

Patrolling males of *Andrena bicolor* F.
(Hymenoptera, Andrenidae) as pollinators of
Ophrys massiliensis VIGLIONE & VÉLA

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Abstract. VERECKEN, N.J. & PATINY, S.- *Patrolling males of Andrena bicolor* F. (Hymenoptera, Andrenidae) as pollinators of *Ophrys massiliensis* VIGLIONE & VÉLA. Observations carried out in situ indicate that *Ophrys massiliensis* is pollinated by patrolling males of *Andrena* (*Euandrena*) *bicolor* FABRICIUS in southern France. A distribution map and a phenogram of the pollinator are provided and this record is compared to previous pollination records found in the literature.

Résumé. VERECKEN, N.J. & PATINY, S.- *Des mâles d'Andrena bicolor* F. (Hymenoptera, Andrenidae) pollinisateurs d'*Ophrys massiliensis* VIGLIONE & VÉLA. Des observations réalisées in situ indiquent qu'*Ophrys massiliensis* est pollinisé par les mâles d'*Andrena* (*Euandrena*) *bicolor* FABRICIUS. Une carte de distribution et un phénogramme du pollinisateur sont fournis et cette observation est discutée à la lumière des données disponibles dans la littérature.

Key-words. *Andrena bicolor*, Andrenidae, Hymenoptera, *Orchidaceae*, *Ophrys massiliensis*, pollination by sexual deception.

Introduction

Sexual deception is arguably the most bizarre mechanism by which orchids achieve cross-pollination. In this system, patrolling male insects, mostly hymenopterans, are attracted by sex pheromone-mimicking odour signals emitted by the flower and attempt copulation (i.e. pseudocopulation) on the female decoy of the orchid labellum. As the aroused male goes through its copulatory routine on the flower, its head or its abdomen tip rubs against sticky pads that are attached to pollen masses (i.e. the pollinia). The compulsive movements of the pseudocopulating male insect then lead to the attachment of the pollen masses on its body and to the subsequent withdrawal of the pollinia. Cross-pollination

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takes place as the male insect becomes later fooled and pseudocopulates on a flower of a conspecific orchid taxa (KULLENBERG 1961; BORG-KARLSON 1990). This sophisticated pollination strategy is thought to be characteristic of orchids, although few non-orchid species have been suggested to be pollinated in the same fashion. Yet, efforts to demonstrate the occurrence of sexual deception in non-orchid species have fallen short so far. Pollination strategies mapped onto genus-level phylogenies within the orchid family have provided evidence for the independent origin of sexual deception in Australia, the Mediterranean region, South Africa and South America (reviewed by SCHIESTL 2005).

In the Mediterranean region, pollination by sexual deceit is exclusive to orchids of the species-rich genus *Ophrys*, which comprises more than 250 species (DELFORGE 2005). This astounding diversity has been suggested to be the consequence of a recent and rapid outburst of speciation events (i.e. a radiation) (SOLIVA et al. 2001) that was driven by reproductive isolation through preferential pollinator shifts as a consequence of minor changes in floral odour among sister taxa (SCHIESTL & AYASSE 2002). Consequently, given the prominent role of floral odour in pollinator attraction and in the evolution of *Ophrys* orchids (SCHIESTL 1999), morphological differentiation among taxa is often poor, and patterns of morphological crypsis are readily found within most species groups in the genus (see e.g. BERNARDOS et al. 2005). Sister *Ophrys* species are often found in sympatry, and reproductive isolation in such cases is usually maintained through the species-specific attraction of distinct pollinator taxa and/or through shifts in flowering periods (PAULUS & GACK 1990).

In this study, we made preliminary investigations on the pollination biology of *Ophrys massiliensis* (Fig. 1), an early-flowering *Ophrys* species closely-related to *O. sphegodes* that can be found in S-France from late December until mid-April. Specifically, we investigated if the pollinator of *O. massiliensis* differs from that of its sister, later flowering species *O. sphegodes*.

Materials and Methods

All observations have been made in spring 2006 at a natural population at Sauteyrargues (north of Montpellier, Department Hérault, France). Patrolling male bees have been observed on the 25.III.2006 and on the 27.III.2006 pseudocopulating on the labellum of *Ophrys massiliensis*. Pollinator observations have been carried out at 10.15am (local time) on the 25.III.2006 and at 11.35am on the 27.III.2006. The specimens caught have been observed attempting copulation during ca. 40 seconds on flowers of *O. massiliensis* that had already been visited previously. Three photographs have been taken, one of which is reproduced herein (Fig. 2). The specimens were caught before the end of their pseudocopulatory activity, put in a 2mL Eppendorf capsule and stored in a chilled box before being freeze-killed, set on an insect pin and prepared for identification.

Bee records included in the BDFGM (Banque de Données Fauniques Gembloux-Mons) have been used to draw (i) the distribution map (100 km × 100km) and (ii) the phenogram of the pollinator species with the Data Fauna Flora software developed by BARBIER et al. (2000). The geographic framework mapped in this study includes France, Belgium, and Luxemburg (a region referred to as Gallia in RASMONT et al. 1995). The distribution range of *Ophrys massiliensis* was drawn from VIGLIONE and VÉLA (1999) and BOURNÉRIAS and PRAT (2005); Orchid and insect taxonomy follows DELFORGE (2005) and GUSENLEITNER and SCHWARZ (2002), respectively.



Figs 1-2. Floral detail of *Ophrys massiliensis* VIGLIONE & VÉLA and pseudocopulating male of *Andrena (Euandrena) bicolor* F. (Hymenoptera, Andrenidae) on the labellum of *Ophrys massiliensis*. Sauteyrargues (France, Hérault), 10.III.2005 & 25.III.2006.

(Photos N.J. VERECKEN)

Results and Discussion: new pollinator record

We here provide evidence that *Ophrys massiliensis* (Fig. 1) is pollinated by patrolling males of *Andrena (Euandrena) bicolor* FABRICIUS in southern France (Fig. 2). Since the time of its description (see VIGLIONE & VÉLA 1999), no pollinator record has ever been published for *Ophrys massiliensis*. Yet, BOURNÉRIAS & PRAT (2005: 372) mention *Andrena nigroaenea* as pollinator of the *Ophrys* of Marseille, presumably (not explicitly) referring to the observations of GASC (1990) on the pollination of an early-flowering *Ophrys araneola* in S-E France by patrolling males of *Andrena nigroaenea*. Collectively, these observations suggest that *Ophrys massiliensis* might share a common pollinator with *O. sphegodes* MILLER, for which *Andrena nigroaenea* has already been shown to be an “effective” pollinator (sensu COX & KNOX 1986) (BORG-KARLSON 1990; PAULUS & GACK 1999; SCHIESTL et al. 1999).

Andrena bicolor ranks among the commonest *Andrena* species in Western Europe (Fig. 3) (WARNCKE et al. 1974; GUSENLEITNER & SCHWARZ 2002), and is characterized by two generations per year. This bee species is usually found from mid-February until mid-May (spring brood), and then from late May until late September (summer brood) (Fig. 4). This species usually nests solitarily in bare (sandy) soil (WESTRICH 1989), a phenomenon that makes nests difficult to locate under natural conditions. Very few data are available on the nesting biology and on the pheromones of this bee species (ELSE, in prep).

Within the *O. sphegodes* species group, all species investigated so far have been shown to be pollinated by patrolling males of *Andrena* (DELFORGE 2005).

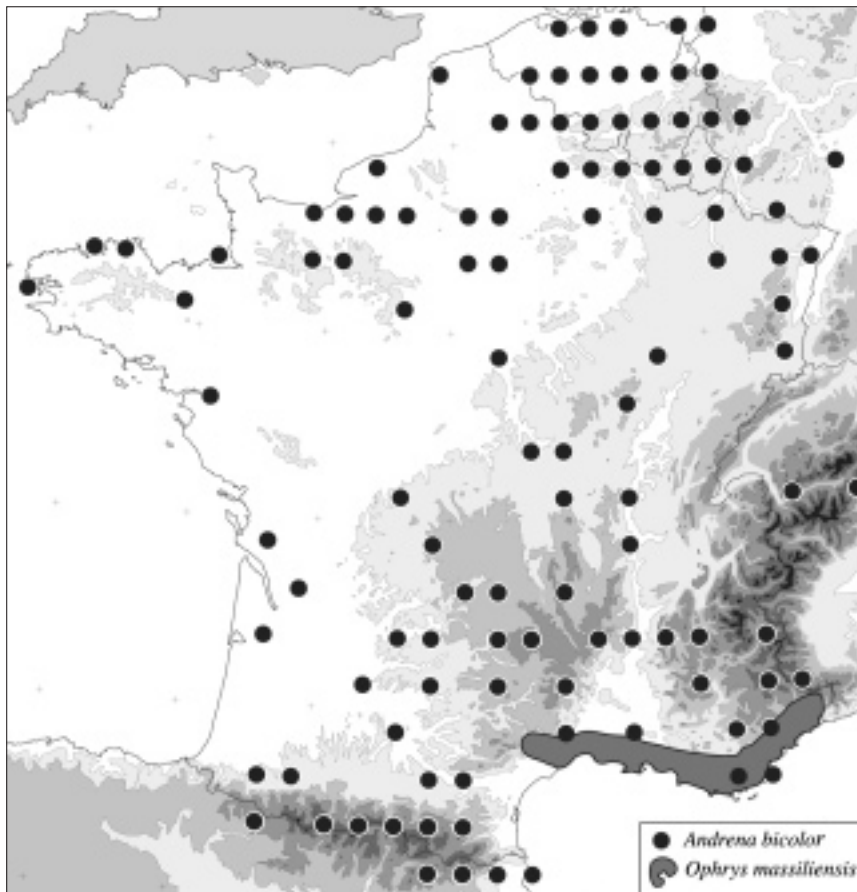


Fig. 3. Comparative biogeography between *Andrena bicolor* (Hymenoptera, Andrenidae) (4,434 records) and *Ophrys massiliensis*.

Males of *Andrena bicolor* have been reported as “putative” pollinators for other *Ophrys* species such as *O. thriptensis* (*O. attaviria* species group in Crete) and *O. sicula* (*O. lutea* species group in Italy) (DELFORGE 2005). Although the flowering period of these orchid species corresponds to the spring generation of this solitary bee, more data are required to test whether these *Ophrys* species are indeed regularly pollinated by males of *Andrena bicolor*.

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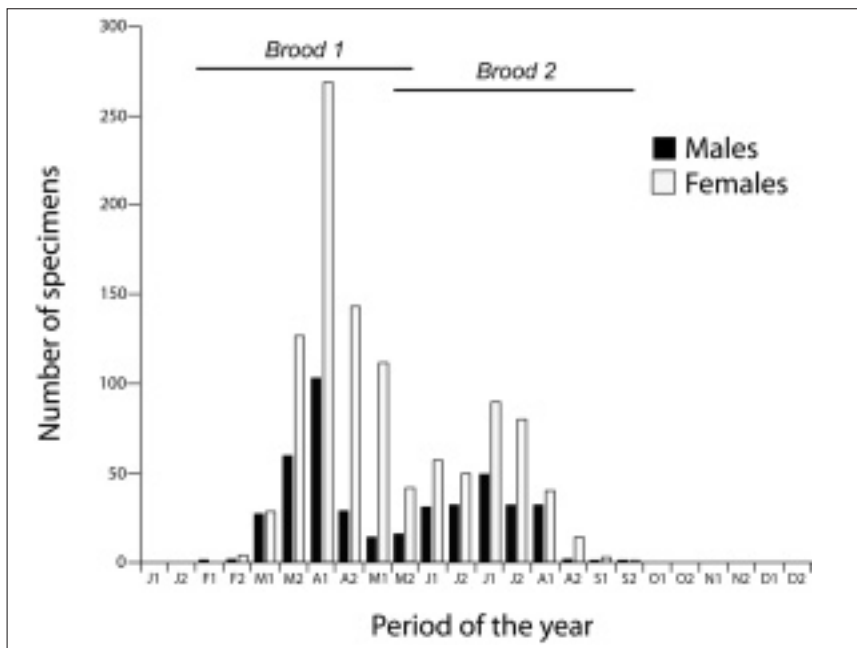


Fig. 4. Phenogram of both sexes of the double-brooded species *Andrena (Euandrena) bicolor* F. (Hymenoptera, Andrenidae) in Western Europe (4,434 records). Each month is divided into 2 fortnights (e.g. 1-15 January = J1; 16-31 January = J2).

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