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Volucella bombylans (Syrphidae, Diptera) recorded from a colony of *Bombus mesomelas* (Apidae, Hymenoptera) in Iran

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A b s t r a c t : During excavation of a colony of *Bombus* (*Thoracobombus*) *mesomelas* GERSTAECKER around Moeil, a village on the lower slopes of the Sabalan Mountains in Meshkinshahr, a city in Ardabil province, in the summer of 2009, larvae of *Volucella bombylans* (LINNAEUS 1758) were collected from the nest. The bumblebee nest was situated in a deserted bird's nest 60 cm below the ground. Twenty eight pale new queen bumblebees were collected from this mature nest. Although *V. bombylans* L. 1758, a species of flower fly, has been collected previously from the nests of several different bumblebee species in the world, this is the first record of this flower fly from a bumblebee's colony within Iran. Adults of the fly are very similar in colour pattern and size to some bumblebees and therefore appear to mimic them. They are resemble to bumblebees on wing, so they could be mistaken with bumblebees on flight. Larvae of the fly were a dirty whitish-yellow color and vermiform. Their mean length was 24 mm. Their integument was hard and wrinkled, the body tapers anteriorly and at the broader posterior end there were, characteristically, six long spines. There were also two rows of small spines running along either side of the body. Posteriorly, on the dorsal surface, there was a prominent reddish-brown respiratory siphon. Larvae of this fly can be harmful on brood of bumblebee when there is a heavy nest infestation. Although most of the larvae were found below the comb feeding on nest debris, some were at the entrance to the nest. It is assumed that these larvae had been moved to the entrance by workers.

K e y w o r d s : Bumblebees, Syrphidae, mimicry, Iran.

Introduction

Members of the genus *Volucella* are generally large and robust which always mimic bees and wasp. *V. bombylans* is a remarkably good mimic of bumblebees that has several different colour forms. Its larvae live as scavengers in the nests of bumblebees and social wasps, eating nest debris under the combs and occasionally attacking its host's larvae too (ALFORD 1975).

Bumblebees have special economic importance because of their role in the pollination of pasture plants as well as horticultural and greenhouse plants and crops (SLADEN 1912, ALFORD 1975, WILLIAMS 1988, WILLIAMS 1989, GOULSON et al., 2005, VELTHUIS & DOORN 2006). These bees are abundant in the mountainous regions of Iran. In this country, 34 species of genus *Bombus* have been recorded by now (MONFARED et al., 2007, TAHMASBI et al., 2008). Bumblebees are among social bees with declining in many

regions of the world (WILLIAMS 1986, WILLIAMS 1989, GOULSON et al., 2005, MONFARED et al., 2009). They have three casts of queen, worker and male like honey bees but with much differences in their biology than *Apis mellifera* L. which are well known by everyone. In spite of honeybees which queen accompany with workers overwinter, bumblebees colonies in temperate regions, die out in autumn, and only the young mated queens overwinter (PRYS-JONES & CORBET 2003). These queens appear in the next spring and after feeding of nectar and pollen find a deserted nest of birds and reptile or natural wholes in the ground and somewhere like these for establishing their nest (ALFORD 1975, SLADEN 1912, PRYS-JONES & CORBET 2003). Having found a suitable site, the queen adjusts the nesting material to form a small chamber. Queen constructs a thimble-like wax honey pot in which stocks nectar and broods. The egg dump would warm by contacting the lower less hairy surface of queen abdomen (PRYS-JONES & CORBET 2003). Bumblebees have considerable control over her body temperature, a brooding queen can keep her body at about 30°C, and maintain her egg dump at 30-32 °C, despite low outside temperatures (HEINRICH 1979). Species differ in the way they feed pollen to the larvae. 'Pocket-makers' construct waxen pouches or pockets near the base of the larval chamber or brood clump. In the other group of species, the 'pollen-storers', pollen brought into the nest is not put into pockets in the brood clump, but instead is stored in empty pupal cocoons and specially constructed wax cells or cylinders (PRYS-JONES & CORBET 2003). The queen or workers then feed it to the larvae, bit by bit. Duration of life cycle of a Pollen-Storer species like *Bombus terrestris* lasts about 40 days. Based on PRYS-JONES & CORBET (2003), Eggs hatch after 4-6 days and larvae make cylindrical cocoon, pupates after 10-20 days and adult workers emerge after about 2 weeks as pupae. These workers carry out functions related to coloney such as collecting nectar and pollen, making new egg cups, feeding larvae, protecting and gurding of nest. Occurrence of such coloney with honey, pollen, wax and many larvae may attract many other organisms like mites (ALFORD 1975, O'TOOLE 2003, AZHARI et al., 2011), nematode (ALFORD 1975, O'TOOLE 2003), Cuckoo bees (WILLIAMS 1988, LOCKEN 1994, MONFARED et al., 2007) and flies like *Volucella bombylans* and *Fannia canicularis* (ALFORD 1975, O'TOOLE 2003). Cuckoo bumblebees are cuckoos in the nests of bumblebees, they are very closely related to their hosts and are in fact placed in *Psithyrus*, a subgenus of *Bombus* (WILLIAMS 2008, O'TOOLE 2003). The females lack pollen baskets or corbiculate and they have a very thick cuticle. This last feature is supposed to help protect the cuckoos against the defending stings of host colonies. It does not always work, though: strong nest populations of *Bombus terrestris* and *B. lucorum* are often littered with the corpses of invading females of *Psithyrus* which have failed to run the gauntlet of defending workers (O'TOOLE 2003). The females of *Volucella bombylans* enter the nests of bumblebees to lay their eggs. They have a superb adaptation if they are attacked and killed by defending workers: as they die, a reflex action eliminates eggs from the body, so the female fly is able to reproduce. The eggs have a very sticky surface which helps them to adhere to the substrate and it may also protect them from the bees (O'TOOLE 2003). Although bumblebees are capable of protecting their coloney because they are from aculeate, have stings and poisons to removing other organism from their coloney but above mentioned organisms could overcome on their defending line and enter to their nest.

Materials and Methods

Extracting nest from field

During sampling of bumblebees, in field, around Sabalan Mountains near Moeil village (Ardabil province, Meshkinshahr), on July 2009, a coloney of *Bombus* (*Thoracobombus*) *mesomeles* GERSTAECKER, found and excavated. Entrance hole of nest was on surface of ground (Fig. 1, a). Before excavating, the patrolling males and workers collected by entomology net. By digging about 80 cm entirely nest and nest material extracted from underground (fig.1, b, c, d) and transported into a plastic container to laboratory. A number of holes made in the walls of container for better ventilation. Removed coloney transported to lab and fed by honey solution (50-50 % W/H) and frizzed pollen collected from honeybees traps.

Collecting *V. bombylans* larvae

At first, two vermiform larvae observed at the entrance of the nest and collected. Other larvae were at the bottom of the nest material. All larval specimens put in the ethanol (70 %). Species of fly which larvae belonged to then were confirmed by Dr. Graham Rotery. A schematic drawing of larvae using a stereomicroscope Olympus SZH without using of drawing tube, drawn by Mr. Afshari, a Plant Protection student in Yasouj University (Fig. 2). Diagnosis features are based on flies specimens were deposited in Dept. of Entomology, 'Plant Protection institute of Iran', Ewin, Tehran.

3. Results

B. mesomelas colony

Materials of nest, which gathered by bees, fully extracted and took to lab, shown that the queen selected a bird nest for settling at the early season. This coloney was fully matured and was at the end of its developing period, because 32 new queens with pale color and 18 males existed in this coloney. Specimens deposited in "Iranian Pollinator Insects Museum" of Yasouj University.

Volucella bombylans LINNAEUS 1758

Musca bombylans LINNAEUS
Musca plumata DE GEER
Volucella basalis SAY
Volucella evecta WALKER
Volucella facialis WILLISTON
Volucella rufomaculata JONES

H e a d : Body length: 13.2-13.4 mm, face yellow, concave basally, covered with long dense yellow hairs and longer than vertical diameter of eye. Oral margin and gena black. Prementum long and dark brown. Scape and pedicel dark brown, postpedicel (= flagellum) yellowish-orange. Arista about 2 times as long as postpedicel and plumose. Frons

and vertex yellow, covered with long yellow hairs. Occiput covered with long black hairs posteroventraly. The posterodorsal portion of occiput with short yellow hairs.

T h o r a x : Black, covered with long hairs. mesonotum covered with long and dense yellow hairs (except the rectangular median portion which covered with black hairs). Scutellum completely yellow with long and dense yellow hairs. Leg: completely black. Wing: hyaline with a relatively distinct dark brown spot anteromedialy. Calypter dark brown.

A b d o m e n : Black, tergite 2 with yellow dense hairs laterally. Apical half of tergite 3, tergites 4-5 with long and dense white hairs. The sternites covered with long yellow hairs.

Discussions

The adaptive resemblance of one organism (the mimic) usually in colour, pattern, form or behavior to another organism (the model) is known as mimicry (DHOORA 2008). Among four types of mimicry: 1. Aggressive mimicry, 2. Weismanian mimicry, 3. Batesian mimicry (it results from the resemblance of one organism (the mimic) to a protected model, thereby providing the mimic some protection from its enemies) and 4. Mullerian mimicry (DHOORA 2008), behavior of *V. Bombylans* considered being of third type. Although some researchers believed that this behavior aroused for ease entrance of *V. bombylans* into the bumblebees nest but protection purpose is more logical and acceptable. This is because, adult flies with various pattern of coloration of bumblebees were seen to enter their nest. *V. bombylans* have different color pattern compare with *Bombus mesomelas* collected in Iran (MONFARED et al., 2008). *V. bombylans* adults collected in Iran is very similar to *B. terrestris* in appearance (Fig. 3) not as said before like *B. mesomelas* (Fig. 4). In bumblebees nest workers as guards of coloney, sting flies during their entrance but they can always come into the nest. Finally, flies would be killed but a reflection mechanism could make flies to throw out the eggs in the nest and these eggs would grow in the nest and complete their life cycle (ALFORD 1975).

In this research observed that a number of *V. bombylans* larvae were at nest entrance, since larvae of this fly is vermiform, with no legs, occurring of some of them at entrance of *Bombus* nest showed that these larvae were removed by workers to out of nest.

Various aspects of interactions between bumblebees' species and this fly not examined yet and need more study. Many questions exist and would be interesting for more researches.

Of 34 species of bumblebees recorded from Iran (MONFARED et al., 2007) by now, just nest of 5 species discovered and excavated. These species included *B. terrestris*, *B. persicus*, *B. argillaceus* and *B. mesomelas* which excavated from underground in Fasham and Lalan around Tehran (MONFARED et al., 2007). Late researches have been shown that all bumblebees species color pattern have coincidence with environmental circumestances for more protections (WILLIAMS 2007). Lately nest of *B. armeniacus* excavated and mite associated recognized by AZHARI et al., 2011. There is not a standard way to easy find nests of bumblebees just by sudden seeing entrance by chance. There are some methods explained by ALFORD (1975) and SLADEN (1912) for this purpose but really it's difficult to find and extracting bumblebees nest. Nest of many of species of bumblebees not seen and studied by biologists by now (HEINRISH 1979).

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Zusammenfassung

Während der Ausgrabung eines Nestes von *Bombus* (*Thoracobombus*) *mesomelas* GERSTAECKER (Hymenoptera, Apidae) in den Sabalan Bergen in Meshkinshahr im nordwestlichen Iran im Sommer 2009 konnten dort Larven von *Volucella bombylans* (LINNAEUS 1758) (Diptera, Syrphidae, Eristalinae) entdeckt werden, ein Erstnachweis dieser Art in einem Hummelnest im Iran.

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Fig 1: Finding and extracting of coloney of bumblebees: (**a**) Hole of entrance of *B. mesomelas* colony, (**b**) first signs of colony, broods appeared, (**c**) materials covered the colony, (**d**) colony under materials appeared.

Fig 2: (**a**) *B. terrestris* queen and (**b**) adult fly of *V. bombylans*.

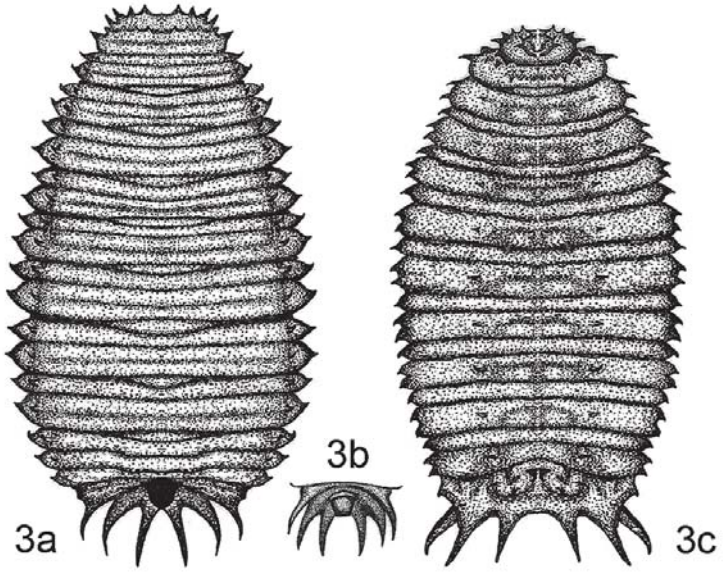

Fig. 3: Schematic drawing of *Volucella bombylans* (without using of drawing-tube attachment), (**a**) Ventral aspect; (**b**) breathing tube, 6 spin processes; (**c**) dorsal view.

Fig. 4: *B. mesomelas* queen (all casts have the same colour pattern in Iran).