Journal *of* Melittology
Bee Biology, Ecology, Evolution, & Systematics
No. 157, 1–6 3 November 2026

A gynandromorph record of *Colletes hederae* (Hymenoptera: Colletidae)

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Abstract. Bees sometimes exhibit both male and female morphological features and these individuals are termed gynandromorphs. Here, I report and describe the first documented case of gynandromorphism in *Colletes hederae* Schmidt & Westrich (Hymenoptera: Colletidae), representing the third known case in this genus. The individual was collected on ivy (*Hedera helix* L.) flowers in Oxfordshire, UK, and appears to be a mosaic gynandromorph.

INTRODUCTION

Gynandromorphs are individuals possessing a combination of male and female morphological features. In bees, around 165 examples of gynandromorphy have been reported across six of the seven known bee families; the exception is Stenotritidae, the smallest family, which is restricted to Australia (Michez *et al.*, 2009; Barrett, 2021; Gorman & Best, 2025). Gynandromorphy appears generally biased towards Megachilidae and Apidae in the Northern Hemisphere, though this likely reflects historical sampling and research biases rather than an increased propensity for genetic aberrations in these families and regions (Michez *et al.*, 2009; Barrett, 2021).

Gynandromorphs have been categorised into three groups: (1) bilateral, evenly split down the middle, with the features of one sex on one side and those of the other sex on the other side; (2) transverse, an asymmetric split of male and female features; and (3) mosaic, an uneven mixture of male and female features throughout the individual (Michez *et al.*, 2009). Earlier works, including Dalla Torre & Friese (1899) and Wcislo *et al.* (2004), recognised a fourth category, frontal, in which male and female features differed between the front and rear of the individual. However, these are now generally regarded as belonging to the transverse category (Michez *et al.*, 2009). The causes of gynandromorphy are presumed to be genetic (Michez *et al.*, 2009), epigenetic (Sommaggio *et al.*, 2021), or associated with irregularities during fertilisation (Michez *et al.*, 2009; Spring *et al.*, 2015). The underlying cause likely varies among gynandromorph forms (Sommaggio *et al.*, 2021).

Here, I report and describe the third known case of gynandromorphy in the genus *Colletes* Latreille: a specimen of *C. hederae* Schmidt & Westrich (Hymenoptera: Colletidae) collected directly into a collection pot from ivy (*Hedera helix* L.) flowers in

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ISSN 2325-4467

Oxfordshire, UK. *Colletes hederae* is a recent natural coloniser of the UK, presumably arriving from mainland Europe, where it is native (Carreck *et al.*, 2023). It was first recorded in Dorset in 2001 (Else, 2001) and has since spread northwards through the UK (Falk & Lewington, 2016). It feeds mainly on ivy, though both sexes visit other flowers, and has a flight season from early August until November (Falk & Lewington, 2016).

This individual appears to be a mosaic of male and female features: the face is clearly split bilaterally, and, though the general appearance of the abdomen is female, one genital clasper partially protrudes from the tip of the abdomen on the right side, leading to this classification as a mosaic gynandromorph.

MATERIAL AND METHODS

I collected this specimen during incidental sampling in Wytham, Oxfordshire, UK (UK National Grid Reference: SP474091), on 16/ix/2025. It was basking on ivy (*Hedera helix*) and made no attempt to collect nectar or pollen. I made no further behavioural observations. It was identified to species using the taxonomic key in Falk & Lewington (2016). Here, I provide a description, morphological measurements, and focus-stacked images of the specimen. Images were taken in the Life Department of the Oxford University Museum of Natural History using a Leica DFC490 digital camera attached to a Leica M165c stereomicroscope with a 0.5× planapochromatic objective (Leica 10446157). The microscope was controlled with Leica Application Suite version 4.12. Image stacking was performed with Helicon Focus version 7.5.8. Left and right refer to the specimen's anatomical sides. Measurements of selected morphological features are presented in Table 1, with some measurements reported separately for the right and left sides. Measurements were taken from the image stacks using ImageJ.JS (Ouyang *et al.*, 2019). The specimen is deposited in Gillson Private Collection.

Table 1. Morphological measurement (mm) of the gynandromorph specimen described herein.

Measurement	Left side	Right side
Total body length	13.12	
Head width	3.98	
Intertegular distance	3.18	
Abdominal width	4.03	
Scape + pedicel length	1.31	0.67
Flagellum length	3.15	4.82
Second flagellomere width	0.32	0.34
Second flagellomere length	0.26	0.35
Forewing length	9.36	9.39

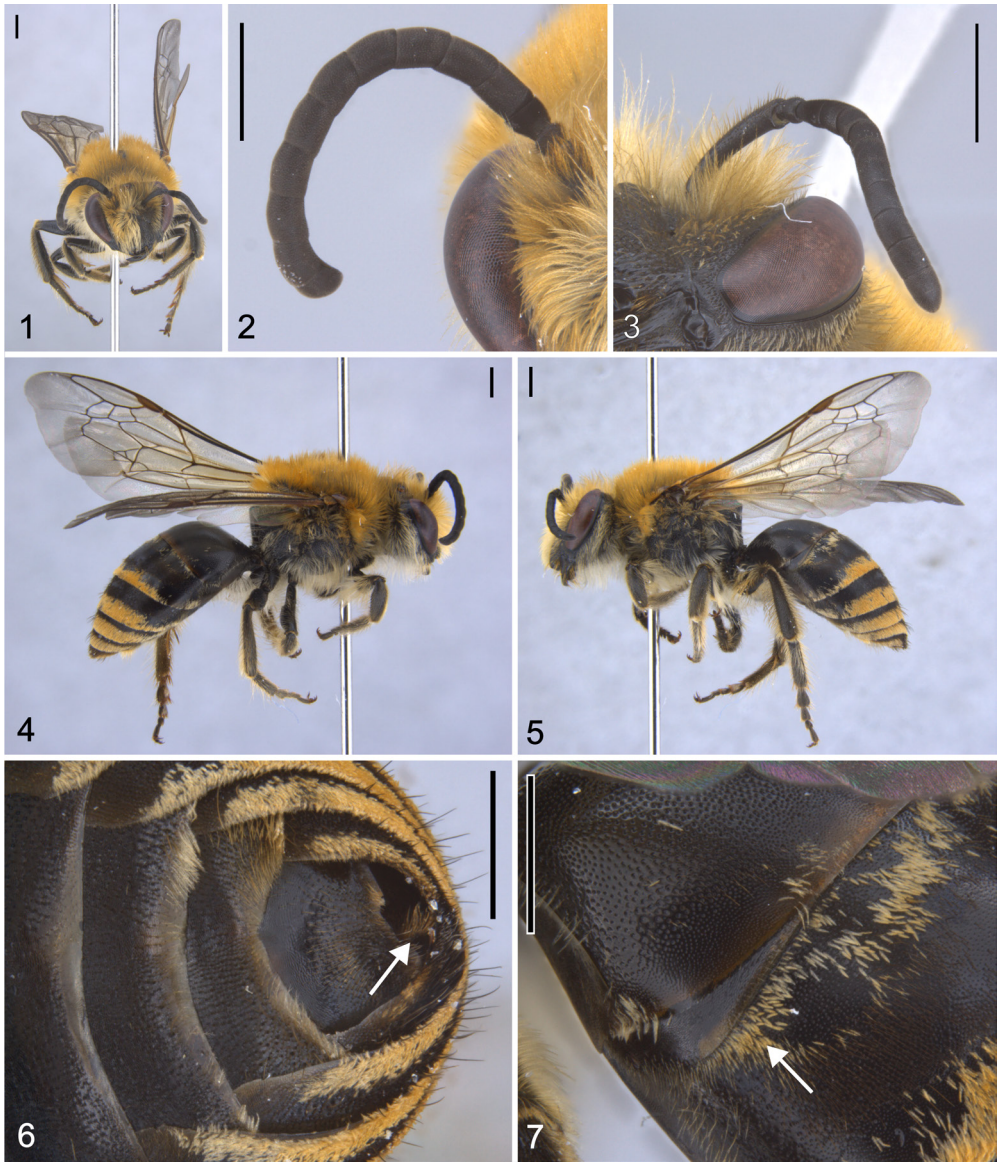
RESULTS

Colletes hederae Schmidt & Westrich
(Figs. 1–7)

DESCRIPTION. The head is clearly divided bilaterally, with the left side showing female features and the right side showing male features (Fig. 1). The right antenna comprises 11 flagellomeres, which are also wider than those of the left antenna (Fig. 2);

the left antenna comprises only 10 flagellomeres (Fig. 3). The right antennal scape is also shorter and stouter than the left (Figs. 2, 3), and facial pilosity is markedly denser on the male side (Fig. 1), consistent with sexual dimorphism in this species (Falk & Lewington, 2016).

The thorax and, superficially, the abdomen look similar on both sides (Figs. 4–5), though the overall appearance of the abdomen is more similar to a female. The tip of the abdomen shows a genital clasper on the male (right) side (Fig. 6) only. Interestingly, the left side of the abdomen appears to be 'pulled out' more than the right, showing a detail of T1 and T2: a strong gradulus on the left side of T2 (Fig. 7). Overall, this specimen appears to be a mosaic of male and female characters having a bilateral head and a superficially female abdomen but with a single male clasper on one side.



Figures 1–7. The gynandromorph *Colletes hederae* collected in Oxfordshire, UK. **1.** Face, frontal view. **2.** Right antenna. **3.** Left antenna. **4.** Habitus, right lateral view. **5.** Habitus, left lateral view. **6.** Abdominal apex, with white arrow indicating the genital clasper on the right side. **7.** Left lateral view of the strong gradulus on the second terga (white arrow). Scale bars: 1 mm.

DISCUSSION

This is the first report of gynandromorphy in the ivy bee *Colletes hederae*. This individual was captured in Oxfordshire, UK, and appears to be a mosaic of male and female features. Superficially, the individual appears to be a bilateral gynandromorph: the face is split bilaterally, with the right male side having a thick antenna with 11 flagellomeres and a hairy face, whilst the left female side has an antenna with 10 flagellomeres and is glabrous in the lower half. The appearance of the abdomen is generally female, however at the tip of the abdomen, one genital clasper protrudes on the right side. Therefore, the individual falls into the mosaic gynandromorph category.

Two gynandromorphs of *Colletes* have been documented previously. O'Toole (1989) reported a bilateral gynandromorph of *C. cunicularius* (Linnaeus), and Ferrari *et al.* (2021) reported a mosaic gynandromorph of *C. hedini* Kuhlmann from China. Gynandromorphs within Colletidae are reported less commonly than those in other families: 6% of reports are from Colletidae, compared with 37%, 31%, and 14% from Apidae, Megachilidae, and Halictidae, respectively (Gorman & Best, 2025). The reason for this taxonomic bias is unclear, although it may reflect historical sampling and research biases (Wcislo *et al.*, 2004; Hinojosa-Díaz *et al.*, 2012; Ferrari *et al.*, 2021). It could also reflect lower levels of dimorphism in secondary sexual characters in this group than in, for example, leaf-cutting megachilids, making gynandromorphs generally less obvious to observers (Ferrari *et al.*, 2021; Hinojosa-Díaz *et al.*, 2012).

Among the reported Colletidae gynandromorphs (including the present specimen; Table 2), one-third of specimens belong to each of the three types of gynandromorphs (transverse, mosaic, and bilateral). Across all bees, Michez *et al.* (2009) suggested that transverse gynandromorphs were the most common, followed by mosaics and then bilaterals (56%, 33%, and 9%, respectively, among records up to 2009). Colletidae appear to deviate from this wider trend. The underlying causes likely differ among gynandromorph types (Michez *et al.*, 2009; Sommaggio *et al.*, 2021). Colletidae may be epigenetically, genetically, or developmentally more prone to producing the rarer forms of gynandromorphs. However, given the generally lower levels of sexual

Table 2. Summary of reported gynandromorphs in Colletidae (Hymenoptera). *Published originally as *Prosopis albofasciatus* and *P. minuta* (see Dathe, 1995, 2022).

Species	Reference	Type
Colletes cunicularius (Linnaeus)	O'Toole (1989)	Bilateral
Colletes hederae Schmidt & Westrich	Present work	Mosaic
Colletes hedini Kuhlmann	Ferrari *et al.* (2021)	Mosaic
Euryglossa sp.	Exley (1976)	Transverse
Hylaeus albonotatus (Walker)*	Stöckhert (1924)	Transverse
Hylaeus brevicornis Nylander	Morice (1915)	Transverse
Hylaeus brevicornis Nylander*	Noskiewicz (1923)	Transverse
Hylaeus hyalinatus Smith	Schoder (2018)	Bilateral
Hylaeus intermedius Förster	Schoder & Zettel (2017)	Bilateral
Hylaeus modestus Say	Lightburn *et al.* (2022)	Bilateral
Hylaeus punctulatissimus Smith	Rolke (2020)	Mosaic
Hylaeus rudbeckiae (Cockerell & Casad)	Oram (2022)	Mosaic

dimorphism within the major genera of this family (Ferrari *et al*., 2021), this trend may reflect bilateral gynandromorphs being more visually striking than transverse or mosaic gynandromorphs and therefore more likely to be noticed and reported.

ACKNOWLEDGEMENTS

I would like to thank the OUMNH and staff for access to photographic facilities used for taking the stacked photographs, Alix Prybyla for comments on the initial manuscript, and Tom Wood for a useful discussion on the specimen. Two anonymous reviewers and the editor for comments and suggestions that improved this note. This work was supported by BBSRC grant number APP5059 to Geraldine Wright.

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ISSN 2325-4467