



SHORT NOTE

The recent spread of the carpenter bee *Xylocopa pubescens* (Hymenoptera, Apidae) in Europe and the first record for the Aegean Archipelago

ROBERTO CATANIA

Dipartimento di Agricoltura, Alimentazione e Ambiente, sez. Entomologia applicata. Università degli Studi di Catania, Catania, Italy

Article History

Edited by

Evandro Nascimento Silva, UEFS, Brazil
 Received 17 October 2022
 Initial Acceptance 13 January 2023
 Final Acceptance 16 January 2023
 Publication date 05 June 2023

Keywords

Aegean Archipelago, Alien bees, Citizen Science, Santorini, *Xylocopa pubescens*.

Corresponding author

Roberto Catania
 Dipartimento di Agricoltura,
 Alimentazione e Ambiente, sez.
 Entomologia Applicata.
 Università degli Studi di Catania,
 Catania - Italy.
 E-Mail: roberto.catania@phd.unict.it

Abstract

The African species *Xylocopa pubescens* Spinola (Hymenoptera, Apidae) has recently stabilized in some European countries such as Cyprus, Greece, and Spain. Wood transportation and climate change are the main hypotheses for the spread of this non-native bee in Europe. I present the first record in the literature from Santorini and the Aegean Archipelago, confirming the Citizen Science data from different websites. The presence and the spread of this species in Europe are discussed.

Genus *Xylocopa* Latreille (Apidae) includes large-sized bees (13-30 mm), commonly known as carpenter bees, due to their nesting habits mainly in trees, logs, and woody materials. This genus includes more than 460 described species in the world, with a high level of diversity in tropical and subtropical areas (Michener, 2007).

Xylocopa pubescens Spinola, 1838 is the only species present in the West-Palaearctic belonging to the subgenus *Koptortosoma* Gribodo, which is reported by some authors as native to West Asia and North Africa. However, molecular studies have placed this species in an 'Ethiopian clade' (Leys et al., 2000, 2002). Considered in the past as a synonym of the Southeast Asian species *X. (Koptortosoma) aestuans* (Linnaeus, 1758), the taxonomic position of *X. pubescens* has been clarified by Lieftinck (1964), who has highlighted the morphological differences between the two species.

It is a multivoltine species that usually produces relatively short tunnels with 1-3 cells (Gerling et al., 1983) in shady sites or inside structures (Gerling et al., 1989). This species

is characterized by its great resilience to high temperatures, enabling it to withstand and remain active in temperatures above 40 °C (Gerling et al., 1989), thus resulting as an effective pollinator in greenhouses (Sadeh et al., 2007).

Recently, *X. pubescens* has become established in Greece and Cyprus (Rasmont et al., 2017), reported for Cyprus in 2006 (Grace, 2010; Varnava et al., 2020), and for mainland Greece in 2012 (Terzo & Rasmont, 2014), resulting in the first reports in Europe since a dubious one from Croatia by Friese (1901). It was later reported in southern Spain in 2016 (Ortiz-Sánchez & Pauly, 2016) and in the Canary Islands in 2020 (Ruiz et al., 2020; Dionisio et al., 2020), and during this time, *X. pubescens* has spread to the south coast of Turkey (Rasmont et al., 2017). Furthermore, *X. pubescens* was recently found in an urban garden in the town of Ronchin in northern France (Le Divelec et al., 2022). The main hypotheses of this rapid spread in the last ten years might be correlated to: 1) wood transportation by cargo ships via the sea routes connecting southern Europe to northern Africa and western Asia (Ruiz et



al., 2020); II) climate change leading to warmer winters and summers, favoring the spread of some heat-adapted carpenter bees (Ghisbain et al., 2021). The first hypothesis would better explain its arrival in the Canary Islands. However, Ruiz et al. (2020) still consider the possibility that *X. pubescens* arrived by its own means, exploiting winds from Morocco. This species, well adapted to high temperatures and xeric conditions, will continue its expansion in Europe.

This paper reports for the first time the presence of *X. pubescens* in the Aegean Archipelago, specifically on the island of Santorini, which confirms the presence of this species following observations from Global Biodiversity Information Facility including observations from Citizen Science websites such as iNaturalist.org and Observation.org (GBIF, 2022). In addition, the presence and recent spread of this non-native species in Europe are discussed.

A single male specimen of *X. pubescens* was collected by the author in Santorini in August 2022, in the village of Perissa (36.355571, 25.474878) (Fig 1). Given below are Citizen Science data regarding some countries or areas in Europe for which, to date, there were no reports concerning the presence of *X. pubescens*. Table 1 shows the spread of this species in European countries, while Figure 2 highlights the growing number of observations from GBIF data from 2008 to 2022. During July and August, most observations were made by Citizen Science websites (Fig 3). The works of Lieftinck (1964) and Warncke (1982) were used to determine the specimen.

Material examined

GREECE. Aegean Archipelago: Santorini, Perissa, 22.VIII.2022, 1 ♂, G. Meleo and R. Catania leg. (Fig 1).

Remarks

There is a single datum from the island of Santorini on Observation.org regarding a female specimen on *Vitex agnus-castus* L. (Verbenaceae), photographed on 18.IX.2021 by Charel Quaezhaegens. The specimen examined in the present work confirms the presence of *X. pubescens* on the island of Santorini, and it is the first record in literature for the Aegean Islands.

Identification of the species

Lieftinck (1964) highlights the morphological differences between *X. pubescens* and the similar species *X. aestuans*, and these characters are shown in detail in Pauly (2016). In particular, the female of *X. pubescens* differs from that of *X. aestuans* for the absence of a longitudinal impunctate line at the center of the clypeus. The males exhibit a greater number of character that allow the identification of the species, first of all, *X. pubescens* has a simple base of the hind femora, while *X. aestuans* presents a visible tooth. The apical process of the hind tibia of *X. pubescens* is more developed than in *X. aestuans*. In addition, the male of *X. aestuans* has a

Xylocopa (Koptortosoma) pubescens Spinola, 1838

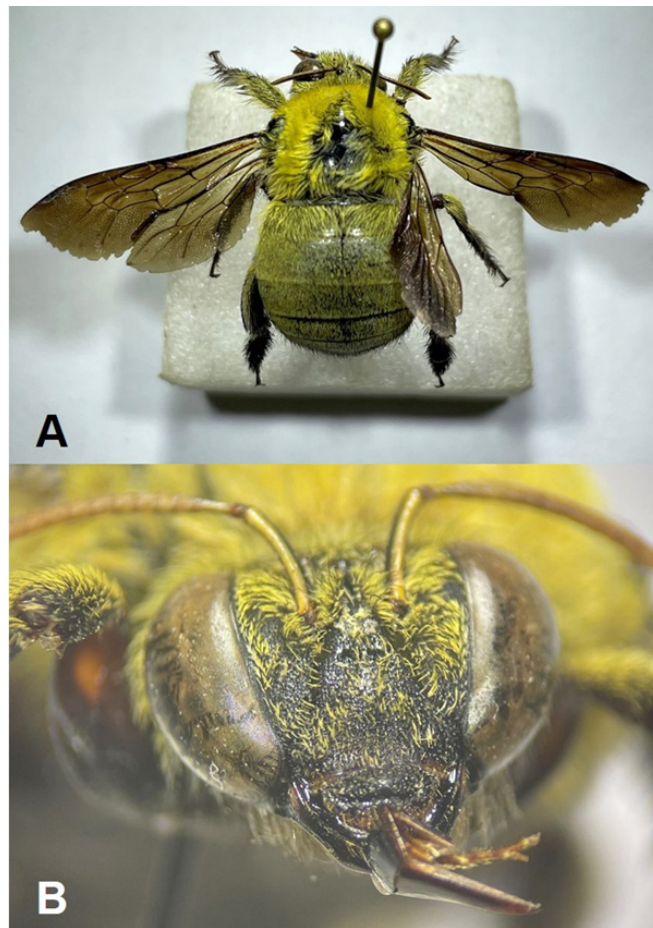


Fig 1 (A-B). Male specimen of *Xylocopa pubescens*, **A:** dorsal view; **B:** head, frontal view. Santorini, Perissa, 22.VIII.2022.

totally yellowish clypeus, while in *X. pubescens* the clypeus is totally black. Further differences can be observed in the male genital capsules.

Citizen Science data in countries or areas in Europe where the presence is not yet reported in the literature

AEGEAN ARCHIPELAGO: CRETE, Heraklion, 16.X.2010, 1 ♀ (iNaturalist.org), 1.VII.2021, 1 ♂ (Observation.org); Stavromeno, 13.VIII.2019, 1 ♀, 28.VIII.2022, 1 ♀; Chania, 14.IV.2020, 1 ♀, 11.VII.2021, 1 ♂ (iNaturalist.org). LESBOS, 13.IX.2021, 1 ♀ (iNaturalist.org). MILOS, Fenerbahce, 18.VII.2021, 1 ♀ (iNaturalist.org). SANTORINI, Exo Gyalos, 18.IX.2021, 1 ♀ (Observation.org). SIRO, Ermoupoli, 6.III.2022 1 ♂ (iNaturalist.org).

IBERIAN PENINSULA: GIBRALTAR, 16.I.2022, 1 ♀ (iNaturalist.org).

Dubious Citizen Science reports

Dubious reports from iNaturalist.org are reported for Croatia (Pag), and Italy (Liguria). Still, both reports present

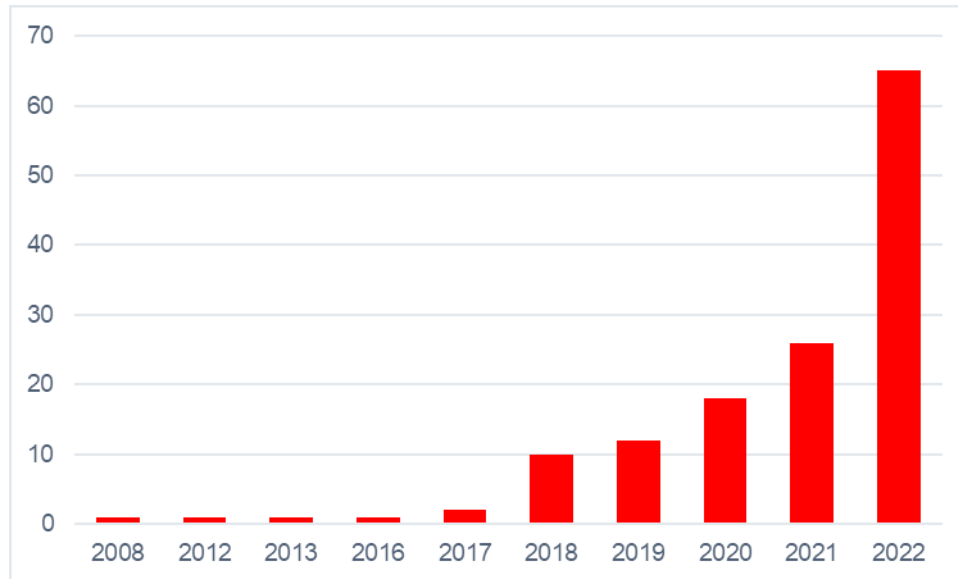


Fig 2. Number of observations per year, from 2008 to 2022, in European countries (Cyprus, Greece mainland and islands, Spain mainland and Canary Islands, and Gibraltar) from GBIF (n = 136).

unclear photographs with specimens presenting yellow pollen on their mesosoma (traces of pollen are also visible on the metasoma and wings), making them similar to *X. pubescens* females and incorrectly determined.

Final Remarks

The impact of a non-native bee species on the ecosystem can be considerable, ranging from effects on wild flora and on native bee populations to the spread of new pathogens in newly colonized areas (Catania et al., 2022). Citizen Science can be an important tool for the early detection of allochthonous species in certain areas (Thomas et al., 2017) and has previously been shown to be effective in reporting invasive bee species in Europe (Bortolotti et al., 2018; Ruzzier et al., 2020).

Xylocopa pubescens has a great dispersal ability, as evidenced by its rapid spread in Europe, which occurred mainly in the last decade. This species joins other alien bee species that recently arrived in Europe, including the megachilids *Megachile (Callomegachile) sculpturalis* (Smith, 1853) (Vereecken & Barbier, 2009), *M. (Callomegachile) disjunctiformis* Cockerell, 1911 (Bortolotti et al., 2018), and other carpenter bees of the genus *Xylocopa*, such as *X. (Rhysoxylocopa) amedaei* Lepeletier, 1841, a North African species found in southern Portugal (Rasmont et al., 2017), the North American *X. (Xylocopoides) virginica* (Linnaeus, 1771) repeatedly found in England (Falk & Lewington, 2015), and the African *X. (Mesotrichia) nigrita* (Fabricius, 1775) recorded by Vicidomini (2006) for Zakythos (Greece, Aegean archipelago) and from Cadiz (Spain). Vicidomini (2006) also recorded another alien carpenter bee on the island

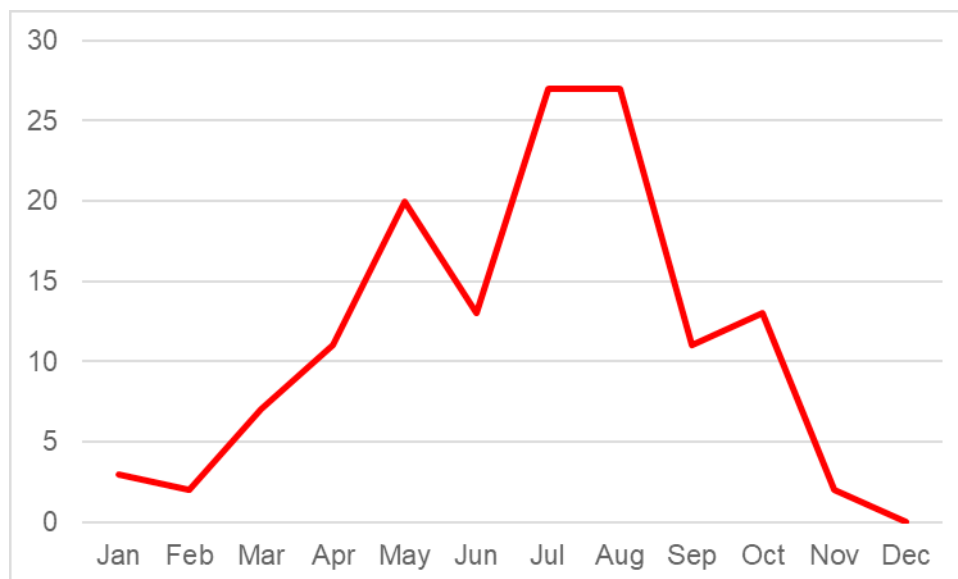


Fig 3. Observation per month of *X. pubescens* in European countries, data from GBIF.

Table 1. Presence in Europe of *Xylocopa pubescens*, country or area of finding, year of the first report, and references.

Country or area	Year of first report	References
Croatia	1901*	Friese (1901)
Cyprus	2006	Grace (2010), Rasmont et al (2017), Varnava et al (2020)
Greece (mainland)	2012	Terzo & Rasmont (2014)
Spain (mainland)	2016	Ortiz-Sánchez & Pauly (2016)
Aegean Archipelago	2018	iNaturalist (GBIF 2022)
Canary Islands	2020	Ruiz et al (2020), Dionisio et al (2020)
Gibraltar	2022	iNaturalist (GBIF 2022)
France	2022	Le Divelec et al (2022)

*The finding has not been confirmed to date, however there is a doubtful report of a female in August 2022 on iNaturalist.org on the island of Pag.

of Zakynthos, *X. (Koptortosoma) caffra* (Linnaeus, 1767), native to Sub-Saharan Africa, which has not been found again. Witt (2022) recently reported a female of *X. (Koptortosoma) aestuans* from Germany, near the Weser estuary, probably arrived by sea transport. However, it would appear to be a misidentification of a specimen not belonging to the subgenus *Koptortosoma*.

Due to their biology and nesting strategies, wood-nesting bees, such as carpenter bees, have a greater island dispersal ability than ground-nesting bees (Poulsen & Rasmussen, 2020). In the case of *X. pubescens*, this is exacerbated by the transportation of wood by sea and climate change, the latter seemingly favoring the spread of species adapted to high temperatures.

Further studies on *X. pubescens* would be needed to better understand the causes of its spread, to monitor it, and evaluate its impact on ecosystems, particularly on native bee populations.

Acknowledgments

I wish to thank Dr. Salvatore Bella (Catania, Italy) for motivating me to write this paper, reading the first draft and giving me valuable suggestions.

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