude (m a.s.l.)	References
Filicudi	3	9.49	45	773	
Lipari	27	37.29	27.5	602	
Panarea	9	3.34	42	421	
Salina	3	26.38	38	962	
Stromboli	3	12.19	55	926	
Vulcano	40	20.87	20	499	
Tuscan Archipelago	96	295	10	1019	Generani et al. 2001
Maltese Islands	104	316	80*	258	Balzan et al. 2016, 2017
Balearic Islands	176	4992	85	1445	Baldock 2014

HALICTIDAE

Gen. *Halictus* Latreille, 1804

Halictus (Halictus) fulvipes (Klug, 1817)

Data from literature: Favignana (Comba 2019).

Distribution: southern Europe (Portugal, Spain, France, Italy, and Croatia), and northern Africa (Morocco, Algeria, and Tunisia).

Gen. *Lasioglossum* Curtis, 1833

Lasioglossum (Dialictus) nitidulum aeneidorsum (Alfken, 1921)

Data from literature: Favignana (Comba 2019).

Examined material: Favignana. Bue Marino, 02.V.2021, 1 ♀.

Distribution: widespread in Europe.

Lasioglossum (Hemihalictus) parvulum (Schenck, 1853)

Examined material: Marettimo. Praia di Pigna, 29.IV.2021, 6 ♀♀ and 1 ♂, on *Cistus creticus* L. (Cistaceae), *Hypochaeris achyrophorus* L. (Asteraceae), and *Glandora rosmarinifolia*

Catania et al., 2022

(Ten.) D.C. Thomas (Boraginaceae); Favignana. Cala Grande, 01.V.2021, 1 ♀; Bue Marino, 02.V.2021, 4 ♀♀ from the nest, and 2 ♂♂ on *Helichrysum panormitanum* and *Convolvulus lineatus* (Convolvulaceae).

Distribution: widespread in Europe, and western Asia (Turkey).

Remark: new record for Favignana, Marettimo, and Egadi's Archipelago.

Lasioglossum (Sphecodogastra) malachurum (Kirby, 1802)

Examined material: Favignana. Calazza, 01.V.2021, 1 ♀, on *Scolymus hispanicus* L. (Asteraceae); Calamoni Beach, 01.V.2021, 1 ♀, on *Hypochaeris achyrophorus* (Asteraceae).

Distribution: widespread in Europe, northern Africa (Morocco, Algeria, Tunisia, and Egypt), and widespread in western Asia.

Remark: new record for Favignana, and Egadi's Archipelago.

MEGACHILIDAE

Gen. *Osmia* Panzer, 1806

Osmia (Helicosmia) alfkenii Ducke, 1899

Examined material: Favignana. Cala Grande, 30.IV.2021, 1 ♀.

Distribution: southern Europe (Sardinia), northern Africa (Morocco, Algeria, Tunisia, and Egypt), and western Asia (Israel, and Jordan).

Remarks: *Osmia alfkenii* (= *O. niveibarbis* Pérez, 1902) (Müller 2022), is reported for Sardinia and Sicily by Comba (2019), who cites Zanden (1989), Pagliano (1994), and Kuhlmann et al. (2018). However, Zanden (1989) reports this species for Sardinia and Algeria, Pagliano (1994) reports it for Sardinia, Algeria, Tunisia, Israel and Jordan, and Kuhlmann et al. (2018) reports it for Sardinia, Italian peninsula, North Africa (except Libya), Israel and Jordan. None of these authors cite *O. alfkenii* for Sicily, and also Müller (2022) does not report the species for the Island. Therefore, the citation of Comba (2019) for Sicily is to be considered incorrect and is to be referred to Italian peninsula.

This is the first report for Egadi's Archipelago, and Sicily.

Osmia (Helicosmia) aurulenta (Panzer, 1799)

Examined material: Favignana. Calazza, 01.V.2021, 1 ♀, on *Visnaga daucooides*; Castello di Santa Caterina, 01.V.2021, 1 ♀, on *Echium vulgare* L. (Boraginaceae); Bue Marino, 02.V.2021, 1 ♀, on *Bituminaria bituminosa*.

Distribution: widespread in Europe, and western Asia (Turkey, Georgia, Armenia, Azerbaijan, and Lebanon).

Remarks: new record for Favignana, and Egadi's Archipelago.

Osmia (Helicosmia) latreillei iberofafricana Peters, 1975

Examined material: Marettimo. Contrada Pelosa, 28.IV.2021, 5 ♀♀, on *Calendula officinalis* L. and *Hypochaeris achyrophorus* (Asteraceae).

Distribution: southern Europe (Portugal, Spain, Corsica, Sardinia, Sicily, and Malta), northern

Africa, and western Asia (Turkey, Cyprus, Israel, and Jordan).

Remarks: new record for Marettimo, and Egadi's Archipelago.

Osmia (Helicosmia) notata (Fabricius, 1804)

Examined material: Favignana. Bue Marino, 02.V.2021, 1 ♀.

Distribution: southern Europe (Portugal, Spain, Corsica, Italy, and Malta), northern Africa, and western Asia (Israel).

Remarks: new record for Favignana, and Egadi's Archipelago.

Osmia (Osmia) kohli Ducke, 1900

Examined material: Marettimo. Contrada Pelosa, 28.IV.2021, 1 ♀, on *Bituminaria bituminosa*; Favignana. Cala Grande, 30.IV.2021, 1 ♀, on *Papaver rhoeas* L (Papaveraceae).

Distribution: southern Europe (Italy, and Malta), and northern Africa (Algeria).

Remarks: new record for Favignana, Marettimo, and Egadi's Archipelago.

Gen. *Protosmia* Ducke, 1900

Protosmia (Protosmia) exenterata (Pérez, 1895)

Examined material: Favignana. Castello di Santa Caterina, 01.V.2021, 1 ♀, on *Crepis* sp. (Asteraceae).

Distribution: southern Europe (Portugal, Spain, and Sicily), and northern Africa (Morocco, Algeria, and Tunisia).

Remarks: new record for Favignana, and Egadi's Archipelago.

Gen. *Rhodanthidium* Isensee, 1927

Rhodanthidium (Rhodanthidium) acuminatum (Mocsáry, 1884)

Data from literature: Levanzo (Comba 2019; Kasperek 2019).

Distribution: southern Europe (Italy, and Greece), northern Africa (Morocco), and western Asia (Turkey).

Rhodanthidium (*Rhodanthidium*) *septemdentatum* (Latreille, 1809)

Examined material: Marettimo. Contrada Pelosa, 28.IV.2021, 1 ♀, on *Hypochaeris achyrophorus* (Asteraceae).

Distribution: southern Europe, and western Asia (Turkey, Georgia, Armenia, and Azerbaijan).

Remarks: new record for Marettimo, and Egadi's Archipelago.

Rhodanthidium (*Rhodanthidium*) *siculum* (Spinola, 1838)

Data from literature: Favignana (Comba 2019).

Examined material: Favignana. Cala Grande, 30.IV.2021, 2 ♂♂; Calazza, 01.V.2021, 1 ♂; Castello di Santa Caterina, 01.V.2021, 1 ♂, on *Teucrium fruticans* (Lamiaceae).

Distribution: southern Europe (Portugal, Spain, France, and Italy), and northern Africa (Morocco, Algeria, Tunisia, and Libya).

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

Data from literature: Favignana (Comba 2019).

Distribution: southern Europe, and northern Africa (Morocco, Algeria, Tunisia, and Libya).

Gen. *Coelioxys* Latreille, 1809

Coelioxys (*Allocoelioxys*) *acanthura* (Illiger, 1806)

Data from literature: Favignana (Comba 2019).

Distribution: southern Europe, northern Africa (Morocco, and Algeria), and western Asia (Turkey, Cyprus, and Israel).

Coelioxys (*Allocoelioxys*) *echinata* Foerster, 1853

Data from literature: Favignana (Comba 2019).

Distribution: widespread in Europe, northern Africa (Morocco, and Algeria), and western Asia (Turkey, Georgia, Armenia, and Azerbaijan).

Coelioxys (*Mesocoelioxys*) *argentea* Lapeletier, 1841

Data from literature: Favignana (Comba 2019).

Distribution: southern Europe, northern Africa (Morocco, Algeria, and Tunisia), and western Asia (Turkey, Cyprus, Georgia, Armenia, Azerbaijan, Israel, and Jordan).

Gen. *Megachile* Latreille, 1802

Megachile (*Eutricharaea*) *pilidens* Alfken, 1923

Data from literature: Favignana (Comba 2019).

Distribution: widespread in Europe, northern Africa (Egypt), western Asia (Turkey, Georgia, Armenia, and Azerbaijan).

Megachile (*Chalicodoma*) *sicula sicula* (Rossi, 1792)

Examined material: Favignana. Castello di Santa Caterina, 01.V.2021, 1 ♀.

Distribution: Italy.

Remarks: new record for Favignana, and Egadi's Archipelago.

APIDAE

Gen. *Xylocopa* Latreille, 1802

Xylocopa (*Xylocopa*) *violacea* (Linnaeus, 1758)

Examined material: Marettimo. Contrada Pelosa, 29.IV.2021, 1 ♀.

Distribution: widespread in Europe, northern Africa (Morocco, Algeria, and Tunisia), and western Asia (Turkey, Georgia, Armenia, and Azerbaijan).

Remarks: new record for Marettimo, and Egadi's Archipelago.

Gen. *Nomada* Scopoli, 1770

Nomada sicula Schwarz, 1974

Data from literature: Favignana (Nobile 1990; Smit 2018).

Examined material: Favignana. Calazza, 01.V.2021, 4 ♂♂, on *Visnaga daucoides* (Apiaceae), *Glebionis coronaria*, and *Pallenis maritima* (Asteraceae); Bue Marino, 02.V.2021, 3 ♀♀, on *Helichrysum panormitanum* subsp. *panormitanus*, and from *Panurgus siculus* and *Lasioglossum parvulum* nests.

Distribution: Sicily.

Bio-ecological aspects: *Nomada* species in Italy were studied by different authors, and to date, 117 species (these numbers should be revised) and some endemic taxa have been reported for Italian fauna (Comba 2019), although new species for Italian fauna or different new regional reports are still reported (Nobile et al. 2021). However, knowledge about the relationship between parasite and host is still fragmented, and for many cleptoparasitic bees, the host species are still unknown. Amongst European *Nomada* (more than 200 species), only 59 host-parasite relationships are confirmed, 116 hosts are unknown, and we can only suggest a possible host for some species (Smit 2018).

Nomada sicula, belonging to the *Nomada fuscicornis*-group, is a small (4-5 mm) cleptoparasitic bee present in Sicily and Favignana Islands (Schwarz, 1974, Smit 2018), which flies during the month of May. Nobile (1990) in his contribution of Sicilian *Nomada*, reported this species for the island specifying the interesting characteristic of being one of the few species of Palaearctic *Nomada* to possess only two cubital cells rather than three.

During our observations in Favignana, we found specimens with two and three cubital cells respectively, and some specimens with the

second submarginal crossvein partially developed (Fig. 4). Females of *N. sicula* were found exiting the nests of *Panurgus siculus* (Andrenidae) and *Lasioglossum parvulum* (Halictidae) at Bue Marino (Favignana), reporting for the first time the host of this species. Specimens of *N. sicula* were also found at Calazza (Favignana), where there were several nests of *P. siculus*. This endemic cleptoparasitic bee was also observed on the flowers of *Visnaga daucoides* (Apiaceae), *Glebionis coronaria*, *Helichrysum panormitanum* subsp. *panormitanus*, and *Pallenis maritima* (Asteraceae).

Gen. *Eucera* Scopoli, 1770

Eucera (Hetereucera) oraniensis Lepelletier, 1841

Examined material: Favignana. Cala Grande, 30.IV.2021, 1 ♀, on *Crepis* sp.; Calazza, 01.V.2021, 4 ♀♀, on *Galactites tomentosus* Moench, and *Glebionis coronaria* (Asteraceae); Castello di Santa Caterina, 01.V.2021, 1 ♀, on *Rapistrum rugosum*.

Distribution: southern Europe (Portugal, Spain, France, and Italy), and northern Africa.

Remarks: new record for Favignana, and Egadi's Archipelago.

Eucera (Synhalonia) rufa Lepelletier, 1841

Examined material: Favignana. Calamoni Beach, 02.V.2021, 2 ♂♂ and 3 ♀♀, on *Bituminaria bituminosa*.

Distribution: southern Europe, northern Africa, and western Asia (Turkey, Israel, and Jordan).

Remarks: new record for Favignana, and Egadi's Archipelago.

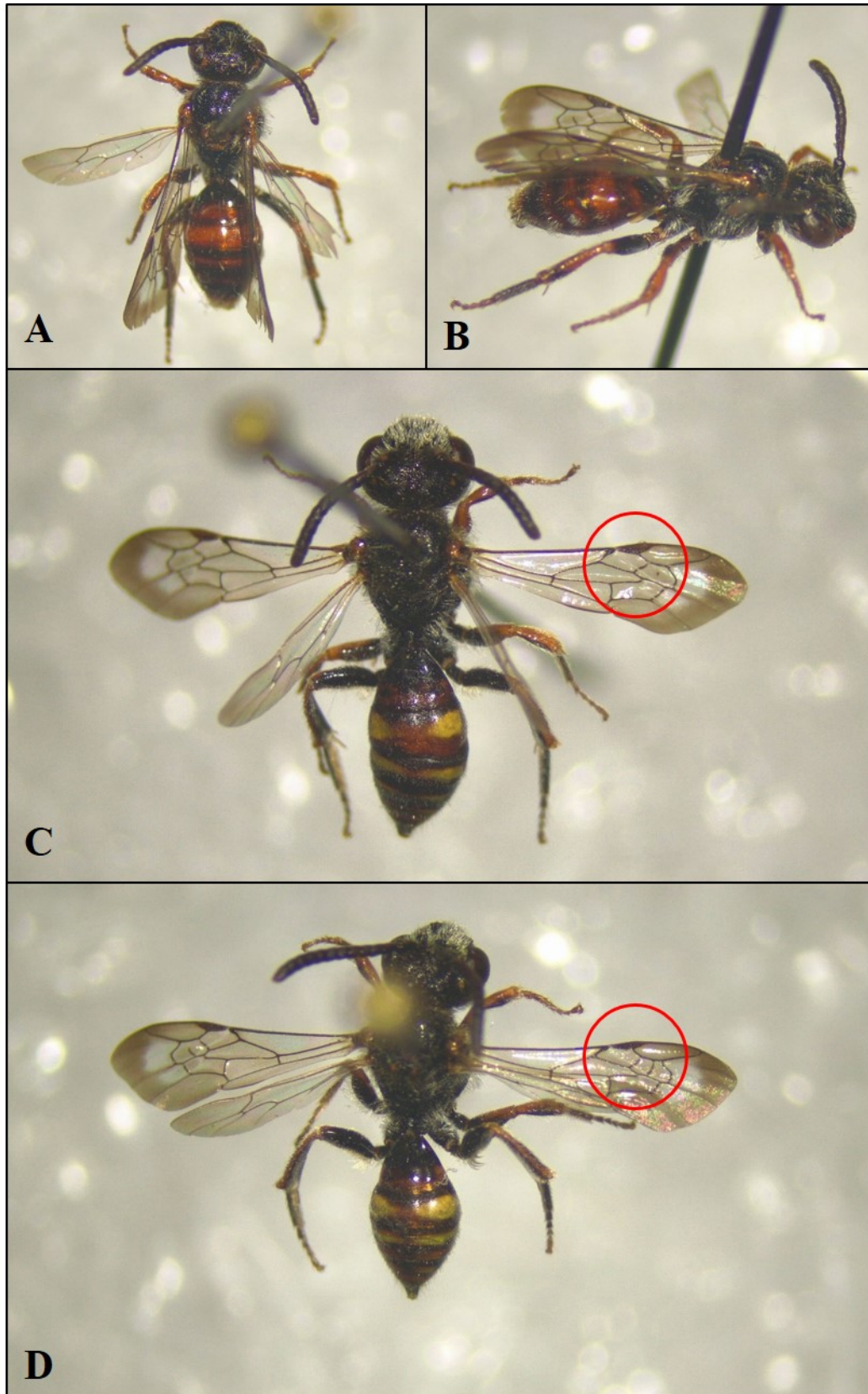


Figure 4. *Nomada sicula* collected in Favignana island (A-D). A-B: female specimens; C-D: males, specimen with two cubital cells (C) and with three cubital cells (D); B-D: specimens with a single wing in which the second submarginal crossvein is partially developed.

Gen. *Amegilla* Friese, 1897

Amegilla (Amegilla) quadrifasciata (de Villers, 1789)

Data from literature: Favignana (Comba 2019).

Distribution: widespread in Europe, northern Africa, and western Asia (Turkey, Georgia, Armenia, Azerbaijan, and Israel).

Gen. *Anthophora* Latreille, 1803

Anthophora (Anthophora) crinipes Smith, 1854

Examined material: Favignana. Cala Grande, 01.V.2021, 1 ♀, on *Papaver rhoeas* L. (Papaveraceae); Bue Marino, 02.V.2021, 2 ♂♂.

Distribution: widespread in Europe, northern Africa (Morocco), and western Asia (Turkey, and Israel).

Remarks: new record for Favignana, and Egadi's Archipelago.

Anthophora (Pyganthophora) pruinosa Smith, 1854

Data from literature: Marettimo (Nobile 1991).

Examined material: Marettimo. Contrada Pelosa, near the town, 28.IV.2021, 1 ♀, on *Hirschfeldia incana* (L.) Lagr.-Foss. (Brassicaceae); Contrada Pelosa, 29.IV.2021, 1 ♀, on *Hirschfeldia incana*.

Distribution: Sicily, and Malta.

Gen. *Bombus* Latreille, 1802

Bombus (Bombus) terrestris (Linnaeus, 1758)

Examined material: Marettimo. Spiaggia de Rotolo, 27.IV.2021, 1 ♀, on *Glebionis coronaria* (Asteraceae); Contrada Pelosa, 28.IV.2021, 1 ♀, 1 ♂, 1 worker, on *Hypochaeris achyrophorus* (Asteraceae), *Cistus creticus* (Cistaceae), *Ruta chalepensis* L. (Rutaceae); Case Romane, 28.IV.2021, 1 worker, on *Cistus creticus* (Cistaceae).

Distribution: widespread in Europe, northern Africa (Morocco, Algeria, Tunisia, and Libya), and western Asia.

Remarks: new record for Marettimo, and Egadi's Archipelago.

Gen. *Apis* Linnaeus, 1758

Apis mellifera (Linnaeus, 1758)

Distribution: cosmopolitan.

Remarks: this species is present in the main islands of the archipelago, linked to the activity of beekeeping.

CONCLUSIONS

The present work records 27 species of wild bees new to Egadi's Archipelago (Favignana, and Marettimo), increasing the total number of known species to 40. Of the 13 bee species previously known to these Islands, only five have been confirmed.

These species belong to families Colletidae (genus *Hylaeus*), Andrenidae (gen. *Andrena*, and *Panurgus*), Halictidae (gen. *Halictus*, and *Lasioglossum*), Megachilidae (gen. *Osmia*, *Protosmia*, *Rhodanthidium*, *Coelioxys*, and *Megachile*), and Apidae (gen. *Xylocopa*, *Nomada*, *Eucera*, *Amegilla*, *Anthophora*, *Bombus*, and *Apis*). The families Colletidae and Andrenidae are recorded for the first time from Egadi's Archipelago, with 3 and 9 taxa respectively. *Hylaeus*, *Andrena*, *Panurgus*, *Osmia*, *Protosmia*, *Lasioglossum*, *Xylocopa*, *Eucera*, and *Bombus* genera are new from Egadi's Archipelago.

Overall, the number of bee species present in the three islands is divided as follows: Favignana 35 species, Levanzo 2 species, and Marettimo 9 species (Table 1).

Amongst the species recorded in our surveys in 2021, *Hylaeus duckei* (Colletidae) and *Osmia alfkenii* (Megachilidae), are not yet mentioned for Sicily, and these are therefore the first citations for the Sicilian fauna.

Andrena nigroaenea nigrosericea, *A. rhypara*, *A. rugothorace*, *Osmia alfkenii*, *O. latreillei iberofricana*, *Protosmia exenterata*, *Rhodanthidium acuminatum*, *R. siculum*, *R. sticticum*, *Nomada sicula* and *Anthophora pruinosa* are not known for continental Italy (Table 2), although *Andrena nigroaenea* and *O. latreillei* are reported for the Italian peninsula with their nominate subspecies.

Andrena agilissima italica, *A. nigroaenea nigrosericea*, *A. rugothorace*, *A. rhypara*, *Panurgus siculus*, *Osmia alfkenii*, *O. kohli*, *O. latreillei iberofricana*, *Rhodanthidium acuminatum*, *Megachile sicula sicula*, *Nomada sicula* and *Anthophora pruinosa* are Mediterranean endemic taxa.

The lowest number of species for Egadi Archipelago are reported in Table 3, probably mainly related to the low number of studies conducted in these islands, and we therefore believe that more investigations are required to increase our knowledge of the Egadi's bee fauna.

Panurgus siculus (Andrenidae) and *Lasioglossum parvulum* (Halictidae) are reported for the first time as host species of the endemic parasitic *Nomada sicula*, thus increasing our knowledge on its bioecology.

The data obtained with the present analysis are the first to be able to evaluate the faunistic diversity of the Apoidea in the different islands of Egadi's Archipelago and continues as part of the authors' research project in order to enrich their knowledge in the Mediterranean context (Bella et al. 2020; Catania et al. 2021; Nobile et al. 2021; Turrise et al. 2021; Las Casas et al. 2022). These results already highlight the importance of their populations, and this is also important for their activity as pollinators in an archipelago rich in endemic botanical species.

REFERENCES

Baldock, D. (2014) A provisional list of the wasps and bees of Mallorca, Balearic Islands, Spain (Hymenoptera aculeata: Chrysoidea, Chrysidoidea,

Scolioidea, Vespoidea, Apoidea). *Entomofauna*, 35, 16, 333-404.

Balzan, M.V., Rasmont, P., Kuhlmann, M., Dathe, H.H., Pauly, A., Patiny, S., Terzo, M., & Michez, D. (2016) The bees (Hymenoptera: Apoidea) of the Maltese Islands. *Zootaxa*, 4162 (2), 225-244. DOI: 10.11646/zootaxa.4162.2.2.

Balzan, M.V., Genoud, D., Rasmont, P., Schwarz, M., & Michez, D. (2017) New records of bees (Hymenoptera: Apoidea) from the Maltese Islands. *Journal of Melittology*, 72, 1-9.

Bella, S., Catania, R., Nobile, V., & Mazzeo, G. (2020) New or little known bees (Hymenoptera, Apoidea) from Sicily. *Fragmenta entomologica*, 52 (1), 113-117. DOI: 10.4081/FE.2020.418.

Blondel, J., Aronson, J., Bodiou, J.-Y., & Boeuf, G. (2010) *The Mediterranean region: biological diversity in space and time*. Oxford University Press, 2nd edn, 392 pp.

Catania, R., Nobile, V., & Bella, S. (2021) The species of *Eucera* Scopoli, subgenus *Tetralonia* Spinola from Sardinia (Italy) with new records and *E. gennargentui* sp. nov. (Hymenoptera, Apidae). *Journal of Hymenoptera Research*, 88, 1-16. DOI: 10.3897/jhr.88.70819.

Comba, M. (2019) Hymenoptera: Apoidea: Anthophila of Italy. Available from: <http://digilander.libero.it/mario.comba> [accessed 10 November, 2021].

Ebmer, A.W. (1969) Die Bienen des Genus *Halictus* Latr. s.l. im Großraum von Linz. (Hymenoptera, Apidae). Teil I. *Naturkundliches Jahrbuch der Stadt Linz*, 15, 133-184.

Ebmer, A.W. (1970) Die Bienen des Genus *Halictus* Latr. s.l. im Großraum von Linz. Teil II. (Hymenoptera, Apidae). *Naturkundliches Jahrbuch der Stadt Linz*, 16, 19-82.

Francini, E., & Messeri, A. (1956) L'isola di Marettimo nell'Arcipelago delle Egadi e la sua vegetazione. *Webbia*, 11, 607-846.

Generani M., Pagliano G., Scaramozzino P., & Strumia F. (2001) Gli Imenotteri delle Isole di Capraia, Giglio, Gorgona, Pianosa e Montecristo (Arcipelago Toscano) (Insecta: Hymenoptera). *Frustula Entomologica*, 24 (37), 51-74.

- Gianguzzi, L., Scuderi, L., & Pasta, S. (2006) La flora vascolare dell'isola di Marettimo (Arcipelago delle Egadi, Sicilia occidentale): aggiornamento e analisi fitogeografica. *Webbia*, 61 (2), 359-402.
- Las Casas, G., Ciaccia, C., Iovino, V., Ferlito, F., Torrisi, B., Lodolini, E.M., Giuffrida, A., Catania, R., Nicolosi, E., & Bella, S. (2022) Effects of different inter-row soil management and intra-row living mulch on spontaneous flora, beneficial insects and growth of young olive trees in Southern Italy. *Plants*, 11, 545. DOI: 10.3390/plants11040545.
- Kasperek, M. (2019) Bees in the Genus *Rhodanthidium*: A Review and Identification Guide. *Entomofauna*, Supplement 24, 132 pp.
- Kuhlmann, M., Ascher, J.S., Dathe, et al. (2018) Checklist of the Western Palearctic Bees (Hymenoptera: Apoidea: Anthophila). Available from: <http://westpalbees.my-species.info> [accessed 10 November, 2021].
- Michener, C.D. (2007) The bees of the world. Second edition. John Hopkins University Press; Baltimore, Maryland, 953 pp., + 20 pls.
- Müller, A. (2022) Palearctic Osmiine Bees, ETH Zürich, <http://blogs.ethz.ch/osmiini>.
- Muscarella, C., & Baragona, A. (2017) The endemic fauna of the sicilian islands. *Biodiversity Journal*, 8 (1), 249-278.
- Nobile, V. (1990) Contributo alla conoscenza delle Api parassite (Insecta, Hymenoptera) di Sicilia. II. Il genere *Nomada* Scopoli 1770, con descrizione di una nuova specie. *Animalia*, 17, 219-243.
- Nobile, V. 1991. Contributo alla conoscenza delle Api Solitarie (Insecta, Hymenoptera) di Sicilia. IV. La tribù Anthophorini Dahlbom, 1835. *Animalia*, 18, 237-259.
- Nobile, V., Catania, R., Niolu, P., Pusceddu, M., Satta, A., Floris, I., Flaminio, S., Bella, S., & Quaranta, M. (2021) Twenty new records of bees (Hymenoptera, Apoidea) from Sardinia (Italy). *Insects*, 12, e627. DOI: 10.3390/insects12070627.
- Pagliano, G. (1994) Catalogo degli Imenotteri Italiani. IV. (Apoidea: Colletidae, Andrenidae, Megachilidae, Anthophoridae, Apidae). *Memorie della Società Entomologica Italiana*, 72, 331-467.
- Pagliano, G., & Scaramozzino, P.L. (1995) Hymenoptera Gasteruptionidae, Ichneumonidae e Aculeata (esclusi Chrysidoidea, Mutillidae e Formicidae). In: Massa B. (ed.), *Arthropoda di Lampedusa, Linosa e Pantelleria (Canale di Sicilia, Mar Mediterraneo)*. Il Naturalista siciliano, 19 (suppl.), 723-738.
- Pasta, S., Sciberras, A., Sciberras, J., & Scuderi, L. (2014) Analysis of the vascular flora of four satellite islets of the Egadi Archipelago (W Sicily), with some notes on their vegetation and fauna. *Biodiversity Journal*, 5 (1), 39-54.
- Polaszek, A. (2013) Fauna Europaea: Apidae. In: Mitroiu M.-D. et al. 2013. Fauna Europaea: Hymenoptera – Apocryta. Fauna Europaea version 2.6. Available from: <http://www.fauna-eu.org> [accessed 09 November, 2021].
- Rasmont, P., & Haubruge, E. (2015) Atlas Hymenoptera. Université de Mons, Gembloux Agro Bio Tech, Mons, Gembloux, Belgium. Available from: <http://www.atlashymenoptera.net> [accessed 10 November, 2021].
- Romano, S., Tobia, G., & Gianguzzi, L. (2006) Rassegna della flora vascolare dell'Isola di Levanzo (Arcipelago delle Egadi, Canale di Sicilia). *Informatore botanico italiano*, 38, 481-502.
- Scheuchl, E. (2000) *Illustrierte Bestimmungstabellen der Wildbienen Deutschlands und Österreichs*. Band I: Anthophoridae. 2. Erweiterte Auflage; Eigenverlag: Berlin, Germany, pp. 158.
- Scheuchl, E. (2006) *Illustrierte Bestimmungstabellen der Wildbienen Deutschlands und Österreichs für Osmia s.l. unter Berücksichtigung der Arten der Schweiz, Norditaliens, Ungarns, Sloweniens und der Slowakei*. Band II, Schlüssel der Arten der Familien Megachilidae und Melittidae, 2nd ed.; Apollo books: Tsim Sha Tsui, Japan, pp. 192.
- Schmid-Egger, C., & Scheuchl, E. (1997) *Illustrierte Bestimmungstabellen der Wildbienen Deutschlands und Österreichs unter Berücksichtigung der Arten der Schweiz*. Band III; Andrenidae: Eigenverlag, Velden, 180 Seiten.

- Schwarz, M. (1974) Zwei neue Arten aus der Gruppe der *Nomada fuscicornis* Nyl., und die Beschreibung des noch unbekanntes Männchens der *Nomada rufoabdominalis* Schwarz. (Hymenoptera, Apidae). *Polskie Pismo Entomologiczne*, 44, 257-266.
- Scuderi, L. (2008) Nuovo contributo alla Flora vascolare di Marettimo (Isole Egadi, Sicilia Occidentale). *Naturalista siciliano*, 32 (3-4), 484-485.
- Smit, J. (2018) Identification key to the European species of the bee genus *Nomada* Scopoli 1770 (Hymenoptera: Apidae), including 23 new species. *Entomofauna, Monographie*, 3, 250 pp.
- Turrisi, G.F., Altadonna, G., Lo Cascio, P., Nobile, V., & Selis, M. (2020) Contribution to the knowledge of Hymenoptera from the Aeolian Archipelago (Sicily), emphasizing Aculeata. *Biodiversity Journal*, 11 (3), 717-750. DOI: 10.31396/Biodiv.Jour.2020.11.3.717.750.
- Turrisi, G.F., Bella, S., Catania, R., La Greca, P., Nobile, V., & D'urso, V. (2021) Bee diversity in fragmented areas of Volcano Etna (Sicily, Italy) at different degrees of anthropic disturbance (Hymenoptera: Apoidea, Anthophila). *Journal of Entomological and Acarological Research*, 53 (2), 10362. DOI: 10.4081/jear.2021.10326.
- Zanden, G. van der (1989) Neue oder wenig bekannte Arten und Unterarten der palaearktischen Megachiliden (Insecta, Hymenoptera, Apoidea: Megachilidae). *Entomologische Abhandlungen Staatliches Museum für Tierkunde Dresden*, 53, 71-86.

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